Tooling News No.558

SUMITOMO
CARBIDE - CBN - DIAMOND
Global Support, Global Solutions.

Endmills for Machining Aerospace Parts

AVIS series

The ultimate in CFRP machining

Diamond Coated Endmills for CFRP **AVIX** New type N

Dramatically reduces burrs in chamfering

Solid Chamfering Endmills **AVIC** New type P M K S

Exit burrs are suppressed by using a dedicated cutting edge

Bore Endmills for Hole Finishing **AVIBo** New type P M K N S

SUMITOMO ELECTRIC GROUP

AVIX type New

■ Features

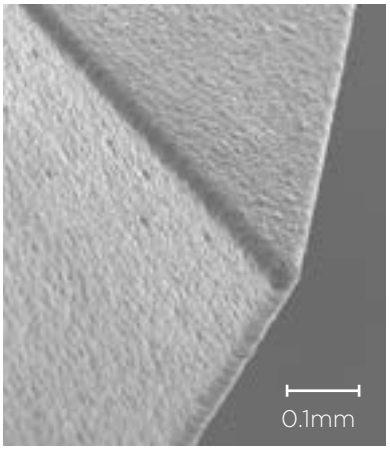
- The use of a complex cross-nicked edge shape reduces cutting force and realises stability in high-efficiency machining
- Sharp cutting edge and uniform coating thickness along the cutting edge length realise high quality and long tool life

■ Tool Shape

■ Complex Cross-nicked Shape

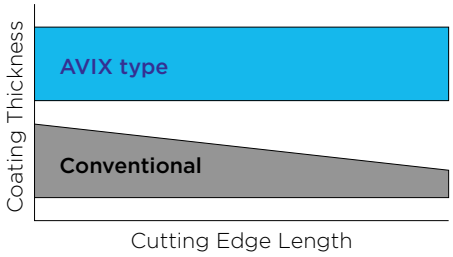
Variably sized nicked cutting edge shape realises stable machining with low resistance

■ Sharp Cutting Edge



New coating process provides high quality sharp cutting edges

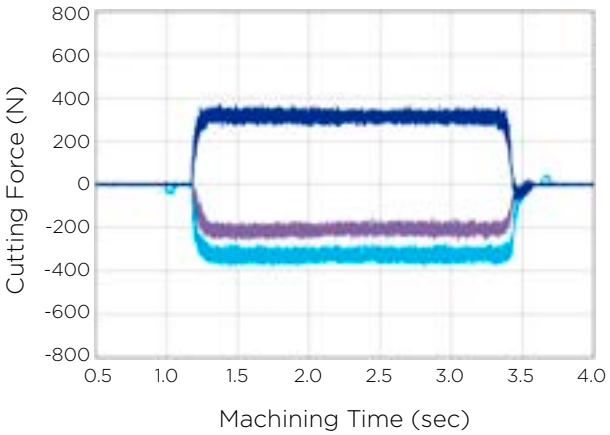
■ Diamond Coating with Uniform Thickness



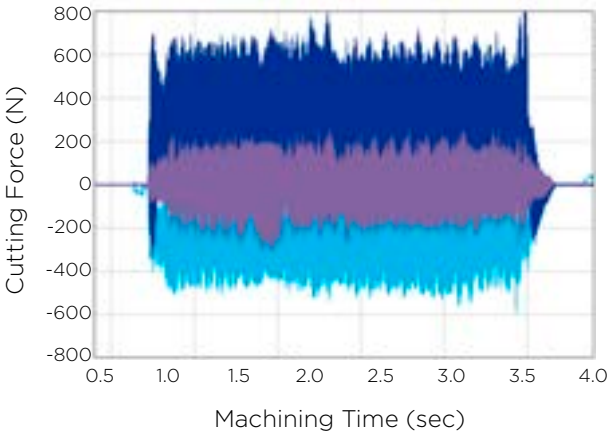
Uniform coating thickness realises stable tool life

■ Cutting Performance

AVIX type



Conventional Tool (Right-hand Helix Endmill)



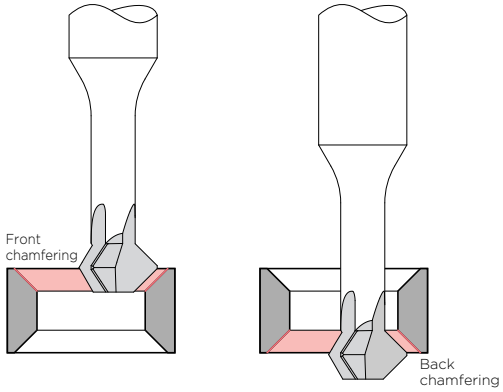
Work Material: CFRP (Thickness 9.5mm)
Tool : AVIX510000-R03 (Tool Diameter ø10, 5 flutes)
Cutting Conditions: vc = 200m/min, vf = 2,000mm/min, Dry, Cutting

Suppresses chatter to realise stable machining

AVIC type New

■ 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

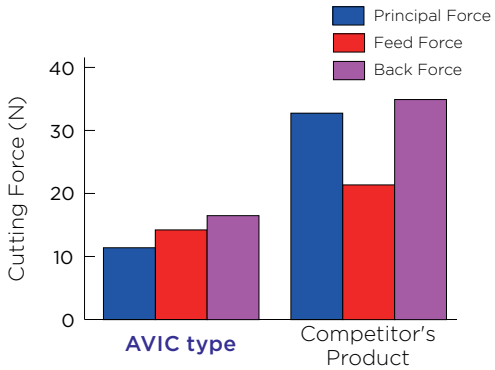
3-flute, high-raked design; large rake angle

- Secondary burr control
- Improved machined surface quality

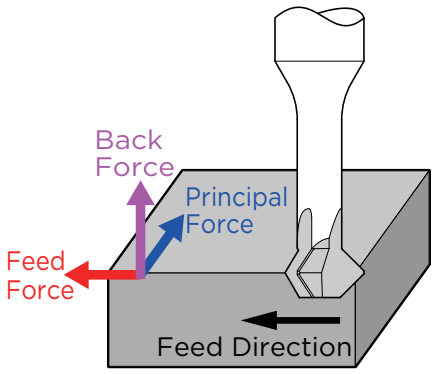
Front and back chamfering is possible with a single tool

■ Cutting Performance

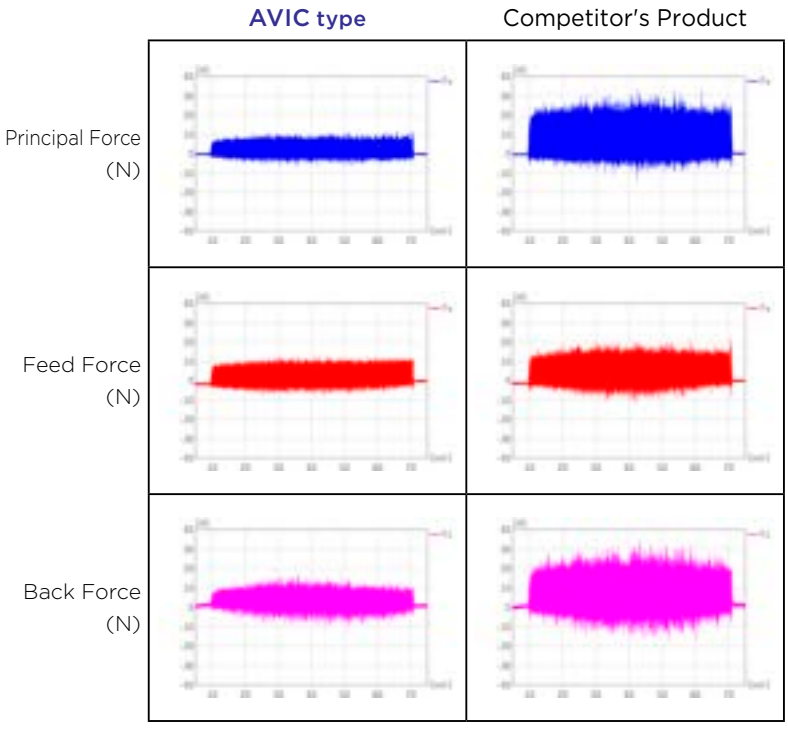
● Cutting Force



Work Material: Ti-6Al-4V
Tool : AVIC 306000-45-1.4 (ø6.0, KH26)
Cutting Conditions: vc = 27m/min, n = 1,070min^{-1}, vf = 107mm/min
Chamfering : C0.3mm

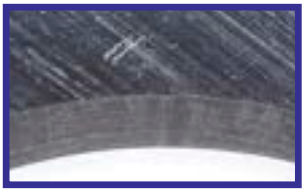


AVIC type effectively suppresses cutting force in chamfering



● Machined Surface Quality

AVIC type

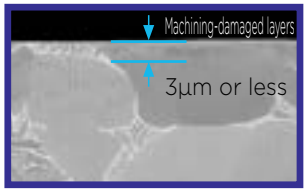


No secondary burrs

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: vc = 27m/min, n = 1,070min^{-1}, vf = 107mm/min
Chamfering : C0.3mm

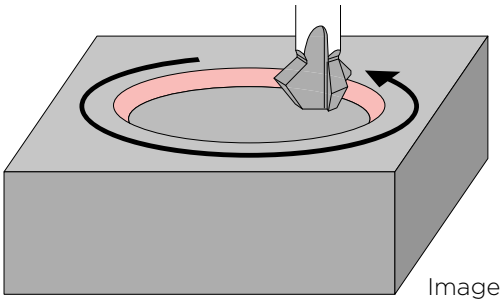
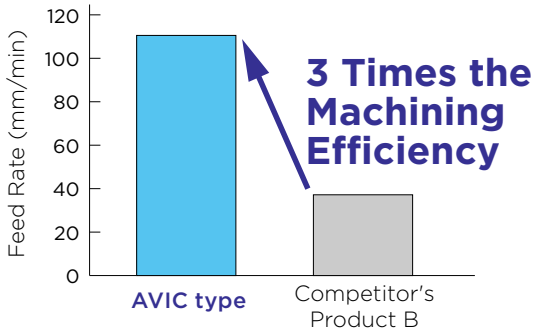


Image of Machining

AVIC type suppresses secondary burr* generation
*Burrs 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

AVIBo type NEW (Made-to-order item)

■ Features

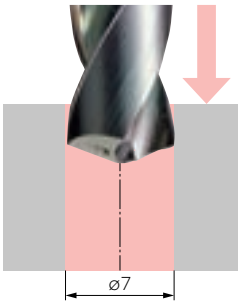
- Tool design can be tailored to the work material and machining application
- Optimal pocket shape improves chip evacuation and achieves good machined surface quality
- Optimal cutting edge design suppresses exit burrs
- Tool life is improved by using the optimal grade for each work material

■ Tool Shape

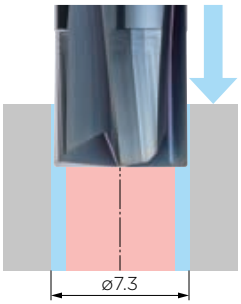
■ Cutting Performance

Process

Process (1) Drilling



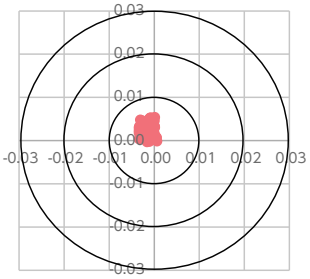
Process (2) Hole Finishing



Cutting Conditions

Process (1) Drilling	Process (2) Hole Finishing
Work Material: Titanium Alloy (Ti-6Al-4V) Tool : Drill (ø7, 2 flutes) Cutting Conditions: vc = 15m/min, f = 0.04mm/rev	Work Material: Titanium Alloy (Ti-6Al-4V) Tool : AVIBo series (ø7.3, 4 flutes) Cutting Conditions: vc = 50m/min, f = 0.05mm/rev

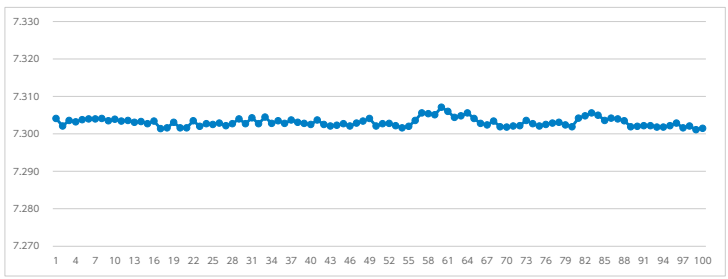
● Hole Position Accuracy



Hole Position Max.	ø0.010
Average	ø0.006

High accuracy of hole position

● Hole Diameter Accuracy



Good hole diameter

● Machined Surface Quality

Good surface quality

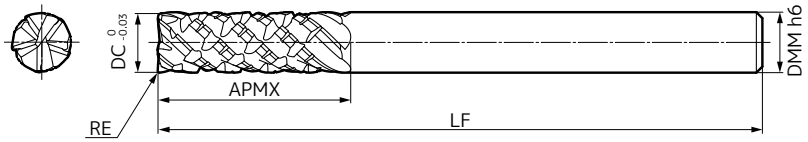
AVIX type New

Graphite CFRP

SUMIDIA Coat | Sharp Corner | 45° Helix Angle | Shoulder Milling | Groove Milling | Groove Finishing | Cut Through | Face Milling | Spot Facing | Helical Milling | Ramping

*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

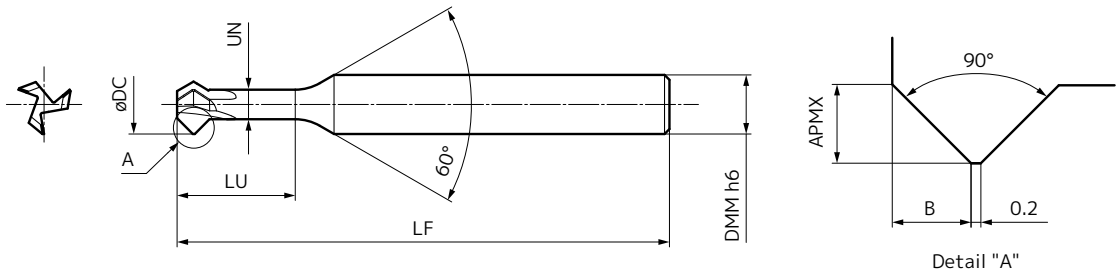
Work Material	CFRP		
Cutting Conditions	Dry		
DC (mm)	Spindle Speed (min⁻¹)	Feed Rate vc (m/min)	Feed Rate f (mm/rev)
4.0	12,000	150	0.08 to 0.17
6.0	10,600	200	0.09 to 0.19
8.0	8,000	200	0.13 to 0.25
10.0	6,400	200	0.16 to 0.31
12.0	5,300	200	0.19 to 0.38
3.175	12,000	120	0.08 to 0.17
6.35	10,000	200	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.

● mark: Standard stocked item

3 Flutes | GS HARD Coat | Uncoated Carbide | Sharp Corner | 30° Helix Angle | Chamfering

Fig 1



■ Body

Dimensions (mm)

	Cat. No.	Stock: KH26 for Titanium Alloys	Stock: ACF07C for Ni-based Heat-resistant Alloys	Dia. DC	Cutting Edge Length B	Cutting Edge Depth APMX	Neck Dia. UN	Neck Length LU	Overall Length LF	Shank Dia. DMM	Fig
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	
DC (mm)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)
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.

● mark: Standard stocked item Blank: Made-to-order item

AVIC type New Design Inquiry Sheet

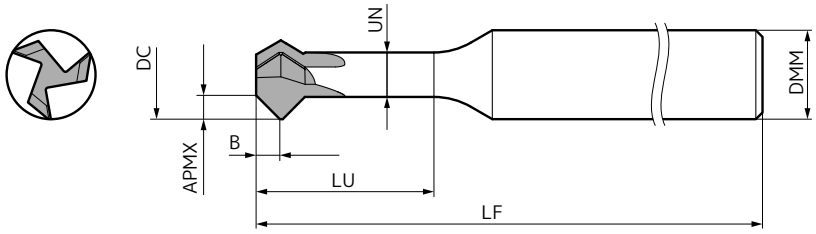
Chamfering Endmills AVIC type Design Inquiry Sheet

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.

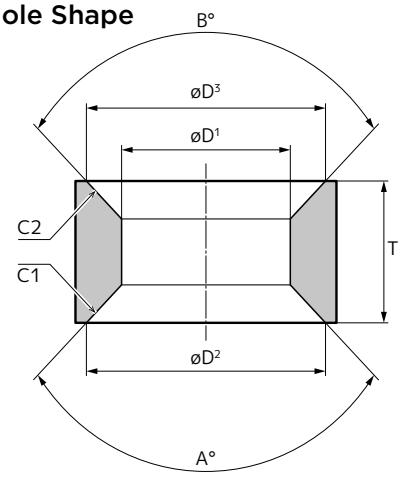
Company Name/Contact

■ Tool Shape



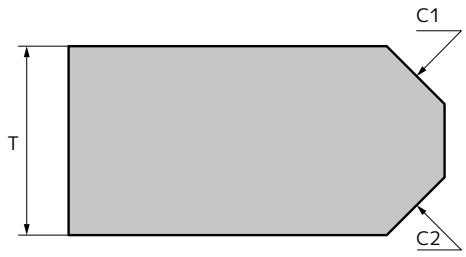
Part	Value
Work Material	
DC	
B	
APMX	
UN	
LU	
LF	
DMM	
No. of Flutes	

■ Workpiece: Hole Shape



Part	Value
Work Material	
Workpiece	☑Hole shape ☑Ext. Shape
øD1	
øD2	
øD3	
A	
B	
C1	
C2	
T	

■ Workpiece: External Shape



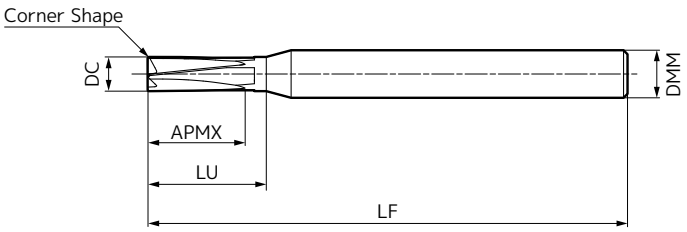
Bore Endmills AVIBo type Design Inquiry Sheet

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.

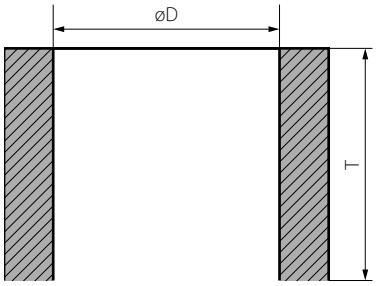
Company Name/Contact

■ Tool Shape

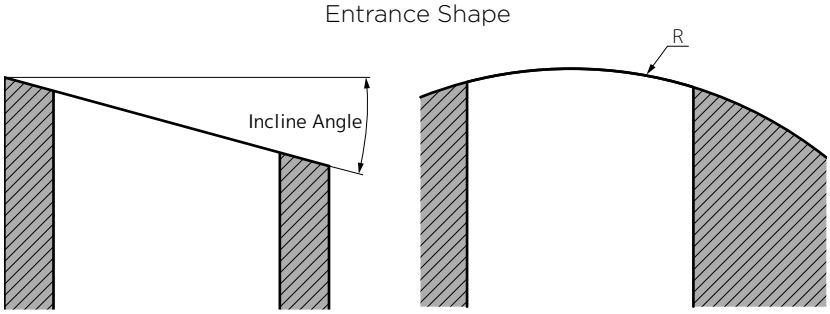


Part	Value
Work Material	
DC	
APMX	
LU	
LF	
DMM	
No. of Flutes	
Corner Shape	

■ Workpiece: Hole Shape



Entrance Shape



Part	Value
Work Material	
øD	
T	
Surface Roughness	
Positioning Accuracy	
Chamfering Y/N	
Entrance Shape	☑Inclined ☑Curved

AVIS series Application Examples

■ Application Examples (AVIX type)

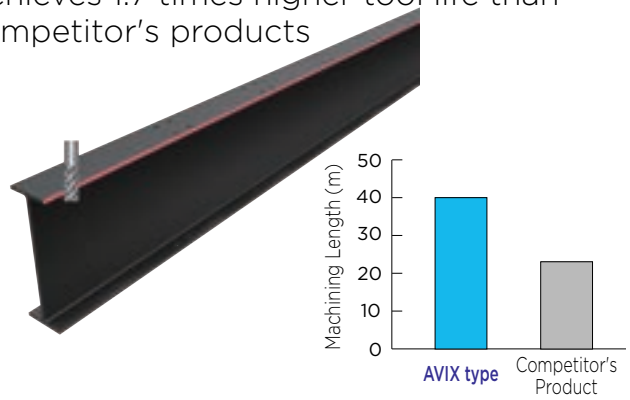
CFRP Aerospace Component (Cutting) N

Achieves 3 times higher machining efficiency than conventional tools

Tool : AVIX510000-R03 (ø10, 5 flutes)
Work Material: CFRP (Thickness 12.7mm)
Cutting Conditions: vc = 200m/min vf = 2,000mm/min (Conv. Tool 600mm/min)
ap = 12.7mm Dry

CFRP Aerospace Component (Trimming) N

Achieves 1.7 times higher tool life than competitor's products

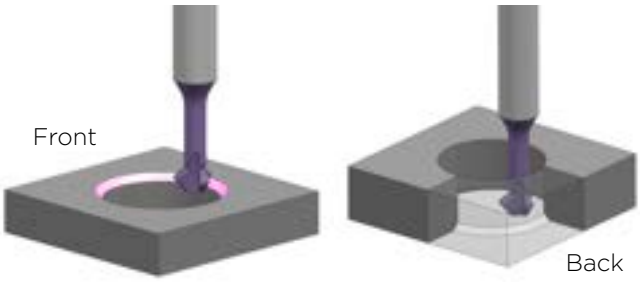


Tool : AVIX506000-R03 (ø6, 5 flutes)
Work Material: CFRP (Thickness 6.35mm)
Cutting Conditions: vc = 200m/min vf = 2,000mm/min
ap = 6.35mm ae = 1mm Dry Up Cutting

■ Application Examples (AVIC type)

Titanium Alloy Ti-6Al-4V Aerospace Component S

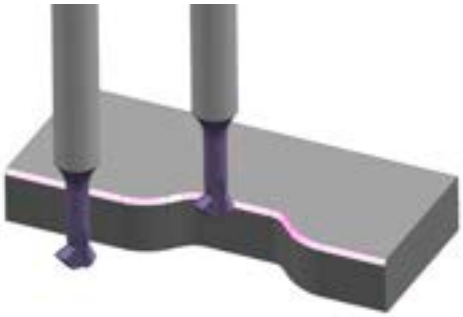
No secondary burrs
3x machining efficiency compared to conventional tools



Tool : AVIC30300-45-0.6(ø3.0, KH26)
Cutting Conditions: vc = 27m/min fz = 0.03mm/t C = 0.3mm
Wet

Titanium Alloy Ti-6Al-4V Aerospace Component S

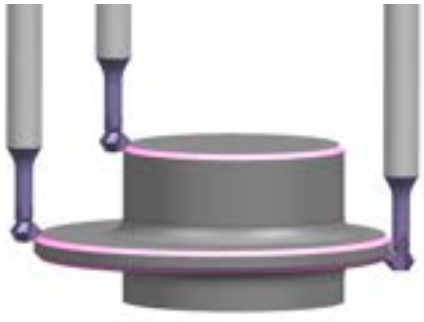
Significantly suppresses secondary burr formation
Good machined laminated workpiece surface



Tool : AVIC30600-45-1.4(ø6.0, KH26)
Cutting Conditions: vc = 90m/min fz = 0.03mm/t C = 0.4mm
Wet

Nickel-based Heat-resistant Alloy Waspaloy Incinerator Component S

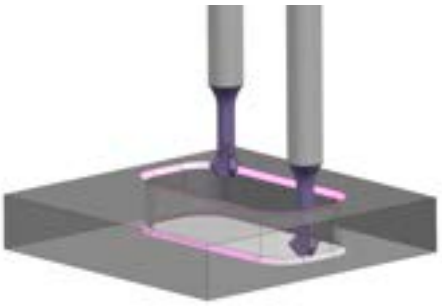
No secondary burrs
Good surface quality



Tool : AVIC30500-45-1.0E(ø5.0, ACF07C)
Cutting Conditions: vc = 14m/min fz = 0.04mm/t C = 0.3mm
Wet

Nickel-based Heat-resistant Alloy Inconel 718 Aerospace Component S

5x tool life compared to competitor's product



Tool : AVIC30500-45-1.4E(ø5.0, ACF07C)
Cutting Conditions: vc = 28m/min fz = 0.05mm/t C = 0.1mm
Wet

AVIS series Application Examples

■ Application Examples (AVIBo type)

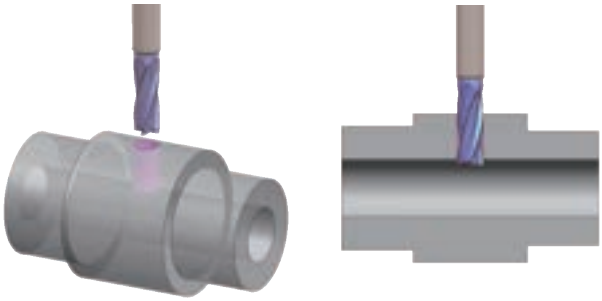
Ni-based Heat-resistant Alloy (Inconel 718) Aerospace Component S

Good machined surface quality
Good hole diameter and position deviation accuracy

Tool : AVIBo type (ø5.0, 4 flutes)
Cutting Conditions: vc = 15m/min f = 0.03mm/rev Wet

Ni-based Heat-resistant Alloy Aerospace Component S

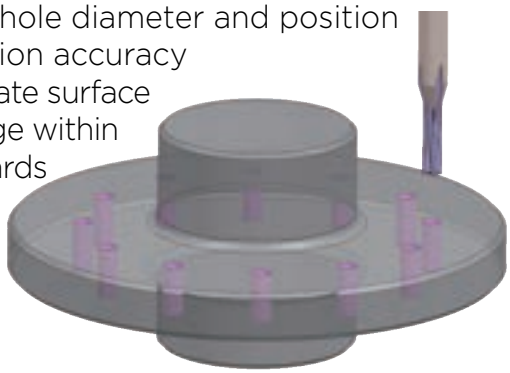
Good machined surface quality
Good hole diameter and position accuracy



Tool : AVIBo type (ø4.7, 4 flutes)
Cutting Conditions: vc = 20m/min f = 0.03mm/rev Wet

Titanium Alloy (Ti-6Al-4V) Aerospace Component S

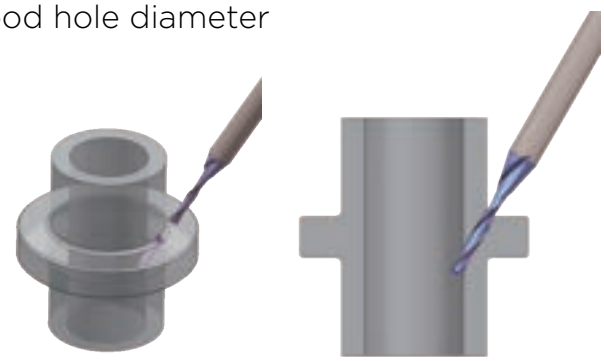
Good machined surface quality
Good hole diameter and position deviation accuracy
Laminate surface damage within standards



Tool : AVIBo type (ø8.0, 4 flutes)
Cutting Conditions: vc = 15m/min f = 0.03mm/rev Wet

Special Steel Aerospace Component S

Good machined surface quality
Good hole diameter



Tool : AVIBo type (ø2.9, 2 flutes)
Cutting Conditions: vc = 20m/min f = 0.02mm/rev Wet

< SAFETY NOTES >

- 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.
- 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.

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