CERAMIC CORNER RADIUS END MILLS

ULTRA HIGH PRODUCTIVITY FOR NICKEL BASED HEAT RESISTANT ALLOYS

MITSUBISHI MATERIALS

CERAMIC CORNER RADIUS END MILLS

FEATURES

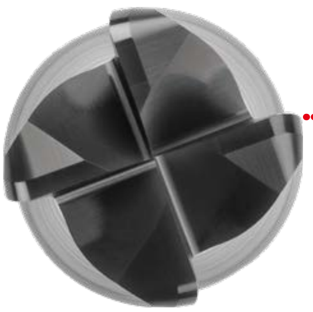
Optimized helix angle reduces cutting forces and to prevents pull-out during milling

Seamless grinding technology gives higher chipping resistance even during extreme roughing applications

4-flute type for pocketing and slotting

6-flute type for face machining and profiling

Optimum ceramic grade for HRSA applications



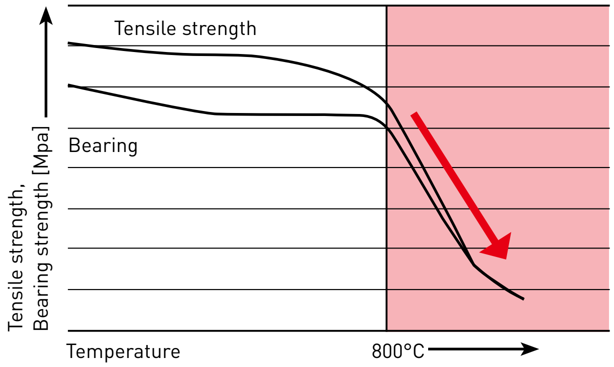
Strong, negative flute and special rake edge withstands high temperatures and loads

CERAMIC CORNER RADIUS END MILLS

FROM DIFFICULT-TO-CUT TO EASY-TO-CUT!

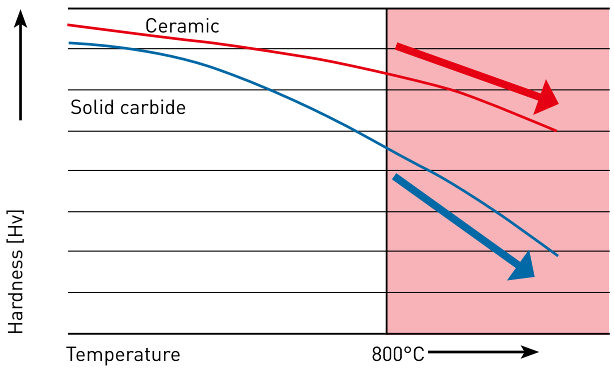
GENERATION OF CUTTING HEAT

FEATURE OF Ni BASED HEAT-RESISTANT ALLOY



Ni based difficult-to-cut heat resistant alloys such as Inconel 718 soften at temperatures exceeding 800ºC. 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 material to be machined by usuing ultra-high feeds and speeds.

HIGH TEMPERATURE HARDNESS OF CEMENTED CARBIDE AND CERAMIC

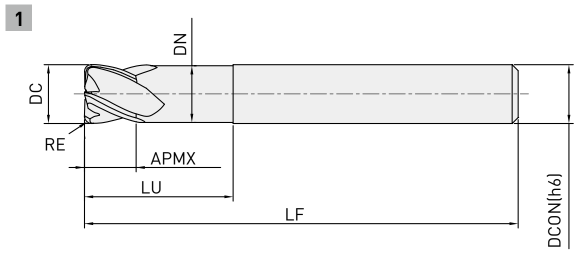


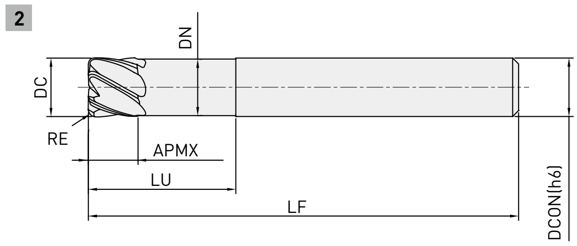
Cemented carbide end mills are significantly reduced in strength when exceeding 800ºC.
However, the strength of ceramic end mills is not affected and therefore can be used at the high speeds and depths of cut required to generate sufficient heat to enable effective machining.

CE4SRB / CE6SRB

CORNER RADIUS END MILL, SHORT CUT LENGTH, 4-6 FLUTE

S Ni





DC<12		
0.02 - 0.02		
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	Stock	DC	RE	APMX	LF	DCON	DN	LU	ZEFP	Type
CE4SRBD0600R050	●	6	0.5	4.5	50	6	5.85	12	4	1
CCE4SRBD0800R100	●	8	1.0	6.0	60	8	7.85	16	4	1
CE4SRBCE4SRBD1000R100	●	10	1.0	7.5	65	10	9.70	20	4	1
CE4SRBCE4SRBD1200R150	●	12	1.5	9.0	70	12	11.70	24	4	1
CE6SRBD0600R050	●	6	0.5	4.5	50	6	5.85	12	6	2
CE6SRBCE6SRBD0800R100	●	8	1.0	6.0	60	8	7.85	16	6	2
CE6SRBCE6SRBD1000R100	●	10	1.0	7.5	65	10	9.70	20	6	2
CE6SRBCE6SRBD1200R150	●	12	1.5	9.0	70	12	11.70	24	6	2

Never use ceramic end mills to cut titanium alloys. Doing so will cause a risk of ignition and can be extremely dangerous.

5 Vc

● : Inventory maintained. ★ : Inventory maintained in Japan.

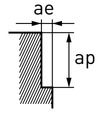
CE4SRB / CE6SRB

RECOMMENDED CUTTING CONDITIONS

CE4SRB

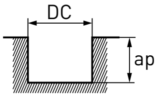
SIDE MILLING

	Material	DC	Vc	fz	ap	ae
S	Nickel-based heat resistant super alloy (Inconel etc.)	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



SLOTTING

	Material	DC	Vc	fz	ap
S	Nickel-based heat resistant super alloy (Inconel etc.)	6	⩾350	⩽0.03	⩽1.0
		8	⩾350	⩽0.03	⩽1.5
		10	⩾350	⩽0.03	⩽2.0
		12	⩾350	⩽0.03	⩽2.5

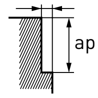


Do not use on titanium alloys.
The outermost layer of the material may be affected by heat. Ensure a minmum of 0.3 mm final machining allowance remains.
The recommended ramping angle is 1.5°C. When conducting ramping it is recommended to reduce the feed rate by 50 % from the cutting conditions shown.
Gradually increase the width of cut (ae) starting from 0.05D.

CE6SRB

SIDE MILLING

	Material	DC	Vc	fz	ap	ae
S	Nickel-based heat resistant super alloy (Inconel etc.)	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



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Gradually increase the width of cut (ae) starting from 0.05D.

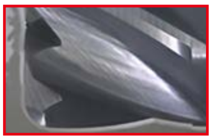
CERAMIC CORNER RADIUS END MILLS

CUTTING PERFORMANCE

TOOL LIFE COMPARISON – INCONEL®718 (HRC 45)

Tool	CE6SRBD1000R100
Depth of cut (mm)	ae = 1.0
	ap = 7.0
Overhang (mm)	20
n (min^{1})	19.098
f (mm/min)	6.875
Cutting mode	Down cut
Ceramic	Dry (No air blow)

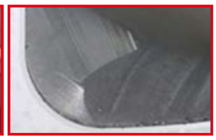
Before cutting*



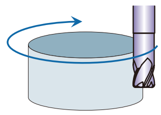
CE6SRB

After cutting (12 m)

Edge



Corner Radius



Tool	VF6MHVRBD1000R100
Depth of cut (mm)	ae = 1.0
	ap = 7.0
Overhang (mm)	20
n (min^{1})	1.910
f (mm/min)	688
Cutting mode	Down cut
Solid Carbide	Wet cutting

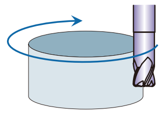
Before cutting*

Carbide end mills
6 flute

After cutting (12 m)

Edge

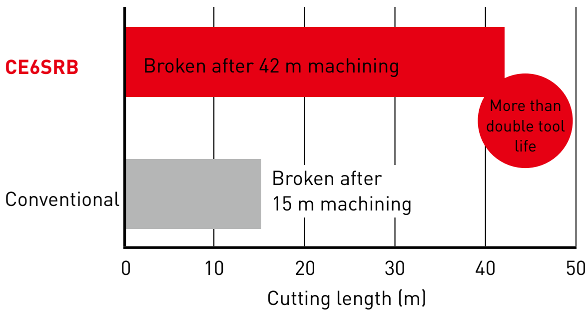
Corner Radius

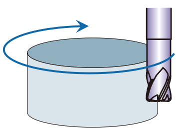


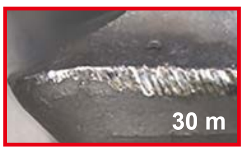
*Cutting efficiency 10 times

TOOL LIFE COMPARISON-INCONEL®718 (HRC 45)

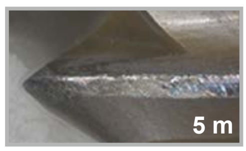
Tool	Ø12 x R 1.5
Depth of cut (mm)	ae = 2.4
	ap = 9.0
n(min^{1})	8.568 (700 m/min)
f (mm/min)	6.684 (0.06 mm/tooth)
Overhang (mm)	24
Cutting mode	Dry (No air blow)







CE6SRB



Conventional

CERAMIC CORNER RADIUS END MILLS

PRECAUTION

CUTTING CONDITIONS

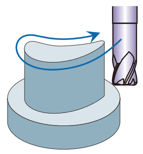
Requires high cutting speeds (from 350 m / min into 1000 m / min)
High speed cutting is required to generate the heat needed to soften materials without causing abrasion or other damage.

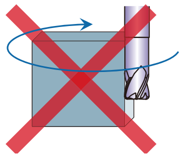
Recommendation for air blow
Do not use coolant, it can cause thermal cracking.
Air blow is not used for the purpose of cooling and should not be directed at the tool. It should be only used for chip evacuation.


Example of thermal cracking

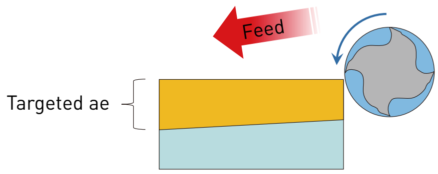
APPLICATIONS

Recommendations for continuous cuttting
Continuous cutting is highly recommended.
Damage or chipping can occur during interrupted cutting.

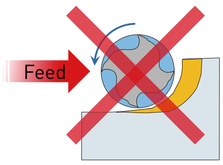

Continuous cutting


Interrupted machining

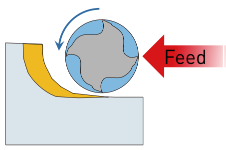
Using maximum width and depth of cut from the start of machining may cause damage.
Increase the width of cut (ae) gradually to maintain tool life.



Down cut / climb milling is highly recommended.
Up cutting can be unstable.



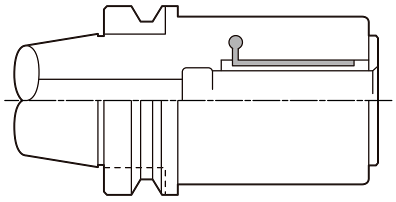
Up cut



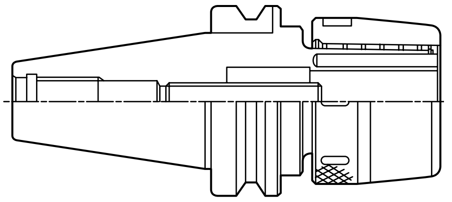
Down cut / climb milling

RECOMMENDATIONS

Tool holder recommendation
First recommendation for tool holding is a hydraulic chuck, second recommendation is a precision milling chuck.
Collet chucks are not suitable.



Hydraulic chuck

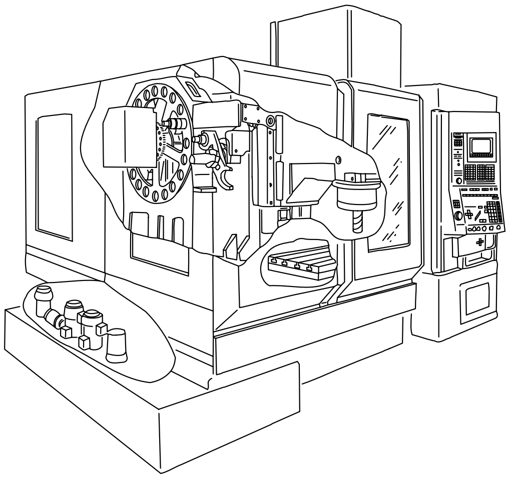


Precision milling chuck

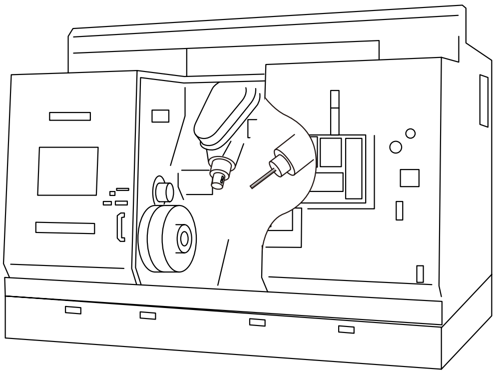
Do not remove any built up edge manually after machining as this may cause chipping.
The built up edge will be removed by the heat generated during the next cutting cycle.

Final machining allowance
Leave a minmum of 0.3 mm 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 extremely hot.
Ensure the inside of the machine is free from any combustible materials.



Covered machining centre



Covered turn mill type machine

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