

Corner Radius End Mill for High Efficiency Titanium Alloy Machining

VQT5MVRB

Renewal

Highly Efficient Deep Slot Milling



Corner Radius End Mill for High Efficiency Titanium Alloy Machining

VQT5MVRB

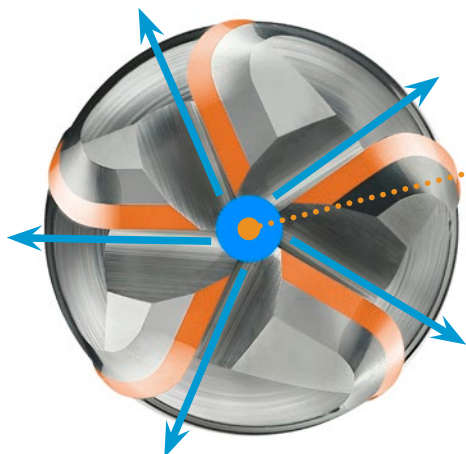
Combining 5 flutes and a through coolant hole enables high efficiency rough machining of titanium alloys.

Corner Radius (Emphasis on Sharpness)

A unique rake angle improves cutting resistance and chip discharge. The seamless blend between the corner radius and peripheral cutting edge suppresses abnormal wear and provides a stable tool life.

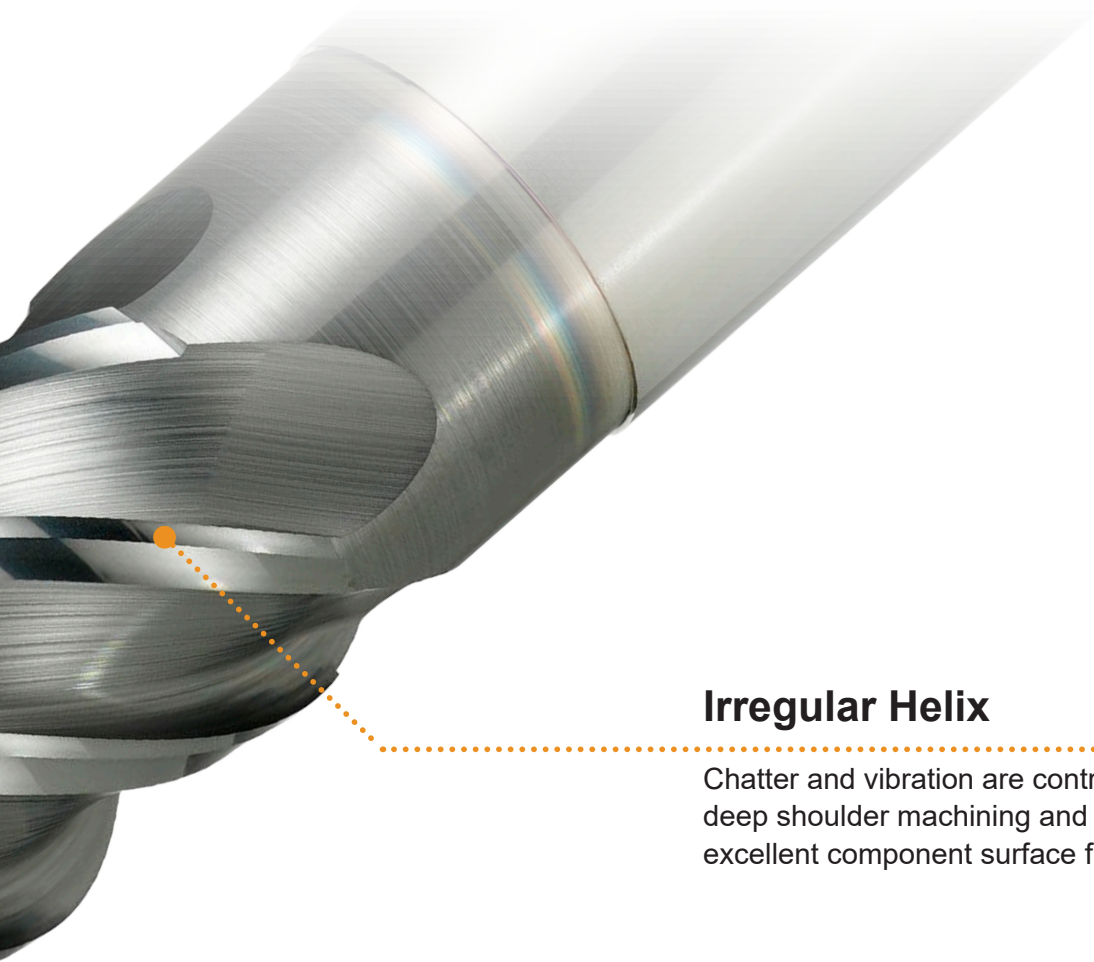
5 Flutes

Having the same chip evacuation properties of a 4 flute type enables deep slot milling. The additional flute and deep cutting capability reduces the number of passes.



Coolant Hole

The center coolant provides a stable supply of cutting fluid and dramatically improves chip evacuation. This also cools the cutting edge and prevents chip biting.



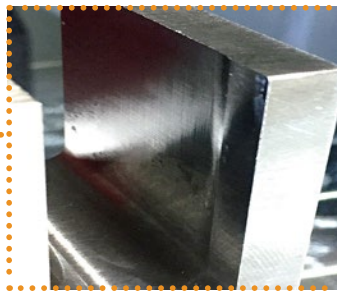
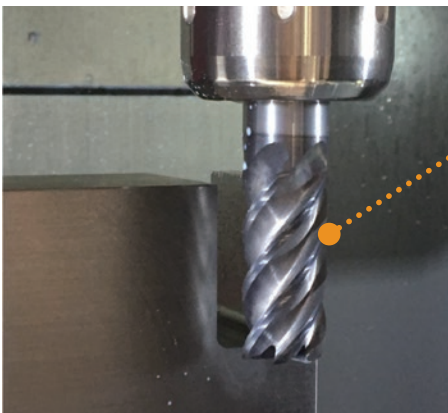
Irregular Helix

Chatter and vibration are controlled even during deep shoulder machining and also provides excellent component surface finishes.

Application Example

Material removal rate : 250cc/min achieved!

Large depths of cut when slotting (DC x 2) in titanium alloy dramatically shortens rough machining times.



Machined Surface

<Cutting Conditions>

Workpiece Material : Ti-6Al-4V
 Tool : VQT5MVRB250R400N075C
 Revolution : n=636 min⁻¹
 Feed Rate : vf=8.110 IPM
 Depth of Cut : ap=1.969 inch (DC×2)
 Width of Cut : ae= .984 inch (Slot)
 Overhang Length : 2.953 inch (DC×3)
 Cutting Mode : Slot Milling
 Internal Coolant +
 External Coolant (Emulsion)
 Machine : Vertical MC (BT50)

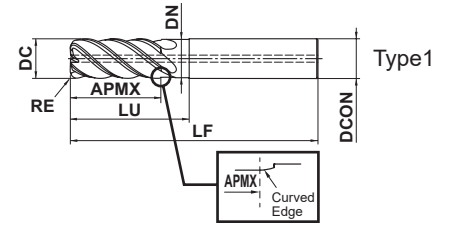
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VQT5MVRB NEW

Corner radius, Medium cut length, 5 flute, Irregular helix flutes, With coolant hole



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



| | | | | | |
|--|---|---|--|--|--|
| | RE | | | | |
| | ±0.02 | | | | |
| | DC ≤ 16 | 20 ≤ DC ≤ 25 | | | |
| | $\begin{matrix} 0 \\ -0.03 \end{matrix}$ | $\begin{matrix} 0 \\ -0.04 \end{matrix}$ | | | |
| | DCON = 16 | 20 ≤ DCON ≤ 25 | | | |
| | $\begin{matrix} 0 \\ -0.011 \end{matrix}$ | $\begin{matrix} 0 \\ -0.013 \end{matrix}$ | | | |

- Flute geometry suitable for deep slotting and effective chip evacuation.
- Sharp cutting edges provide long tool life when machining titanium alloys.

(mm)

| Order Number | DC | RE | APMX | LU | DN | LF | DCON | * No.F | Stock | Type |
|---------------------|----|----|------|----|------|-----|------|--------|-------|------|
| VQT5MVRB160R100N48C | 16 | 1 | 34 | 48 | 15.5 | 120 | 16 | 5 | ● | 1 |
| VQT5MVRB160R300N48C | 16 | 3 | 34 | 48 | 15.5 | 120 | 16 | 5 | ● | 1 |
| VQT5MVRB160R400N48C | 16 | 4 | 34 | 48 | 15.5 | 120 | 16 | 5 | ● | 1 |
| VQT5MVRB200R100N60C | 20 | 1 | 44 | 60 | 19.5 | 135 | 20 | 5 | ● | 1 |
| VQT5MVRB200R300N60C | 20 | 3 | 44 | 60 | 19.5 | 135 | 20 | 5 | ● | 1 |
| VQT5MVRB200R400N60C | 20 | 4 | 44 | 60 | 19.5 | 135 | 20 | 5 | ● | 1 |
| VQT5MVRB200R600N60C | 20 | 6 | 44 | 60 | 19.5 | 135 | 20 | 5 | ● | 1 |
| VQT5MVRB250R100N75C | 25 | 1 | 54 | 75 | 24.5 | 155 | 25 | 5 | ● | 1 |
| VQT5MVRB250R300N75C | 25 | 3 | 54 | 75 | 24.5 | 155 | 25 | 5 | ● | 1 |
| VQT5MVRB250R400N75C | 25 | 4 | 54 | 75 | 24.5 | 155 | 25 | 5 | ● | 1 |
| VQT5MVRB250R600N75C | 25 | 6 | 54 | 75 | 24.5 | 155 | 25 | 5 | ● | 1 |

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.

* Number of Flutes

DC = Dia.
 RE = Corner Radius
 APMX = Length of Cut
 LU = Neck Length
 DN = Neck Dia.
 LF = Overall Length
 DCON = Shank Dia.

● : Inventory maintained.

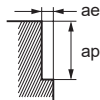
Recommended Cutting Conditions

Shoulder Milling

Overhang Length DC×1 (DC=Dia.) (inch)

| Workpiece Material | | Titanium Alloys Ti-6Al-4V etc. | | | | | | |
|--------------------|--------|-----------------------------------|--------|---------------------------|--------------------------------------|-----------------------|--------------------|--------------------|
| DC | | RE | | Cutting Speed vc (SFM) | Revolution n (min ⁻¹) | Feed Rate vf (IPM) | Depth of Cut ap | Width of Cut ae |
| (mm) | (inch) | (mm) | (inch) | | | | | |
| 16 | .630 | 1 | .039 | 260 | 1600 | 31.5 | 1.260 | .097 |
| | | 3 | .118 | 260 | 1600 | 31.5 | 1.260 | .094 |
| | | 4 | .157 | 260 | 1600 | 31.5 | 1.260 | .094 |
| 20 | .787 | 1 | .039 | 260 | 1300 | 25.6 | 1.575 | .118 |
| | | 3 | .118 | 260 | 1300 | 25.6 | 1.575 | .118 |
| | | 4 | .157 | 260 | 1300 | 25.6 | 1.575 | .118 |
| | | 6 | .236 | 260 | 1300 | 25.6 | 1.575 | .118 |
| 25 | .984 | 1 | .039 | 260 | 1000 | 19.7 | 1.969 | .150 |
| | | 3 | .118 | 260 | 1000 | 19.7 | 1.969 | .150 |
| | | 4 | .157 | 260 | 1000 | 19.7 | 1.969 | .150 |
| | | 6 | .236 | 260 | 1000 | 19.7 | 1.969 | .150 |

Depth of Cut

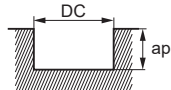


Slot Milling

Depth of Cut DC×1 (inch)

| Workpiece Material | | Titanium Alloys Ti-6Al-4V etc. | | | | | |
|--------------------|--------|-----------------------------------|--------|---------------------------|--------------------------------------|-----------------------|--------------------|
| DC | | RE | | Cutting Speed vc (SFM) | Revolution n (min ⁻¹) | Feed Rate vf (IPM) | Depth of Cut ap |
| (mm) | (inch) | (mm) | (inch) | | | | |
| 16 | .630 | 1 | .039 | 195 | 1200 | 16.5 | .630 |
| | | 3 | .118 | 195 | 1200 | 16.5 | .630 |
| | | 4 | .157 | 195 | 1200 | 11.8 | .630 |
| 20 | .787 | 1 | .039 | 195 | 950 | 13.0 | .787 |
| | | 3 | .118 | 195 | 950 | 13.0 | .787 |
| | | 4 | .157 | 195 | 950 | 13.0 | .787 |
| | | 6 | .236 | 195 | 950 | 9.4 | .787 |
| 25 | .984 | 1 | .039 | 165 | 640 | 8.7 | .984 |
| | | 3 | .118 | 165 | 640 | 8.7 | .984 |
| | | 4 | .157 | 165 | 640 | 8.7 | .984 |
| | | 6 | .236 | 165 | 640 | 6.3 | .984 |

Depth of Cut

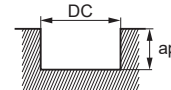


DC=Dia.

Depth of Cut DC×2 (inch)

| Workpiece Material | | Titanium Alloys Ti-6Al-4V etc. | | | | | |
|--------------------|--------|-----------------------------------|--------|---------------------------|--------------------------------------|-----------------------|--------------------|
| DC | | RE | | Cutting Speed vc (SFM) | Revolution n (min ⁻¹) | Feed Rate vf (IPM) | Depth of Cut ap |
| (mm) | (inch) | (mm) | (inch) | | | | |
| 16 | .630 | 1 | .039 | 195 | 1200 | 9.4 | 1.260 |
| | | 3 | .118 | 195 | 1200 | 9.4 | 1.260 |
| | | 4 | .157 | 195 | 1200 | 7.1 | 1.260 |
| 20 | .787 | 1 | .039 | 195 | 950 | 7.5 | 1.575 |
| | | 3 | .118 | 195 | 950 | 7.5 | 1.575 |
| | | 4 | .157 | 195 | 950 | 7.5 | 1.575 |
| | | 6 | .236 | 195 | 950 | 5.6 | 1.575 |
| 25 | .984 | 1 | .039 | 165 | 640 | 5.1 | 1.969 |
| | | 3 | .118 | 165 | 640 | 5.1 | 1.969 |
| | | 4 | .157 | 165 | 640 | 5.1 | 1.969 |
| | | 6 | .236 | 165 | 640 | 3.8 | 1.969 |

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.

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 work 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.

(Note 4) If the depth of cut is smaller, the revolution and the feed rate can be increased.

(Note 5) When machining deep slots where the depth of cut exceeds the diameter DC, use a high strength holder or one equipped with a retaining mechanism.

Additionally ensure the clamping and workpiece material rigidity are sufficient.

Refer to page 6 for

(Note 6) When machining a deep slot exceeding 1D, use a holder with a high gripping strength or an anti slippage mechanism.

Also, make sure that the clamping force and rigidity are sufficient before use.

Cutting Performance

Slot Milling with Deep Depths of Cut in Titanium Alloy

The seamless corner radii achieves stable tool life.

Conventional



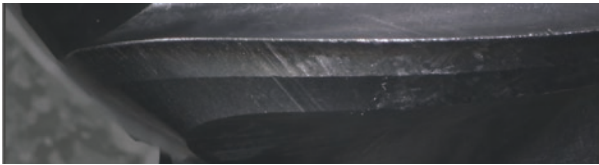
Fractures (After 6 slots)



<Cutting Conditions>

Workpiece Material : Ti-6Al-4V
 Tool : VQT5MVRB160R300N048C
 Revolution : $n = 1200 \text{ min}^{-1}$
 Feed Rate : $vf = 26.0 \text{ IPM}$
 Depth of Cut : $ap = .630 \text{ inch}$
 Width of Cut : $ae = .630 \text{ inch (slot)}$
 Cutting Length : 2.362 inch (1 slot)
 Overhang Length : 1.890 inch (DC×3)
 Cutting Mode : Slot Milling
 Internal Coolant +
 External Coolant (Emulsion)
 Machine : Vertical MC (BT50)

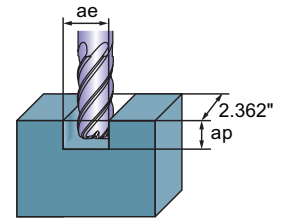
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After 17 slots

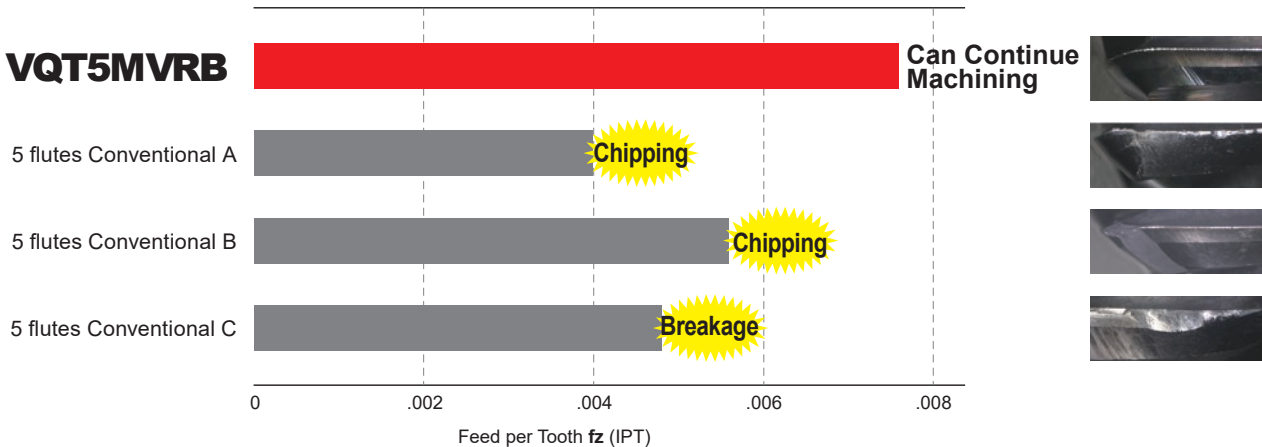


**Triple
Tool Life**



Comparison of Maximum Cutting Feed for Titanium Alloy Slot Milling

When compared with conventional products, high efficiency milling can be achieved.



<Cutting Conditions>

Workpiece Material : Ti-6Al-4V
 Tool : VQT5MVRB160R300N048C
 Revolution : $n = 1200 \text{ min}^{-1}$
 Depth of Cut : $ap = .630 \text{ inch}$
 Width of Cut : $ae = .630 \text{ inch (Slot)}$

Cutting Length : 2.362 inch (1 slot)
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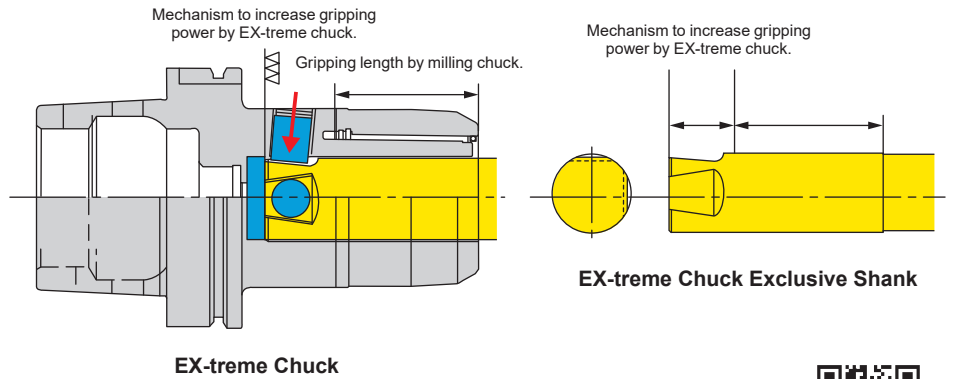
Key Point for High Efficiency Machining of Titanium Alloys

For high efficiency machining, it is recommended to use a precision, high strength holder to prevent pull out of the tool. Some high strength holders require modification of the cutting tool shank.



Never Pull Down
Great Reliability in the
Aircraft Industry

X-Treme Shank X-Treme Chuck



<https://www.nikken-kosakusho.co.jp/en/>



MST corporation

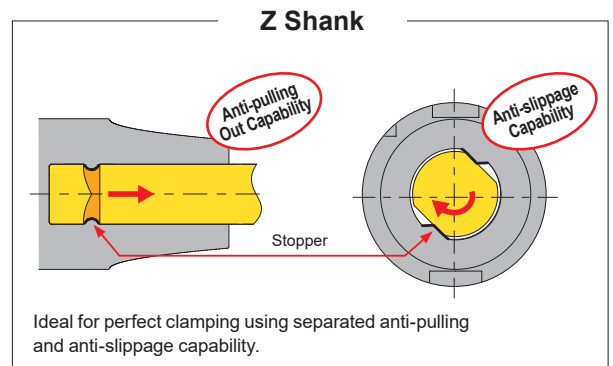
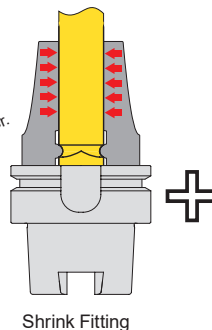
Superior Rigidity and
Thick Body Design

Shrink-fit Holder with Anti Slippage Capability

SLIMLINE Z



Strong Gripping Force
2 times stronger gripping force compared with a standard shrink-fit holder.



<http://www.mst-corp.co.jp/en/slimline/z/>





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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 using rotating tools, please make a trial run to check run-out, vibration and abnormal sounds etc.

 **MITSUBISHI MATERIALS U.S.A. CORPORATION**

Customer Service : 800-523-0800
Technical Service : 800-486-2341

LOS ANGELES HEAD OFFICE
3535 Hyland Avenue, Suite 200, Costa Mesa, CA 92626
TEL : 714-352-6100 FAX : 714-668-1320

NORTH CAROLINA OFFICE
105 Corporate Center Drive Suite A, Mooresville, NC 28117
TEL : 980-312-3100 FAX : 704-746-9292

CHICAGO OFFICE
1314B North Plum Grove Road, Schaumburg, IL 60173
TEL : 847-252-6300 FAX : 847-519-1732

TORONTO OFFICE
3535 Laird Road, Units 15 & 16, Mississauga, Ontario, L5L 5Y7, Canada
TEL : 905-814-0240 FAX : 905-814-0245

MMC METAL DE MEXICO, S.A. DE C.V.
Av. La Cañada No.16, Parque Industrial Bernardo Quintana,
El Marques, Queretaro, CP76246, Mexico
TEL : +52-442-221-6136 FAX : +52-442-221-6134

URL : <http://www.mmus-carbide.com>
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