DIA EDGE
TOOL NEWS
B232A

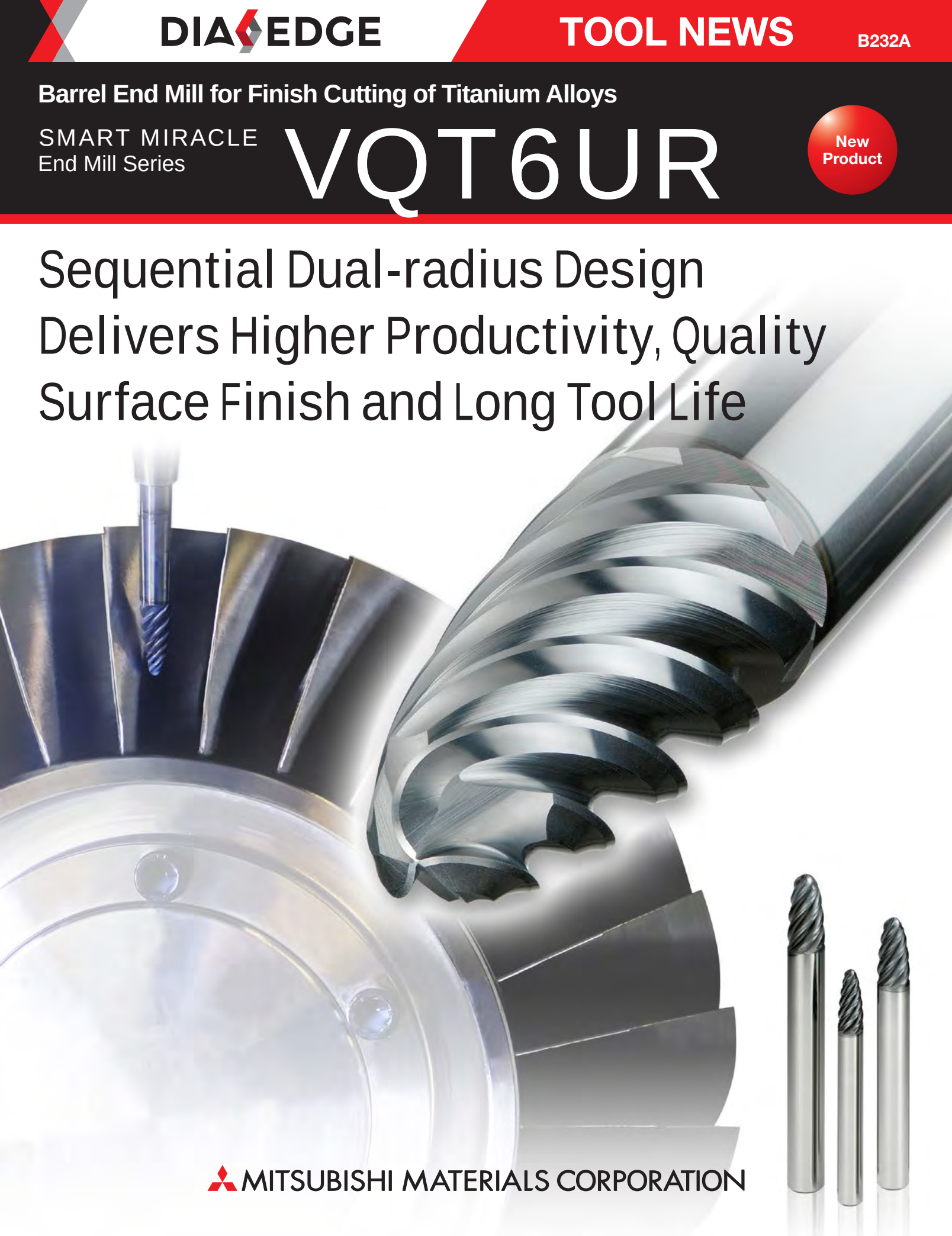
Barrel End Mill for Finish Cutting of Titanium Alloys

SMART MIRACLE
End Mill Series

VQT6UR

New Product

Sequential Dual-radius Design Delivers Higher Productivity, Quality Surface Finish and Long Tool Life



MITSUBISHI MATERIALS CORPORATION

Barrel End Mill for Finish Cutting of Titanium Alloys

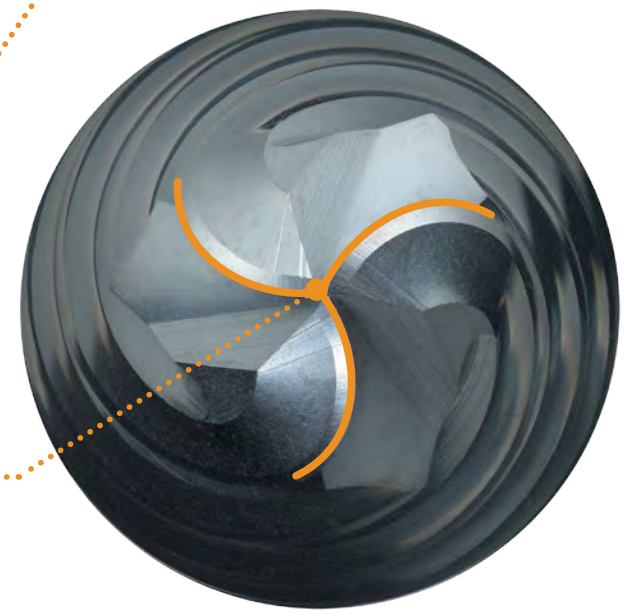
VQT6UR

Nose radius designed for both fillet milling and tangential form radius blade surface machining.

Radial Accuracy

RE1 and RE2 ±.0004 inch

Optimum Cutting Edge Design



6-flute Peripheral Cutting Edge

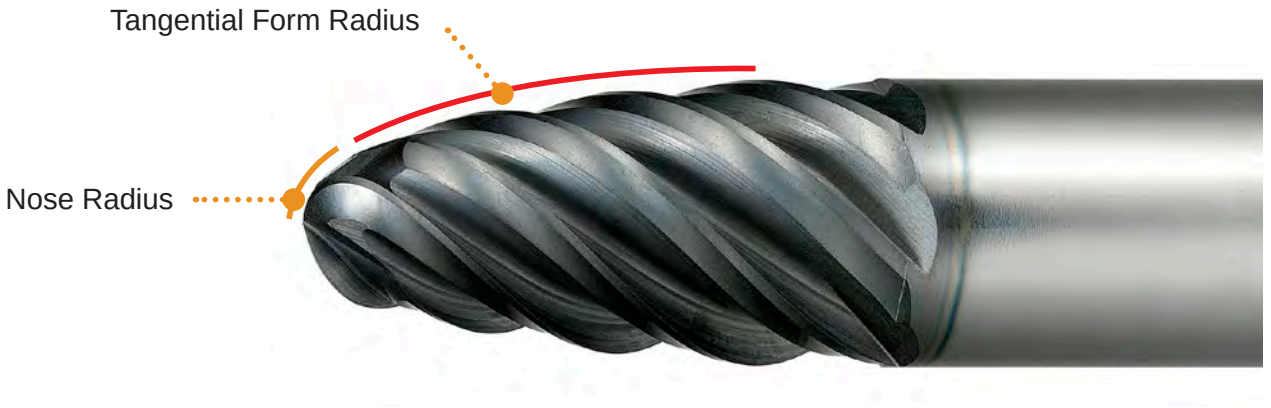
Multi cutting edge designed for high efficiency machining.
Irregular pitch design prevents chattering.

3-flute End Cutting Edge

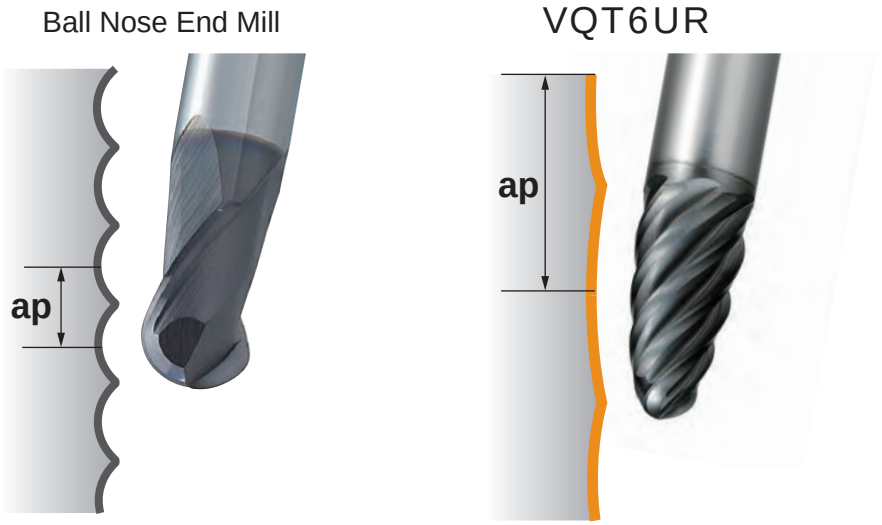
A wide flute for superior chip evacuation.

Ideal Shape

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

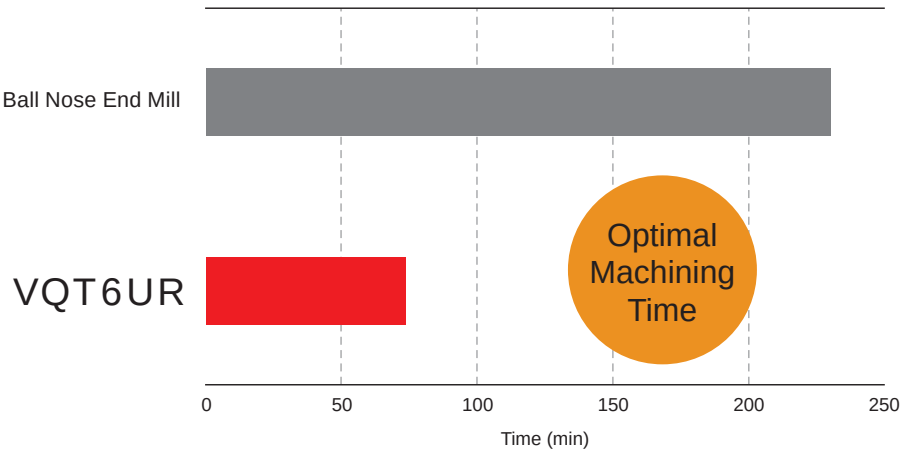


Nose and tangential form part has two distinct radii.



Shorter cutting distance contributes to longer tool life.

Comparison of Machining Time by CAM Simulation

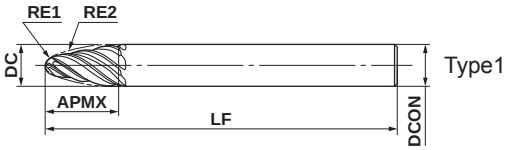


Tools for Simulation
Ball Nose End Mill : R.197
ø.394 inch
VQT6URR020R085S10 : R.079xR3.346
ø.394 inch

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	Heat Resistant Alloy	Copper Alloy	Aluminum Alloy
○				○	◎		○



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 distinct radii.
- 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, an internal contact/non-electric type or laser tool setter is recommended.

* Number of Flutes

DC = Cutting Dia.
RE1 = Nose Radius
RE2 = Tangential Form Radius
APMX = Depth of Cut Max.
LF = Functional Length
DCON = Connection Diameter

● : **Inventory maintained.**

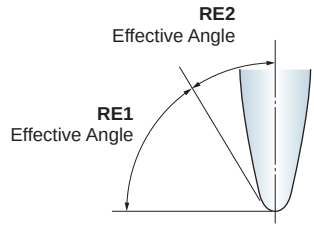
Recommended Cutting Conditions

Effective Angle

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

(inch)

Order Number	Nose Radius		Tangential Form Radius	
	RE1	Effective Angle	**RE2**	Effective Angle
VQT6URR020R075S08	.079 (2mm)	76.6°	2.953 (75mm)	13.4°
VQT6URR020R085S10	.079 (2mm)	74.5°	3.346 (85mm)	15.5°
VQT6URR030R075S10	.118 (3mm)	76.4°	2.953 (75mm)	13.6°
VQT6URR040R100S12	.157 (4mm)	78.3°	3.937 (100mm)	11.7°



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

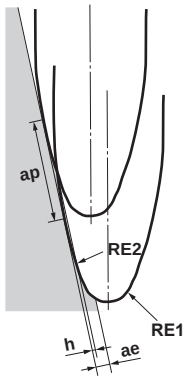
(inch)

Workpiece Material				Mild Steels (≤180HB) Carbon Steels, Alloy Steels (180−280HB)				Austenitic Stainless Steels (≤200HB) Titanium Alloys				Aluminum Alloys (Si<5%)			
DC		**RE2**		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	mm	inch												
8	.315	75	2.953	8000	94.5	.031	.002–.012	3200	30.3	.031	.002–.012	16000	189.0	.031	.002–.012
10	.394	85	3.346	6400	74.8	.033	.002–.012	2500	23.6	.033	.002–.012	13000	153.5	.033	.002–.012
10	.394	75	2.953	6400	74.8	.031	.002–.012	2500	23.6	.031	.002–.012	13000	153.5	.031	.002–.012
12	.472	100	3.937	5300	63.0	.035	.002–.012	2100	19.7	.035	.002–.012	11000	129.9	.035	.002–.012

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, an internal contact/non-electric type or laser tool setter is recommended.

Note 2) Recommended for finish cutting only.

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)

(inch)

Order Number	**RE2**	Cusp Height **h**	.000004	.000012	.000020	.000031	.000039	.000118	.000197	.000315
VQT6URR020R075S08	2.953 (75mm)	Depth of Cut **ae**	.0096	.0167	.0216	.0273	.0305	.0528	.0682	.0863
VQT6URR030R075S10	2.953 (75mm)		.0096	.0167	.0216	.0273	.0305	.0528	.0682	.0863
VQT6URR020R085S10	3.346 (85mm)		.0103	.0178	.0230	.0291	.0325	.0562	.0726	.0918
VQT6URR040R100S12	3.937 (100mm)		.0111	.0193	.0249	.0315	.0352	.0610	.0787	.0996

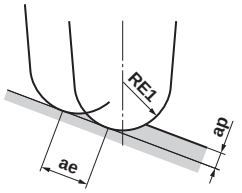
Recommended Cutting Conditions

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

(inch)

Workpiece Material				Mild Steels (≤180HB) Carbon Steels, Alloy Steels (180−280HB)				Austenitic Stainless Steels (≤200HB) Titanium Alloys				Aluminum Alloys (Si<5%)			
DC		RE1		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	mm	inch												
8	.315	2	.079	16000	94.5	.016	.039	6400	22.8	.016	.039	32000	189.0	.016	.039
10	.394	2	.079	16000	94.5	.016	.039	6400	22.8	.016	.039	32000	189.0	.016	.039
10	.394	3	.118	11000	66.9	.024	.059	4200	15.0	.024	.059	21000	126.0	.024	.059
12	.472	4	.157	8000	47.2	.031	.079	3200	11.4	.031	.079	16000	94.5	.031	.079

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, an internal contact/non-electric type or laser tool setter is recommended.
Note 2) Recommended for finish cutting only.
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.

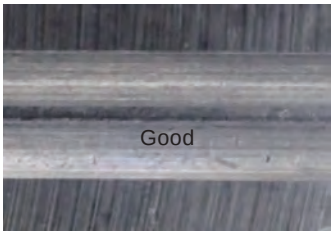


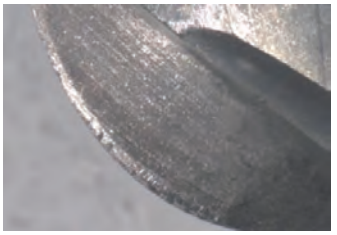
Cutting Performance

Fillet Milling of Titanium Alloy

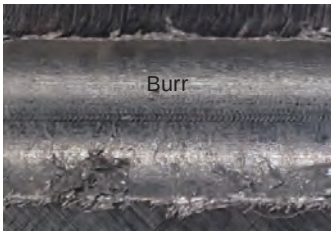
Achieves a quality surface finish with no chipping on the cutting edge.

VQT6UR





Conventional



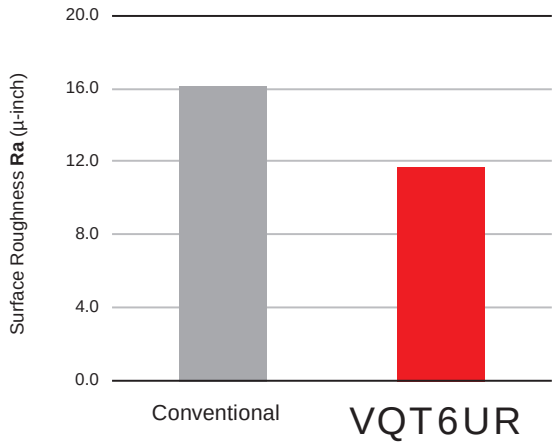
Surface　　Cutting Edge

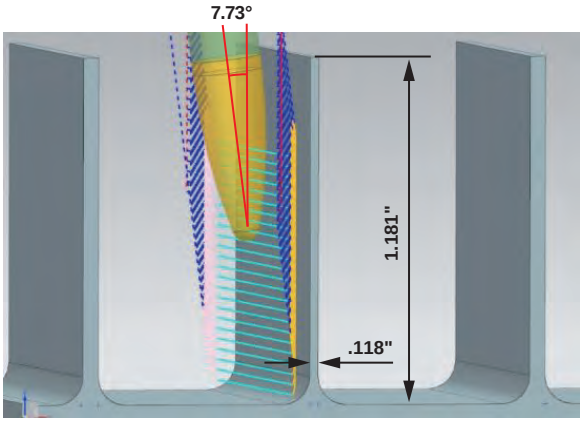
<Cutting Conditions>
Workpiece Material : Ti-6Al-4V
Tool : VQT6URR020R085S10
Cutting Speed : vc=260 SFM
Revolution : n=6770 min^{-1}
Feed per Tooth : fz=.001 IPT
Depth of Cut : ap=.039 inch
Cutting Mode : External Coolant (Emulsion)
Machine : 5-axisl MC (HSK63)

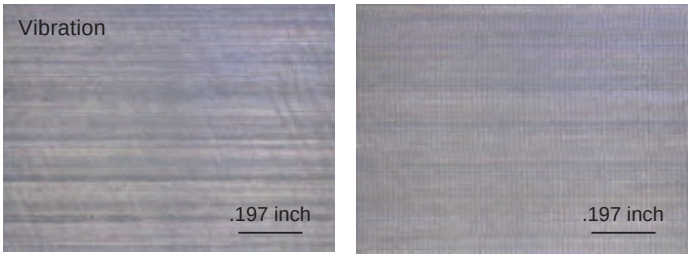
Cutting Performance

Deep Wall Machining of Titanium Alloy

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

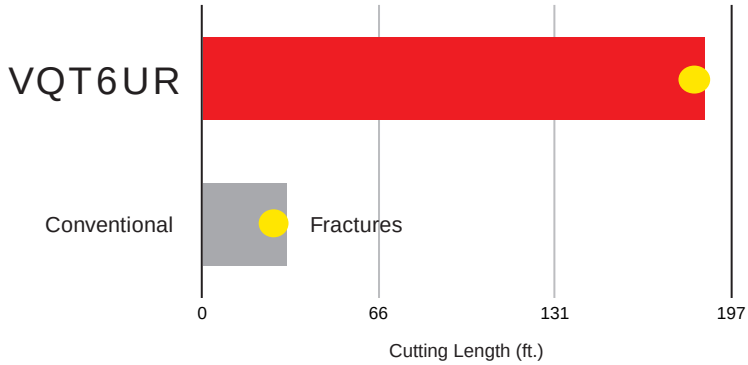


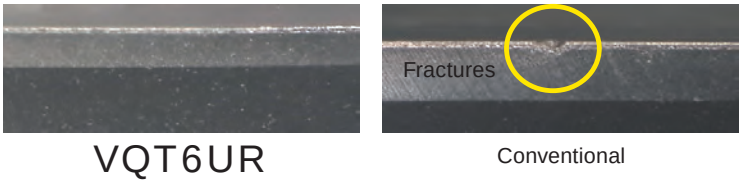




<Cutting Conditions>
Workpiece Material : Ti-6Al-4V
Tool : VQT6URR020R085S10
Revolution : n=2546min^{-1}
Feed per Tooth : fz=.001 IPT
Depth of Cut : ap=.059 inch
: ae=.012 inch
Tilt Angle : 7.73°
Cutting Mode : Side Milling
External Coolant (Emulsion)
Machine : 5-axis MC (HSK63)

Comparison of Tool Life in Titanium Alloy

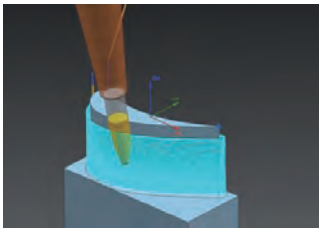


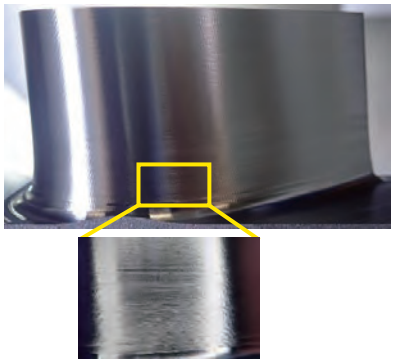


<Cutting Conditions>
Workpiece Material : Ti-6Al-4V
Tool : VQT6URR020R085S10
Revolution : n=2546min^{-1}
Feed per Tooth : fz=.001 IPT
Depth of Cut : ap=.157 inch
: ae=.012 inch
Tilt Angle : 8°
Overhang Length : 1.575 inch
Cutting Mode : External Coolant (Emulsion)
Machine : 5-axisl MC (HSK63)

Machining Example

Blade Surface Machining

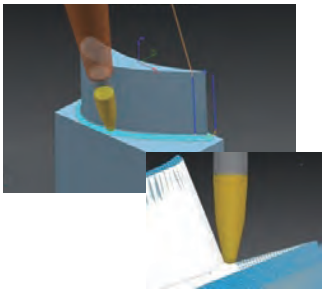


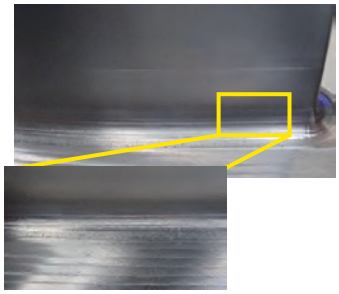


<Cutting Conditions>

Workpiece Material	: Ti-6Al-4V
Tool	: VQT6URR020R085S10
Cutting Speed	: vc=395 SFM
Feed per Rev.	: vf= 36.22 IPM
Depth of Cut	: ap=.056 inch
	: ae=.008 inch
Tilt Angle	: 10°
Cutting Mode	: External Coolant (Emulsion)
Machine	: 5-axisl MC (HSK63)

Fillet Milling





<Cutting Conditions>

Workpiece Material	: Ti-6Al-4V
Tool	: VQT6URR020R085S10
Cutting Speed	: vc=260 SFM
Feed per Rev.	: vf= 29.92 IPM
Depth of Cut	: ap=.009 inch
	: ae=.008 inch
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 using rotating tools, please make a trial run to check run-out, vibration and abnormal sounds etc.

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