Able to machine a wide variety of complex geometries.

For machining of undercut geometries that were difficult to machine with a conventional end mill and complicated geometries using a 5-axis machine.
 IMPACT MIRACLE end mill series

2 Flute IMPACT MIRACLE Wide Ball Nose End Mill
VF-2WB

Features

Special helical flute geometry for excellent cutting performance

Newly developed Impact Miracle coating
Impact Miracle coating with high heat resistance is used to ensure longer tool life.

Properties of Impact Miracle coating

<table>
<thead>
<tr>
<th></th>
<th>IMPACT MIRACLE</th>
<th>(Al,Ti,Si)N</th>
<th>(Al,Ti)N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness</td>
<td>3700HV</td>
<td>3200HV</td>
<td>2800HV</td>
</tr>
<tr>
<td>Adhesion</td>
<td>100N</td>
<td>80N</td>
<td>80N</td>
</tr>
<tr>
<td>Oxidation temp</td>
<td>1300°C</td>
<td>1100°C</td>
<td>840°C</td>
</tr>
<tr>
<td>Coefficient of friction</td>
<td>0.48</td>
<td>0.53</td>
<td>0.58</td>
</tr>
</tbody>
</table>

For machining of complex geometries
Possible to machine complex geometries that were difficult to machine with conventional ball nose and long neck ball nose end mills.
Cutting Performance

Excellent surface finishes (vertical wall machining)

Dramatically improves surface finishes of vertical walls.

<table>
<thead>
<tr>
<th>Surface roughness</th>
<th>VF-2WB</th>
<th>Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machined surface</td>
<td><img src="image1" alt="Surface roughness comparison" /></td>
<td><img src="image2" alt="Surface roughness comparison" /></td>
</tr>
</tbody>
</table>

Cutting resistance comparison (vertical wall machining)

Unique helical flute geometry improves sharpness and substantially reduces cutting resistance.

<table>
<thead>
<tr>
<th>Y-axis force</th>
<th>X-axis force</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Y-axis force comparison" /></td>
<td><img src="image4" alt="X-axis force comparison" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Z-axis force</th>
<th>Feed direction</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Z-axis force comparison" /></td>
<td><img src="image6" alt="Feed direction" /></td>
</tr>
</tbody>
</table>

**Work material**
- NAK80 (42HRC)
- JIS SKD61 (52HRC)

**Revolution**
- 24,800min⁻¹ (155m/min)
- 24,000min⁻¹ (150m/min)

**Feed rate**
- 1,350mm/min (0.028mm/tooth)

**Cutting method**
- Down cut, Coolant mist
Ball nose end mill suitable for machining of undercut geometries and complex geometries using a 5-axis machine.

### Cutting Conditions

<table>
<thead>
<tr>
<th>Work material</th>
<th>Carbon steel, Alloy steel (−30HRC)</th>
<th>JIS SS400, JIS 55C, JIS SCM Cast iron, JIS FC20</th>
<th>Alloy steel, Tool steel Pre-hardened steel (30−45HRC)</th>
<th>JIS SKD61, NAK</th>
<th>Austenitic stainless steel</th>
<th>JIS SUS304, JIS SUS316</th>
<th>Titanium alloy</th>
<th>JIS Ti-6Al-4V</th>
<th>Hardened steel (45−55HRC)</th>
<th>JIS SKD61</th>
</tr>
</thead>
<tbody>
<tr>
<td>R (mm)</td>
<td>Revolution (min⁻¹)</td>
<td>Feed Rate (mm/min)</td>
<td>Depth of Cut ap (mm)</td>
<td>Revolution (min⁻¹)</td>
<td>Feed Rate (mm/min)</td>
<td>Depth of Cut ap (mm)</td>
<td>Revolution (min⁻¹)</td>
<td>Feed Rate (mm/min)</td>
<td>Depth of Cut ap (mm)</td>
<td>Revolution (min⁻¹)</td>
</tr>
<tr>
<td>R1</td>
<td>40,000</td>
<td>5,000</td>
<td>0.070</td>
<td>40,000</td>
<td>5,000</td>
<td>0.060</td>
<td>32,000</td>
<td>2,500</td>
<td>0.050</td>
<td>32,000</td>
</tr>
<tr>
<td>R1.5</td>
<td>32,000</td>
<td>5,000</td>
<td>0.120</td>
<td>32,000</td>
<td>5,000</td>
<td>0.110</td>
<td>26,000</td>
<td>2,500</td>
<td>0.100</td>
<td>26,000</td>
</tr>
<tr>
<td>R2</td>
<td>24,000</td>
<td>3,800</td>
<td>0.150</td>
<td>24,000</td>
<td>3,800</td>
<td>0.130</td>
<td>20,000</td>
<td>2,000</td>
<td>0.120</td>
<td>20,000</td>
</tr>
<tr>
<td>R3</td>
<td>16,000</td>
<td>2,800</td>
<td>0.200</td>
<td>16,000</td>
<td>2,800</td>
<td>0.180</td>
<td>13,000</td>
<td>1,500</td>
<td>0.150</td>
<td>13,000</td>
</tr>
</tbody>
</table>

**Unit:** mm

- **1)** If the inclination of machining surface is very big, or cutting load is big, please reduce the revolution and the feed rate proportionately.
- **2)** If using the small size, we recommend coolant mist.
- **3)** If the depth of cut is shallow, the feed rate can be increased.
- **4)** When machining undercut geometries, care should be taken about neck interference.

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 CORPORATION**

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(Tools specifications subject to change without notice.)

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