MITSUBISHI MATERIALS

# VQ Smart Miracle

## HIGH-PERFORMANCE END MILL SERIES



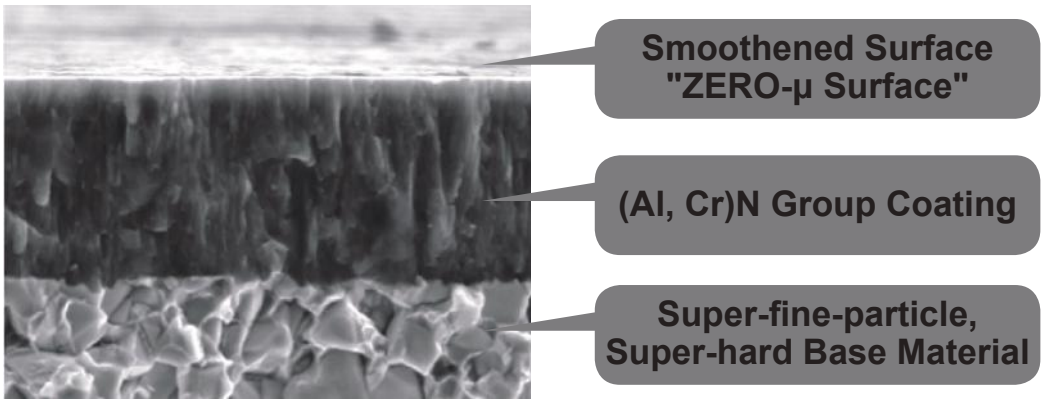


TOOL NEWS **B197A**

# SMART MIRACLE

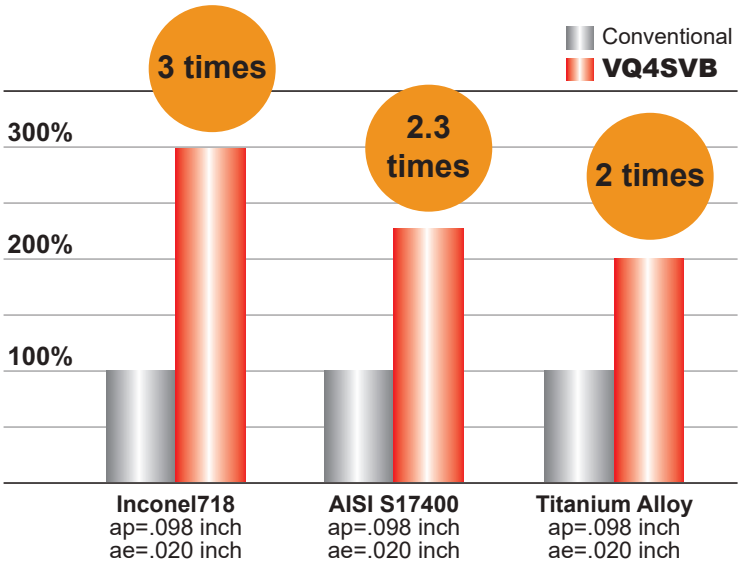
## SMART MIRACLE Coating

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.





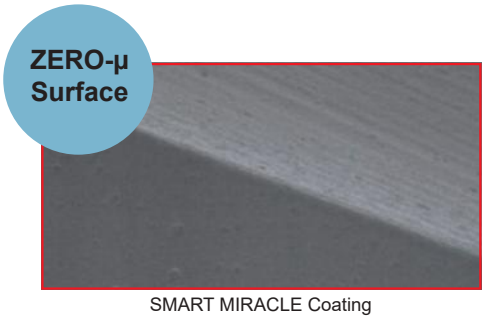

# VQ4SVB achieves double tool life when machining difficult-to-cut materials.



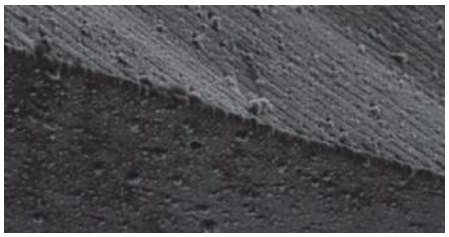

See page 71 for test data details.

## ZERO-μ Surface

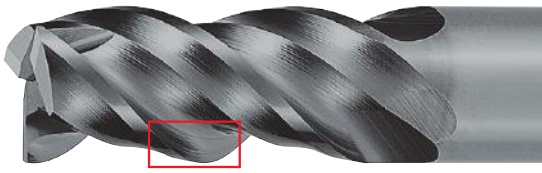
With the unique ZERO-μ Surface, the cutting edge retains its sharpness. While previous technologies often resulted in diminished sharpness, the ZERO-μ Surface achieves both smoothness and sharpness, as well as longer tool life.

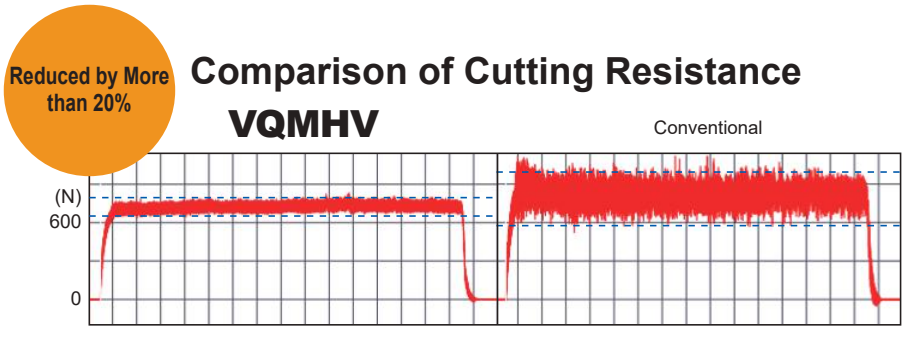



SMART MIRACLE Coating



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<br>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.



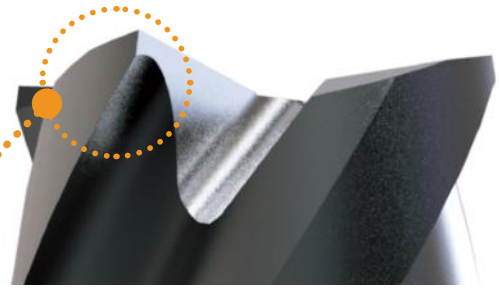
### High Rigidity Long Neck

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%)

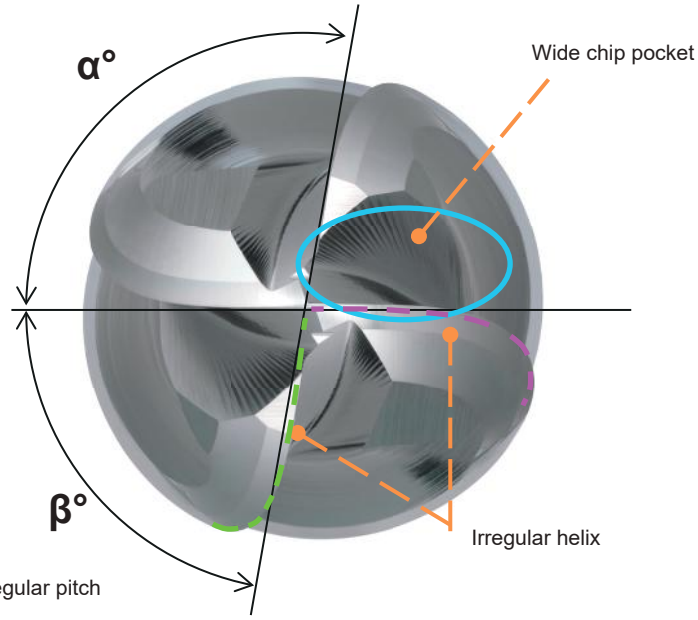


# VQ4XLB Ball Nose

## Irregular Helix and Irregular Pitch Flutes

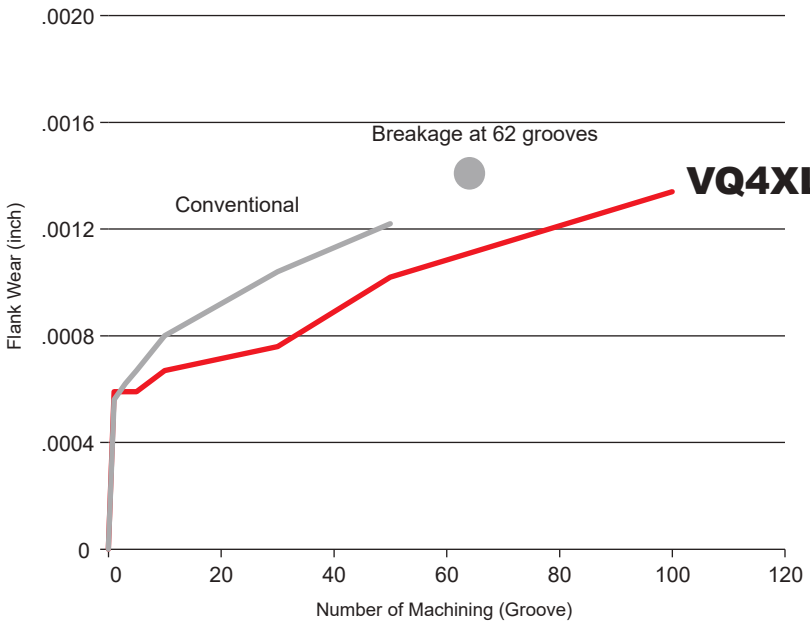
The irregular helix and irregular pitch flutes shape improve the cutting edge's resistance to chatter vibration.
The unequal curve shape improves chip removal by providing a wide chip pocket on the long cutting edge.
This enables high efficiency and stable machining of ball end mills.






## 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

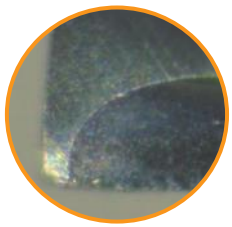
## Cobalt Chromium Alloy : Wear Resistance Comparison

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

**VQ4XLB**



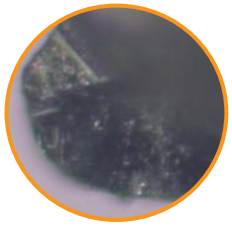




Conventional







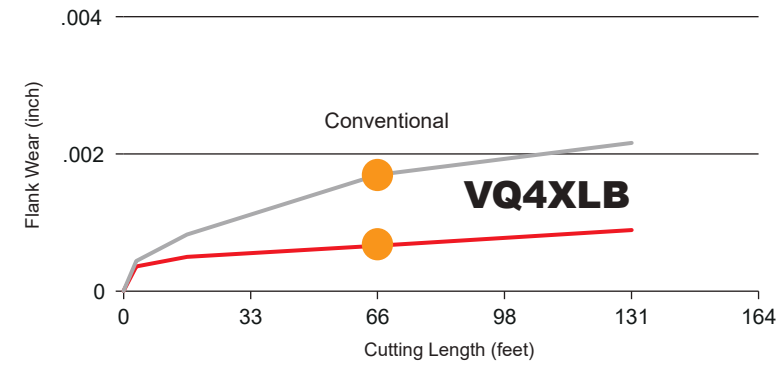
**Double Tool Life**

<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<br>ae=.0010 inch |
| Cutting Mode | : Down Cutting<br>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.

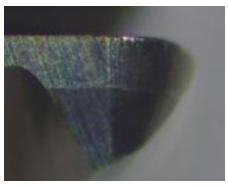



● : Photographed point

<Cutting Conditions>

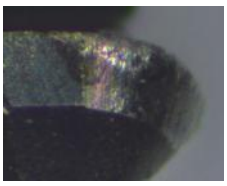
| | |
|---|---|
| Material | : Titanium Alloy |
| Tool | : VQ4XLRBDU031R008N5D |
| Revolution | : n=18000 $min^{-1}$ |
| Cutting Speed | : vc=150 SFM |
| Feed Rate | : fz=.0003 IPT |
| Depth of Cut | : ap=.0016 inch |
| Cutting Mode | : Grooving<br>External Coolant (Emulsion) |

**VQ4XLB**



Less wear

Conventional



Severe wear on RE part

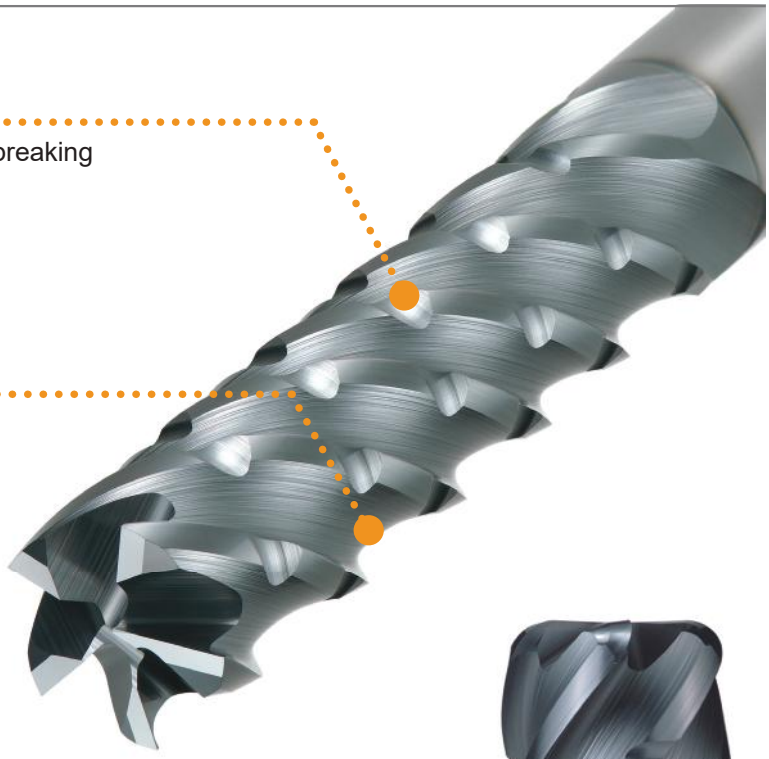
**Double Tool Life**

End mill, 5 flute, Irregular pitch flutes, Chipbreaker

# VQJCS/VQLCS/VQELCS VQJCSR/VQLCSR/VQELCSR

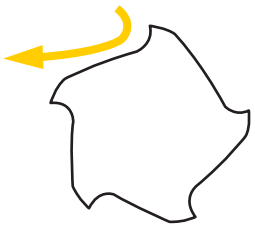
## Chipbreaker Function

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

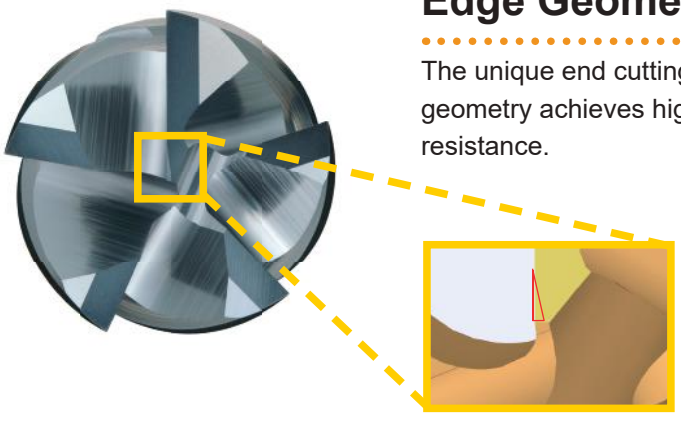


## Irregular Pitch Flutes and Micro Clearance Angle of the Peripheral Cutting Edge

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.

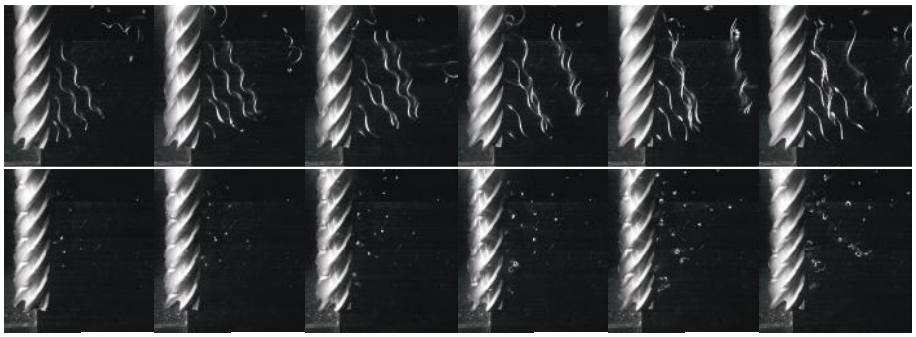


# Chipbreaker Function : High-Speed Camera Comparison

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

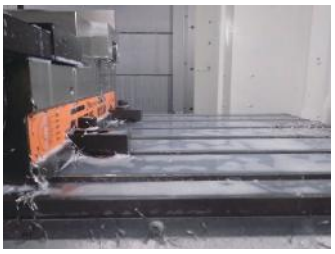
Conventional

**VQLCS**





After Machining with Conventional



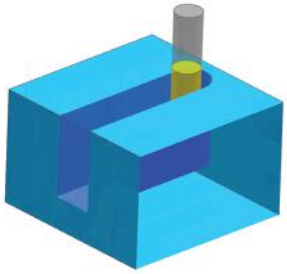
After Machining with **VQLCS**

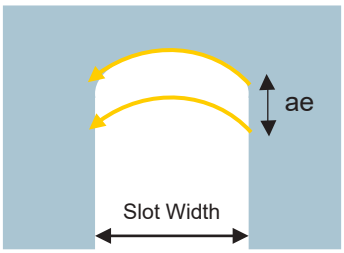
YouTube

# 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

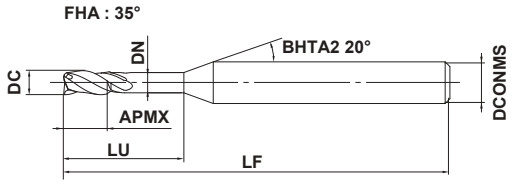


# VQ3XL NEW

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<br>- 0.020 | | | | |
| DCONMS | | | | |
| 0<br>- 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 |

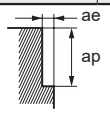
● = NEW

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.

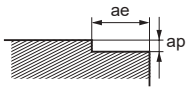
● :USA Stock

# RECOMMENDED CUTTING CONDITIONS

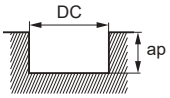
## Side milling

| 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 | | | |  | | | | | | | |

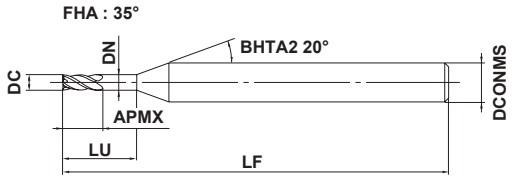
DC : Dia.

# 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<br>- 0.020 | | | | |
| DCONMS | | | | |
| 0<br>- 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 |

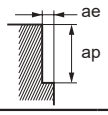
● = NEW

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.

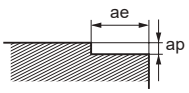
● :USA Stock

# 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 | 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) |
| **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 | 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) |
| **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

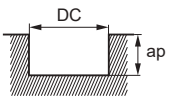
End mill, Short cut length, 4 flute, Long neck

## 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** | | **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) | | | | | | | | |
| **0.4** | **.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.

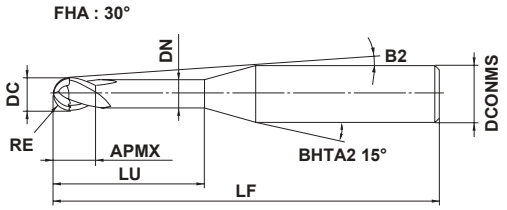
# VQ2XLB

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<br>- 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 | 6 | 2 | ● | 1 |
| **VQ2XLBR0150N140** | 1.5 | 3 | 2.3 | 14 | 2.9 | 4.7° | 60 | 6 | 2 | ● | 1 |
| **VQ2XLBR0150N160** | 1.5 | 3 | 2.3 | 16 | 2.9 | 4.3° | 60 | 6 | 2 | ● | 1 |

● = NEW

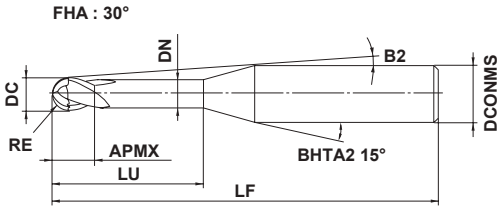
● :USA Stock

# 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

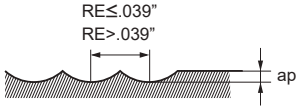
# VQ2XLB

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 |

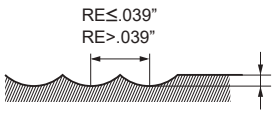
Depth of Cut




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

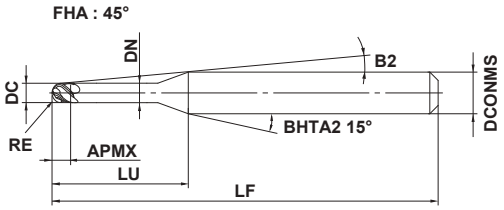
Note 1) The SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electrically transmitted) may not work.
When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.
Note 2) When cutting titanium 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

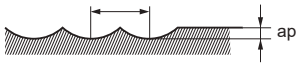
● :USA Stock

## 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

≤.004" RE (RE≤.039")
≤.008" RE (RE>.039")




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.

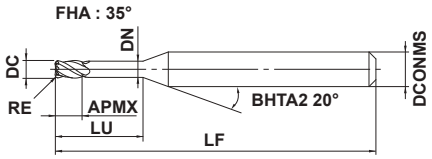
# VQ4XLRB NEW

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<br>- 0.02 | | | |
| **DCONMS** | | | |
| 0<br>- 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 |

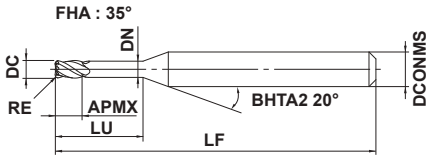
● = NEW

# 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)

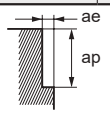
| Order Number | DC | RE | APMX | LU | DN | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|---|---|---|
| **VQ4XLRBDU090R005N3D** | .0900 | .0050 | .1350 | .2700 | .0873 | 1.58 | .1575 | 4 | ● | 1 |
| **VQ4XLRBDU090R005N5D** | .0900 | .0050 | .1350 | .4500 | .0873 | 1.77 | .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 |
| **VQ4XLRBDU125R008N3D** | .1250 | .0080 | .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 |
| **VQ4XLRBDU125R008N5D** | .1250 | .0080 | .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 |
| **VQ4XLRBDU125R008N8D** | .1250 | .0080 | .1875 | 1.0000 | .1223 | 2.17 | .1575 | 4 | ● | 1 |

● = NEW

● :USA Stock

# RECOMMENDED CUTTING CONDITIONS

## Side milling

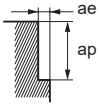
| Material | | | | Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys | | | | | Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC | | LU | | Cutting Speed **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

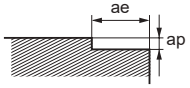
Corner radius, Short cut length, 4 flute, Long neck

## 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

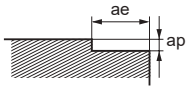
| Material | | | | Carbon Steel, Alloy Steel, Austenitic Stainless Steel, Titanium Alloys, Cobalt Chromium Alloys, Copper, Copper Alloys | | | | | Heat Resistant Alloys, Pre-Hardened Steel, Hardened Steel | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC | | LU | | Cutting Speed **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

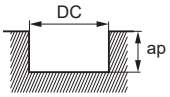
### Bottm face milling

| 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

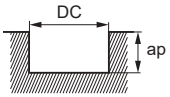
Corner radius, Short cut length, 4 flute, Long neck

## 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.

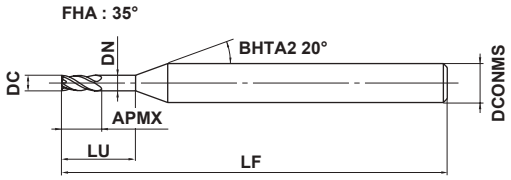
# VQXL

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




| 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<br>- 0.010 | | | | |
| h6 | DCONMS | | | | |
| | 0<br>- 0.005 | | | | |

- The use of SMART MIRACLE coating improves chip discharge dramatically.
- Multi-cutters at a small diameter of $\phi$1 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<br>TORX Type |
|---|---|
| **VQXLD0020N006** | T4 |
| **VQXLD0030N009** | T6 |
| **VQXLD0030N015** | |
| **VQXLD0040N010** | T8 |
| **VQXLD0040N018** | |
| **VQXLD0050N015** | T15 |
| **VQXLD0050N025** | |
| **VQXLD0050N030** | |
| **VQXLD0080N024** | T25 |
| **VQXLD0080N040** | |
| **VQXLD0100N050** | T40 |

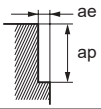
● : **USA Stock**

# VQXL

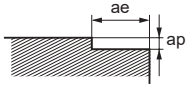
End mill, Short cut length, 3 or 4 flute, Long neck

## 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

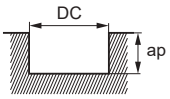
| Material | | Carbon Steel, Alloy Steel, Mild Steel, Alloy Tool Steel, Austenitic Stainless Steel, Titanium Alloys Cobalt Chromium Alloys, Copper, Copper Alloys | | | | | Heat Resistant Alloy, Pre-Hardened Steel, Hardened Steel | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DC (mm) | 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.

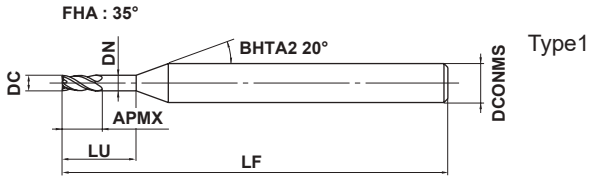
# VQXL – Inch sizes

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.

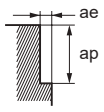
# VQXL – Inch sizes

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.

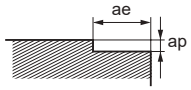
Note 3) When the depth of cut is smaller than shown the revolution and feed rate can be increased.

## 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.

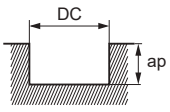
# VQXL – Inch sizes

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 |

| 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) |
| **.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 | |   | | | | | |

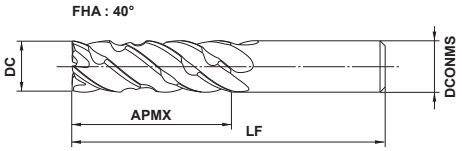
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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<br>- 0.030 | 0<br>- 0.040 | | | |
| DCONMS=6 | DCONMS=8,10 | DCONMS=12 | DCONMS=16 | DCONMS=20 |
| 0<br>- 0.005 | 0<br>- 0.006 | 0<br>- 0.008 | 0<br>- 0.011 | 0<br>- 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**

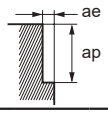
# VQJCS

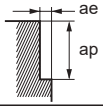
End mill, Semi long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

## 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 | |  | | | | | | | |

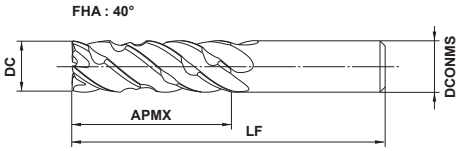
Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an electrical contact type of tool setter may not work. When measuring the tool length, please use a mechanical contact type or a laser tool setter.
Note 2) The irregular pitch flute end mill has a larger effect on controlling 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

| 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**

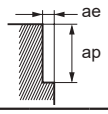
# VQLCS

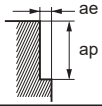
End mill, Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

## 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.

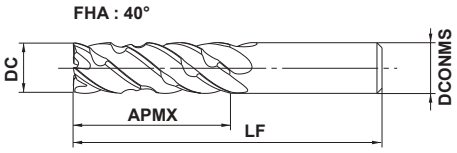
Note 4) For stainless steel, titanium alloys and heat resistant alloys, the use of water-soluble coolant is effective.

# 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

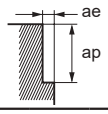
# VQELCS

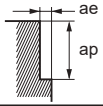
End mill, Extra Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

## 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 | 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** | 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 | 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** | 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.

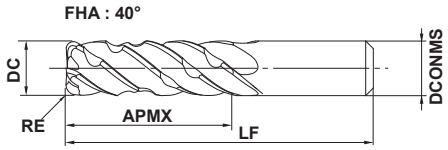
# VQJCSRB NEW

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




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

● :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.

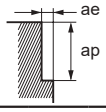
**DC** = Cutting dia.
**RE** = Corner radius
**APMX** = Depth of cut max.
**LF** = Functional length
**DCONMS** = Connection dia.

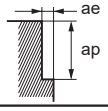
● :USA Stock

## 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 | 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** | 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 | 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** | 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.

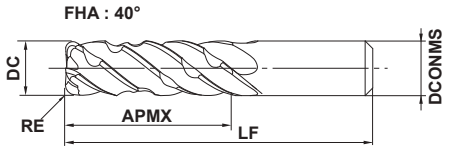
# VQLCSRB NEW

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.

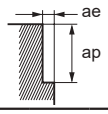
# VQLCSRB

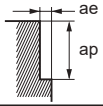
Corner radius, Long cut length, 5 flute, Irregular pitch flutes, Chipbreaker

## 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 | 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 at smaller depths of cut.

Note 4) For stainless steel, titanium alloys and heat resistant alloys, the use of water-soluble coolant is effective.

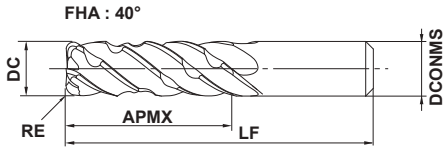
# VQELCSRB NEW

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




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

● :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.

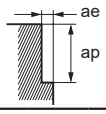
**DC** = Cutting dia.
**RE** = Corner radius
**APMX** = Depth of cut max.
**LF** = Functional length
**DCONMS** = Connection dia.

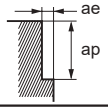
● :USA Stock

## 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 | 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** | 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 | 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** | 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.

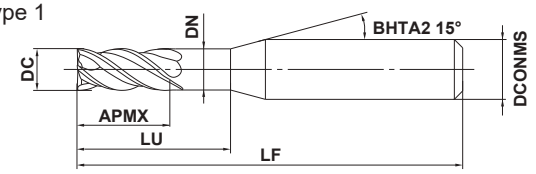
# VQ4MVM

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

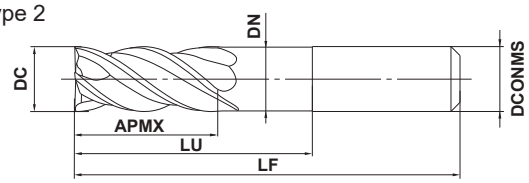
| Carbon Steel, Alloy Steel, Cast Iron (<30HRC) | Tool Steel, Pre-hardened Steel,Hardened Steel (≤45HRC) | Hardened Steel (≤55HRC) | Hardened Steel (>55HRC) | Austenitic Stainless Steel | Cobalt Chrome Alloy Titanium Alloy | Heat Resistanse Alloy | Copper Alloy |
|---|---|---|---|---|---|---|---|
| ◎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



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 |

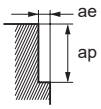
Note 1) SMART MIRACLE coating has very low electrical conductivity. Therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

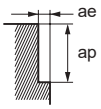
**DC** = Cutting dia. **DN** = Neck dia.
**APMX** = Depth of cut max. **LF** = Functional length
**LU** = Usable length **DCONMS** = Connection dia.

● :USA Stock

# RECOMMENDED CUTTING CONDITIONS

## Side Milling

| Material | | Mild Steel, Carbon Steel<br>Alloy Steel (180–280HB)<br>AISI 1045, AISI 4140 | | | | Pre-Hardened Steel (≤45HRC)<br>Alloy Tool Steel<br>NAK, PX5, SKD,SKT | | | | Austenitic Stainless Steel<br>Ferritic and Martensitic Stainless Steel, Titanium Alloys<br>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<br>Cobalt Chromium Alloys<br>AISI 630, AISI 631 | | | | Heat Resistant Alloys<br>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.

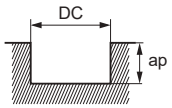
Note 2) When cutting austenitic stainless steels and titanium alloys, the use of water-soluble cutting fluid is effective.

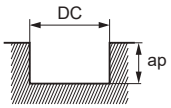
Note 3) If the depth of cut is shallow, the revolution and feed rate can be increased.

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<br>Alloy Steel (180–280HB)<br>AISI 1045, AISI 4140 | | | | Pre-Hardened Steel (≤45HRC)<br>Alloy Tool Steel<br>NAK, PX5, SKD,SKT | | | | Austenitic Stainless Steel<br>Ferritic and Martensitic Stainless Steel, Titanium Alloys<br>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<br>Cobalt Chromium Alloys<br>AISI 630, AISI 631 | | | | Heat Resistant Alloys<br>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.

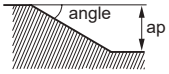
Note 2) When cutting austenitic stainless steels and titanium alloys, the use of water-soluble cutting fluid is effective.

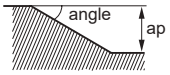
Note 3) When performing machining with a strong ramping angle, a high gripping force holder is recommended.

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<br>Alloy Steel (180–280HB) | | | | | | | Pre-Hardened Steel (≤45HRC)<br>Alloy Tool Steel | | | Austenitic Stainless Steel<br>Ferritic and Martensitic Stainless Steel<br>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<br>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.

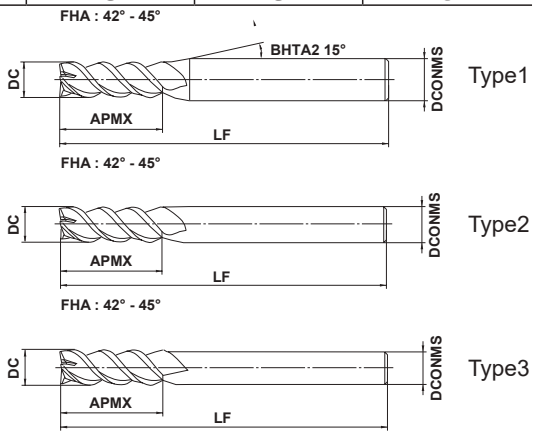
Note 5) When performing ramping deeper than the recommended depth of cut, please divide the process into multiple steps within the recommended depth of cut.

# 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 |
|---|---|---|---|---|---|---|---|
| ◎ | ○ | | | ◎ | ◎ | ○ | ○ |






| 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

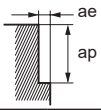
End mill, Medium cut length, 3 flute for drilling and slotting

## RECOMMENDED CUTTING CONDITIONS

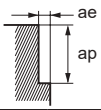
### Side milling

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

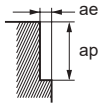
| Material | Carbon Steel, Alloy Steel, Mild Steel | | | | | Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel | | | | | Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys | | | | | Hardened Stainless Steel, Cobalt Chromium Alloys | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.

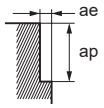
## Side milling

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

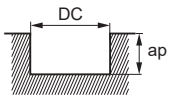
### Slotting

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

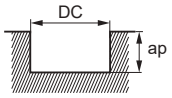



DC:Dia.

### 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.

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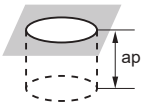
When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting of stainless steel, titanium alloy and heat resistant alloy etc. can be achieved with the use of emulsion.
Note 3) Chattering can still occur if 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.

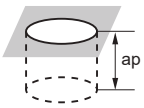
## Plunging

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.

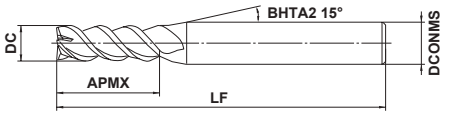
# VQMHZV – Inch sizes

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 |
|---|---|---|---|---|---|---|---|
| ◎ | ○ | | | ◎ | ◎ | ○ | ○ |

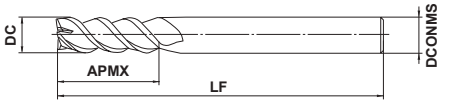


FHA : 42° - 45°




Type1

FHA : 42° - 45°




Type2

| 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)

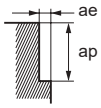
| Order Number | DC | APMX | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|
| **VQMHZVD1/16** | .0625 | .1250 | 2.0 | .2500 | 3 | ● | 1 |
| **VQMHZVD5/64** | .0781 | .1560 | 2.0 | .2500 | 3 | ● | 1 |
| **VQMHZVD3/32** | .0938 | .1880 | 2.0 | .2500 | 3 | ● | 1 |
| **VQMHZVD7/64** | .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 |

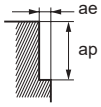
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.

● :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 |  | | | | | | | | | | | | | | | | | |

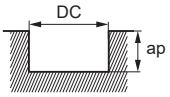
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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.

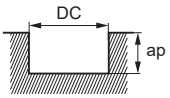
# VQMHZV – Inch sizes

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

## RECOMMENDED CUTTING CONDITIONS

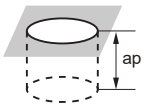
### Slotting

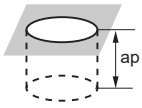
| Material | Carbon Steel (<30HRC) | | | | | Alloy Steel, Pre-Hardened Steel | | | | | Austenitic Stainless Steel, Titanium Alloys | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC (inch) | High speed cutting | | General purpose cutting | | Depth of cut ap (inch) | High 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. | | | | | | | | | | | | | | |

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.

## Drilling

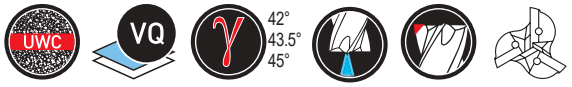
| Material | Carbon Steel (<30HRC) | | | | | | | Alloy Steel, Pre-Hardened Steel | | | | | | | Austenitic Stainless Steel, Titanium Alloys | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC (inch) | High speed cutting | | | General purpose cutting | | | 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

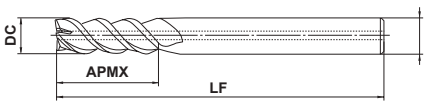
End mill, Medium cut length, 3 flute for drilling and slotting with thru-coolant




| 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 | | | |
| **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

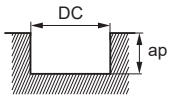
## Slotting

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

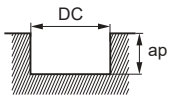



DC : Dia.

### 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

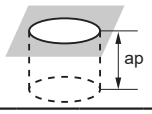
End mill, Medium cut length, 3 flute for drilling and slotting with thru-coolant

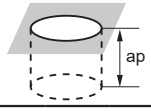
## RECOMMENDED CUTTING CONDITIONS

### 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.

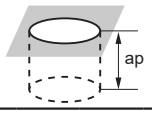
### High efficiency conditions

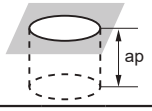
| Material | Carbon Steel, Alloy Steel, Mild Steel | | | | | Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel | | | | | Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys | | | | | Hardened Stainless Steel, Cobalt Chromium Alloys | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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

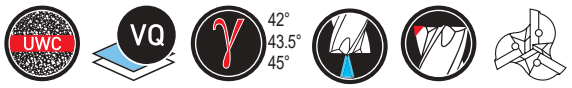
| Material | Carbon Steel, Alloy Steel, Mild Steel | | | | | Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel | | | | | Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys | | | | | Hardened Stainless Steel, Cobalt Chromium Alloys | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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

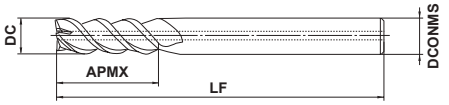
End mill, Medium cut length, 3 flute for drilling and slotting with thru-coolant




| 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)

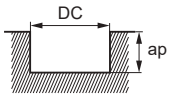
| Order Number | DC | APMX | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|
| **VQMHZVOHD1/4** | .2500 | .6252 | 2.5 | .2500 | 3 | ● | 1 |
| **VQMHZVOHD5/16** | .3125 | .7500 | 2.75 | .3125 | 3 | ● | 1 |
| **VQMHZVOHD3/8** | .3750 | .8752 | 3.0 | .3750 | 3 | ● | 1 |
|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

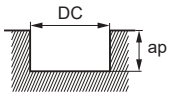
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.

● :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. | | | | | | | | | | | | | | |

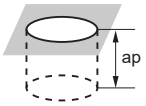
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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.

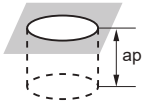
# VQMHZVOH – Inch sizes

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 |   | | | | | | | | | | | | | |

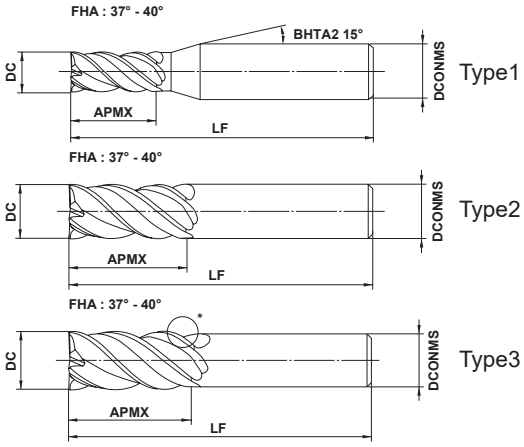
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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

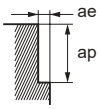
End mill, Medium cut length, 4 flute, Irregular helix flutes

## RECOMMENDED CUTTING CONDITIONS

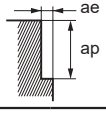
### Side milling

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

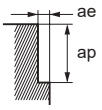
| Material | Carbon Steel, Alloy Steel, Mild Steel | | | | | Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel | | | | | Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys | | | | | Hardened Stainless Steel, Cobalt Chromium Alloys | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.

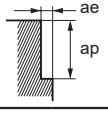
## Side milling

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

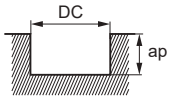
### Slotting

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

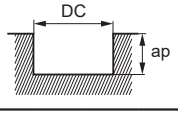



DC : Dia.

### 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.

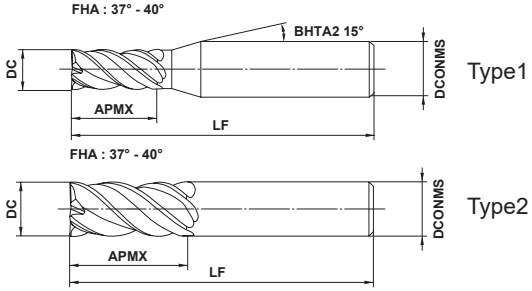
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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 |
|---|---|---|---|---|---|---|---|
| ◎ | ○ | | | ◎ | ◎ | ○ | ○ |






| 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.

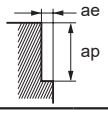
● : **USA Stock**

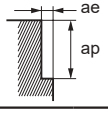
# VQMHV – Inch sizes

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

## RECOMMENDED CUTTING CONDITIONS

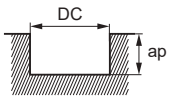
### Side milling

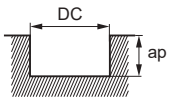
| Material | Carbon Steel (<30HRC) | | | | | | Alloy Steel, Pre-Hardened Steel | | | | | | Austenitic Stainless Steel, Titanium Alloys | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC (inch) | High speed cutting | | General purpose cutting | | Depth of cut 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

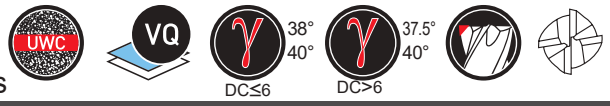
| Material | Carbon Steel (<30HRC) | | | | | Alloy Steel, Pre-Hardened Steel | | | | | Austenitic Stainless Steel, Titanium Alloys | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC (inch) | High speed cutting | | General purpose cutting | | Depth of cut ap (inch) | High 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.

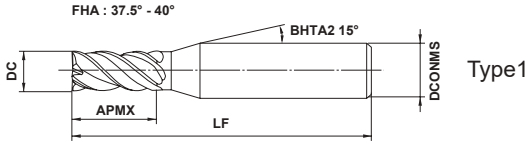
# VQJHV

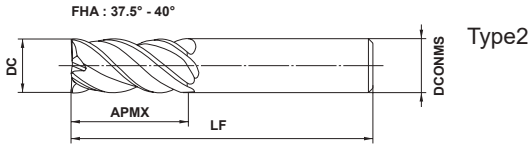
End mill, Semi long cut length, 4 flute, Irregular helix flutes




| 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)

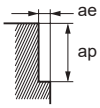
| Order Number | DC | APMX | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|
| **VQJHVD0100** | 1 | 4 | 45 | 4 | 4 | ● | 1 |
| **VQJHVD0150** | 1.5 | 6 | 45 | 4 | 4 | ● | 1 |
| **VQJHVD0200** | 2 | 8 | 60 | 6 | 4 | ● | 1 |
| **VQJHVD0250** | 2.5 | 10 | 60 | 6 | 4 | ● | 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 |

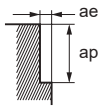
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.

**● : USA Stock ★ : Stocked in Japan**

# RECOMMENDED CUTTING CONDITIONS

## Side milling

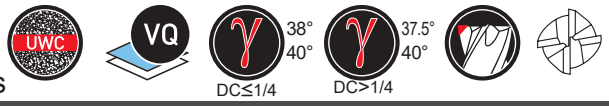
| Material | Carbon Steel, Alloy Steel, Mild Steel | | | | | Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel | | | | | Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys | | | | | Hardened Stainless Steel, Cobalt Chromium Alloys | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.

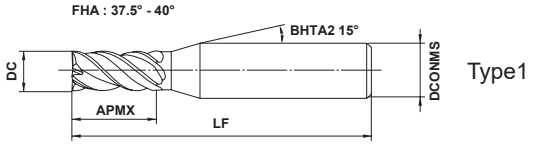
# VQJHV – Inch sizes

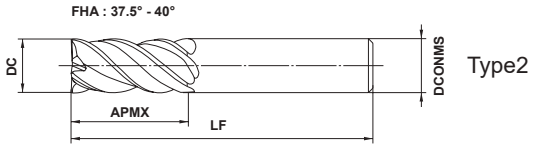
End mill, Semi long cut length, 4 flute, Irregular helix flutes




| 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)

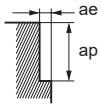
| Order Number | DC | APMX | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|
| **VQJHVD1/8** | .1250 | .5000 | 2.5 | .2500 | 4 | ● | 1 |
| **VQJHVD3/16** | .1875 | .7500 | 2.5 | .2500 | 4 | ● | 1 |
| **VQJHVD1/4** | .2500 | 1.0000 | 2.5 | .2500 | 4 | ● | 2 |
| **VQJHVD5/16** | .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 |

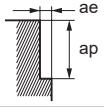
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.

● :USA Stock

# RECOMMENDED CUTTING CONDITIONS

## Side milling

| Material | Carbon Steel, Alloy Steel, Mild Steel | | | | Pre-Hardened Steel, Carbon Steel, Alloy 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 |  | | | | | | | |

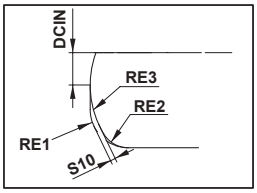
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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.

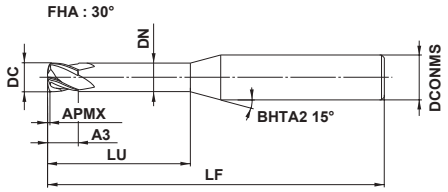
# VQFDRB

Duplex corner radius end mill for high speed cutting

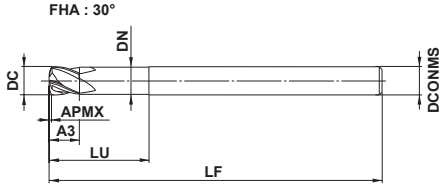
| Carbon Steel, Alloy Steel, Cast Iron (<30HRC) | Tool Steel, Pre-hardened Steel,Hardened Steel (≤45HRC) | Hardened Steel (≤55HRC) | Hardened Steel (>55HRC) | Austenitic Stainless Steel | Cobalt Chrome Alloy Titanium Alloy | Heat Resistanse Alloy | Copper Alloy |
|---|---|---|---|---|---|---|---|
| |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






Type 1




Type 2

| DC | | | | |
|---|---|---|---|---|
| 0<br>- 0.020 | | | | |
| **DCONMS** | | | | |
| 0<br>- 0.005 | | | | |

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

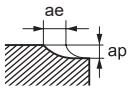
(mm)

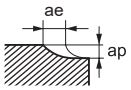
| Order Number | DC | *1 RE1 | APMX | *3 A3 | LU | DN | LF | DCONMS | No. of Flutes | Multi-task radius part | | | | *2 RMPX | Stock | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | S10 | DCIN | RE2 | RE3 | | | |
| **VQFDRBD0300N080** | 3 | 0.64 | 0.18 | 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<br>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.

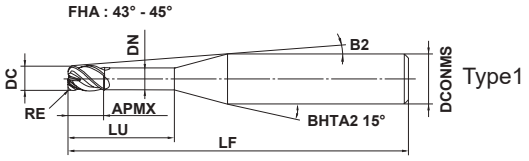
# VQHVRB

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

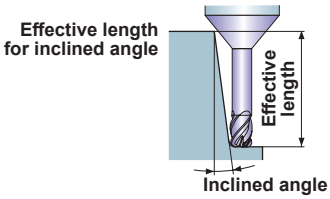



| Carbon Steel, Alloy Steel, Cast Iron (<30HRC) | Tool Steel, Pre-hardened Steel,Hardened Steel (≤45HRC) | Hardened Steel (≤55HRC) | Hardened Steel (>55HRC) | Austenitic Stainless Steel | Cobalt Chrome Alloy Titanium Alloy | Heat Resistanse Alloy | Copper Alloy |
|---|---|---|---|---|---|---|---|
| |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






| RE | | | |
|---|---|---|---|
| ±0.01 | | | |
| **DC** | | | |
| 0<br>- 0.02 | | | |
| **DCONMS** | | | |
| 0<br>- 0.005 | | | |



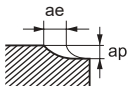

● SMART MIRACLE corner radius end mill for high feed rates and efficient machining.

(mm)

| Order Number | DC | RE | APMX | LU | DN | B2 | LF | DCONMS | 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<br>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 | | | |  | | | | | | | | | |

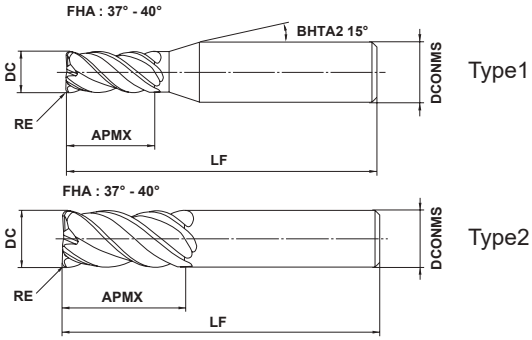
Note 1) SMART MIRACLE coating has very low electrical conductivity; therefore, an external contact type of tool setter (electric transmitted) may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) or a laser tool setter.
Note 2) When cutting titanium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

| 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

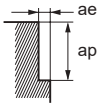
Corner radius, Medium cut length, 4 flute, Irregular helix flutes

## RECOMMENDED CUTTING CONDITIONS

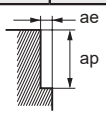
### Side milling

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

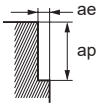
| Material | Carbon Steel, Alloy Steel, Mild Steel | | | | | Pre-Hardened Steel, Carbon Steel, Alloy Steel, Alloy Tool Steel | | | | | Austenitic, Ferritic and Martensitic Stainless Steel, Titanium Alloys | | | | | Hardened Stainless Steel, Cobalt Chromium Alloys | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.

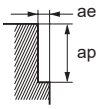
## Side milling

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

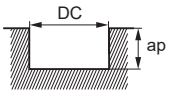
### Slotting

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

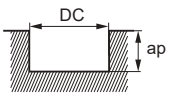



DC : Dia.

### 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.

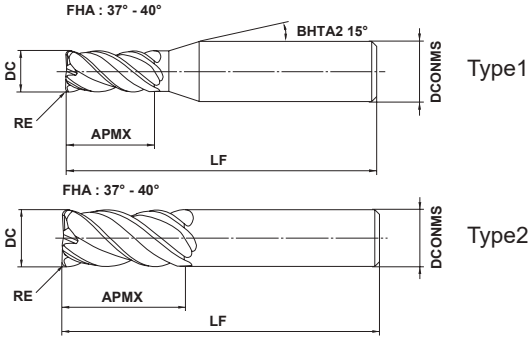
# VQMHVRB – Inch sizes

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

UWC | VQ | 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 | | | | |
|---|---|---|---|---|
| ±.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.

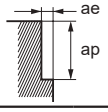
● : USA Stock

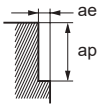
# VQMHVRB – Inch sizes

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

## RECOMMENDED CUTTING CONDITIONS

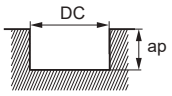
### Side milling

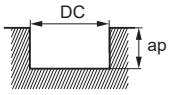
| Material | Carbon Steel (<30HRC) | | | | | | Alloy Steel, Pre-Hardened Steel | | | | | | Austenitic Stainless Steel, Titanium Alloys | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC (inch) | High speed cutting | | General purpose cutting | | Depth of cut 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. | | | | | | | | | | | | | | |

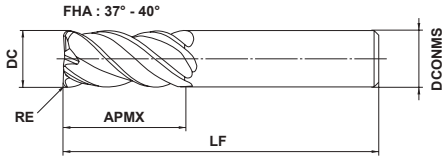
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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.

# VQMHVRBF

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 | | | | |
|---|---|---|---|---|
| ±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)

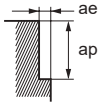
| Order Number | DC | RE | APMX | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|---|
| **VQMHVRBFD0600R030** | 6 | 0.3 | 13 | 50 | 6 | 4 | ● | 1 |
| **VQMHVRBFD0600R050** | 6 | 0.5 | 13 | 50 | 6 | 4 | ● | 1 |
| **VQMHVRBFD0600R100** | 6 | 1 | 13 | 50 | 6 | 4 | ● | 1 |
| **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.

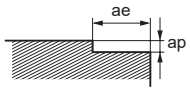
● : USA Stock ★ : Stocked in Japan

# 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.

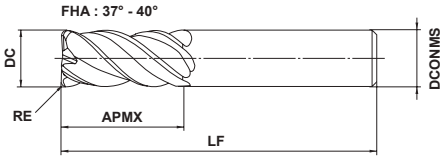
# VQMHVRBF – Inch sizes

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)

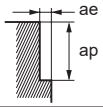
| Order Number | DC | RE | APMX | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|---|
| **VQMHVRBFD1/4R015** | .2500 | .0150 | .6250 | 2.5 | .2500 | 4 | ● | 1 |
| **VQMHVRBFD1/4R030** | .2500 | .0300 | .6250 | 2.5 | .2500 | 4 | ● | 1 |
| **VQMHVRBFD5/16R015** | .3125 | .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 |

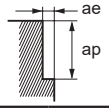
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.

● :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 |  | | | | | | | |

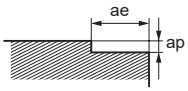
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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.

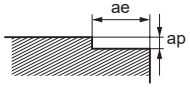
# VQMHVRBF – Inch sizes

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 |  | | | | | | | |

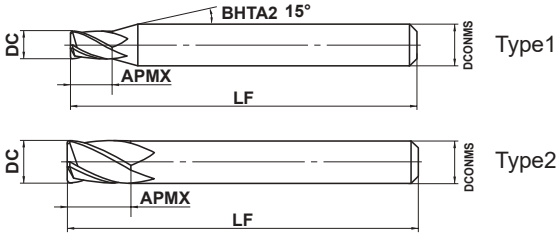
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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<br>- 0.020 | | | | |
| DCONMS=6 | DCONMS=8, 10 | | | |
| 0<br>- 0.008 | 0<br>- 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.

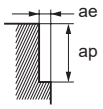
● : **USA Stock**

# VQ4MRB-FB

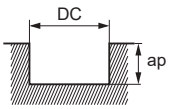
Corner radius end mill, Medium cut length, 4 flute, For Swiss-Type lathe

## 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 | | 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) |
| (mm) | (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

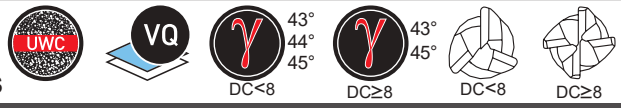
| Material | | Carbon Steel, Cast Iron, Alloy Steel (－30HRC) | | | Alloy Steel, Tool Steel, Pre-Hardened Steel | | | Austenitic Stainless Steel, Titanium Alloys | | | Copper, Copper Alloys | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC | | Revolution ($min^{-1}$) | Table Feed (IPM) | 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** |
| (mm) | (inch) | | | | | | | | | | | | |
| **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

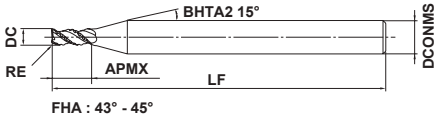
Roughing end mill, Short cut length, 3–4 flute, Irregular helix flutes




| 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 |
|---|---|---|---|---|---|---|---|
| ◎ | ○ | | | ◎ | ◎ | ○ | ○ |

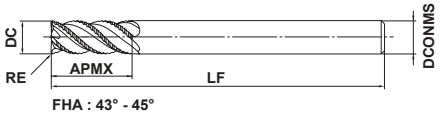


FHA : 43° - 45°




Type1

FHA : 43° - 45°




Type2

FHA : 43° - 45°




Type3

h6

| DCONMS=6 | DCONMS=8, 10 | DCONMS=12, 16 | DCONMS=20 |
|---|---|---|---|
| 0<br>- 0.008 | 0<br>- 0.009 | 0<br>- 0.011 | 0<br>- 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

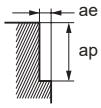
Roughing end mill, Short cut length, 3—4 flute, Irregular helix flutes

## RECOMMENDED CUTTING CONDITIONS

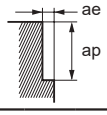
### Side milling

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.

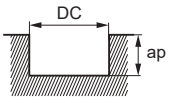
## Slotting

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

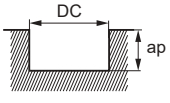



DC : Dia.

### 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.

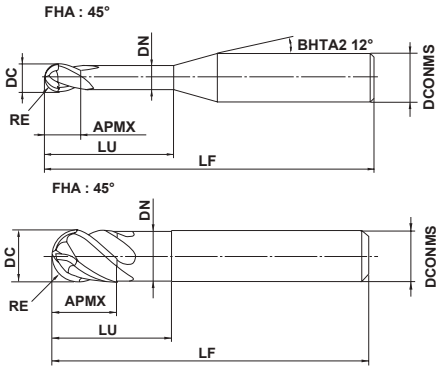
Note 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work.
When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
Note 2) Effective cutting 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)

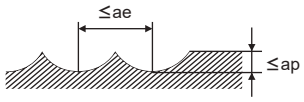
| Order Number | RE | DC | APMX | LU | DN | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|---|---|---|
| **VQ4SVBR0100** | 1 | 2 | 3 | 5 | 1.9 | 50 | 6 | 4 | ● | 1 |
| **VQ4SVBR0150** | 1.5 | 3 | 4.5 | 7.5 | 2.9 | 50 | 6 | 4 | ● | 1 |
| **VQ4SVBR0200** | 2 | 4 | 6 | 10 | 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.

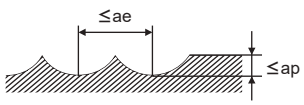
● :USA Stock

# RECOMMENDED CUTTING CONDITIONS

## Shoulder milling (slotting)

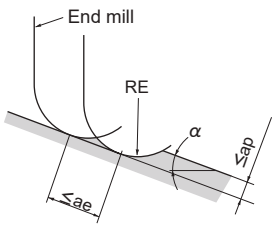
| Material | Carbon Steel, Alloy Steel, Mild Steel, Pre-Hardened Steel | | | | | | | | Austenitic Stainless Steel, Titanium Alloys, Precipitation Hardening Stainless Steel, Cobalt Chromium Alloys, Ferritic and Martensitic Stainless Steel | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.

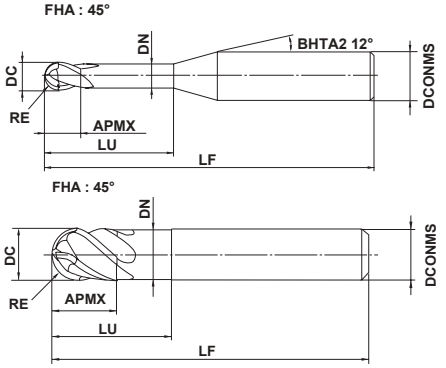


# VQ4SVB –Inch sizes

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" | | | |
| 0 - .00035" | 0 - .00043" | | | |

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

(inch)

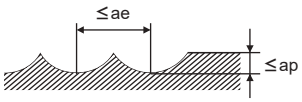
| Order Number | RE | DC | APMX | LU | DN | LF | DCONMS | No. of Flutes | Stock | Type |
|---|---|---|---|---|---|---|---|---|---|---|
| **VQ4SVBD1/8** | .0625 | .1250 | .188 | .3126 | .1213 | 2.0 | .2500 | 4 | ● | 1 |
| **VQ4SVBD3/16** | .0938 | .1875 | .281 | .4689 | .1835 | 2.0 | .2500 | 4 | ● | 1 |
| **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.

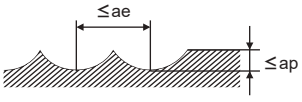
● :USA Stock

# RECOMMENDED CUTTING CONDITIONS

## Shoulder milling (Slotting)

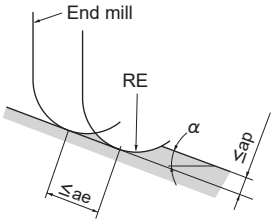
| Material | Carbon Steel, Alloy Steel, Mild Steel, Pre-Hardened Steel | | | | | | Austenitic Steinless Steel, Precipitation Hardening Stainless Steel, Ferritic and Martensitic Stainless Steel, Cobalt Chomium Alloys, Titanium alloys | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |  | | | | | | | | | | | |

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 |  | | | | | | | | | | | |

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.

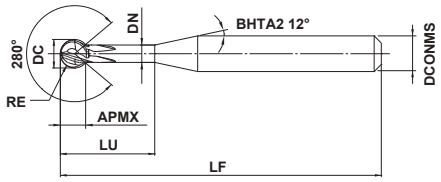


# VQ4WB

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<br>- 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.

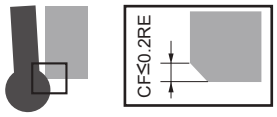
**<Order for Special Product>**

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.)

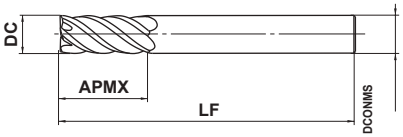
# VQ5MHV – Inch sizes

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

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<br>- .0012" | | | | |
| DCONMS≤.3750" | DCONMS=.5000" | | | |
| 0<br>- .0002" | 0<br>- .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**

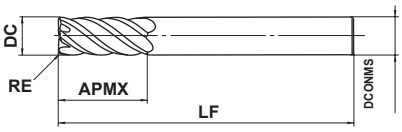
# VQ5MHVRB – Inch sizes

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<br>- .0012" | | | | |
| DCONMS≤.3750" | DCONMS=.5000" | | | |
| 0<br>- .0002" | 0<br>- .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

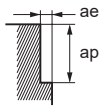
# VQ5MHV – Inch sizes
End mill, Medium cut length, 5 flute, Irregular helix flutes

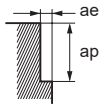
# VQ5MHVRB – Inch sizes
Corner radius, Medium cut length, 5 flute, Irregular helix flutes

## 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.

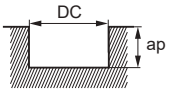
# VQ5MHV – Inch sizes

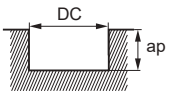
End mill, Medium cut length, 5 flute, Irregular helix flutes

# 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 | High Speed Cutting | | General Purpose Cutting | | Depth of Cut |
| (mm) | (inch) | Revolution **n** ($min^{-1}$) | Table Feed **vf** (IPM) | Revolution **n** ($min^{-1}$) | Table Feed **vf** (IPM) | **ap** (inch) | Revolution **n** ($min^{-1}$) | Table Feed **vf** (IPM) | Revolution **n** ($min^{-1}$) | Table Feed **vf** (IPM) | **ap** (inch) |
| **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 | High Speed Cutting | | General Purpose Cutting | | Depth of Cut |
| (mm) | (inch) | Revolution **n** ($min^{-1}$) | Table Feed **vf** (IPM) | Revolution **n** ($min^{-1}$) | Table Feed **vf** (IPM) | **ap** (inch) | Revolution **n** ($min^{-1}$) | Table Feed **vf** (IPM) | Revolution **n** ($min^{-1}$) | Table Feed **vf** (IPM) | **ap** (inch) |
| **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.

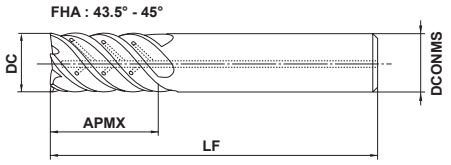
# VQ6MHVCH

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

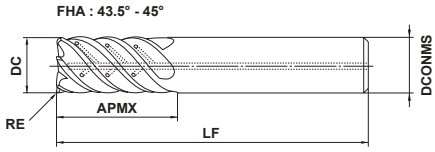
Corner radius, Medium cut length, 6 flute, Irregular helix flutes, with multiple thru-coolant




| 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 |
| **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

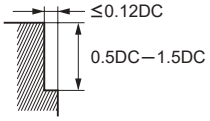
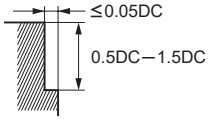
End mill, Medium cut length, 6 flute, Irregular helix flutes, with multiple thru-coolant

# VQ6MHVRBCH

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

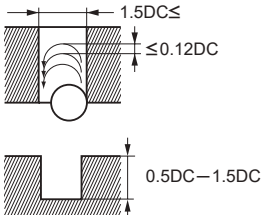
## RECOMMENDED CUTTING CONDITIONS

### 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

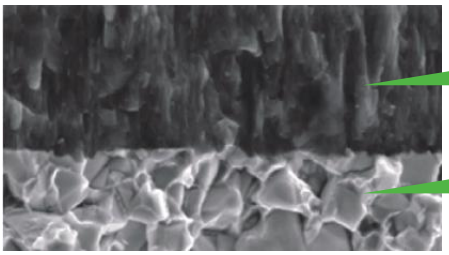
# VQXL

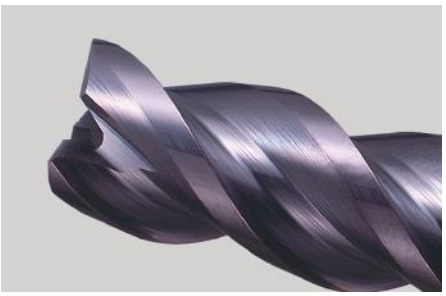
## SMART MIRACLE Coating

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



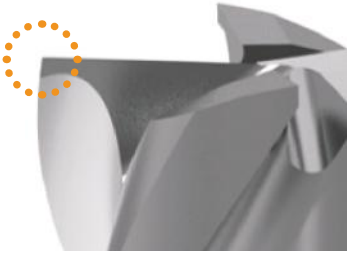
Conventional Coating

## 3 or 4 Flutes

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

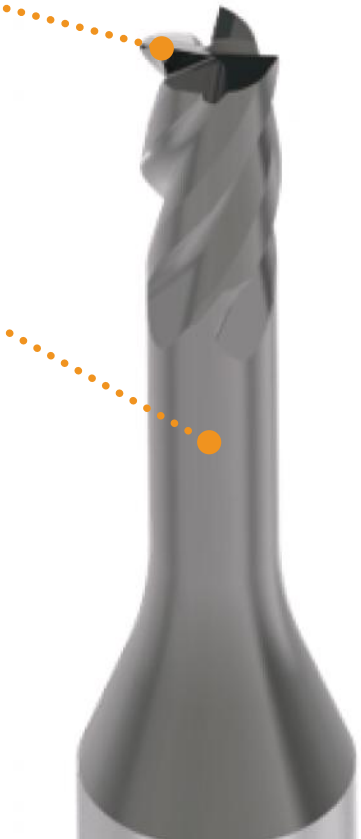
## High Rigidity Neck Design

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



## Optimized Gash Land

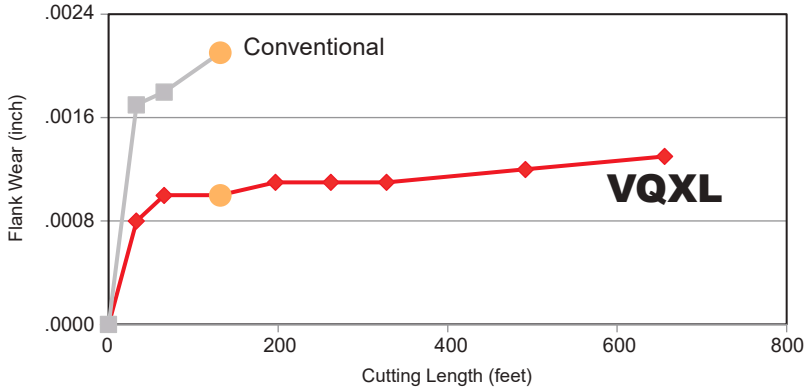
Micro gash land design minimizes corner residue while maintaining corner strength.



# 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 Length 131.2 feet



VQXL



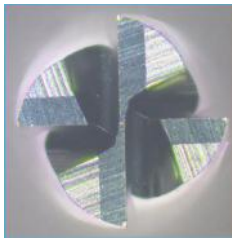
Conventional

<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

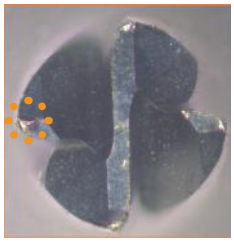
## Comparison of TPRX Machining Cobalt Chromium Alloy

VQXL achieved longer tool life and good machined surface.

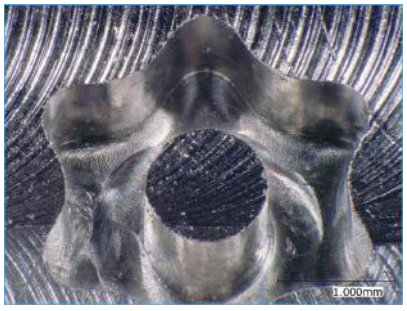
VQXL



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

## SMART MIRACLE End Mill Series

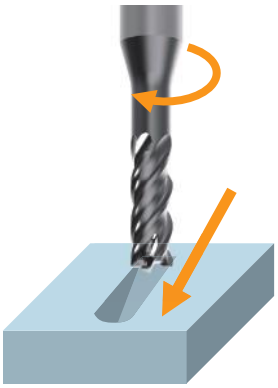
# VQ4MVM

## 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.

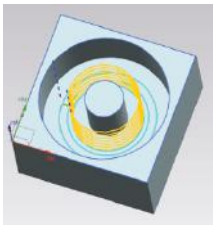
This eliminates the need for a pilot hole when machining pockets, thereby reducing costs through tool consolidation. Compared to direct plunge cutting, ramping enables simultaneous multi-axis feed at high speeds to lower machining times. This method is ideal for machining wide and shallow pockets.

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.



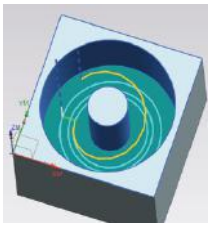
Steep Ramping Capability

**27 sec**

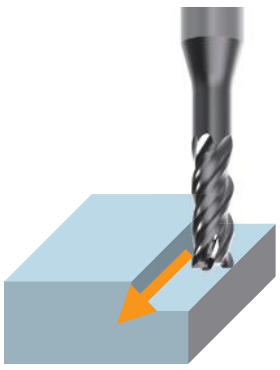


Conventional
Helical Milling
7 passes needed

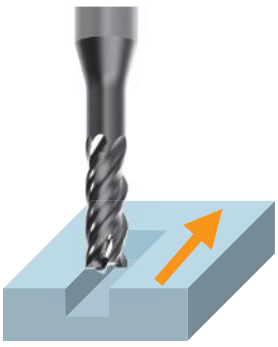
**14 sec**



**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.

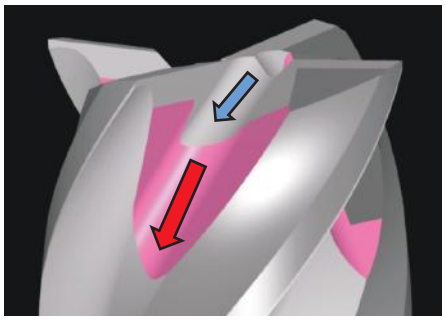
**SMART MIRACLE Coating** (Al,Cr)N coating is the most suitable coating for higher efficiency machining.

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



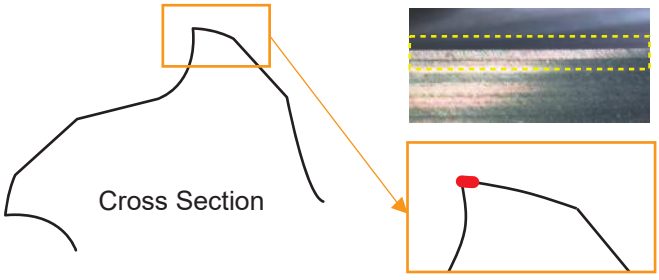
## Secondary Gash

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



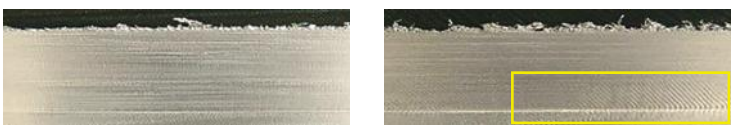

## Micro Relief Angle

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

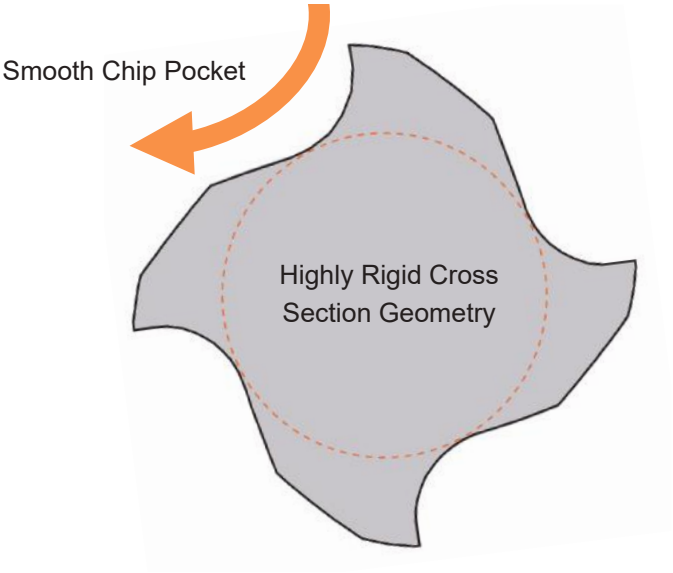



**VQ4MVM** Conventional

# Chip Pocket and Highly Rigid Geometry

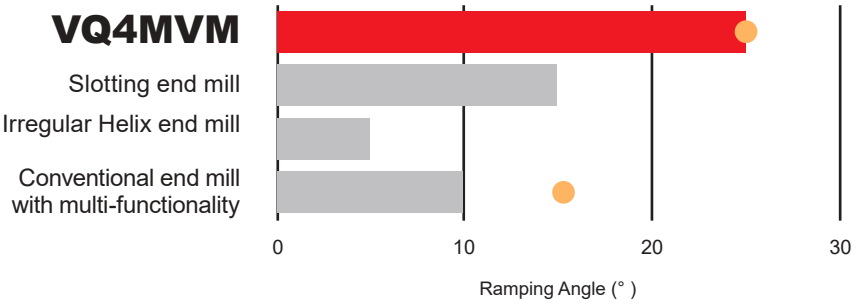
VQ4MVM is suitable for steep ramping and chip evacuation performance due to the highly rigid geometry.





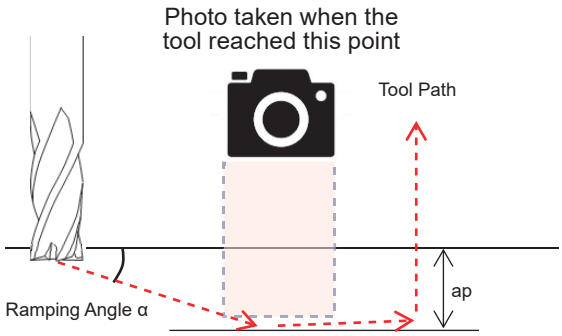

# Comparison of Ramping Angles when Machining 304

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<br>ae=.394 inch |
| Over Length | : 1.378 inch |
| Cutting Mode | : External Coolant (Emulsion) |
| Machine | : Vertical M/C (BT50) |




● : Machining Surface



**VQ4MVM** 25°



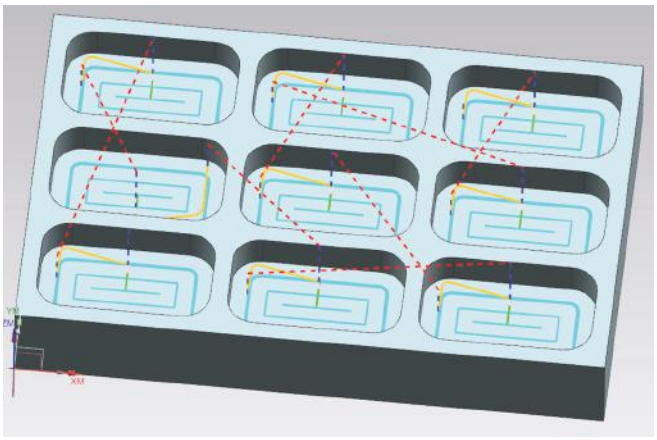
Conventional end mill 15°

# 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

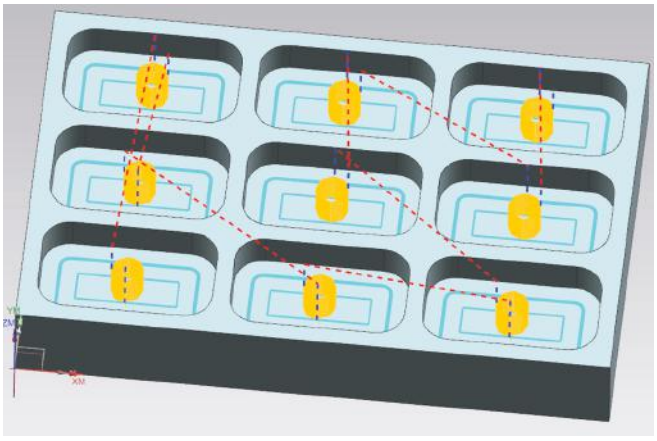
### Rough Cutting

<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

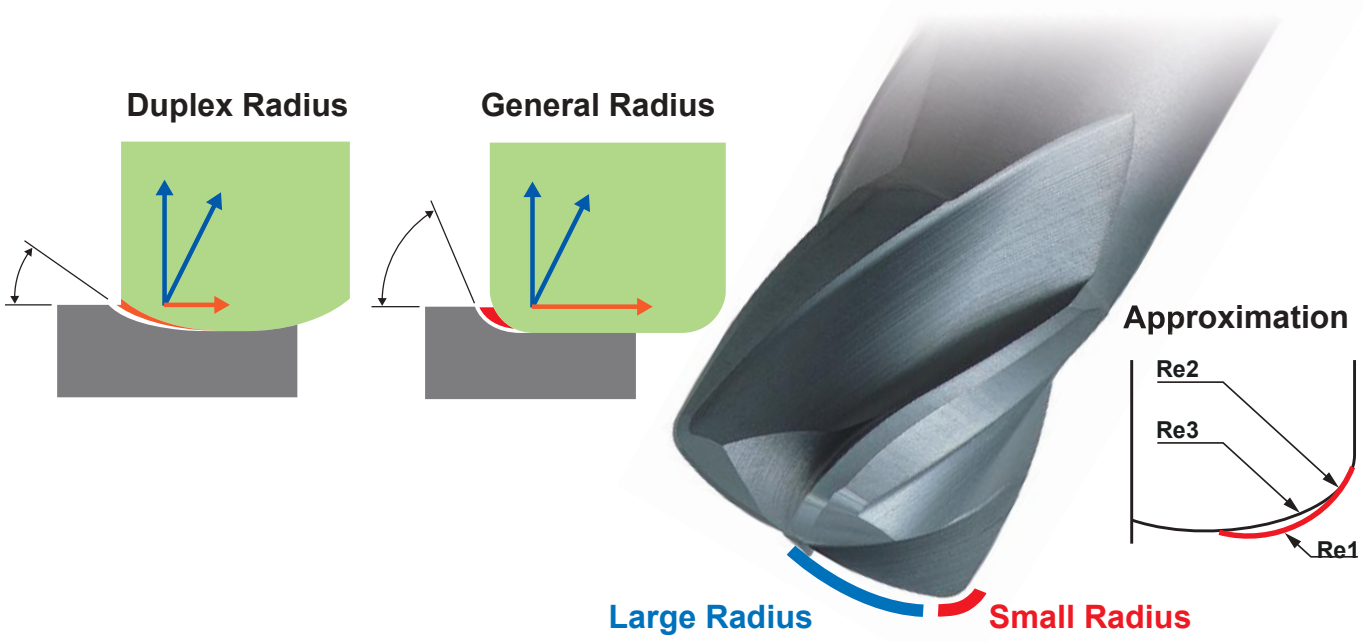
### Finish Cutting

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

# 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.

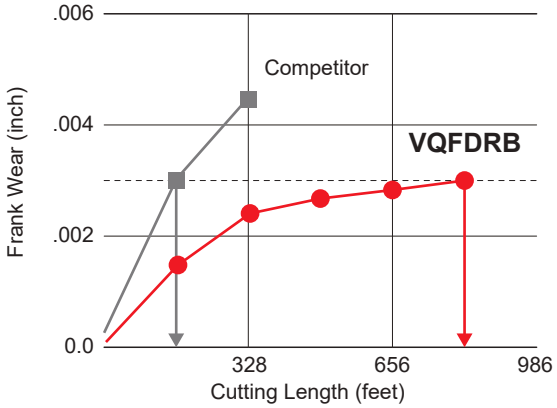



## Cutting Performance : Competitive Comparison

**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=8600 $min^{-1}$ (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=8600 $min^{-1}$ (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.

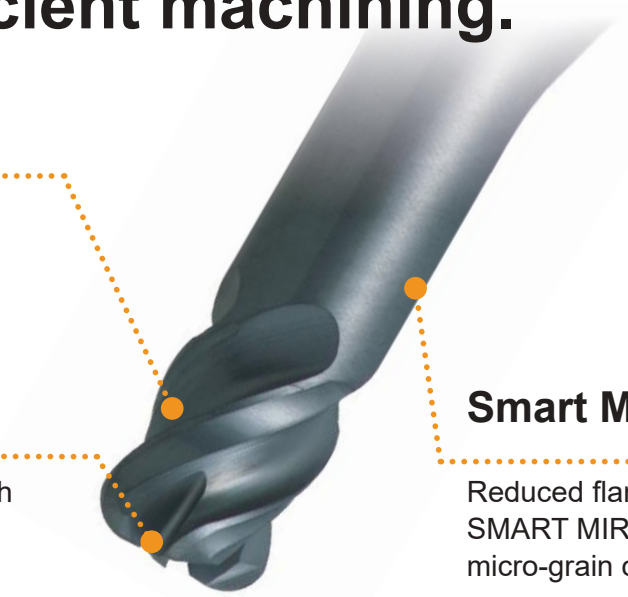
## SMART MIRACLE End Mill Series for Dental Milling

## 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>

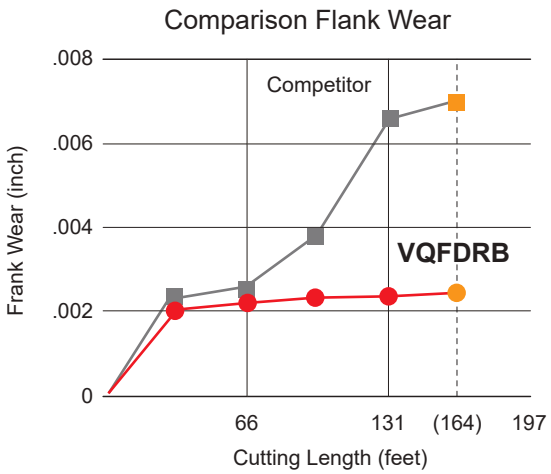
| | |
|---|---|
| Material | : Titanium Alloy |
| Tool | : VQHVRBD0300R05N180 (ø.118") |
| Revolution | : n=8600 $min^{-1}$ (vc=260 SFM) |
| Feed Rate | : vf=51.2 IPM (.002 IPT) |
| Depth of Cut | : ap=.008" ae=.051" |
| Coolant | : Emulsion |
| Cutting Length | : 164 feet |

**VQHVRB**



Competitor





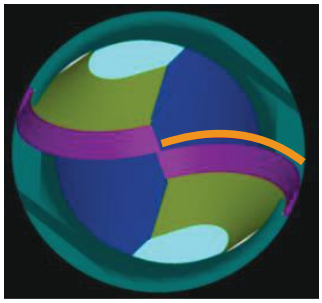
## SMART MIRACLE End Mill Series for Dental Milling

# 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"

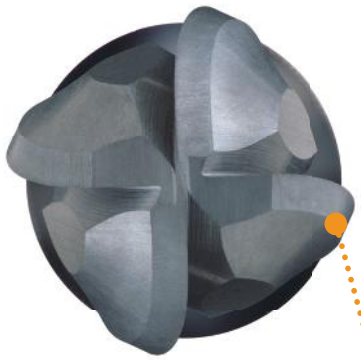
| Process | | Rough 1 | Rough 2 | Finish 1 | Finish 2 |
|---|---|---|---|---|---|
| Tool | | VQ2XLBR0150N140 Ø.118"(RE.059") | VQ2XLBR0150N140 Ø.118"(RE.059") | VQ2XLBR0100N100S06 Ø.079"(RE.039") | VQ2XLBR0050N080N06 Ø.039"(RE.020") |
| Cutting Speed **vc** (SFM) | | 195 | 260 | 245 | 205 |
| Revolution **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

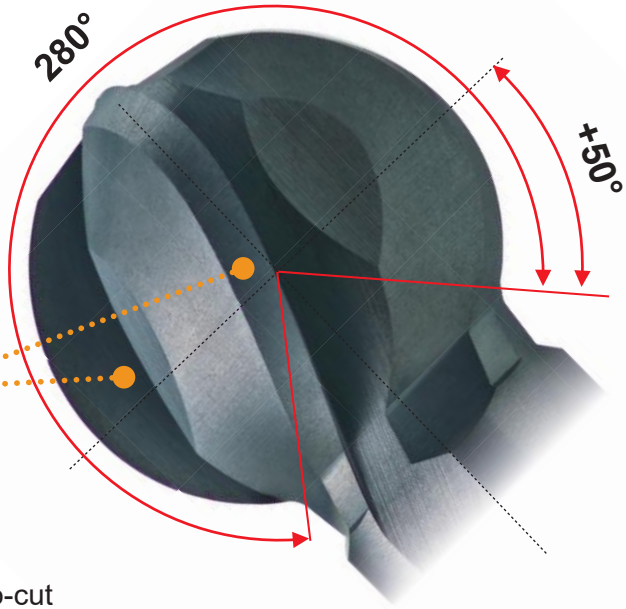
Constant edge and rake geometry helps to prevent burrs and chattering.

### Long Tool Life

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

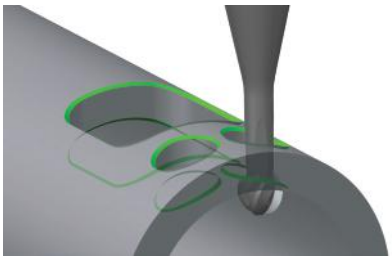
### Multiple-Applications

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

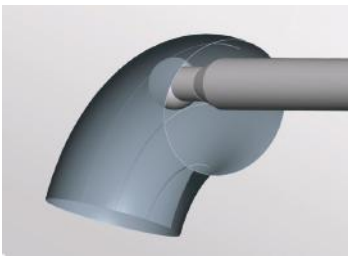



## Multiple Applications

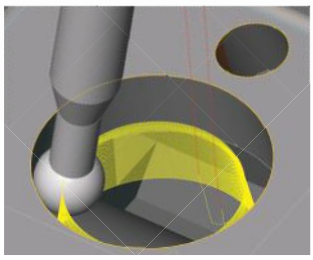
Deburring (Chamfering)



Internal Profile Milling



Undercut Machining



# Application Example

①Rounded Shape Slotting



②Deburring
(Top & Back Face)



Internal Profile



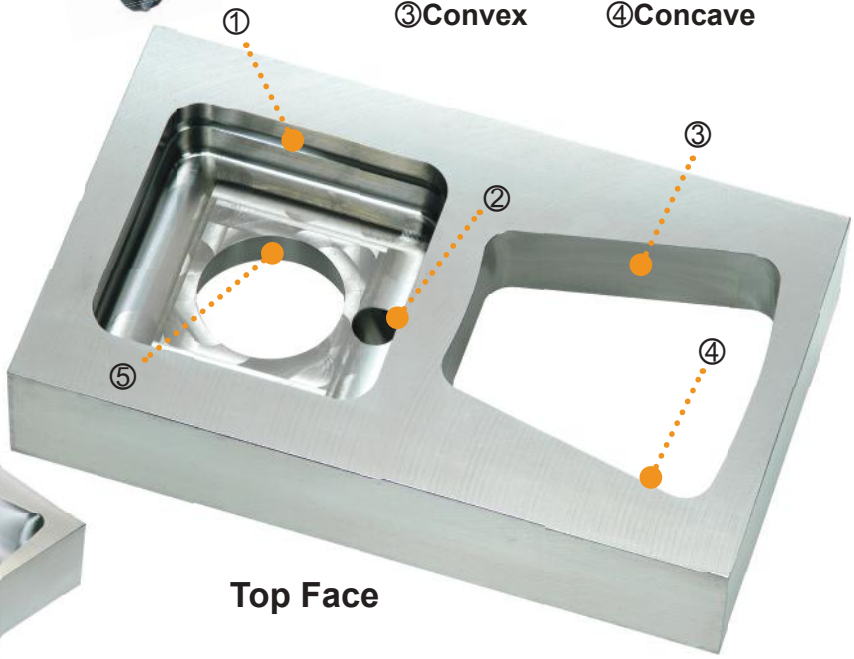
③Convex



④Concave

⑤Undercut (Taper Hole)





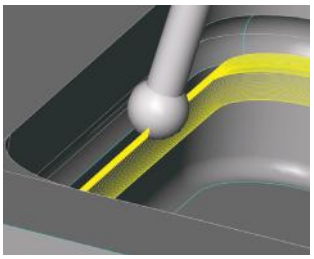

Top Face



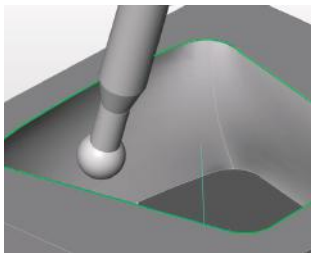
Back Face

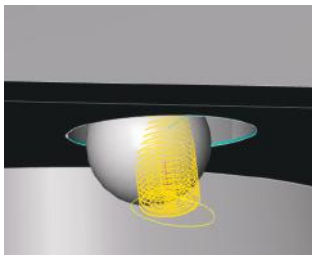
## Multiple Applications

Rounded Shape Slotting

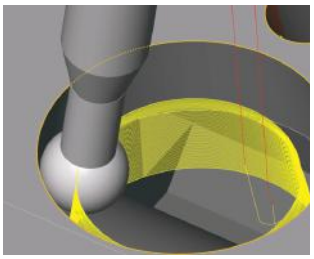


Deburring and Chamfering

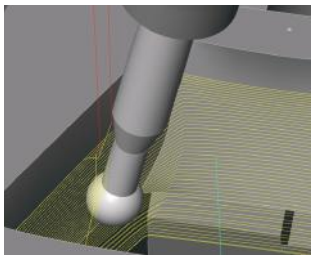


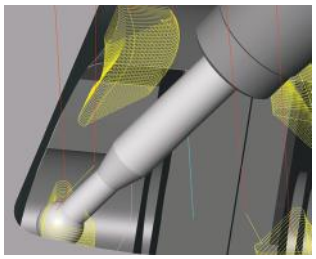


Under Cut (Taper Hole)



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

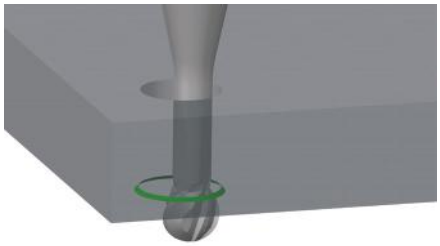


Competitor B

Visible Burrs Persist







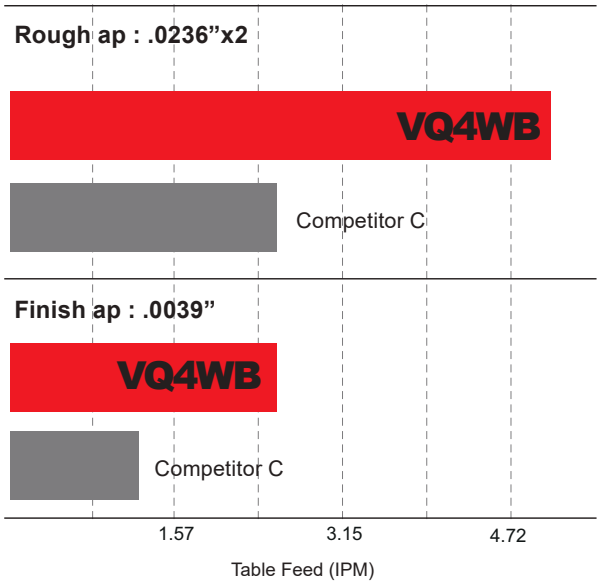
<Cutting Conditions>

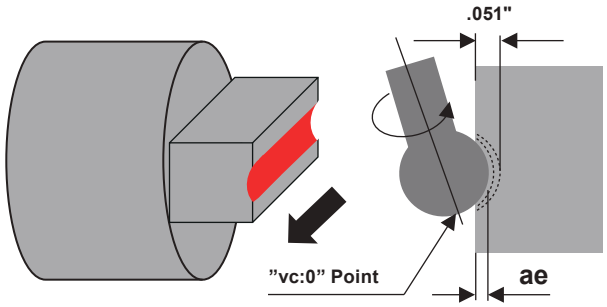
| | |
|---|---|
| Material | : AISI S17400 |
| Tool | : VQ4WBR0150N08E280 |
| | DC = .1181” |
| Revolution | : n = 3200 $min^{-1}$ |
| Cutting Speed | : vc = 98.5 SFM |
| Feed Rate | : vf = 2.16 IPM, fz = .0002 IPT |
| Chamfer Width | : .0394” |
| Cutting Mode | : Hole Size .1575” |
| | External Coolant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

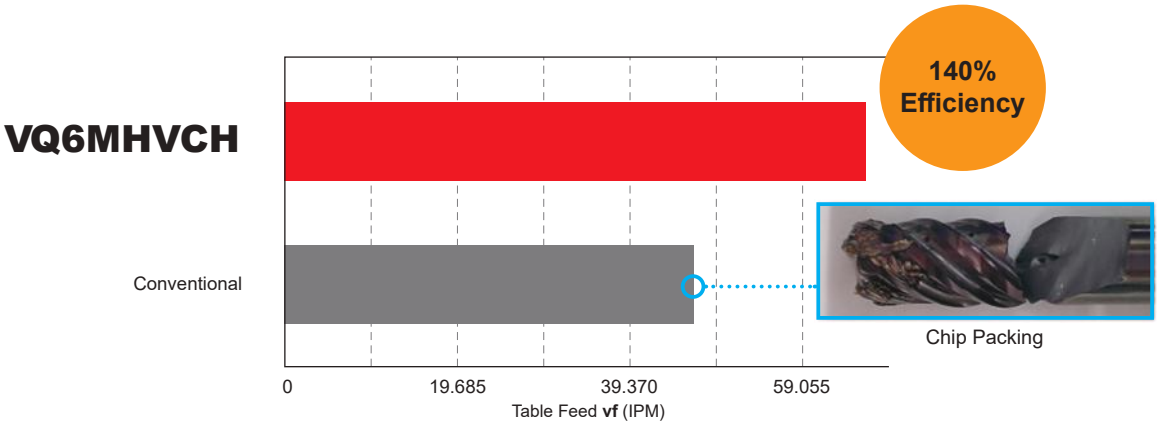
Corner radius, Medium cut length,
6 flute, Irregular helix flutes,
with multiple thru-coolant holes

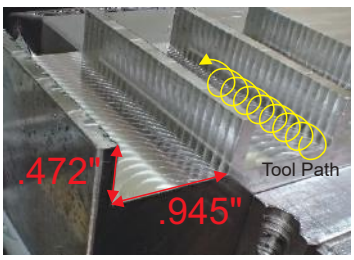


## Cutting Performance

### AISI 304 Efficiency Comparison in Trochoid Milling

VQ6MHVCH achieves machine 140% more efficiently compared to conventional.




<Cutting Conditions>

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

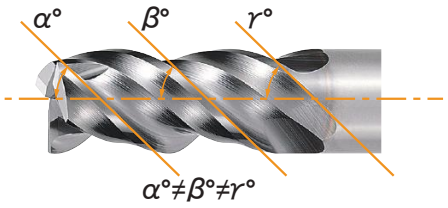
# Features

**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.**

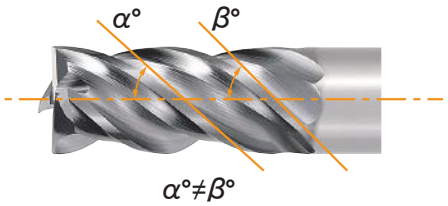
## Geometry

**Irregular Helical Flutes**

### No Vibration!



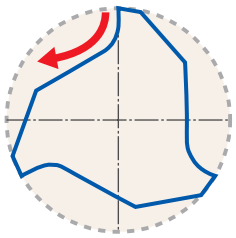

3 flute

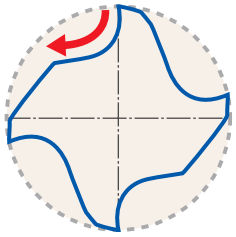



4 flute

**Special Flute Geometry**

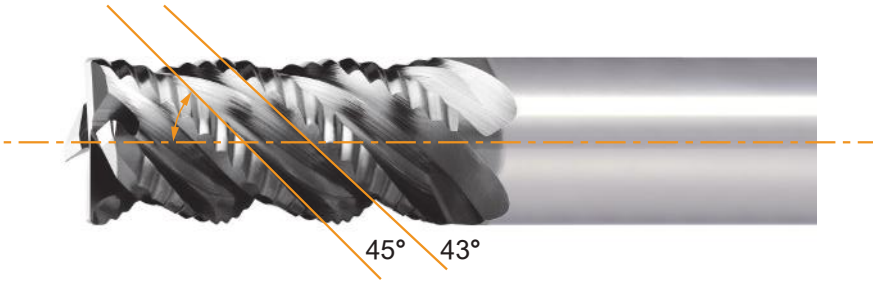
### Improved Chip Disposal





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

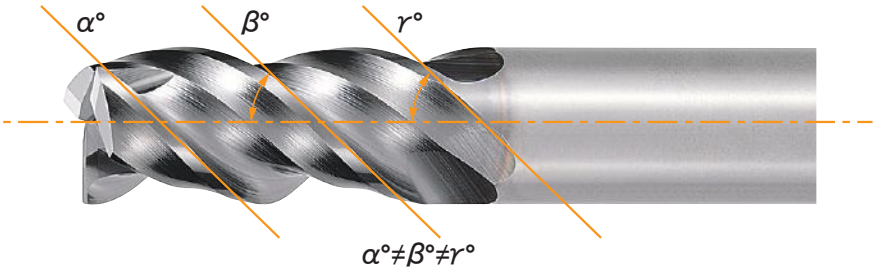
**Multi-functional machining with one end mill.**
**Drilling, slot milling and shoulder milling.**



## VQMHZVOH

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



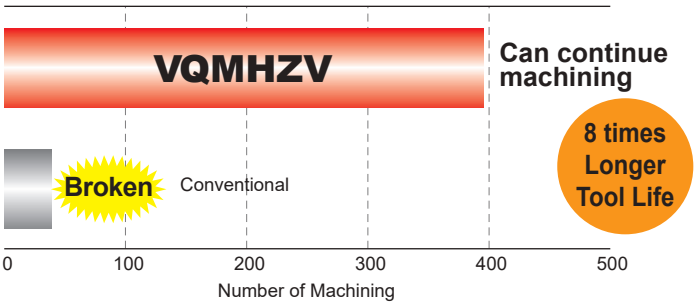



Unique geometry - 3 flute end mill with irregular helix flutes suppresses chatter for increased machining stability.
Optimized tool geometry and SMART MIRACLE coating give excellent chip evacuation for higher efficiency.
The performance of VQMHZVOH when drilling is significantly improved on difficult-to-cut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

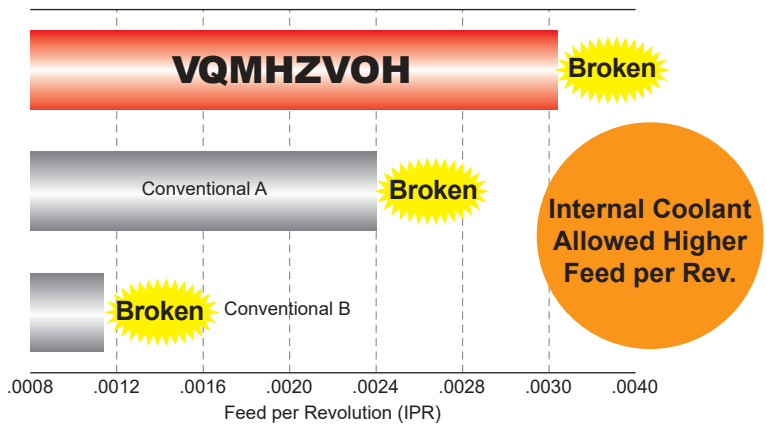



<Cutting Conditions>

| | |
|---|---|
| Material | : AISI 304 |
| End Mill | : VQMHZVD0800 (DC=.315") |
| Revolution | : 2400 $min^{-1}$ |
| 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 | : 3200 $min^{-1}$ |
| 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

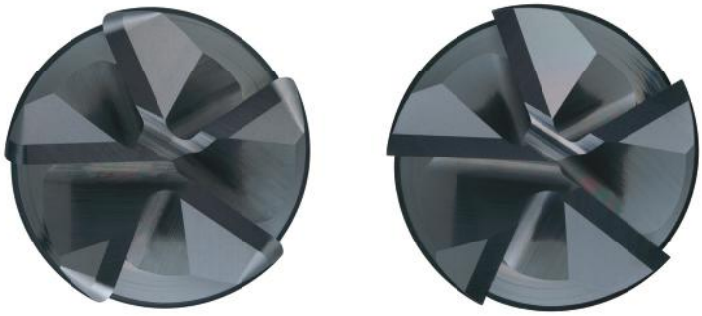
SMART MIRACLE End Mill Series

# 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.

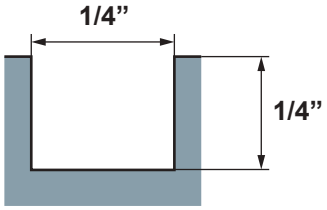
## SMART MIRACLE Coating

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

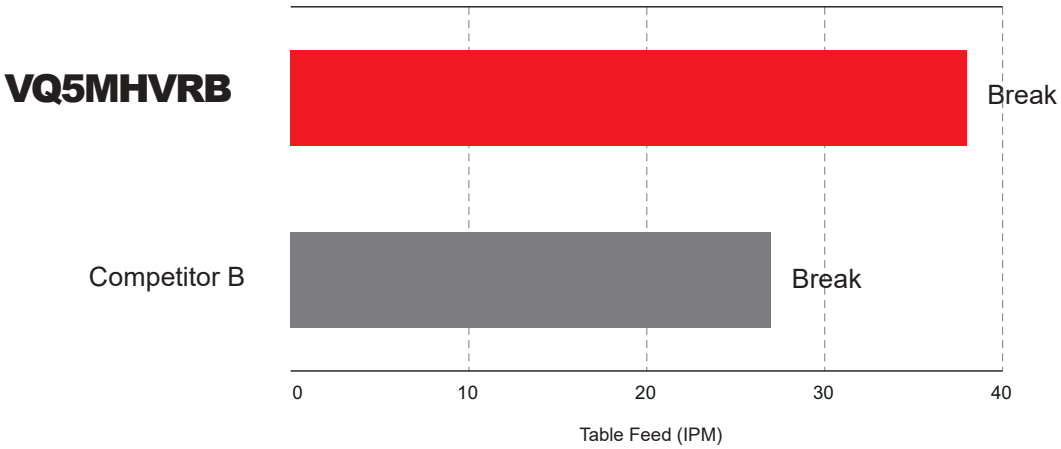


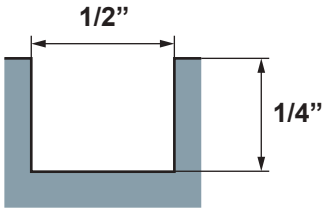
VQ5MHVRB VQ5MHV

# 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)

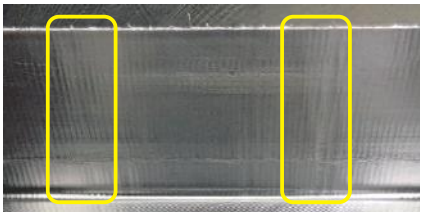


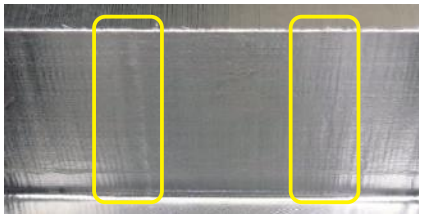




<Cutting Conditions>
Material : 17-4PH (AISI S17400)
Tool : VQ5MHVRBD1/2R030
ø1/2 RE = .030
Revolution : n = 1754 $min^{-1}$
Cutting Speed : vc = 230 SFM
Table Feed : vf = 24.17 IPM
Feed per Tooth : .0038 inch
Cutting Mode : External Coolant (Emulsion)
Machine : Vertical M/C (HSK100A)

VQ5MHVRB | Competitor A | Competitor B







Smooth Surface Finish

Uneven Surface

# 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

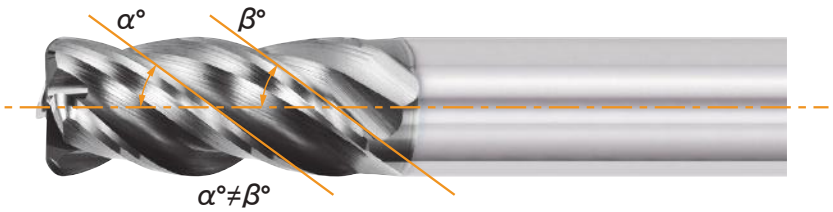
**Available in a wide range of corner radius, including large sizes suitable for aerospace components.**



## VQMHVRBF

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

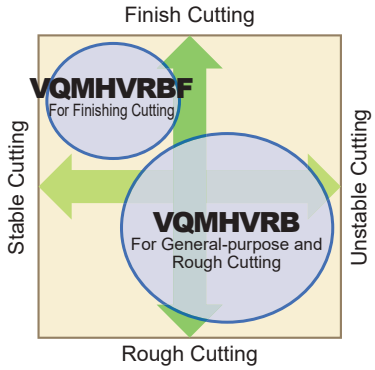





Optimised irregular helix angle improves cutting performance.
The combination of an excellent carbide substrate and SMART MIRACLE coating allows a wide range of machining applications.

## 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 | ◎ | ◎ | ○ | ○ |

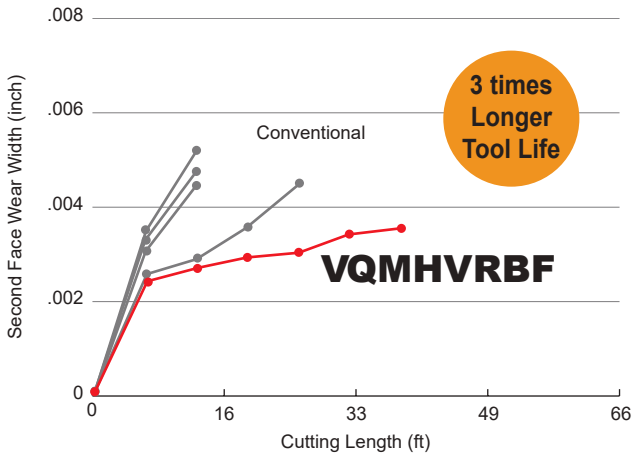
## Cutting Performance

### 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<br>External Coolant (Emulsion) |
| Machine | : Vertical M/C (BT50) |

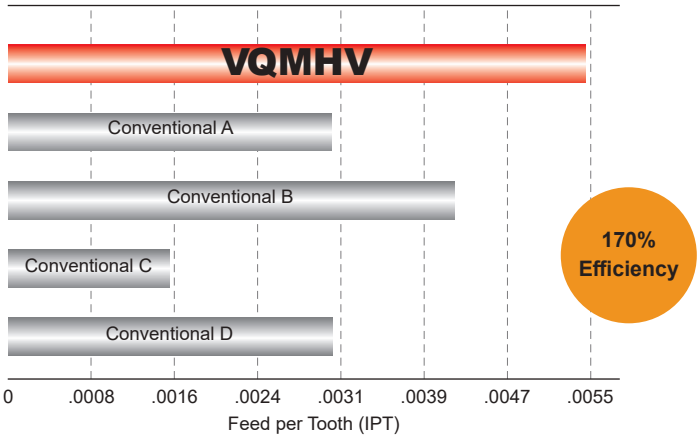


# Cutting Performance

## Efficiency Comparison in AISI 304

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

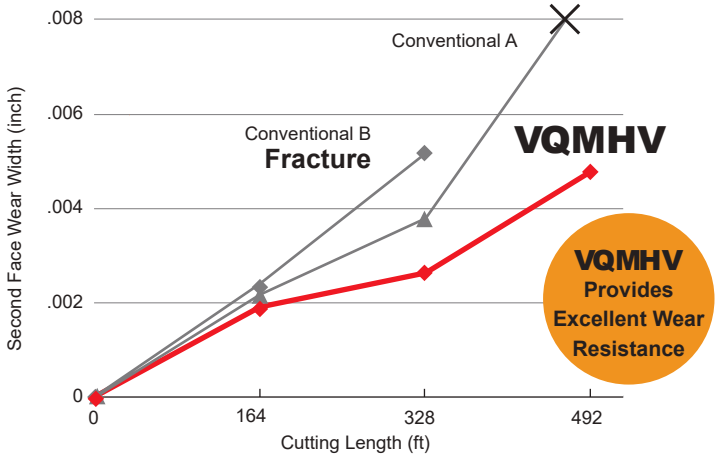
### Maximum of Slotting Feed Rate




<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

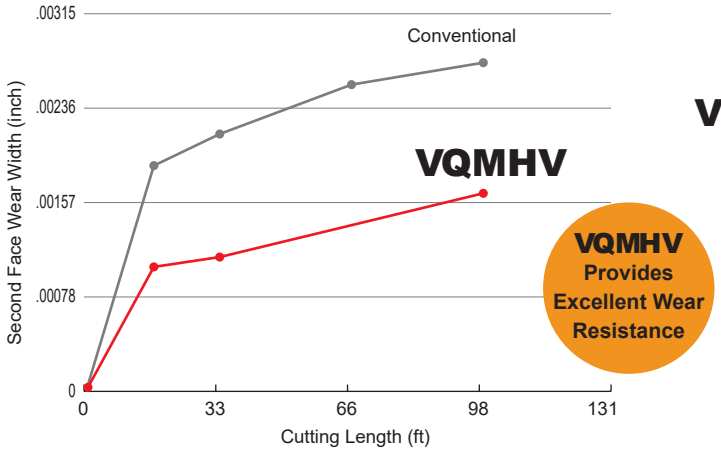
The wear resistance of SMART MIRACLE End Mills exceeds that of conventional end mills when machining Ti-6Al-4V.



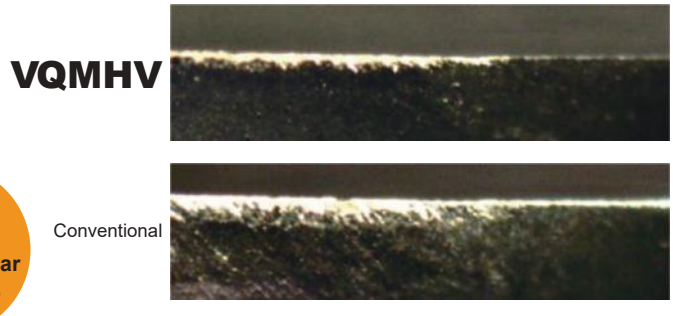

<Cutting Conditions>
Material : Ti-6Al-4V
End Mill : VQMHVD0600(DC=.236")
Revolution : 8000 min$^{-1}$
Cutting Speed : 490 SFM
Feed Rate : 63 IPM(.002 IPT)
Depth of Cut : ap=.236"
Width of Cut ae=.012"
Overhang Length : .787"
Cutting Mode : Down (Climb) Cut
External Coolant (Emulsion)
Machine : Vertical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

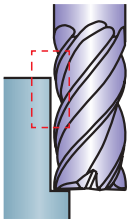
## Comparison of Wear in Co-Cr-Mo Alloy

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

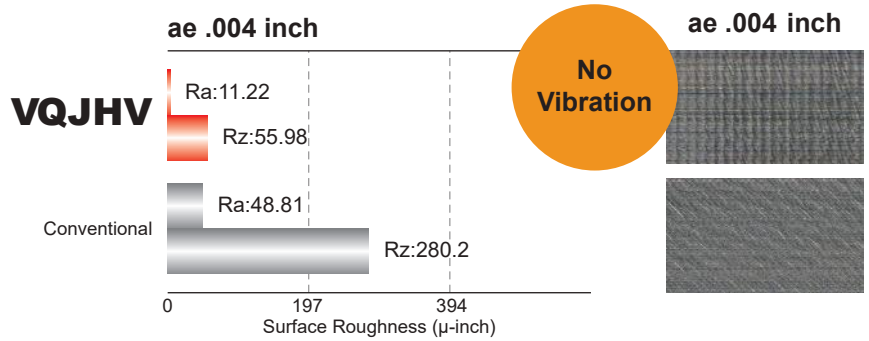


<Cutting Conditions>
Material : Co-Cr-Mo Alloy
End Mill : VQMHVD0600(DC=.236")
Revolution : 3700 min$^{-1}$
Cutting Speed : 227 SFM
Feed Rate : 29 IPM(.002 IPT)
Depth of Cut : ap=.079"
Width of Cut ae=.012"
Overhang Length : .787"
Cutting Mode : Down (Climb) Cut
External Coolant (Emulsion)
Machine :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

# Cutting Performance

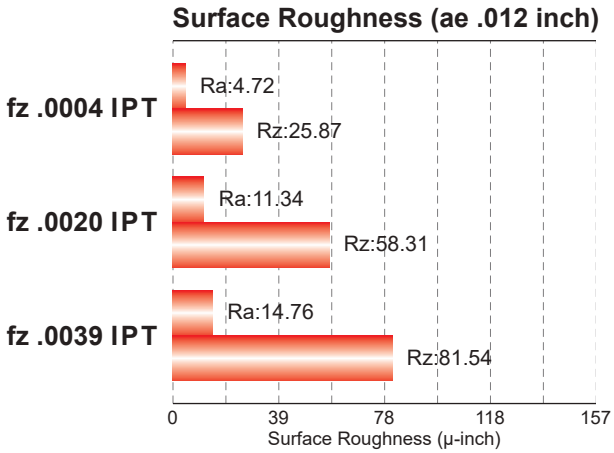
Irregular helix provides an excellent finishing performance without vibration.




<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

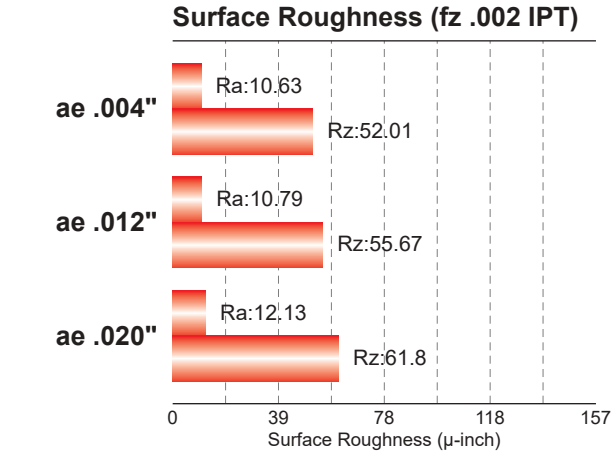
Surface roughness is improved by decreasing a feed rate.




<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)

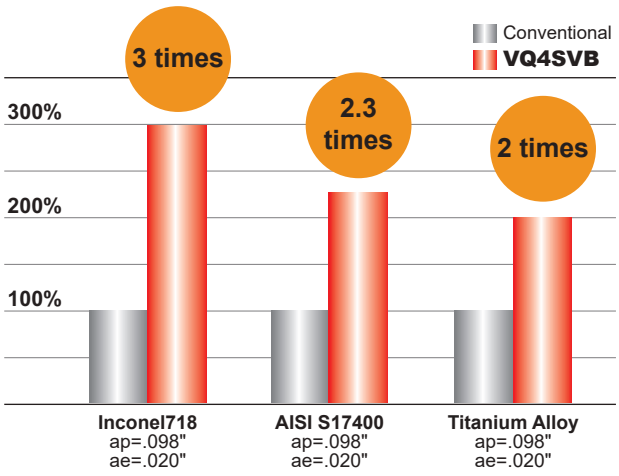
## Test of Changing the Width of Cut

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

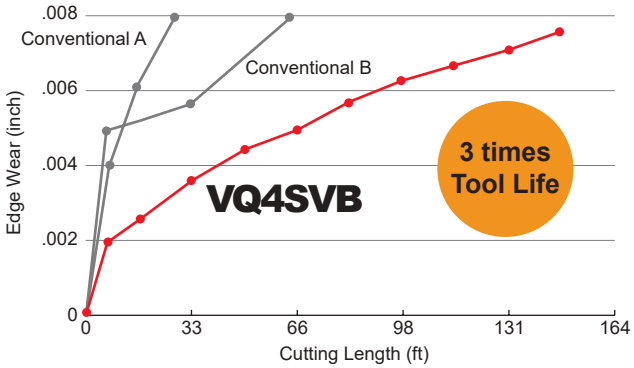



<Cutting Conditions>
Material : AISI 304
Tool Size : DC=10mm, .394"
Revolution : 2500min$^{-1}$ (260 SFM)
Feed Rate : 19.7 IPM (.002 IPT)
Depth of Cut : ap=1.18"
Width of Cut : ae=.004"−.020"
Overhang Length : 1.77"
Cutting Mode : Shoulder Milling
External Coolant (Emulsion)
Machine : Vertical M/C (BT50)

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



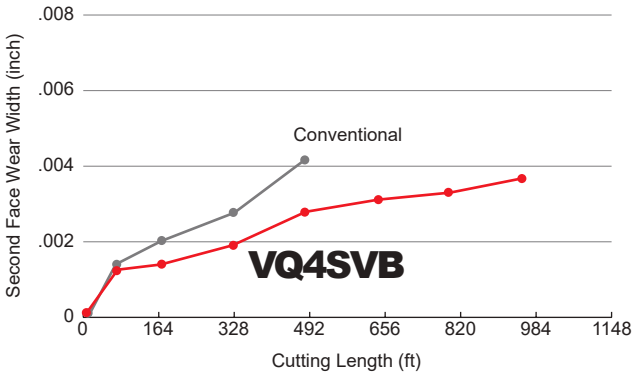

## Comparison of Edge Wear when Shoulder Milling Inconel 718




<Cutting Conditions>

| | |
|---|---|
| Material | : Inconel718 |
| End Mill | : VQ4SVBR0500(RE=.197") |
| Revolution | : 1100 $min^{-1}$ |
| 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<br>External Coolant (Emulsion) |
| Machine | : Vertical M/C (BT40) |

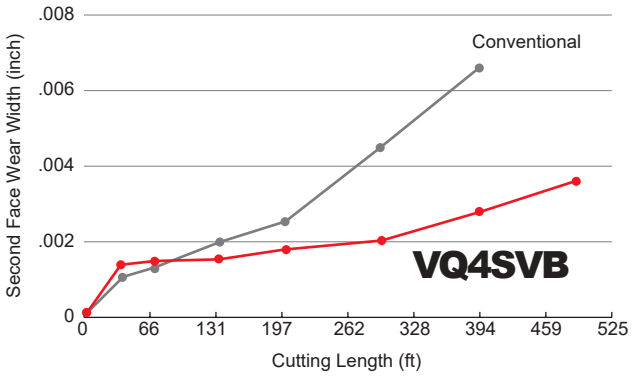
## Comparison of Edge Wear when Shoulder Milling AISI S17400




<Cutting Conditions>

| | |
|---|---|
| Material | : AISI S17400 |
| End Mill | : VQ4SVBR0500(RE=.197") |
| Revolution | : 2600 $min^{-1}$ |
| 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<br>External Coolant (Emulsion) |
| Machine | : Vertical M/C (BT40) |

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



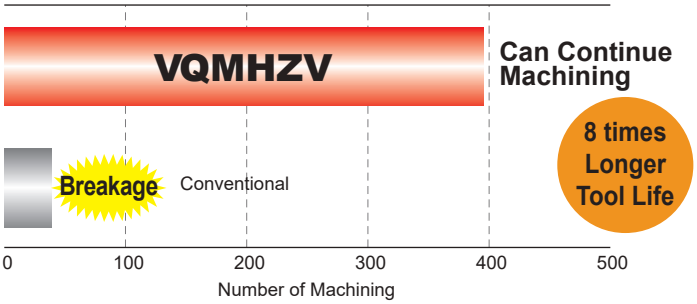

<Cutting Conditions>

| | |
|---|---|
| Material | : Ti-6Al-4V |
| End Mill | : VQ4SVBR0500(RE=.197") |
| Revolution | : 4800 $min^{-1}$ |
| 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<br>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.

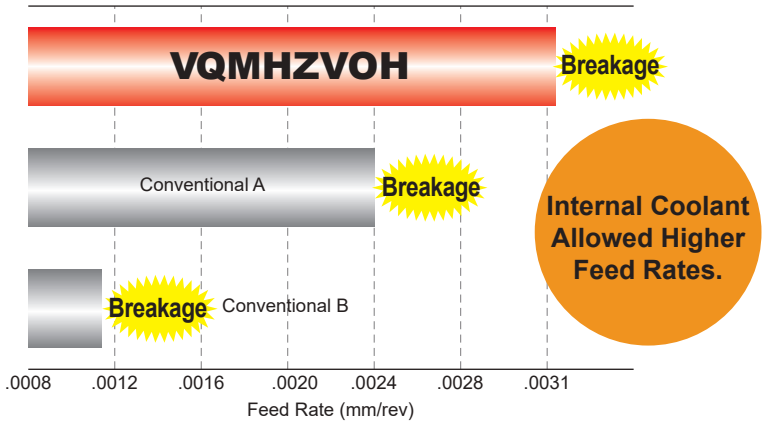



<Cutting Conditions>

| | |
|---|---|
| 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.**

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## 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

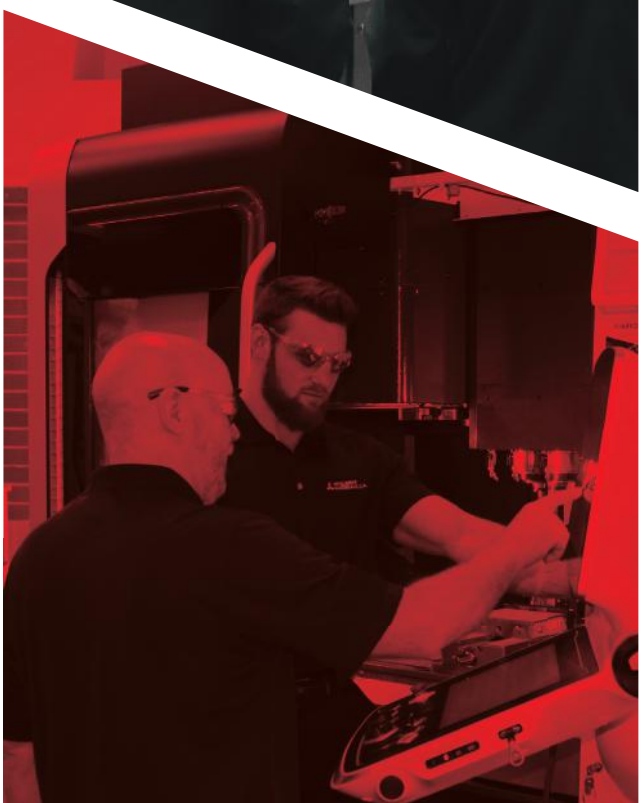
We are excited to offer several levels of training with goals to reach our highest level--Craftsman Machining Technology. At MTEC NC, we will train using a combination of classroom and hands-on machine time to develop skills and real-world understanding of materials, tools and applications. In addition 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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Fax: 905.814.0245


## 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.

**www.mmc-carbide.com/us**

Tools specifications subject to change without notice.

B197A-US-2026.9