

End Mill Series

CERAMIC END MILL

**Ultra high productivity for
nickel based heat resistant alloys**



CERAMIC

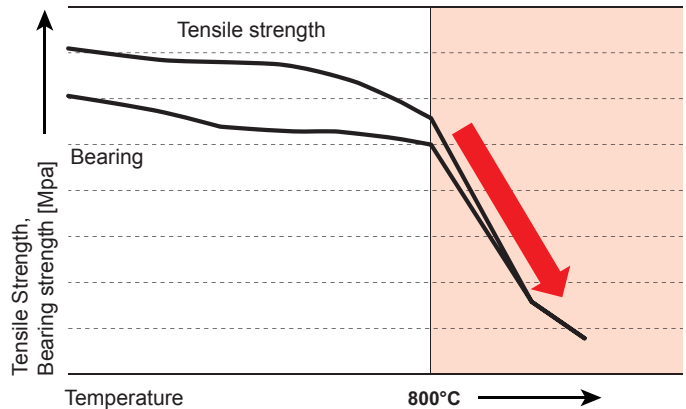
End Mill Series

From difficult-to-cut to easy-to-cut!

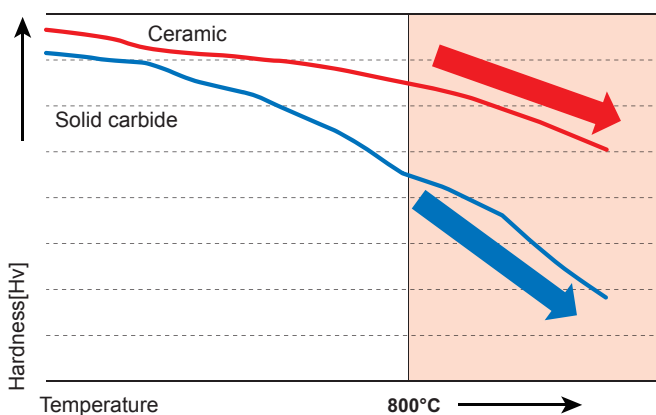
Generation of cutting heat

Feature of Ni based heat-resistant alloy

Ni based difficult-to-cut heat resistant alloys such as Inconel 718 soften at temperatures exceeding 800°C. At these temperatures, difficult-to-cut materials become easier to machine because their bearing and tensile strengths are lowered. Ceramic end mills can work effectively at these high temperatures and self generate the heat required to soften the machined material through ultra-high feeds and speeds.



High temperature hardness of cemented carbide and ceramic



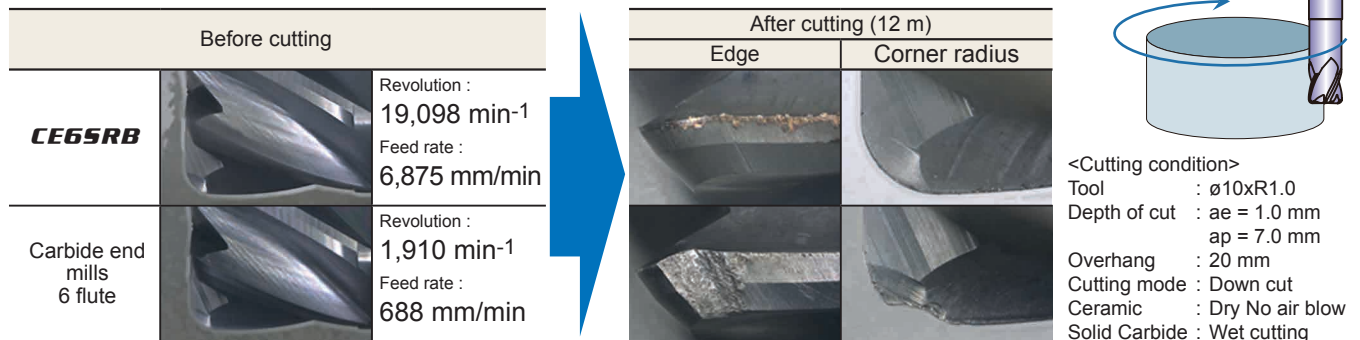
Cemented carbide end mills are significantly reduced in strength when exceeding 800 degrees. However, the strength of ceramic end mills is not affected and therefore can be used at the high speeds and depths of cut required to generate sufficient heat to enable machining.

Features



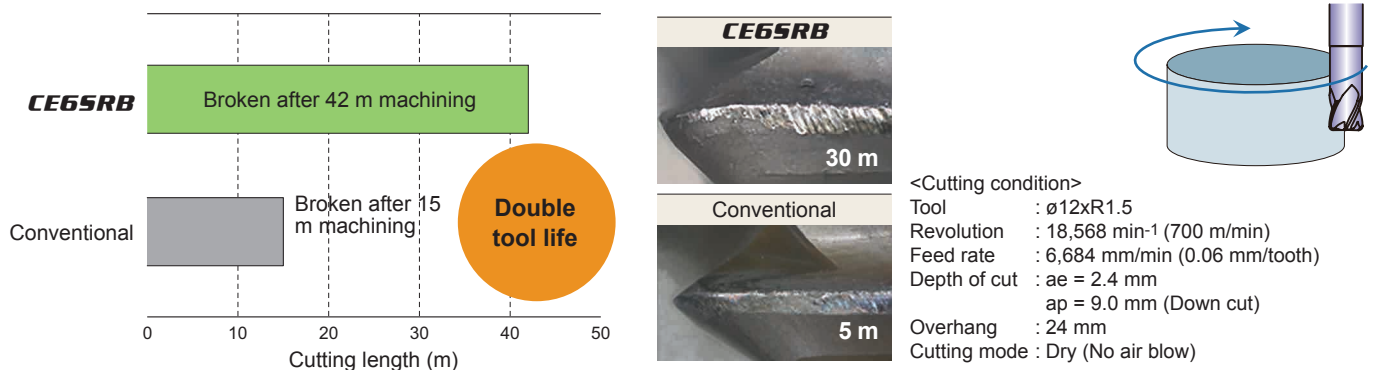
Cutting Performance

Tool life comparison - Inconel®718 (HRC 45)



Cutting efficiency 10 times

Tool life comparison - Inconel®718 (HRC 45)



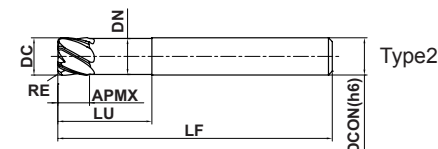
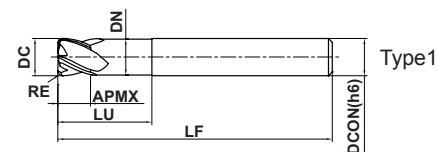
CERAMIC END MILLS

CE4SRB/CE6SRB

Corner radius end mill, short cut length, 4-6 flute



Steel, Cast Iron (≤30HRC)	Tool Steel, Pre-Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Heat Resistant Alloy	Copper Alloy	Aluminium Alloy
					☉		



R	DC≤12				
	0.02 - 0.02				
h6	DC=6	DC=8,10	DC=12		
	- 0.008 - 0.028	- 0.009 - 0.029	- 0.011 - 0.031		
	DCON=6	DCON=8,10	DCON=12		
	0 - 0.008	0 - 0.009	0 - 0.011		

- Ceramic corner radius end mill with high heat resistance.
- Capable of softening Ni based alloys by generating heat during machining

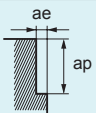
Order Number	DC	RE	APMX	LU	DN	LF	DCON	Flutes	Stock	Type
CE4SRBD0600R050	6	0.5	4.5	12	5.85	50	6	4	●	1
CE4SRBD0800R100	8	1.0	6.0	16	7.85	60	8	4	●	1
CE4SRBD1000R100	10	1.0	7.5	20	9.70	65	10	4	●	1
CE4SRBD1200R150	12	1.5	9.0	24	11.70	70	12	4	●	1
CE6SRBD0600R050	6	0.5	4.5	12	5.85	50	6	6	●	2
CE6SRBD0800R100	8	1.0	6.0	16	7.85	60	8	6	●	2
CE6SRBD1000R100	10	1.0	7.5	20	9.70	65	10	6	●	2
CE6SRBD1200R150	12	1.5	9.0	24	11.70	70	12	6	●	2

NOTE: DO NOT USE ON TITANIUM ALLOYS

RECOMMENDED CUTTING CONDITIONS

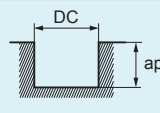
CE4SRB

Side milling

Work material	Inconel			
DC (mm)	Vc (m/min)	fz (mm)	ap (mm)	ae (mm)
6	>350	<0.06	<4.5	<1.2
8	>350	<0.06	<6.0	<1.6
10	>350	<0.06	<7.5	<2.0
12	>350	<0.06	<9.0	<2.4
Depth of cut				

NOTE: DO NOT USE ON TITANIUM ALLOYS

Slotting

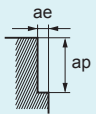
Work material	Inconel		
DC (mm)	Vc (m/min)	fz (mm)	ap (mm)
6	>350	<0.03	<1.5
8	>350	<0.03	<1.5
10	>350	<0.03	<2.0
12	>350	<0.03	<2.5
Depth of cut			

NOTE: DO NOT USE ON TITANIUM ALLOYS

*Under 0.3 x D

CE6SRB


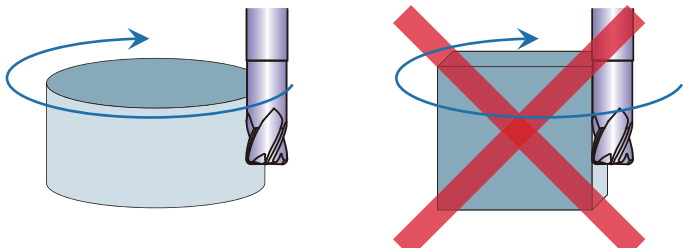
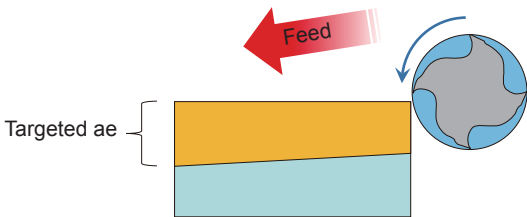
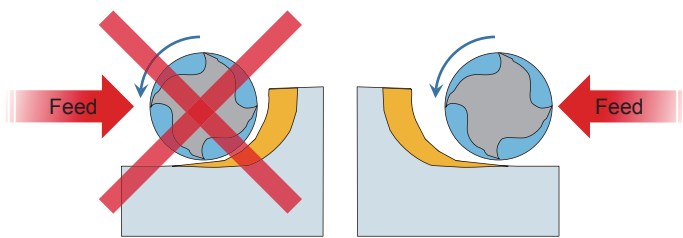
Side milling

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Depth of cut				

NOTE: DO NOT USE ON TITANIUM ALLOYS

- 1) The outermost layer of the material may be affected by heat. Ensure a minimum of 0.3 mm final machining allowance remains.
- 2) The recommended ramping angle is 1.5°. For ramping it is recommended to reduce the feed by 50%.
- 3) Gradually increase the width of cut (ae) starting from 0.05 x DC.

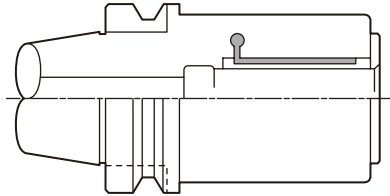
PRECAUTION

Cutting Conditions	<p>Requires high cutting speeds (from 350m/min to 1000m/min) High speed cutting is required to generate the heat needed to soften materials without causing abrasion or other damage.</p> <hr/> <p>Recommendation for air blow Do not use coolant, it can cause thermal cracking. Air blow is not used for the purpose of cooling and should not be directed at the tool. It should only be used for good chip evacuation.</p> <div data-bbox="1066 568 1449 757"> <p>Example of thermal cracking</p>  </div>
Applications	<p>Recommendations for continuous cutting Continuous cutting is highly recommended. Damage or chipping can occur during interrupted cutting.</p> <div data-bbox="507 918 1193 1205">  <div> <p>Continuous cutting</p> <p>Interrupted machining</p> </div> </div> <p>Using maximum width and depth of cut from the start of machining may cause damage. Increase the width of cut (ae) gradually to maintain tool life.</p> <div data-bbox="533 1429 1062 1644">  </div> <p>Method: Down cut (climb milling) Down cut / climb milling is highly recommended. Up cutting can be unstable.</p> <div data-bbox="507 1823 1193 2101">  <div> <p>Up cut</p> <p>Down cut / climb milling</p> </div> </div>

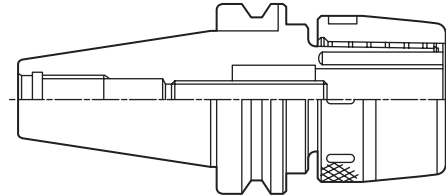
Tool holder recommendation - Hydraulic chuck

First recommendation for tool holding is a hydraulic chuck, second recommendation is a precision milling chuck.

Collet chucks are not suitable.



Hydraulic chuck



Precision milling chuck

Do not remove the built up edge

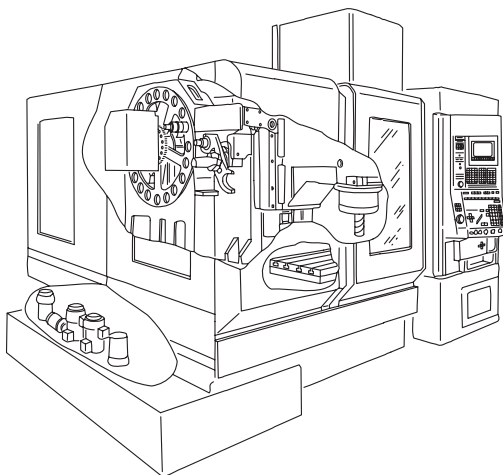
Do not remove any built up edge manually after machining as this may cause chipping. The built up edge will be removed by the heat generated during the next cutting cycle.

Final machining allowance of more than 0.3mm

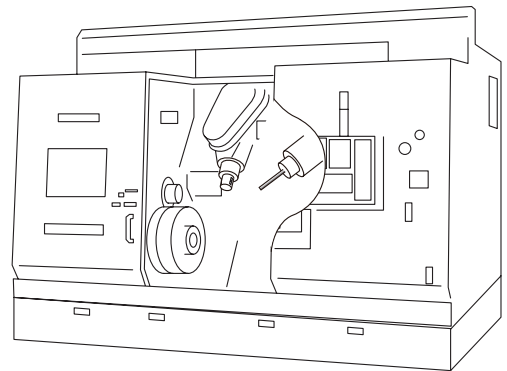
Leave a minimum of 0.3mm finishing allowance. Machining with ceramic end mills at high temperatures can affect the outermost layer of the machined material, therefore a final machining allowance must remain.

Do not use open type machines

The chips generated during machining are at extremely high temperatures. Ensure the inside of the machine is free from any combustible materials.



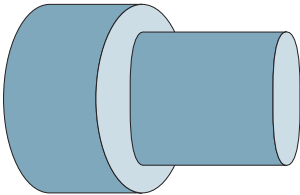
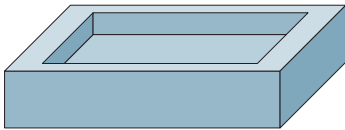
Covered machining centre



Covered turn mill type machine

Others

APPLICATION EXAMPLES

End Mill		CE6SRBD1000R100	CE6SRBD1200R150
Workpiece		Inconel®718 	Inconel®718 
Component		Turbine blade	Pocket component
Process		Blade machining	Pocket machining
Cutting Conditions	Vc (m/min)	628	700
	fz (mm)	0.03	0.06
	ap (mm)	ap = 0.7, ae = 1.2	ap = 1.5, ae = 5.0
Cutting mode		Dry (No air blow)	Air blow
Machine		Turn mill centre	Vertical machining centre
Results		Cutting efficiency 3 times higher compared to solid carbide end mills.	Pocket milling of 100 mm × 100 mm × 10 mm is completed without a prepared hole in 2 min. 40 seconds.



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