New Successive Two Radius Design Achieve High Efficiency Machining
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

Barrel, Medium cut length, 6 flute

<table>
<thead>
<tr>
<th>Cutoff Steel, Alloy Steel</th>
<th>Cast Iron (≤30HRC)</th>
<th>30-45HRC Stainless Steel</th>
<th>Hardened Steel (≤55HRC)</th>
<th>Hardened Steel (&gt;55HRC)</th>
<th>Austenitic Stainless Steel</th>
<th>Titanium Alloy</th>
<th>Copper Alloy</th>
<th>Aluminum Alloy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC RE1 RE2 APMX LF DCON</td>
<td>8 2 75 21 90 8 6</td>
<td>10 3 75 22 100 10 6</td>
<td>12 4 100 25 110 12 6</td>
<td>12 4 100 25 110 12 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Renewed 2020.10.11)

(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.

- Inventory maintained in Japan.

**Table:**

<table>
<thead>
<tr>
<th>Order Number</th>
<th>DC</th>
<th>RE1</th>
<th>RE2</th>
<th>APMX</th>
<th>LF</th>
<th>DCON</th>
<th>No.F</th>
<th>Stock</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>VQT6URR020R075S08</td>
<td>8</td>
<td>2</td>
<td>75</td>
<td>21</td>
<td>90</td>
<td>8</td>
<td>6</td>
<td>●</td>
<td>1</td>
</tr>
<tr>
<td>VQT6URR020R085S10</td>
<td>10</td>
<td>2</td>
<td>85</td>
<td>26</td>
<td>100</td>
<td>10</td>
<td>6</td>
<td>●</td>
<td>1</td>
</tr>
<tr>
<td>VQT6URR030R075S10</td>
<td>10</td>
<td>3</td>
<td>75</td>
<td>22</td>
<td>100</td>
<td>10</td>
<td>6</td>
<td>●</td>
<td>1</td>
</tr>
<tr>
<td>VQT6URR040R100S12</td>
<td>12</td>
<td>4</td>
<td>100</td>
<td>25</td>
<td>110</td>
<td>12</td>
<td>6</td>
<td>●</td>
<td>1</td>
</tr>
</tbody>
</table>

- DC = Dia.
- APMX = Length of Cut
- RE1 = Nose Radius
- LF = Overall Length
- RE2 = Tangential Form Radius
- DCON = Shank Dia.
Recommended Cutting Conditions

Effective Angle

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

<table>
<thead>
<tr>
<th>Order Number</th>
<th>Nose Radius</th>
<th>Tangential Form Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RE1</td>
<td>Effective Angle</td>
</tr>
<tr>
<td>VQT6URR020R075S08</td>
<td>2</td>
<td>76.6°</td>
</tr>
<tr>
<td>VQT6URR020R085S10</td>
<td>2</td>
<td>74.5°</td>
</tr>
<tr>
<td>VQT6URR030R075S10</td>
<td>3</td>
<td>76.4°</td>
</tr>
<tr>
<td>VQT6URR040R100S12</td>
<td>4</td>
<td>78.3°</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Work Material</th>
<th>Mild Steels (≤180HB)</th>
<th>Carbon Steels, Cast Irons (180—280HB)</th>
<th>Austenitic Stainless Steels (≤200HB)</th>
<th>Titanium Alloys</th>
<th>Aluminum Alloys (Si&lt;5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>RE2</td>
<td>n (min⁻¹)</td>
<td>vf (mm/min)</td>
<td>ap</td>
<td>ae</td>
</tr>
<tr>
<td>8</td>
<td>75</td>
<td>8000</td>
<td>2400</td>
<td>0.78</td>
<td>0.05—0.3</td>
</tr>
<tr>
<td>10</td>
<td>85</td>
<td>6400</td>
<td>1900</td>
<td>0.83</td>
<td>0.05—0.3</td>
</tr>
<tr>
<td>10</td>
<td>75</td>
<td>6400</td>
<td>1900</td>
<td>0.78</td>
<td>0.05—0.3</td>
</tr>
<tr>
<td>12</td>
<td>100</td>
<td>5300</td>
<td>1600</td>
<td>0.89</td>
<td>0.05—0.3</td>
</tr>
</tbody>
</table>

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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)

<table>
<thead>
<tr>
<th>Work Material</th>
<th>RE2</th>
<th>Cusp Height h</th>
<th>Depth of Cut ae</th>
</tr>
</thead>
<tbody>
<tr>
<td>VQT6URR020R075S08</td>
<td>75</td>
<td>0.0001</td>
<td>0.245</td>
</tr>
<tr>
<td>VQT6URR030R075S10</td>
<td>75</td>
<td>0.0003</td>
<td>0.245</td>
</tr>
<tr>
<td>VQT6URR020R085S10</td>
<td>85</td>
<td>0.0005</td>
<td>0.261</td>
</tr>
<tr>
<td>VQT6URR040R100S12</td>
<td>100</td>
<td>0.0008</td>
<td>0.283</td>
</tr>
</tbody>
</table>
Barrel End Mill for Finish Cutting of Titanium Alloys

Recommended Cutting Conditions

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

<table>
<thead>
<tr>
<th>Work Material</th>
<th>Mild Steels (≤ 180HB)</th>
<th>Carbon Steels, Cast Irons (180–280HB)</th>
<th>Austenitic Stainless Steels (≤ 200HB)</th>
<th>Titanium Alloys</th>
<th>Aluminum Alloys (Si &lt; 5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>RE1</td>
<td>n (min⁻¹)</td>
<td>vf (mm/min)</td>
<td>ap</td>
<td>ae</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>16000</td>
<td>2400</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>16000</td>
<td>2400</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>11000</td>
<td>1700</td>
<td>0.6</td>
<td>1.5</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>8000</td>
<td>1200</td>
<td>0.8</td>
<td>2</td>
</tr>
</tbody>
</table>

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(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**

<Cutting Conditions>
- Workpiece: Ti-6Al-4V
- Tool: VQT6URR020R085S10
- Cutting Speed: \( v_c = 80 \text{ m/min} \)
- Revolution: \( n = 6770 \text{ min}^{-1} \)
- Feed per Tooth: \( f_z = 0.03 \text{ mm/t} \)
- Depth of Cut: \( a_p = 1.0 \text{ mm} \)
- Cutting Mode: External Coolant (Emulsion)
- Machine: 5-axis MC (HSK63)
Cutting Performance

Deep Wall Machining of Titanium Alloy

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

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=1.5mm
Width of Cut: ae= 0.3mm
Tilt Angle: 7.73°
Cutting Mode: Side Milling
External Coolant (Emulsion)
Machine: 5-axis 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.

Machining Example

Blade Surface Machining

<Cutting Conditions>
- Workpiece: Ti-6Al-4V
- Tool: VQT6URR020R085S10
- Cutting Speed: \( v_c = 120 \text{ m/min} \)
- Feed per Rev.: \( v_f = 920 \text{ mm/min} \)
- Depth of Cut: \( a_p = 1.42 \text{ mm} \)
- Width of Cut: \( a_e = 0.2 \text{ mm} \)
- Tilt Angle: 10°
- Cutting Mode: External Coolant (Emulsion)
- Machine: 5-axis MC (HSK63)

Fillet Milling

<Cutting Conditions>
- Workpiece: Ti-6Al-4V
- Tool: VQT6URR020R085S10
- Cutting Speed: \( v_c = 80 \text{ m/min} \)
- Feed per Rev.: \( v_f = 760 \text{ mm/min} \)
- Depth of Cut: \( a_p = 0.218 \text{ mm} \)
- Width of Cut: \( a_e = 0.2 \text{ mm} \)
- Tilt Angle: 20°
- Cutting Mode: External Coolant (Emulsion)
- Machine: 5-axis MC (HSK63)