

## Endmills for Machining Aerospace Parts

# AVIS series

## The ultimate in CFRP machining

Diamond Coated Endmills for CFRP **AVIX** <sup>New</sup> type <sub>N</sub>



## Dramatically reduces burrs in chamfering

Solid Chamfering Endmills **AVIC** <sup>New</sup> type <sub>P M K S</sub>

## Exit burrs are suppressed by using a dedicated cutting edge

Bore Endmills for Hole Finishing **AVIBo** <sup>New</sup> type <sub>P M K N S</sub>

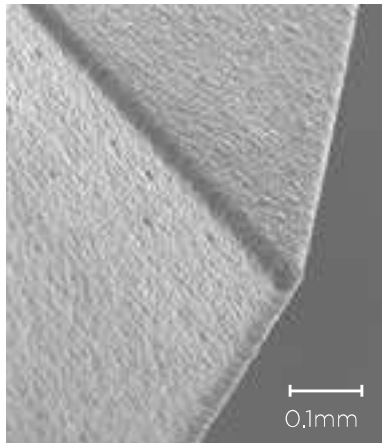


**AVIX type****■ Features**

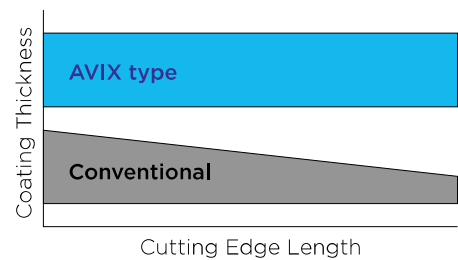
- The use of a complex cross-nicked edge shape reduces cutting force and realises stability in high-efficiency machining
- Sharp cutting edge and uniform coating thickness along the cutting edge length realise high quality and long tool life

**■ Tool Shape****■ Complex Cross-nicked Shape**

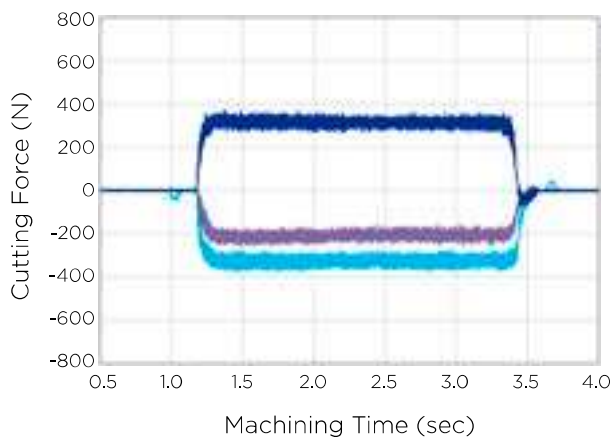
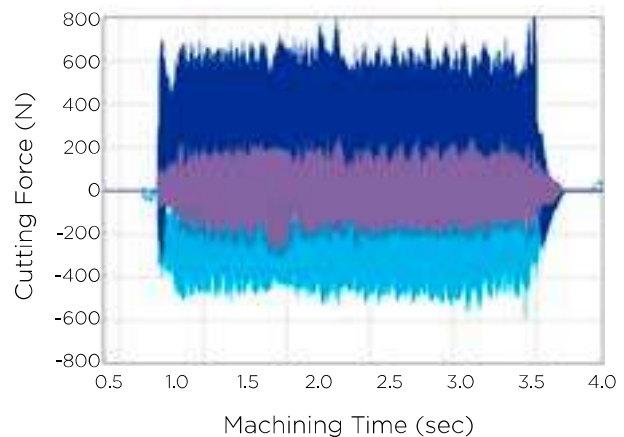
Variably sized nicked cutting edge shape realises stable machining with low resistance

**■ Sharp Cutting Edge**

New coating process provides high quality sharp cutting edges

**■ Diamond Coating with Uniform Thickness**

Uniform coating thickness realises stable tool life

**■ Cutting Performance****AVIX type****Conventional Tool (Right-hand Helix Endmill)**

Work Material: CFRP (Thickness 9.5mm)  
 Tool : AVIX510000-R03 (Tool Diameter  $\phi 10$ , 5 flutes)  
 Cutting Conditions:  $v_c = 200\text{m/min}$ ,  $v_f = 2,000\text{mm/min}$ , Dry, Cutting

Suppresses chatter to realise stable machining



## ■ Features

- High-raked cutting edge design significantly reduces cutting force  
Realises burr-free machining and suppresses damage to laminated workpieces during machining
- Dedicated grades for machining titanium alloys (KH26) and nickel-based heat-resistant alloys (ACF07C) to achieve long and stable tool life
- 3-flute design enables high-efficiency machining
- Front and back chamfering is possible with a single tool

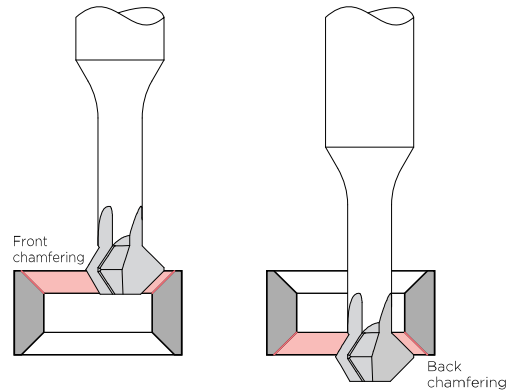
## ■ Tool Shape



3-flute, high-raked design;  
large rake angle



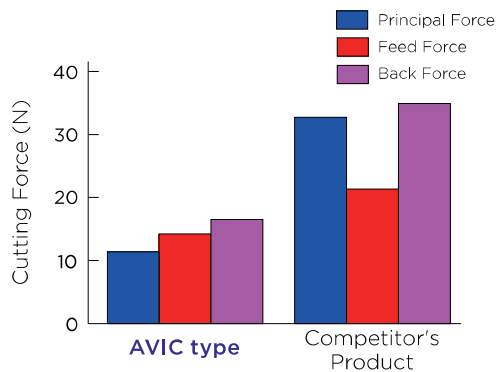
- Secondary burr control
- Improved machined surface quality



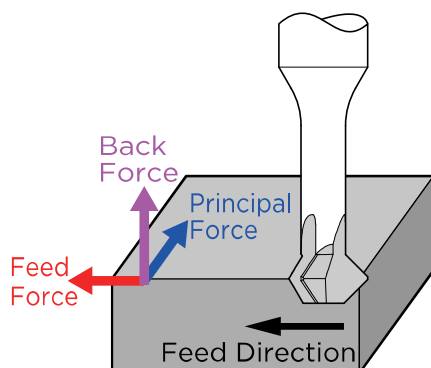
Front and back chamfering  
is possible with a single tool

## ■ Cutting Performance

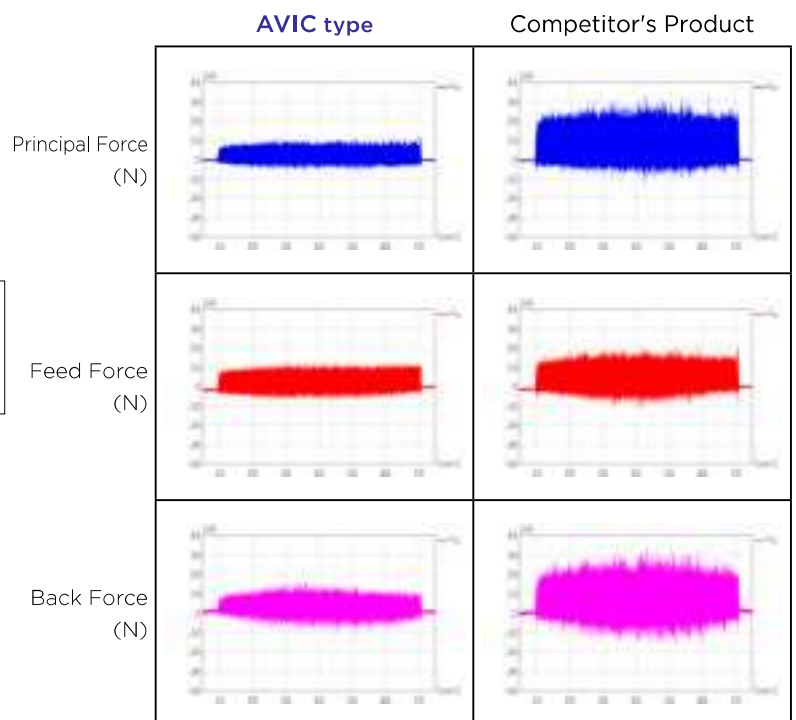
### ● Cutting Force



Work Material: Ti-6Al-4V  
Tool : AVIC 306000-45-1,4 (ø6,0, KH26)  
Cutting Conditions:  $v_c = 27\text{m/min}$ ,  $n = 1,070\text{min}^{-1}$ ,  $v_f = 107\text{mm/min}$   
Chamfering : C0.3mm



AVIC type effectively suppresses  
cutting force in chamfering



## ● Machined Surface Quality

AVIC type



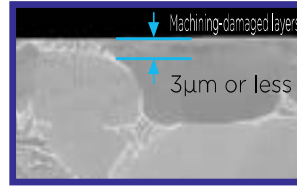
No secondary burrs

Competitor's Product A



Secondary burrs

AVIC type



Good, within specifications

Competitor's Product A

Workpiece  
laminate damage  
from machining  
- Not acceptable

Work Material: Ti-6Al-4V  
Tool : AVIC 306000-45-1.4 (3-flute, KH26, solid carbide)  
Competitor's Product B (1-flute, indexable cutter:  
standard product)  
Cutting Conditions:  $v_c = 27\text{m/min}$ ,  $n = 1,070\text{min}^{-1}$ ,  $v_f = 107\text{mm/min}$   
Chamfering : C0.3mm

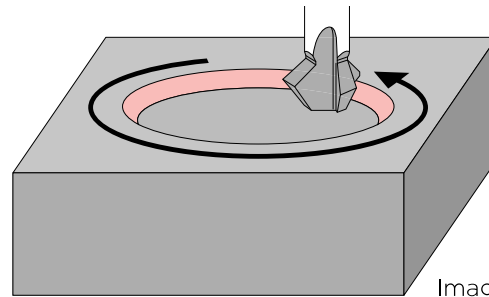


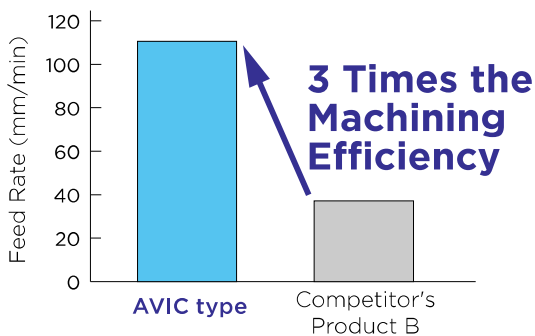
Image of Machining

## AVIC type suppresses secondary burr\* generation

\*Burr generated during chamfering (deburring)

AVIC type suppresses the generation of the machining-damaged layers which cause problems on the finished surface of machined aerospace components

## ● Machining Efficiency



AVIC type has 3 flutes for higher-efficiency machining



### ■ Features

- Tool design can be tailored to the work material and machining application
- Optimal pocket shape improves chip evacuation and achieves good machined surface quality
- Optimal cutting edge design suppresses exit burrs
- Tool life is improved by using the optimal grade for each work material

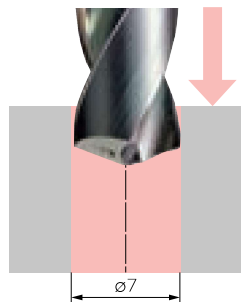
### ■ Tool Shape



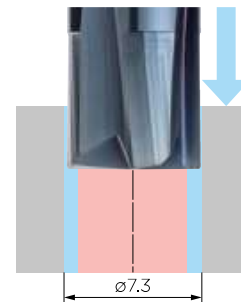
### ■ Cutting Performance

#### Process

Process (1) Drilling



Process (2) Hole Finishing

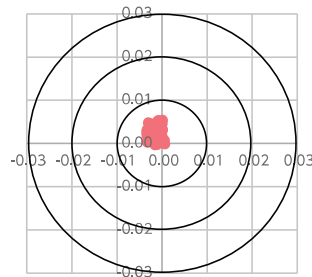


#### Cutting Conditions

Work Material: Titanium Alloy (Ti-6Al-4V)  
Tool : Drill ( $\phi 7$ , 2 flutes)  
Cutting Conditions:  $vc = 15\text{m/min}$ ,  $f = 0.04\text{mm/rev}$

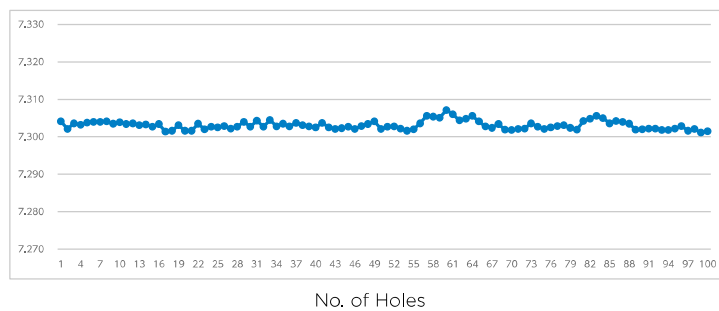
Work Material: Titanium Alloy (Ti-6Al-4V)  
Tool : AVIBo series ( $\phi 7.3$ , 4 flutes)  
Cutting Conditions:  $vc = 50\text{m/min}$ ,  $f = 0.05\text{mm/rev}$

### ● Hole Position Accuracy ● Hole Diameter Accuracy



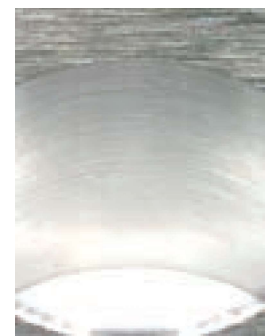
Hole Position Max.	$\phi 0.010$
Average	$\phi 0.006$

High accuracy  
of hole position



Good hole diameter

### ● Machined Surface Quality

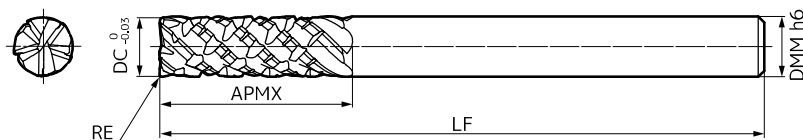


Good surface  
quality



\*For h6 tolerance, refer to Chapter N of the General Catalogue

Fig 1



## Body

Dimensions (mm)

	Cat. No.	Stock	Dia. DC	Corner Radius RE	Cutting Edge Length APMX	Overall Length LF	Shank Dia. DMM	No. of Flutes	Bottom Cutting Edges	Fig
Metric	AVIX 404000-R03	●	4.0	0.3	12	60	4	4	4	1
	506000-R03	●	6.0	0.3	18	70	6	5	5	1
	508000-R03	●	8.0	0.3	24	80	8	5	5	1
	510000-R03	●	10.0	0.3	30	80	10	5	5	1
	612000-R03	●	12.0	0.3	36	90	12	6	6	1
Inch	AVIX 403175-R03	●	3.175	0.3	10	60	3.175	4	4	1
	506350-R03	●	6.35	0.3	19	70	6.35	5	5	1
	509525-R03	●	9.525	0.3	28	80	9.525	5	5	1
	612700-R03	●	12.7	0.3	38	90	12.7	6	6	1

Grade: DCT30X

## Identification Code

# AVIX 6 12700 - R03

Type Code

No. of  
Flutes

Dia.

Corner  
Radius

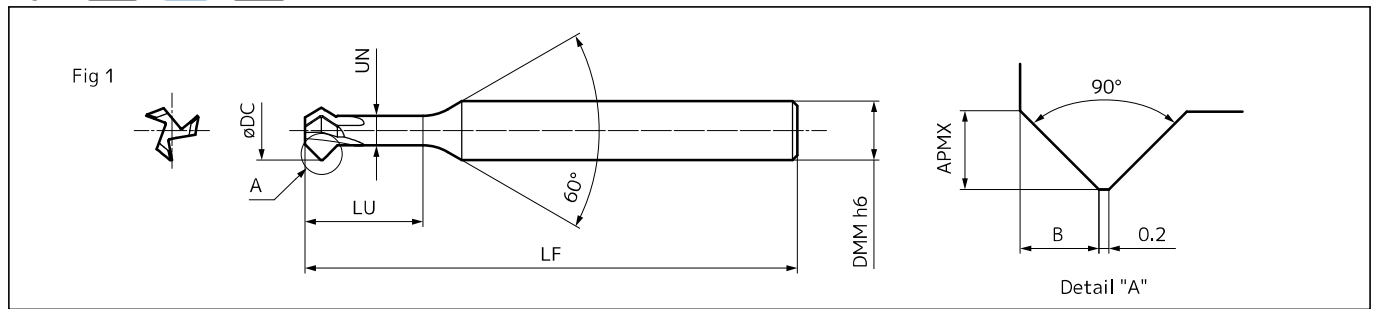
## Recommended Cutting Conditions

Work Material	CFRP		
Cutting Conditions	Dry		
DC (mm)	Spindle Speed (min <sup>-1</sup> )	Feed Rate vc (m/min)	Feed Rate f (mm/rev)
4.0	12,000	150	0.08 to 0.17
6.0	10,600	200	0.09 to 0.19
8.0	8,000	200	0.13 to 0.25
10.0	6,400	200	0.16 to 0.31
12.0	5,300	200	0.19 to 0.38
3.175	12,000	120	0.08 to 0.17
6.35	10,000	200	0.10 to 0.20
9.525	6,700	200	0.15 to 0.30
12.7	5,000	200	0.20 to 0.40

1. If cutting noise and vibration occur, please reduce the cutting conditions accordingly.

2. If the machine cannot achieve the recommended spindle speed, please use the maximum spindle speed available.





## Body

Dimensions (mm)

Cat. No.		Stock		Dia. DC	Cutting Edge Length B	Cutting Edge Depth APMX	Neck Dia. UN	Neck Length LU	Overall Length LF	Shank Dia. DMM	Fig
		KH26 for Titanium Alloys	ACF07C for Ni-based Heat-resistant Alloys								
Metric	AVIC 302000-45-0.4(E)	●	●	2.0	0.5	0.4	1.0	4	40	4	1
	303000-45-0.6(E)	●	●	3.0	0.7	0.6	1.6	6	40	4	1
	304000-45-0.8(E)	●	●	4.0	0.9	0.8	2.2	8	50	4	1
	305000-45-1.0(E)	●	●	5.0	1.2	1.0	2.6	10	50	6	1
	306000-45-1.4(E)	●	●	6.0	1.6	1.4	3.0	12	50	6	1
	308000-45-1.5(E)	●	●	8.0	1.7	1.5	4.6	16	60	8	1
	310000-45-1.7(E)	●	●	10.0	1.9	1.7	6.0	20	70	10	1
	312000-45-2.0(E)	●	●	12.0	2.2	2.0	7.5	24	70	12	1
Inch	AVIC 302383-45-0.4(E)	●	●	2.383	0.5	0.4	1.3	3.9	38.1	3.175	1
	303175-45-0.6(E)	●	●	3.175	0.7	0.6	1.6	6.3	38.1	3.175	1
	303969-45-0.8(E)	●	●	3.969	0.9	0.8	2.1	7.9	50.8	4.763	1
	304763-45-1.0(E)	●	●	4.763	1.2	1.0	2.4	9.5	50.8	4.763	1
	306350-45-1.4(E)	●	●	6.350	1.6	1.4	3.0	12.7	50.8	6.350	1
	307938-45-1.5(E)	●	●	7.938	1.7	1.5	4.6	15.8	63.5	7.938	1
	309525-45-1.7(E)	●	●	9.525	1.9	1.7	5.6	20.6	76.2	9.525	1
	312700-45-2.0(E)	●	●	12.700	2.2	2.0	8.0	23.8	76.2	12.700	1

\*Add E as the part number suffix for ACF07C

Grades: Uncoated: KH26 Coated: ACF07C

## Identification Code

# AVIC 3 12700 - 45 - 2.0

Type Code    No. of Flutes    Dia.    C chamfer    Cutting Edge Depth

## Recommended Cutting Conditions

Work Material Cutting Conditions	Structural Steel, Carbon Steel SS, SC		Stainless Steel SUS304, SUS316		Titanium Alloy		Ni-based Heat-resistant Alloy	
	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)	Spindle Speed (min <sup>-1</sup> )	Feed Rate (mm/min)
DC (mm)								
2.0	11,100	1,700	8,000	720	4,800	430	3,200	190
3.0	7,400	1,100	5,300	480	3,200	290	2,100	130
4.0	5,600	840	4,000	360	2,400	220	1,600	100
5.0	4,500	670	3,200	290	1,900	170	1,300	80
6.0	3,700	560	2,700	240	1,600	140	1,100	60
8.0	2,800	420	2,000	180	1,200	110	800	50
10.0	2,200	330	1,600	140	960	90	640	40
12.0	1,900	280	1,300	120	800	70	530	30

1. If cutting noise and vibration occur, please reduce the cutting conditions accordingly.

2. If the machine cannot achieve the recommended spindle speed, please use the maximum spindle speed available.

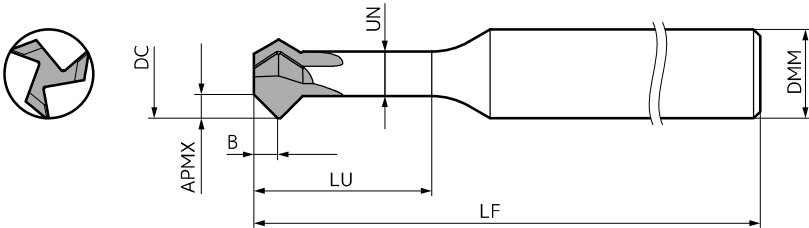
Chamfering Endmills AVIC type Design Inquiry Sheet

After filling in the required dimensions and other information, contact our nearest sales office or distributor.

Feel free to contact us with other requests as well.

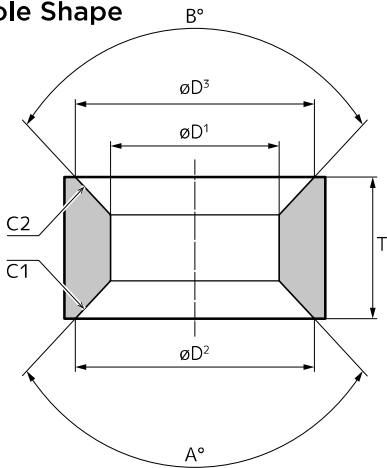
Company Name/Contact

Tool Shape



Part	Value
Work Material	
DC	
B	
APMX	
UN	
LU	
LF	
DMM	
No. of Flutes	

Workpiece: Hole Shape



Workpiece: External Shape



Part	Value
Work Material	
Workpiece	<input checked="" type="checkbox"/> Hole shape <input type="checkbox"/> Ext. Shape
øD¹	
øD²	
øD³	
A	
B	
C1	
C2	
T	



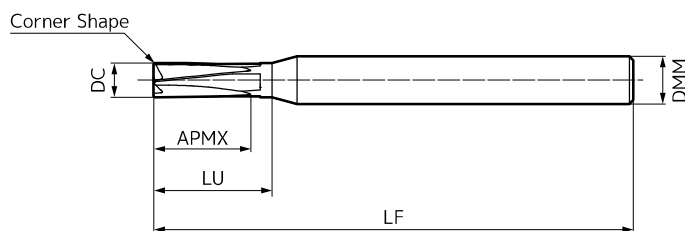
## ◀ Bore Endmills AVIBo type Design Inquiry Sheet ▶

After filling in the required dimensions and other information, contact our nearest sales office or distributor.

Feel free to contact us with other requests as well.

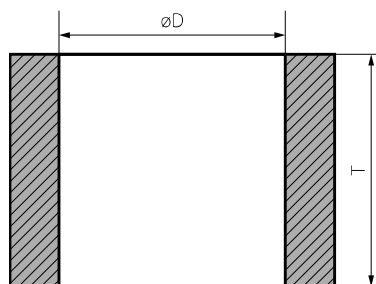
Company Name/Contact

### ■ Tool Shape

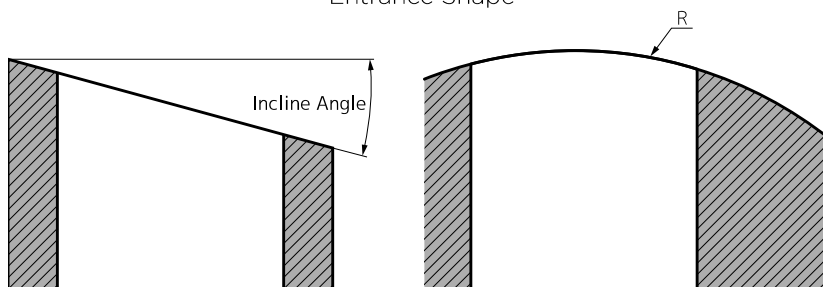


Part	Value
Work Material	
DC	
APMX	
LU	
LF	
DMM	
No. of Flutes	
Corner Shape	

### ■ Workpiece: Hole Shape




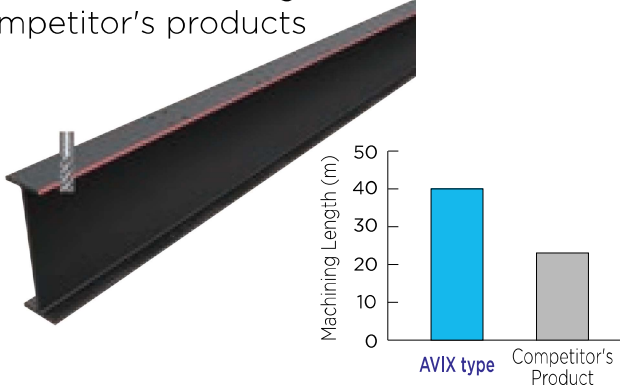
Entrance Shape



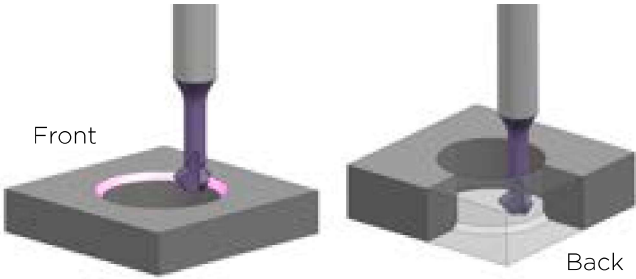
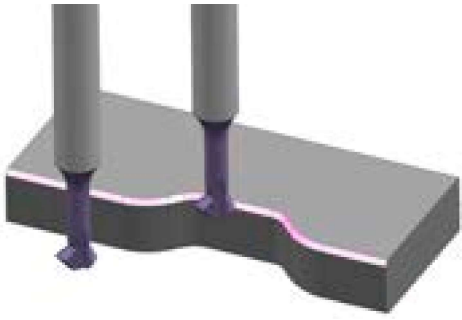
Part	Value
Work Material	
øD	
T	
Surface Roughness	
Positioning Accuracy	
Chamfering Y/N	
Entrance Shape	<input type="checkbox"/> Inlined <input type="checkbox"/> Curved

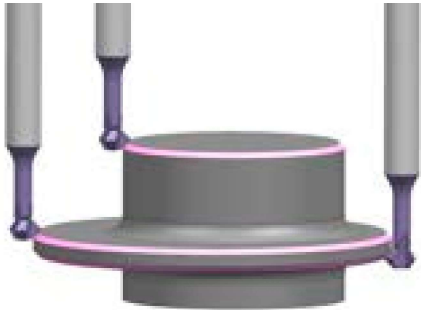
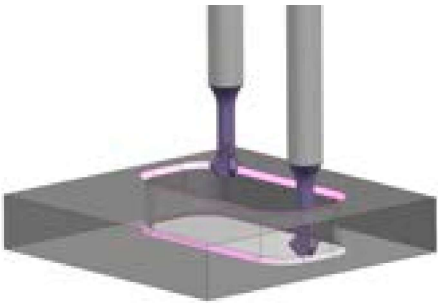
# AVIS series Application Examples

## ■ Application Examples (AVIX type)

CFRP Aerospace Component (Cutting) <span>N</span>	CFRP Aerospace Component (Trimming) <span>N</span>						
<p>Achieves 3 times higher machining efficiency than conventional tools</p> 	<p>Achieves 1.7 times higher tool life than competitor's products</p>  <table border="1"> <caption>Machining Length Comparison</caption> <thead> <tr> <th>Product</th> <th>Machining Length (m)</th> </tr> </thead> <tbody> <tr> <td>AVIX type</td> <td>40</td> </tr> <tr> <td>Competitor's Product</td> <td>23</td> </tr> </tbody> </table>	Product	Machining Length (m)	AVIX type	40	Competitor's Product	23
Product	Machining Length (m)						
AVIX type	40						
Competitor's Product	23						
<p>Tool : AVIX510000-R03 (ø10, 5 flutes)</p> <p>Work Material: CFRP (Thickness 12.7mm)</p> <p>Cutting Conditions: <math>vc = 200\text{m/min}</math> <math>vf = 2,000\text{mm/min}</math> (Conv. Tool 600mm/min)</p> <p><math>ap = 12.7\text{mm}</math> Dry</p>	<p>Tool : AVIX506000-R03 (ø6, 5 flutes)</p> <p>Work Material: CFRP (Thickness 6.35mm)</p> <p>Cutting Conditions: <math>vc = 200\text{m/min}</math> <math>vf = 2,000\text{mm/min}</math></p> <p><math>ap = 6.35\text{mm}</math> <math>ae = 1\text{mm}</math> Dry Up Cutting</p>						


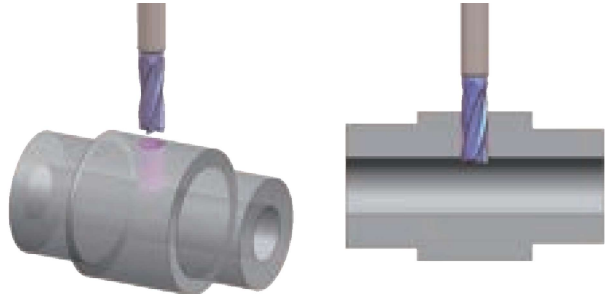
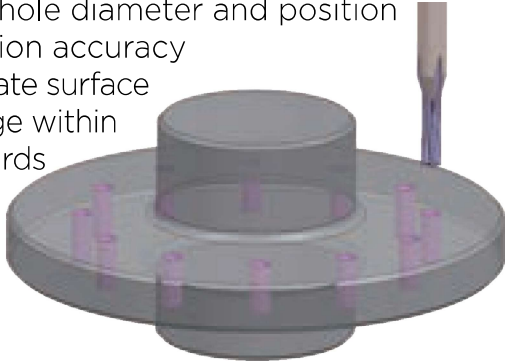
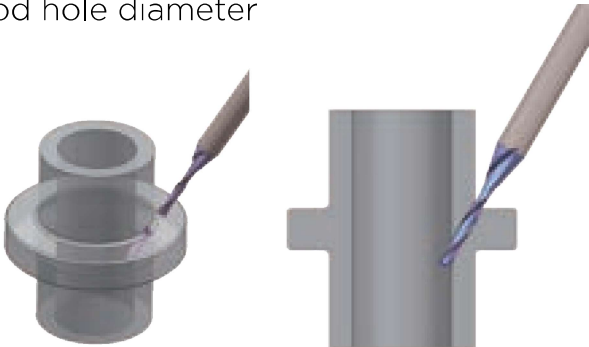
## ■ Application Examples (AVIC type)

Titanium Alloy Ti-6Al-4V Aerospace Component <span>S</span>	Titanium Alloy Ti-6Al-4V Aerospace Component <span>S</span>
<p>No secondary burrs</p> <p>3x machining efficiency compared to conventional tools</p> 	<p>Significantly suppresses secondary burr formation</p> <p>Good machined laminated workpiece surface</p> 
<p>Tool : AVIC30300-45-0.6 (ø3.0, KH26)</p> <p>Cutting Conditions: <math>vc = 27\text{m/min}</math> <math>fz = 0.03\text{mm/t}</math> <math>C = 0.3\text{mm}</math></p> <p>Wet</p>	<p>Tool : AVIC30600-45-1.4 (ø6.0, KH26)</p> <p>Cutting Conditions: <math>vc = 90\text{m/min}</math> <math>fz = 0.03\text{mm/t}</math> <math>C = 0.4\text{mm}</math></p> <p>Wet</p>

Nickel-based Heat-resistant Alloy Waspaloy Incinerator Component <span>S</span>	Nickel-based Heat-resistant Alloy Inconel 718 Aerospace Component <span>S</span>
<p>No secondary burrs</p> <p>Good surface quality</p> 	<p>5x tool life compared to competitor's product</p> 
<p>Tool : AVIC30500-45-1.0E (ø5.0, ACF07C)</p> <p>Cutting Conditions: <math>vc = 14\text{m/min}</math> <math>fz = 0.04\text{mm/t}</math> <math>C = 0.3\text{mm}</math></p> <p>Wet</p>	<p>Tool : AVIC30500-45-1.4E (ø5.0, ACF07C)</p> <p>Cutting Conditions: <math>vc = 28\text{m/min}</math> <math>fz = 0.05\text{mm/t}</math> <math>C = 0.1\text{mm}</math></p> <p>Wet</p>

# AVIS series Application Examples

## Application Examples (AVIBo type)

Ni-based Heat-resistant Alloy (Inconel 718) Aerospace Component <span>S</span>	Ni-based Heat-resistant Alloy Aerospace Component <span>S</span>
<p>Good machined surface quality Good hole diameter and position deviation accuracy</p> 	<p>Good machined surface quality Good hole diameter and position accuracy</p> 
<p>Tool : AVIBo type (ø5.0, 4 flutes) Cutting Conditions: <math>v_c = 15\text{m/min}</math> <math>f = 0.03\text{mm/rev}</math> Wet</p>	<p>Tool : AVIBo type (ø4.7, 4 flutes) Cutting Conditions: <math>v_c = 20\text{m/min}</math> <math>f = 0.03\text{mm/rev}</math> Wet</p>
Titanium Alloy (Ti-6Al-4V) Aerospace Component <span>S</span>	Special Steel Aerospace Component <span>S</span>
<p>Good machined surface quality Good hole diameter and position deviation accuracy Laminate surface damage within standards</p> 	<p>Good machined surface quality Good hole diameter</p> 
<p>Tool : AVIBo type (ø8.0, 4 flutes) Cutting Conditions: <math>v_c = 15\text{m/min}</math> <math>f = 0.03\text{mm/rev}</math> Wet</p>	<p>Tool : AVIBo type (ø2.9, 2 flutes) Cutting Conditions: <math>v_c = 20\text{m/min}</math> <math>f = 0.02\text{mm/rev}</math> Wet</p>



- Very hot or lengthy chips may be discharged while the machine is in operation. Therefore, machine guards, safety goggles or other protective covers must be used. Fire safety precautions must also be considered.

#### < SAFETY NOTES >

- Please handle with care as this product has sharp edges.
- Improper cutting conditions or mis-handling of the tool may result in breakages or projectiles. Therefore, please use the tool within its recommended conditions.

- When using non-water soluble cutting oil, precautions against fire must be taken and please ensure that a fire extinguisher is placed near the machine.



# Sumitomo Electric Industries, Ltd.

## Hardmetal Division

Global Marketing Department : 1-1-1, Koyakita, Itami, Hyogo 664-0016, Japan

<https://www.sumitool.com/global>