DIA EDGE

TOOL NEWS B232G

Barrel End Mill for Finish Cutting of Titanium Alloys

SMART MIRACLE
End Mill Series

VQT6UR

New Product

New Successive Two Radius Design Achieve High Efficiency Machining

MITSUBISHI MATERIALS CORPORATION

Barrel End Mill for Finish Cutting of Titanium Alloys

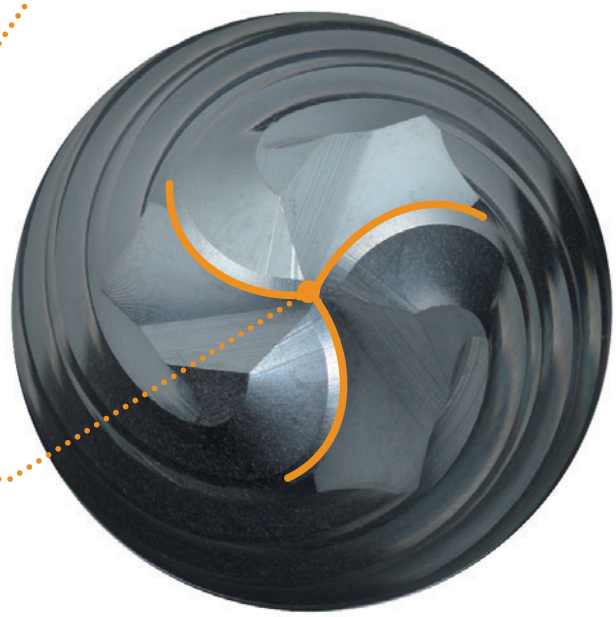
VQT6UR

Nose radius suitable for fillet milling, also tangential form radius fit composite blade surface machining.

Radial Accuracy

RE1 and RE2 ±0.010mm

Optimum Cutting Edge Design



6-flute Peripheral Cutting Edge

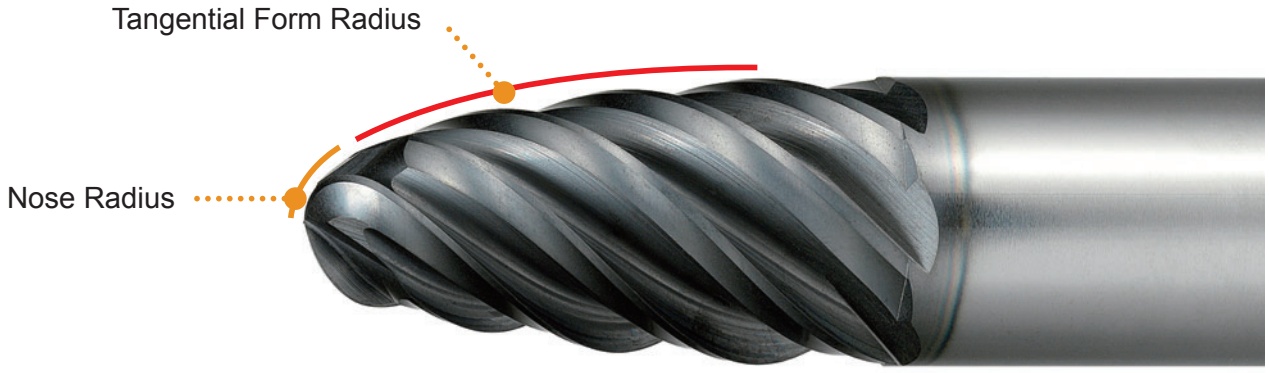
Multi cutting edge design achieve high efficiency machining.
Irregular pitch design prevents chattering.

3-flute End Cutting Edge

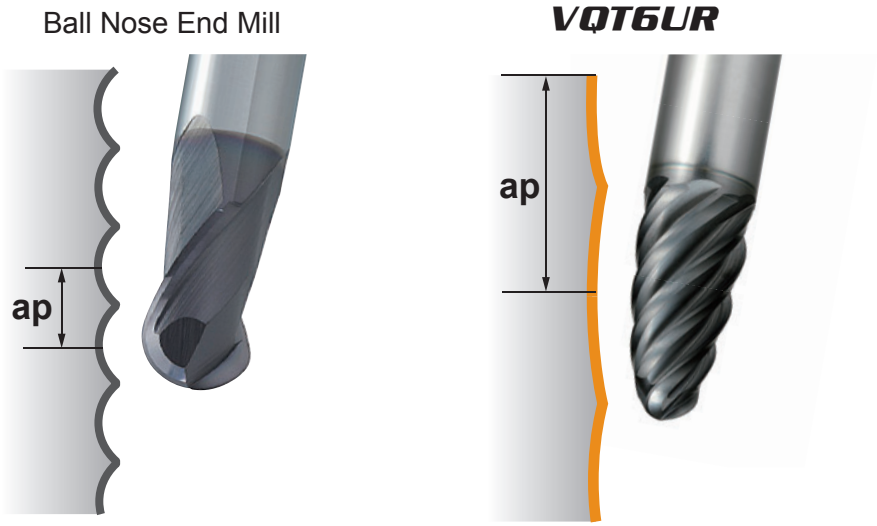
A wide flute improves chip evacuation.

Ideal Shape

Compared with ball nose end mill, an tangential form radius is larger and cusp height is controllable.
This design makes highly efficient machining with larger pick feed.

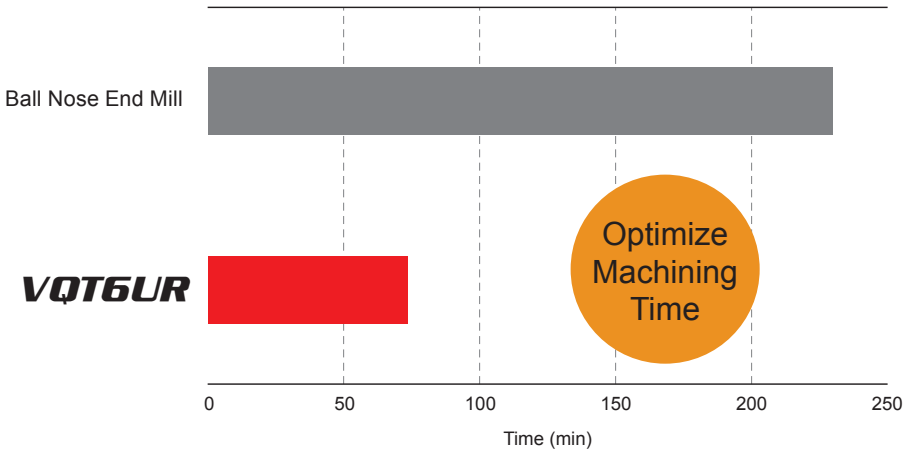


Nose and tangential form part has two different radius.



Shorter cutting distance contribute to longer tool life.

Comparison of Machining Time by CAM Simulation



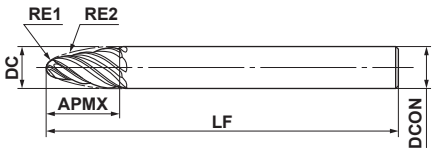
Tools for Simulation
Ball Nose End Mill : R5 ø10mm
VQT6URR020R085S10 : R2xR85 ø10mm

Barrel End Mill for Finish Cutting of Titanium Alloys

VQT6UR

Barrel, Medium cut length, 6 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	Titanium Alloy	Copper Alloy	Aluminum Alloy
○				○	◎		○



Type1

R				
RE1≤4	RE2≤100			
±0.01	±0.01			
h6				
DCON≤10	DCON=12			
0 - 0.009	0 - 0.011			

- Nose and tangential form part has two different radius.
- Irregular pitch design prevents chattering.

(mm)

Order Number	DC	RE1	RE2	APMX	LF	DCON	No.F *	Stock	Type
VQT6URR020R075S08	8	2	75	21	90	8	6	●	1
VQT6URR020R085S10	10	2	85	26	100	10	6	●	1
VQT6URR030R075S10	10	3	75	22	100	10	6	●	1
VQT6URR040R100S12	12	4	100	25	110	12	6	●	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.
RE1 = Nose Radius
RE2 = Tangential Form Radius
APMX = Length of Cut
LF = Overall Length
DCON = Shank Dia.

● : **Inventory maintained in Japan.**

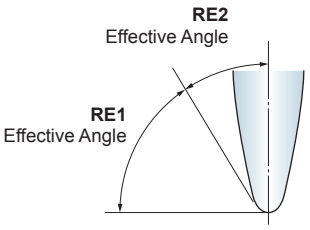
Recommended Cutting Conditions

Effective Angle

Please refer to the table below for the use of the nose radius (RE1) and tangential form radius (RE2).

(mm)

Order Number	Nose Radius		Tangential Form Radius	
	RE1	Effective Angle	**RE2**	Effective Angle
VQT6URR020R075S08	2	76.6°	75	13.4°
VQT6URR020R085S10	2	74.5°	85	15.5°
VQT6URR030R075S10	3	76.4°	75	13.6°
VQT6URR040R100S12	4	78.3°	100	11.7°



Side Milling with the Use of the Tangential Form Radius (RE2)

(mm)

Work Material		Mild Steels (≤180HB) Carbon Steels, Cast Irons (180−280HB)				Austenitic Stainless Steels (≤200HB) Titanium Alloys				Aluminum Alloys (Si<5%)			
DC	**RE2**	**n** (min^{-1})	**vf** (mm/min)	**ap**	**ae**	**n** (min^{-1})	**vf** (mm/min)	**ap**	**ae**	**n** (min^{-1})	**vf** (mm/min)	**ap**	**ae**
8	**75**	8000	2400	0.78	0.05−0.3	3200	770	0.78	0.05−0.3	16000	4800	0.78	0.05−0.3
10	**85**	6400	1900	0.83	0.05−0.3	2500	600	0.83	0.05−0.3	13000	3900	0.83	0.05−0.3
10	**75**	6400	1900	0.78	0.05−0.3	2500	600	0.78	0.05−0.3	13000	3900	0.78	0.05−0.3
12	**100**	5300	1600	0.89	0.05−0.3	2100	500	0.89	0.05−0.3	11000	3300	0.89	0.05−0.3

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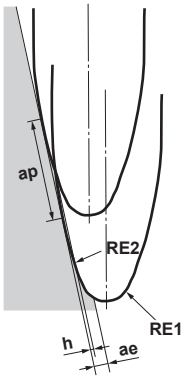
When measuring the tool length, please use an internal contact type (non-electricity type) or a laser tool setter.
(Note 2) It is recommended to use this tool only for finish cutting.
(Note 3) The tool contact part differs between the nose radius and tangential form radius depending on machining geometries and tilt angles. Select suitable cutting conditions according to tool contact parts.



Depth of Cut Calculation Table Based on Tangential Form Radius (RE2) and Cusp Height (h)

(mm)

Work Material	**RE2**	Cusp Height **h**	0.0001	0.0003	0.0005	0.0008	0.001	0.003	0.005	0.008
VQT6URR020R075S08	75	Depth of Cut **ae**	0.245	0.424	0.548	0.693	0.775	1.342	1.732	2.191
VQT6URR030R075S10	75		0.245	0.424	0.548	0.693	0.775	1.342	1.732	2.191
VQT6URR020R085S10	85		0.261	0.452	0.583	0.738	0.825	1.428	1.844	2.332
VQT6URR040R100S12	100		0.283	0.49	0.632	0.8	0.894	1.549	2	2.53

Recommended Cutting Conditions

Slot Milling with the Use of the Nose Radius (RE1)

(mm)

Work Material		Mild Steels (≤180HB) Carbon Steels, Cast Irons (180−280HB)				Austenitic Stainless Steels (≤200HB) Titanium Alloys				Aluminum Alloys (Si<5%)			
DC	RE1	n (min^{-1})	vf (mm/min)	ap	ae	n (min^{-1})	vf (mm/min)	ap	ae	n (min^{-1})	vf (mm/min)	ap	ae
8	2	16000	2400	0.4	1	6400	580	0.4	1	32000	4800	0.4	1
10	2	16000	2400	0.4	1	6400	580	0.4	1	32000	4800	0.4	1
10	3	11000	1700	0.6	1.5	4200	380	0.6	1.5	21000	3200	0.6	1.5
12	4	8000	1200	0.8	2	3200	290	0.8	2	16000	2400	0.8	2

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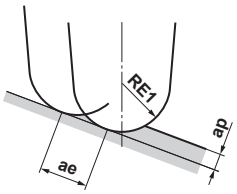
(Note 2) It is recommended to use this tool only for finish cutting.
(Note 3) The tool contact part differs between the nose radius and tangential form radius depending on machining geometries and tilt angles. Select suitable cutting conditions according to tool contact parts.

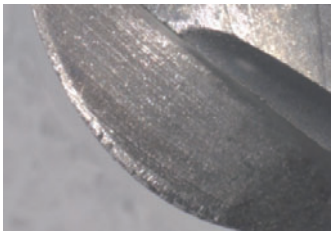


Cutting Performance

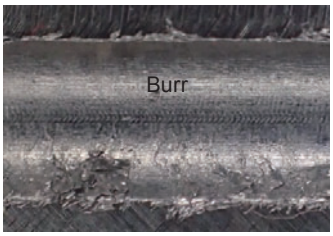
Slot Milling of Titanium Alloy

Provided good surface finishes and there was no chipping on the cutting edge.

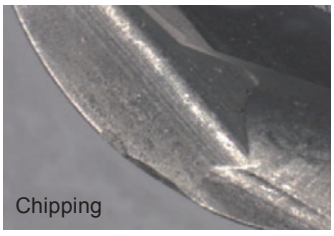
VQT6UR



Conventional



Surface



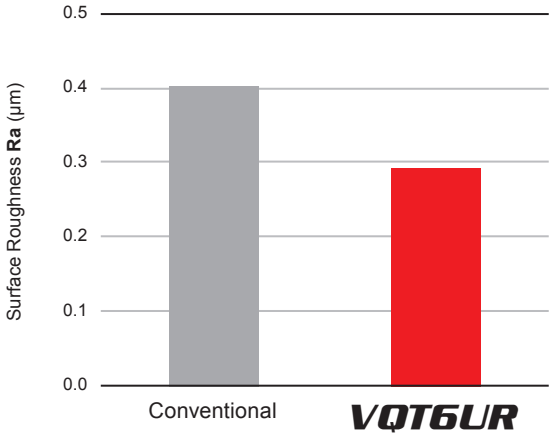
Cutting Edge

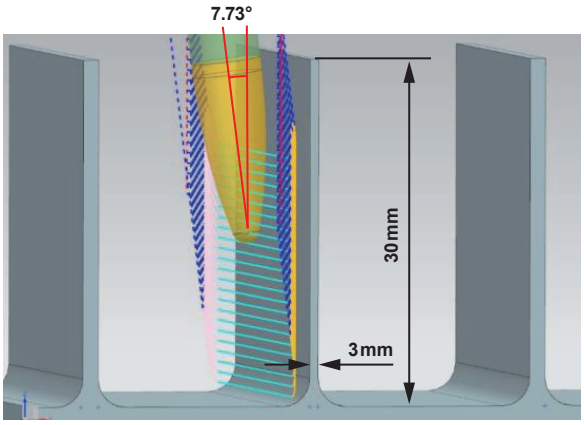
<Cutting Conditions>
Workpiece : Ti-6Al-4V
Tool : VQT6URR020R085S10
Cutting Speed : vc=80m/min
Revolution : n=6770min^{-1}
Feed per Tooth : fz=0.03mm/t.
Depth of Cut : ap=1.0mm
Cutting Mode : External Coolant (Emulsion)
Machine : 5-axisl MC (HSK63)

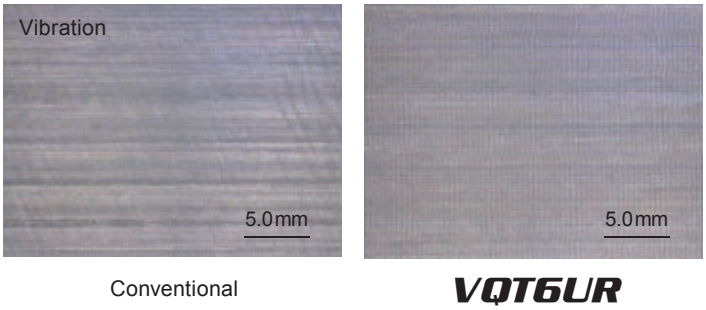
Cutting Performance

Deep Wall Machining of Titanium Alloy

High efficiency machining is possible while maintaining quality of machined surface.

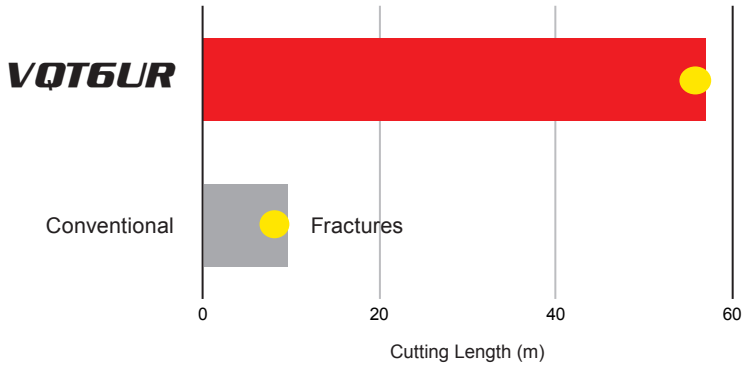


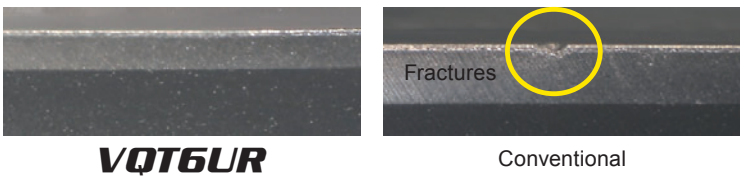




<Cutting Conditions>
Workpiece : Ti-6Al-4V
Tool : VQT6URR020R085S10
Revolution : n=2546min-1
Feed per Tooth : fz= 0.03mm/t.
Depth of Cut : ap=1.5mm
Width of Cut : ae=0.3mm
Tilt Angle : 7.73°
Cutting Mode : Side Milling
External Coolant (Emulsion)
Machine : 5-axis MC (HSK63)

Comparison of Tool Life in Titanium Alloy

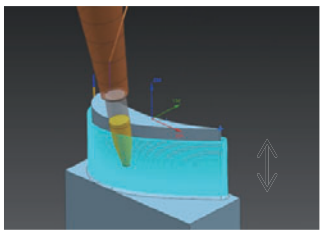


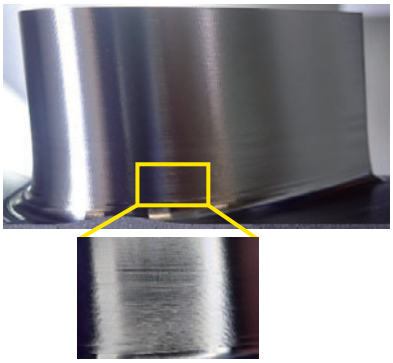


<Cutting Conditions>
Workpiece : Ti-6Al-4V
Tool : VQT6URR020R085S10
Revolution : n=2546min-1
Feed per Tooth : fz= 0.03mm/t.
Depth of Cut : ap=4.0mm
Width of Cut : ae=0.3mm
Tilt Angle : 8°
Overhang Length : 40mm
Cutting Mode : External Coolant (Emulsion)
Machine : 5-axisl MC (HSK63)

Machining Example

Blade Surface Machining

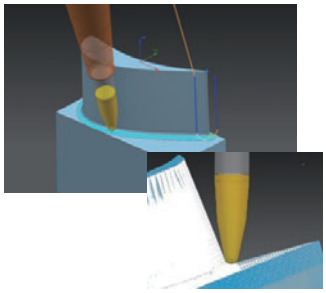


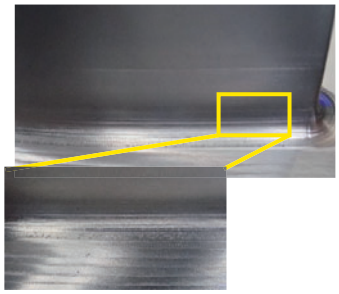


<Cutting Conditions>

Workpiece	: Ti-6Al-4V
Tool	: VQT6URR020R085S10
Cutting Speed	: vc=120m/min
Feed per Rev.	: vf=920mm/min
Depth of Cut	: ap=1.42mm
Width of Cut	: ae=0.2mm
Tilt Angle	: 10°
Cutting Mode	: External Coolant (Emulsion)
Machine	: 5-axisl MC (HSK63)

Fillet Milling





<Cutting Conditions>

Workpiece	: Ti-6Al-4V
Tool	: VQT6URR020R085S10
Cutting Speed	: vc=80m/min
Feed per Rev.	: vf=760mm/min.
Depth of Cut	: ap=0.218mm
Width of Cut	: ae=0.2mm
Tilt Angle	: 20°
Cutting Mode	: External Coolant (Emulsion)
Machine	: 5-axisl MC (HSK63)

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.

MITSUBISHI MATERIALS CORPORATION

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(Tools specifications subject to change without notice.)

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