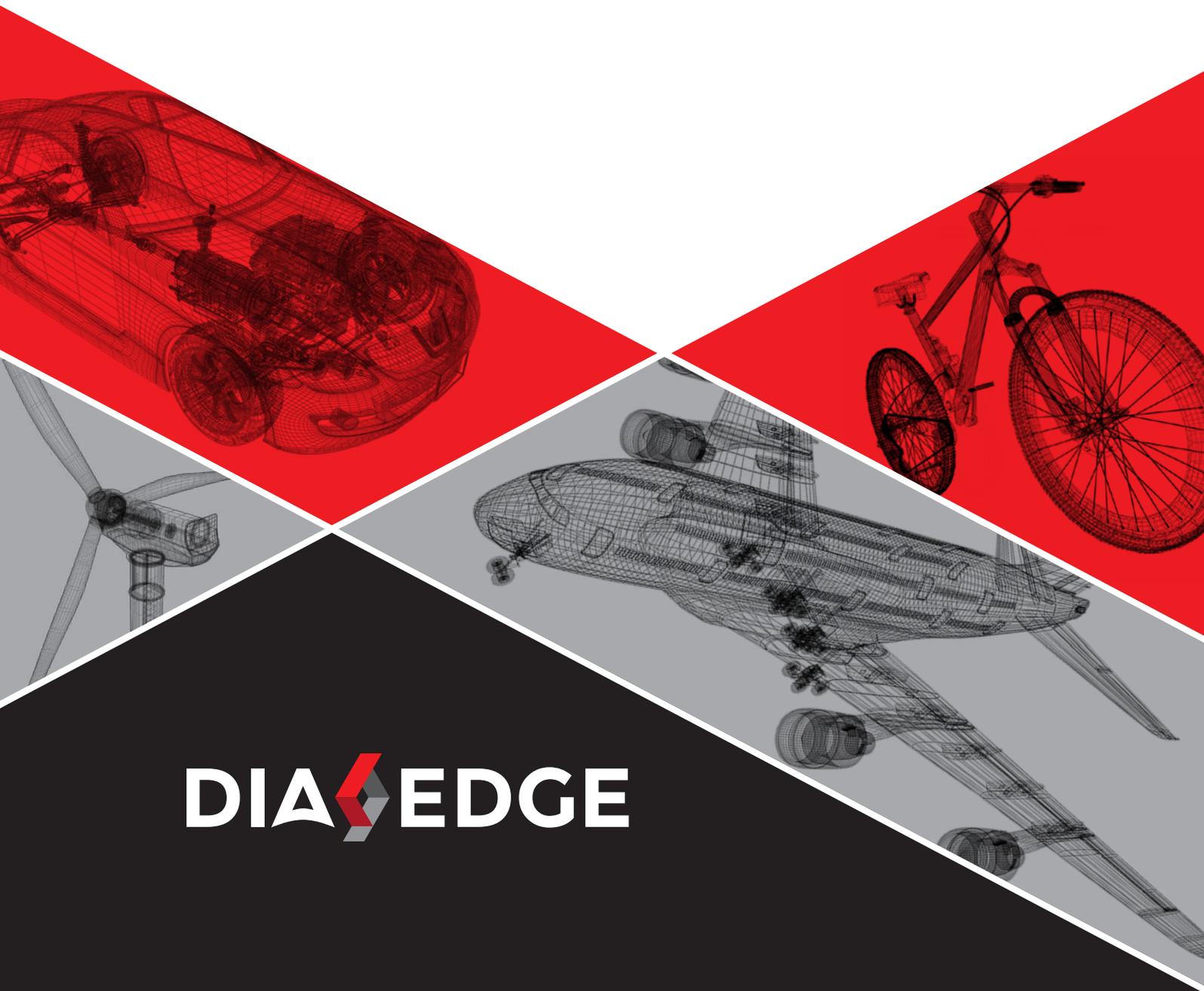


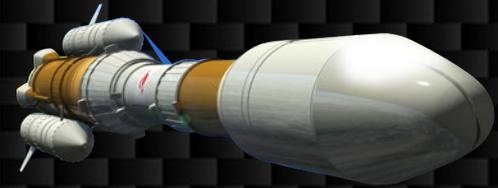
SOLUTION FOR COMPOSITE



DIA  **EDGE**

MARKET

AEROSPACE



AUTOMOTIVE



**CARE &
WELFARE**



SPORTS GEAR



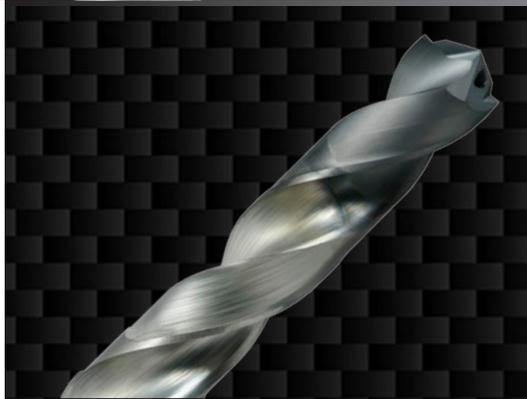
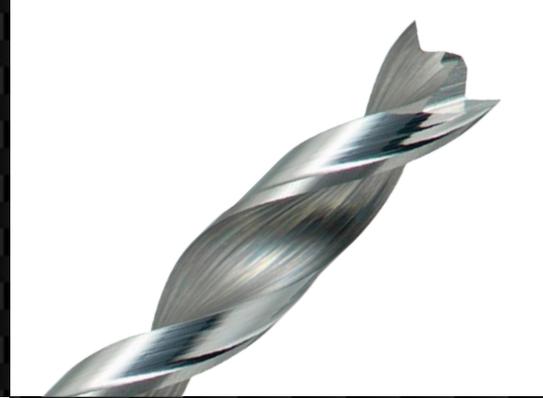
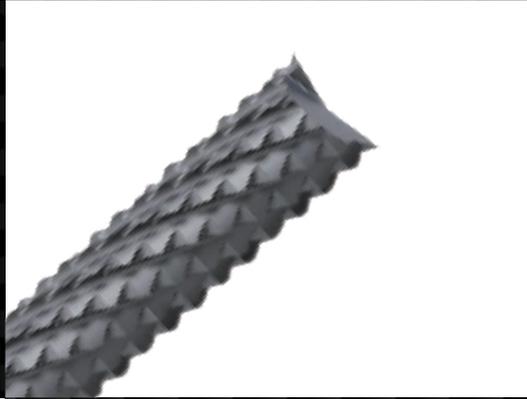
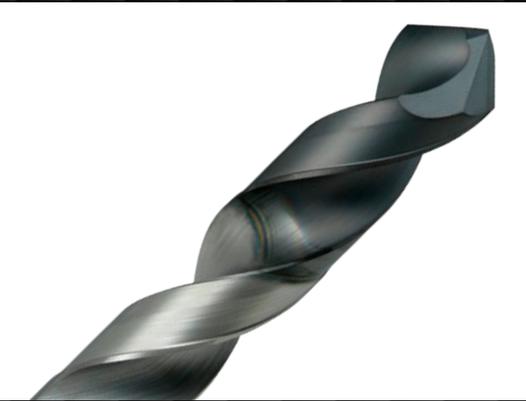
MEDICAL



ENERGY

SOLUTIONS

DRILLING
&
MILLING





These are our solutions

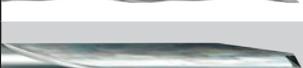
mitsubishi materials has developed original special designs and coating to solve customers' problems with CFRP (Carbon fiber reinforced plastics) and CFRP/metal stack materials. We use our accumulated experience and improved technology to propose the best solution.

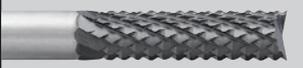
CONTENTS

TOOL SELECTION CHART	5 - 8
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DRILLING / MILLING TOOLS

SELECTION CHART

Items	Product overview	Machine type			Composite Suitability	
		CNC Machine	Pneumatic	Hand Tool	CFRP ★CFRTP	CFRP/Al Stack
NEW MCR		✓	✓		○	
MCC		✓	✓		○	
MCA		✓	✓			○
MCT		✓	✓			
MCW		✓	✓		○	○
MCW Uncoated		✓	✓		○	
NEW MCK		✓		✓		
MCCH				✓	○	
MCAH				✓		○
NEW MCN		✓	✓	✓	○	○
NEW Indexable Drill		✓	✓		○	○

Items	Product overview	Machine type	Composite Suitability		
		CNC	Surface and inside: Cloth material	Surface : Cloth material Inside : Uni-direction material	Surface : Glass fiber material Inside : Uni-direction material
DFC4JC		✓	○	○	○
DFCJRT		✓	○	○	○
NEW PCD		✓			

Stock status indication: ● : Inventory maintained in Japan. □ : Non stock, produced to order only.

★CFRTP=Carbon Fiber Reinforced Thermoplastics

★CMC=Ceramic Matrix Composites

Composite Suitability			Other Material	Size Range		Grade	Stock	Page
CFRP/Ti Stack	★CMC	Aramid	Aluminum	Diameter	Depth	Coating		
	○			ø5~13	~5XD	Diamond	Specialized	13-14
				ø2.5~13	~5XD	Diamond	●	15-16
				ø2.5~13	~5XD	Diamond	□	17-18
◎				ø2.5~13	~5XD	Uncoated	□	19-20
				ø5~13	~5XD	Diamond	□	21-22
○				ø5~13	~5XD	Uncoated	□	21-22
		◎		ø2.5~13	~5XD	Uncoated	Specialized	23-24
				ø2.5~13	~5XD	Uncoated	●	25-26
○			○	ø2.5~13	~5XD	Uncoated	●	27-28
○			◎	ø2.5~20	~5XD	Uncoated	Specialized	29-30
○				ø10~18.4	~5XD	Uncoated	Specialized	31-32

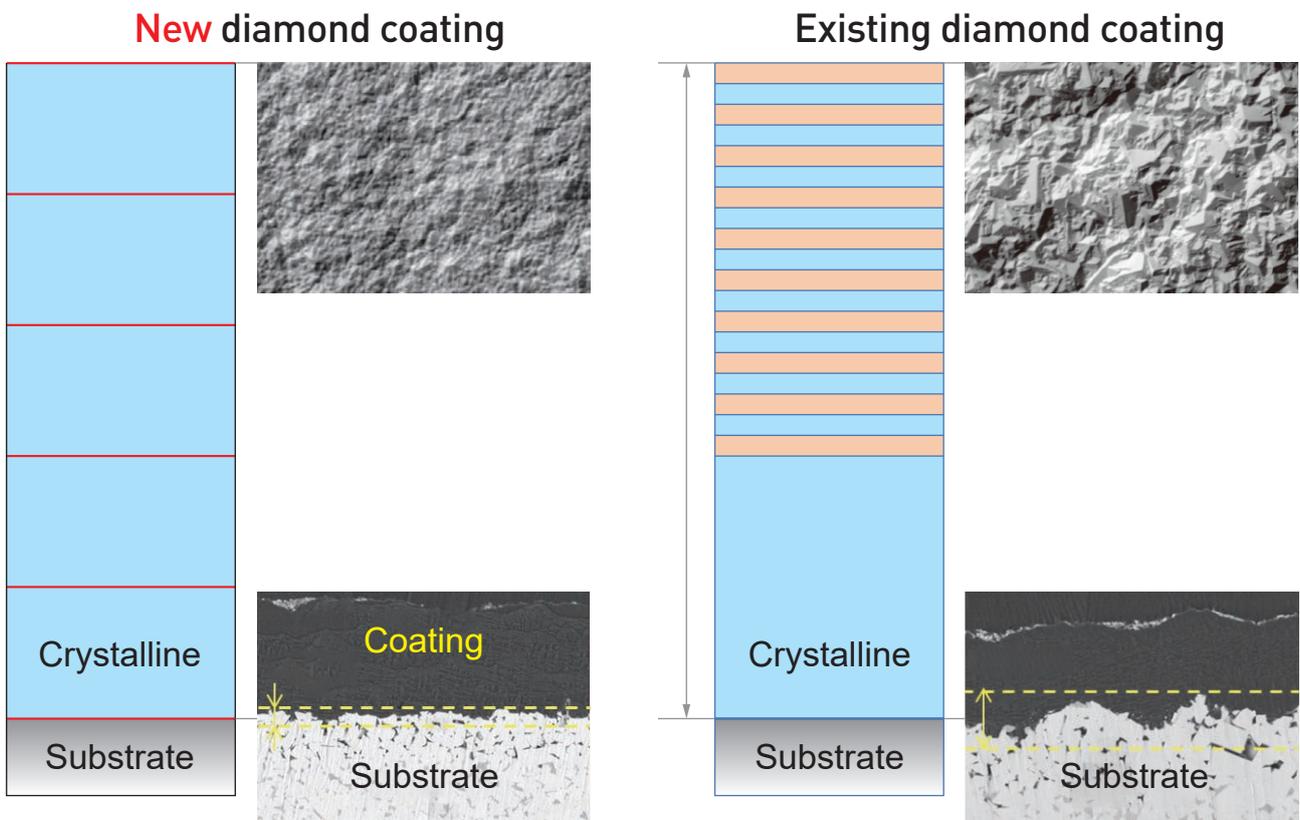
★CMC	Size Range		Grade	Stock	Page
	Diameter	Number of Flutes	Coating		
	ø6~12	4	Diamond	●	35-36
	ø2.5~20	10/12	Diamond	●	
◎	ø2~6	2~8	PCD	Specialized	

DRILLING / MILLING TOOLS

New diamond coating is applied to Drilling Tools

MITSUBISHI MATERIALS CORPORATION new CVD diamond coating realizes excellent wear resistance and smoothness.

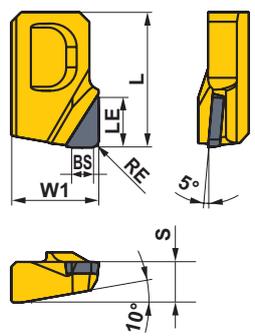
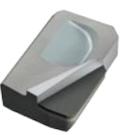
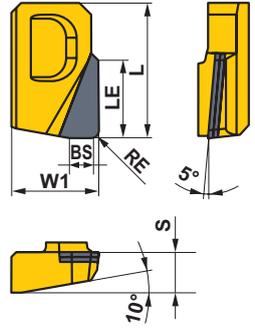
Smooth CVD diamond coating provides longer tool life by MITSUBISHI MATERIALS CORPORATION fine multi-layer diamond crystal control technology.



INDEXABLE MILLING TOOLS

SELECTION CHART

Items	Product overview	Size Range	Stock	Page
		Diameter		
FMAX		ø40~160	●	37-38

Shape	Order Number	MD220	MD2030	Dimensions (mm)						Geometry
				L	LE	W1	S	BS	RE	
 General Purpose	GOER1404PXFR2	●	●	14.0	5.0	9.0	4.2	2.0	0.4	
	GOER1408PXFR2	●	●	14.0	5.0	9.0	4.2	2.0	0.8	
 Long Edge	GOER1408PXFR2-8	●		14.0	8.0	9.0	4.2	2.0	0.8	

● : Inventory maintained in Japan.

FEATURED ITEM

Solution for Pneumatic

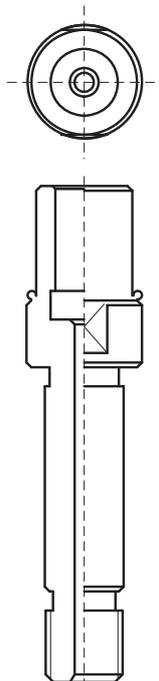
Thread Items For Pneumatic

SPECIALIZED THREAD ADAPTERS

Drill units, which are mainly used by aerospace manufacturers, simply hold a carbide drill through an embedded thread on the drill. Generally, a thread is embedded by being brazed to a drill. However, this process increases manufacturing cost. Furthermore, it is difficult for a brazed drill to improve tool life dramatically if coating cannot be applied on the brazed drill. MITSUBISHI MATERIALS provides a solution that improves cutting performance by superior coated drill.



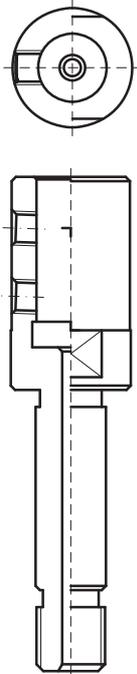
SHRINK ADAPTER (Specialized)



The shrink fit type is designed to hold a carbide drill by thermal displacement. The drill needs to be preset on a tool shrinking machine. The shrink type holder provides good runout accuracy.



SIDE LOCK ADAPTER (Specialized)



The side lock holder is designed to hold an inserted carbide drill easily by side locking screws. Side lock type does not need a pre-setter.



FEATURED ITEM

Solution for Pneumatic

Thread Items For Pneumatic

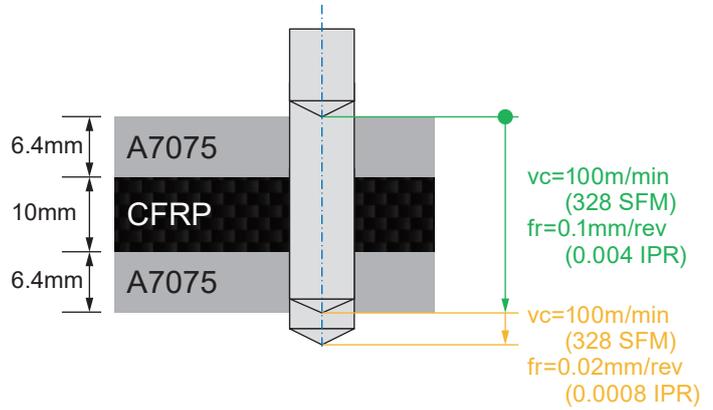
HOLE OVERSIZE BY SHRINK AND SIDE LOCK ADAPTERS

<Cutting condition>

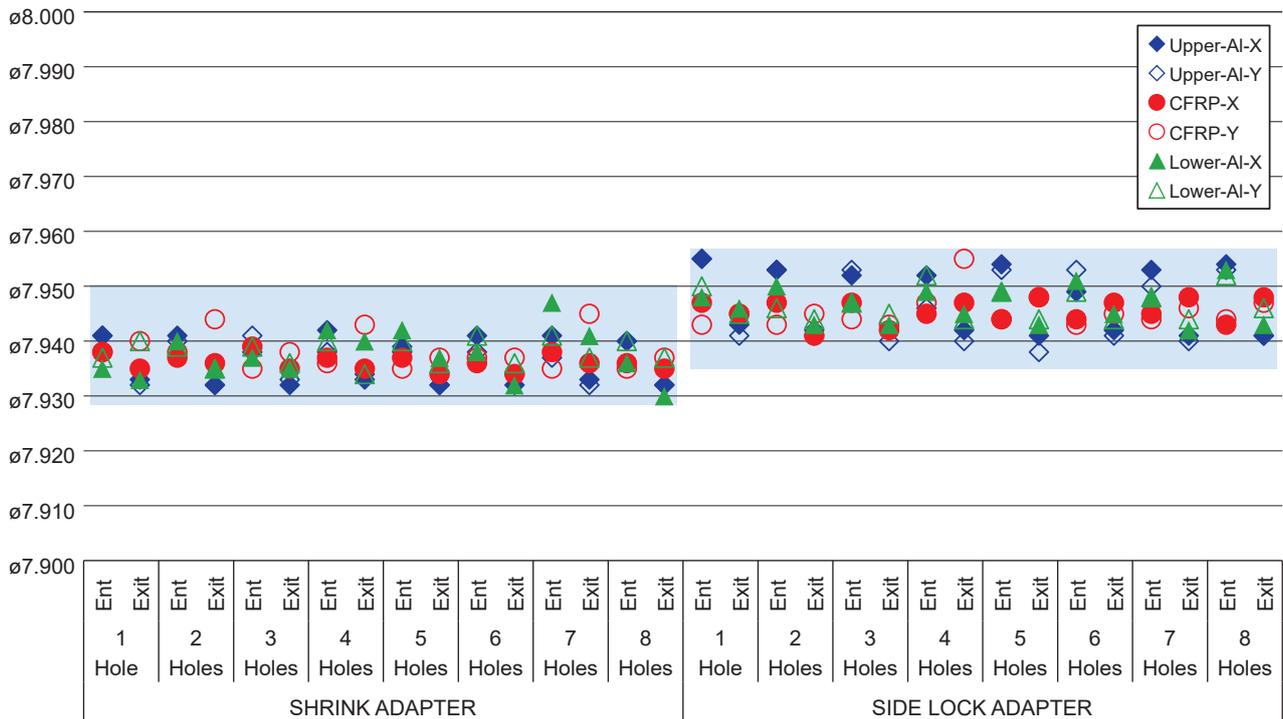
Tool : $\phi 7.94$ (5/16inch)

Vibration assistance : Vernier 5/
Amplitude 0.15 mm

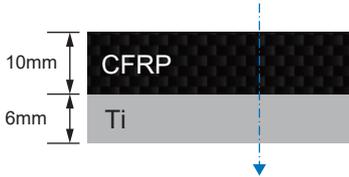
Cutting mode : Internal coolant



HOLE OVERSIZE



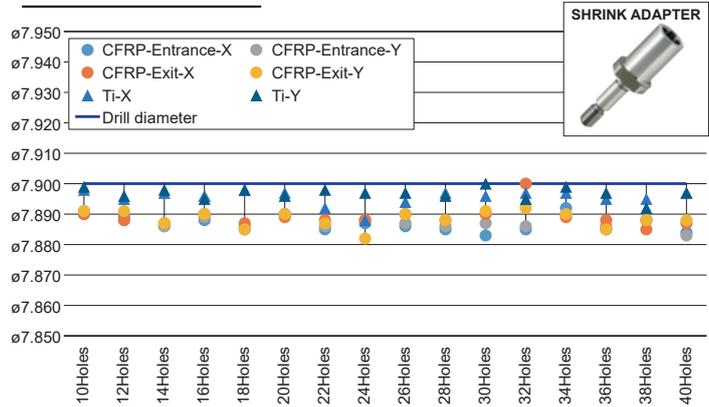
CFRP/Ti



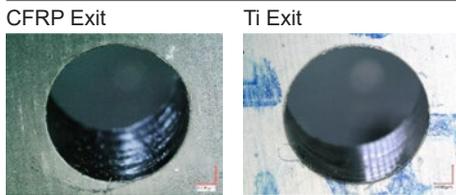
<Cutting condition>

- Tool : $\phi 7.9$ (5/16 inch)
- Cutting speed : 10 m/min (32.8 SFM)
- Feed : 0.05 mm/min (0.002 IPR)
- Vibration assistance : Vernier 3 /
Amplitude 0.15 mm
- Cutting mode : Internal coolant (MQL)

HOLE OVERSIZE



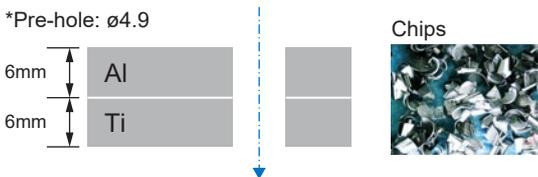
Hole (After drilling 40 holes)



Drill (After drilling 40 holes)



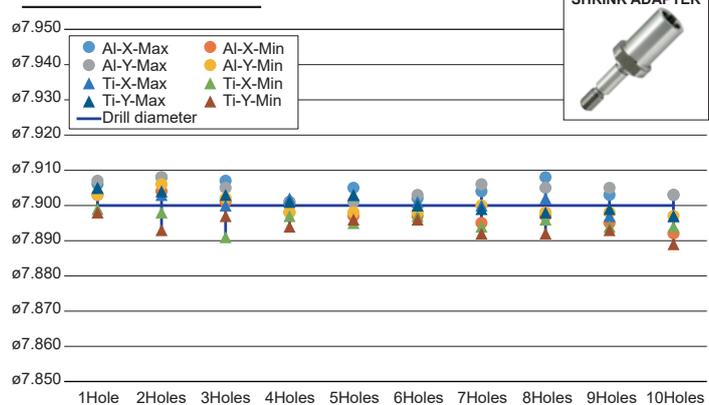
Al/Ti



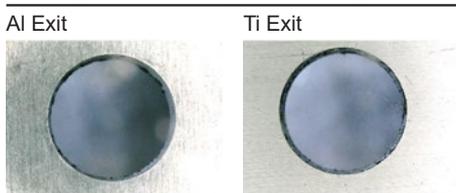
<Cutting condition>

- Tool : $\phi 7.9$ (5/16 inch)
- Cutting speed : 10 m/min (32.8 SFM)
- Feed : 0.05 mm/min (0.002 IPR)
- Vibration assistance : Vernier 5 /
Amplitude 0.15mm
- Cutting mode : Internal coolant (MQL)

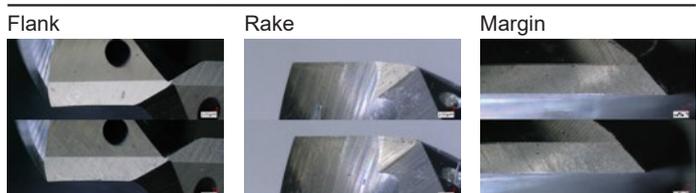
HOLE OVERSIZE



Hole (After drilling 10 holes)



Drill (After drilling 10 holes)



DRILLING TOOLS for CFRP

MCR (Specialized)

The unique corner radius shape has the effect of minimizing thrust, suppresses the occurrence of delamination even under high feed cutting conditions, and realizes high-quality hole machining such as reamer finishing.

Diameter : $\phi 5-13$

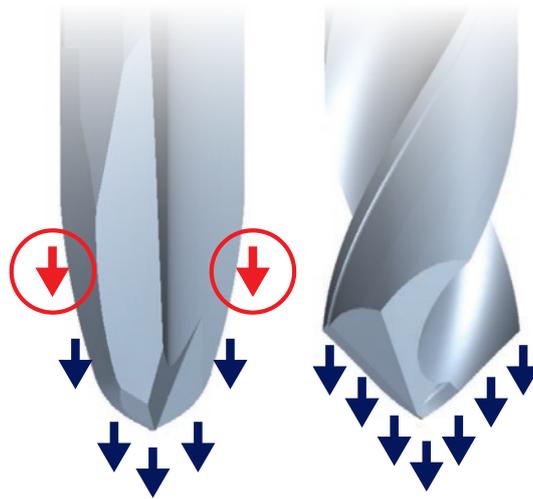
Hole Depth(L/D): ~ 5

Coating : Diamond



VARIABLE CORNER R

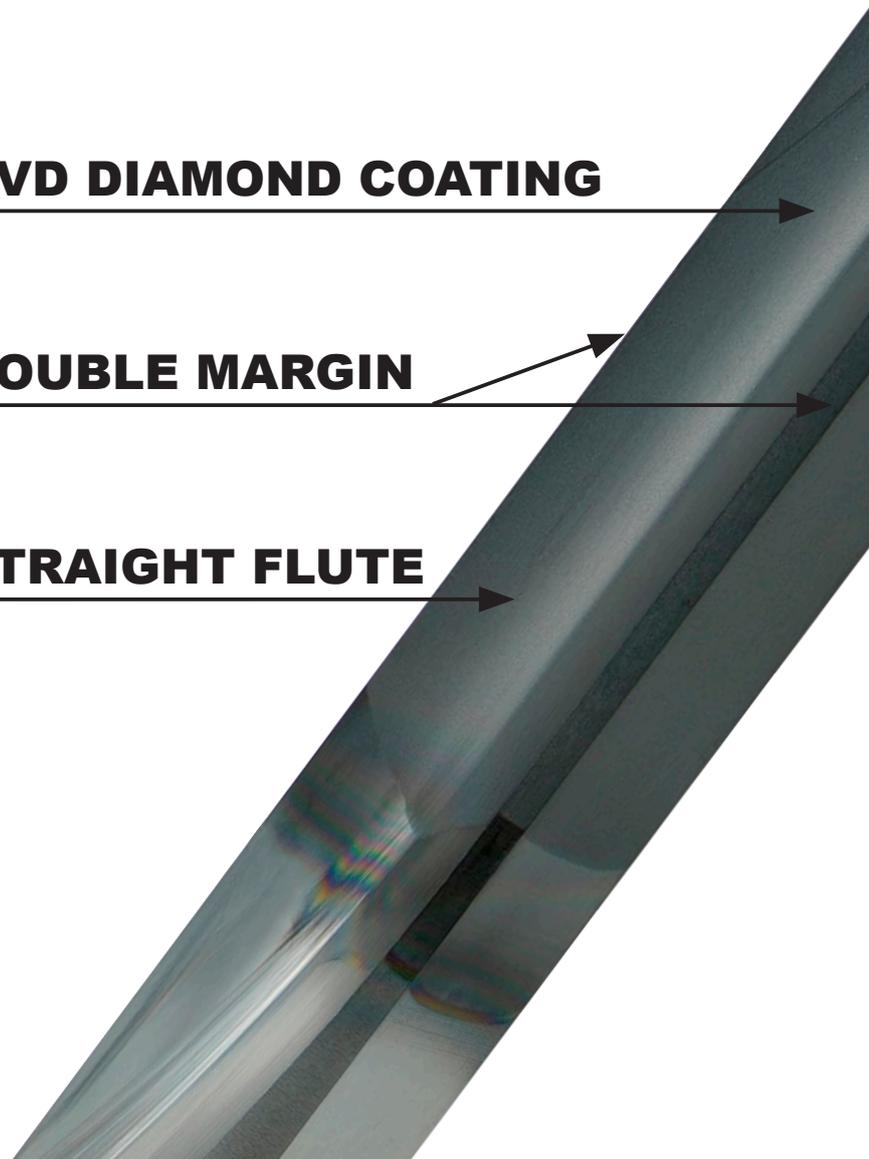
In part outside cutting edge
almost "0 Zero" thrust



CVD DIAMOND COATING

DOUBLE MARGIN

STRAIGHT FLUTE

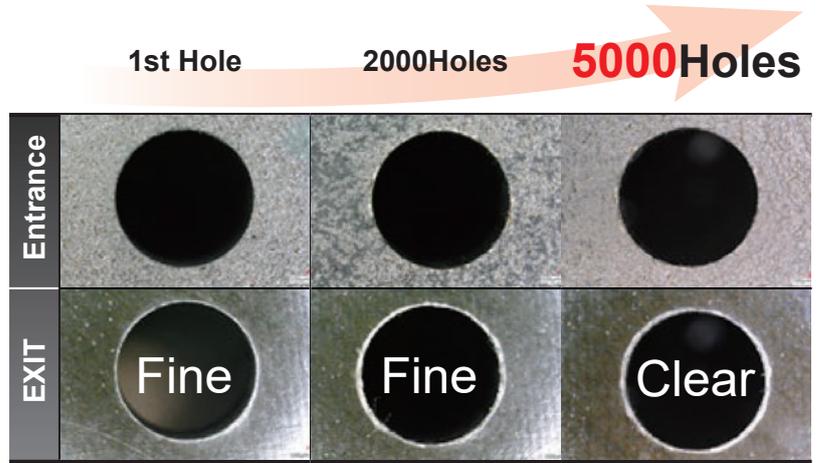


<Cutting condition>

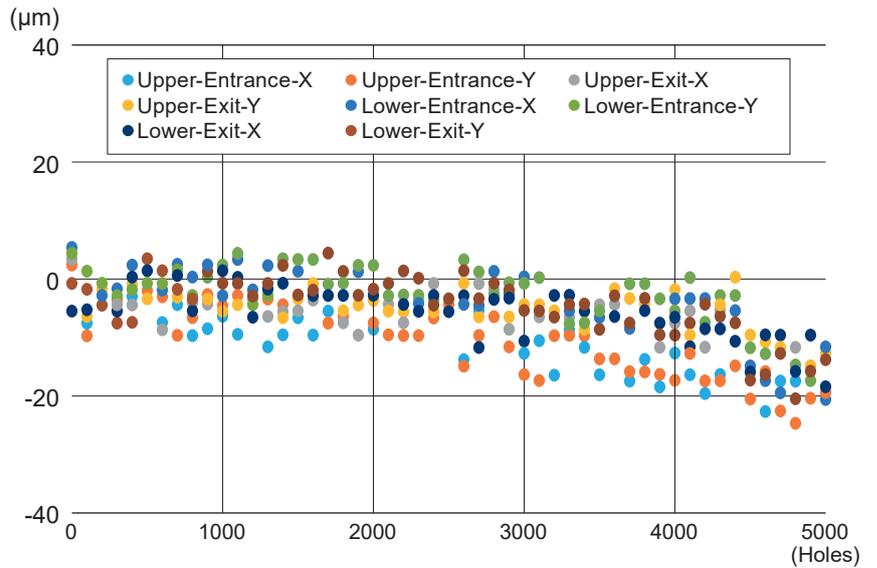
Tool : $\phi 6.376$ (0.251 inch)
 Work material : CFRP /
 CFRP stack 20 mm
 (0.8 inch)
 Cutting speed : 90 m/min (295 SFM)
 Feed : 0.2 mm/min (0.008 IPR)
 Cutting mode : Dry
 Machine : CNC Machine



HOLE QUALITY



HOLE OVERSIZE



RECOMMENDED CUTTING CONDITION

Dia. DC (mm)	Flute Length After the Drilling 	Cutting Speed (m/min)	SFM	Feed (Min. -Max.) (mm/rev)	IPR
5-7	20 mm (0.787 inch)	60-120	200-395	0.12-0.30	0.005-0.008
7-10	25 mm (0.984 inch)				
10-13	30 mm (1.181 inch)	80-160	265-525	0.20-0.40	0.008-0.016

DRILLING TOOLS for CFRP

MCC

90° point angle minimizes cutting resistance in thrust direction.

And this provides good hole quality and delamination-free surfaces.

Diameter : $\phi 2.5-13$

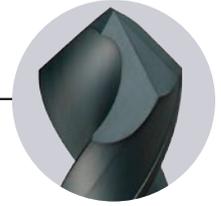
Hole Depth(L/D): ~ 5

Coating : Diamond



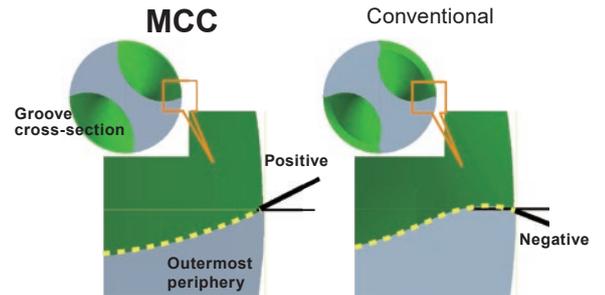
90° POINT ANGLE

The acute point angle reduces thrust and minimizes delamination.

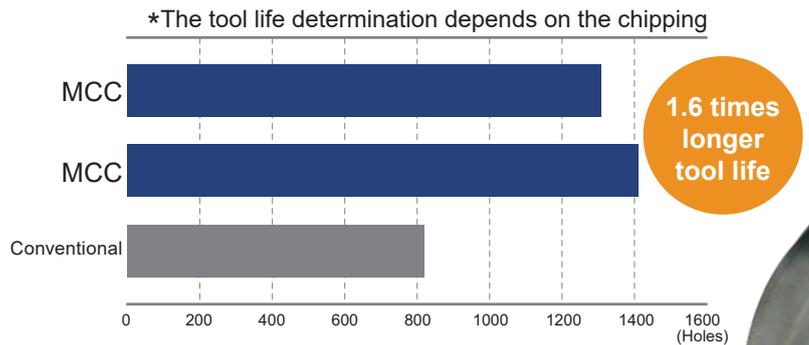


HIGHLY POSITIVE RAKE FLUTES

Highly positive rake angle in the vertical direction to the rotation axis minimizes uncut fiber and delamination.



TOOL LIFE

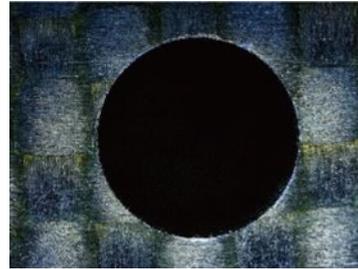


<Cutting condition>

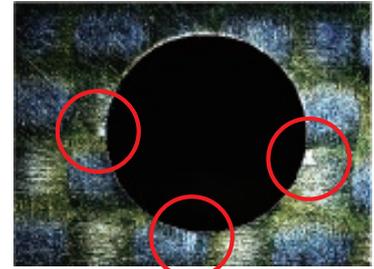
Tool : $\phi 6.55(0.258 \text{ inch})$
 Work material : CFRP 20 mm (0.8 inch)
 For tool life 10 mm (0.39 inch)
 For hole quality 12.5 mm (0.49 inch)
 Cutting speed : 120 m/min (394 SFM)
 Feed : 0.10 mm/rev (0.004 IPR)
 Cutting mode : Dry cutting
 Machine : CNC Machine

HOLE QUALITY (EXIT)

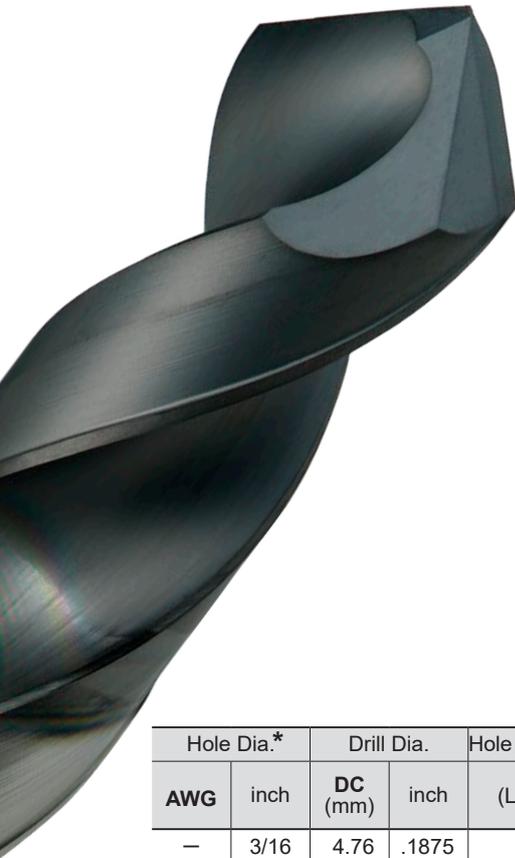
MCC 1192Holes



Competitor 300Holes

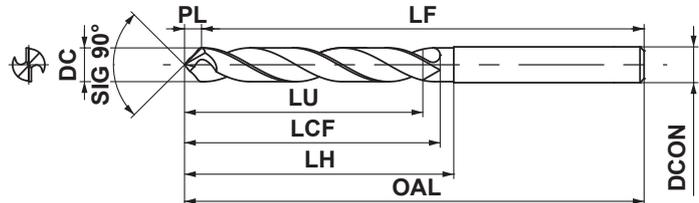


Delamination



STOCK LIST

	3<DC≤6	6<DC≤10	10<DC≤18	18<DC≤20
0	0	0	0	0
-0.018	-0.018	-0.022	-0.027	-0.033
h6↑	0	0	0	0
-0.008	-0.008	-0.009	-0.011	-0.013



Hole Dia.*		Drill Dia.		Hole Depth	Order Number	Grade	Dimensions (mm)						
AWG	inch	DC (mm)	inch	(L/D)			DD2105	LU	LCF	LH	OAL	LF	PL
—	3/16	4.76	.1875	3	MCC0476X03S060	●	16.7	40	40	80	77.6	2.4	6
—	1/4	6.38	.251	3	MCC0638X03S080	●	22.3	50	50	90	86.8	3.2	8
—	5/16	7.96	.3125	3	MCC0796X03S080	●	27.9	50	50	90	86.0	4.0	8
—	3/8	9.55	.375	3	MCC0955X03S100	●	33.5	50	50	100	95.2	4.8	10
—	7/16	11.14	.4375	3	MCC1114X03S120	●	39.0	60	60	110	104.4	5.6	12

*AWG : American Wire Gage

RECOMMENDED CUTTING CONDITIONS

Work Material				CFRP		
Dia. DC (inch)	Dia. DC (mm)	Cutting speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)	IPR	
.1875	4.76	100	328	0.08 (0.05—0.12)	0.003 (0.002—0.005)	
.251	6.38			0.1 (0.05—0.12)	0.004 (0.002—0.005)	
.3125	7.96			0.1 (0.05—0.12)	0.004 (0.002—0.005)	
.375	9.55			0.1 (0.05—0.12)	0.004 (0.002—0.005)	
.4375	11.14			0.1 (0.05—0.12)	0.004 (0.002—0.005)	

● : Inventory maintained in Japan.

DRILLING TOOLS for CFRP/Al stack

MCA

The groove design that wraps up chips also minimizes gaps of CFRP and aluminum hole diameter in addition to preventing contact between the chips and the CFRP hole wall surface.

Diameter : $\varnothing 2.5-13$

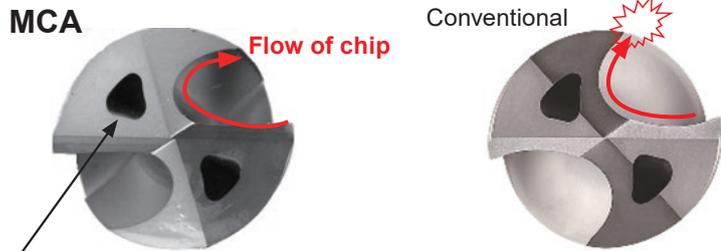
Hole Depth(L/D): ~ 5

Coating : Diamond



NEW FLUTE STRUCTURE

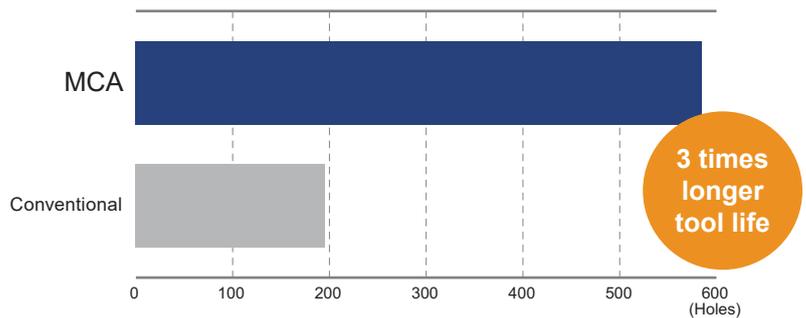
MCA flute, designed to wrap aluminum chips in the groove, prevents the chip from scratching the wall surface of the CFRP hole and also minimizes back counter.



TRI-COOLING[®] TECHNOLOGY

TRI-Cooling[®] improves internal coolant effectiveness and reduces heat generation that deteriorates the precision of the CFRP hole.

TOOL LIFE



<Cutting condition>

Tool : $\varnothing 7.976$ (0.314 inch)

Work material : CFRP+Al+Al

CFRP (Upper) 13 mm (0.51 inch)

Al (Middle) 4 mm (0.16 inch)

Al (Lower) 6.35 mm (0.25 inch)

Cutting speed : 125 m/min (410 SFM)

Feed : 0.03 mm/rev (0.001 IPR)

Cutting mode : Dry cutting

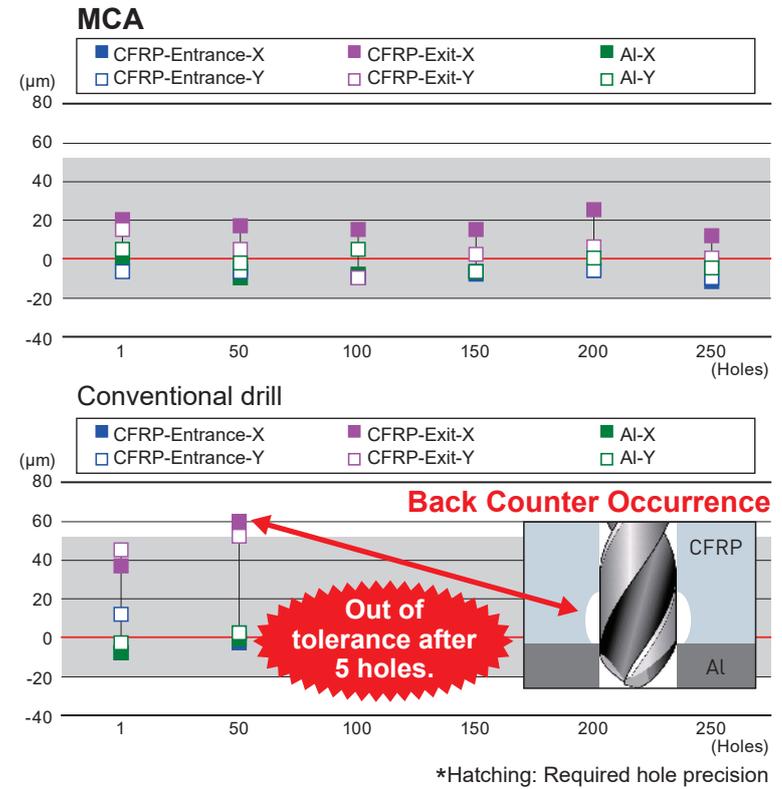
Machine : CNC Machine

<Cutting condition>

Tool : ϕ 6.38 (0.251 inch)
 Work material : CFRP+Al
 CFRP (Upper) 11 mm (0.43 inch)
 Al (Lower) 5 mm (0.20 inch)
 Cutting speed : 100 m/min (328 SFM)
 Feed : 0.15 mm/rev (0.006 IPR)
 Cutting mode : Internal air
 Machine : CNC Machine

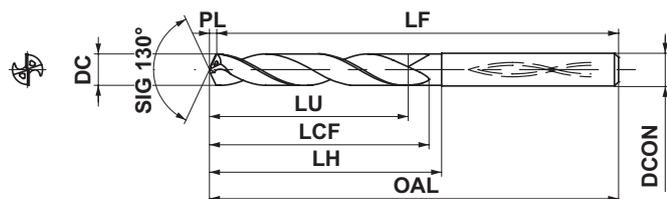


HOLE OVERSIZE



STOCK LIST

	3<DC≤6	6<DC≤10	10<DC≤18	18<DC≤20
	0	0	0	0
	-0.018	-0.022	-0.027	-0.033
	0	0	0	0
	-0.008	-0.009	-0.011	-0.013



Hole Dia. AWG*	Drill Dia. DC (mm)	Hole Depth (L/D)	Order Number	Grade	Dimensions (mm)							
					LU	LCF	LH	OAL	LF	PL	DCON	
—	1/4	6.38 .251	5	MCA0638X05S070	□	33.4	51	51	91	89.5	1.5	7
—	3/8	9.55 .375	5	MCA0955X05S100	□	50.0	77	77	118	115.8	2.2	10

*AWG : American Wire Gage

RECOMMENDED CUTTING CONDITIONS

Work Material		CFRP				Aluminum Alloy (Si<5%) A6061, A7075 etc.			
Dia. DC (inch)	Dia. DC (mm)	Cutting speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)	IPR	Cutting speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)	IPR
.251	6.38	100	328	0.15 (0.10—0.20)	0.006 (0.004—0.008)	100	328	0.03 (0.02—0.04)	0.001 (0.001—0.002)
.375	9.55								

1) We recommend to divide cutting conditions in each work materials.

□ : Non stock, produced to order only.

DRILLING TOOLS for CFRP/Ti stack

MCT

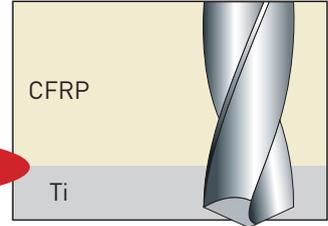
The sharp cutting edge of MCT realizes high quality hole machining on CFRP/Ti stack material that requires to handle delamination, uncut-fiber and cutting heat.

Diameter : $\phi 2.5-13$
Hole Depth(L/D): ~ 5
Coating : Uncoated



STRAIGHT CUTTING EDGES

The MCT cutting edge realizes high quality hole machining on CFRP/Ti stack materials.

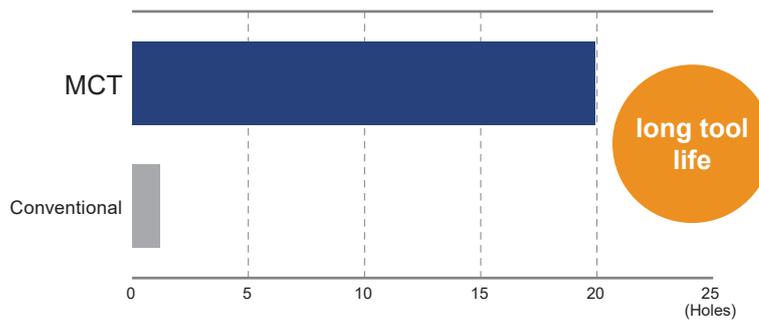


1 Step process

TRI-COOLING® TECHNOLOGY

TRI-Cooling® improves internal coolant effectiveness and reduces heat generation that deteriorates the precision of the CFRP hole.

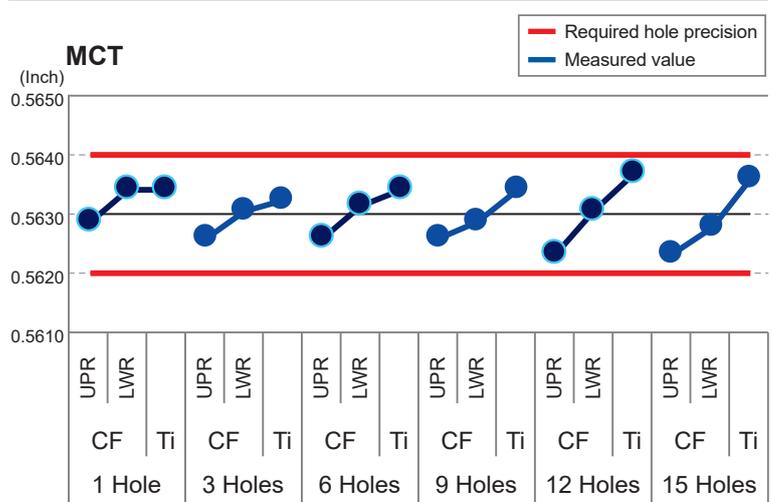
TOOL LIFE



<Cutting condition>

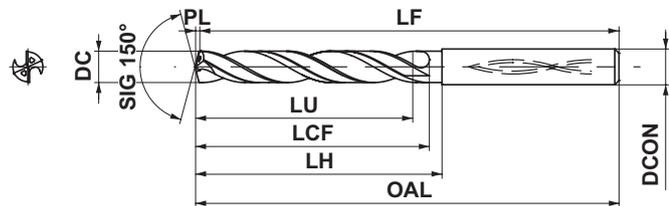
Tool : $\phi 6.38$ (0.251 inch)
Work material : CFRP+Ti
CFRP (Upper) 11 mm (0.43 inch)
Ti (Lower) 5 mm (0.20 inch)
Cutting speed : CFRP 60 m/min (197 SFM)
Ti 10 m/min (33 SFM)
Feed : CFRP 0.1 mm/rev (0.004 IPR)
Ti 0.05 mm/rev (0.002 IPR)
Peck feed : Ti 0.125mm (0.005 inch)
Cutting mode : Internal air
Machine : CNC Machine

HOLE OVERSIZE



STOCK LIST

	3<DC≤6	6<DC≤10	10<DC≤18	18<DC≤20
	0	-0.022	-0.027	-0.033
	0	-0.009	-0.011	-0.013



Hole Dia. AWG*	Drill Dia.		Hole Depth (L/D)	Order Number	Grade TF15	Dimensions (mm)						
	inch	DC (mm)				inch	LU	LCF	LH	OAL	LF	PL
—	1/4	6.38	.251	5	□	32.8	47	47	96	95.1	0.9	7
	3/8	9.55	.375			MCT0955X05S100	49.1	71	71	122	120.7	1.3

*AWG : American Wire Gage

RECOMMENDED CUTTING CONDITIONS

Work Material		CFRP				Titanium Alloy Ti-6Al-4V etc.				Peck machining (mm)
Dia. DC (inch)	Dia. DC (mm)	Cutting speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)	IPR	Cutting speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)	IPR	
.251	6.38	100	328	0.15 (0.10—0.20)	0.006 (0.004—0.008)	15	50	0.02 (0.01—0.03)	0.0008 (0.0004—0.001)	1
.375	9.55									

- 1) This condition is for when internal air or mist is used.
- 2) We recommend to divide cutting conditions in each work materials.

□ : Non stock, produced to order only.

DRILLING TOOLS for CFRP, CFRP/Al stack, CFRP/Ti

MCW

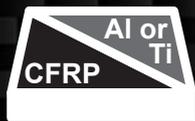
The MCW cutting edge with V-shaped grooves controls chip flow and directs cutting force to the parallel to the spindle axis.

This provides less variations in hole diameter in the stack material and less burr on the hole exit.

Diameter : $\phi 2.5-13$

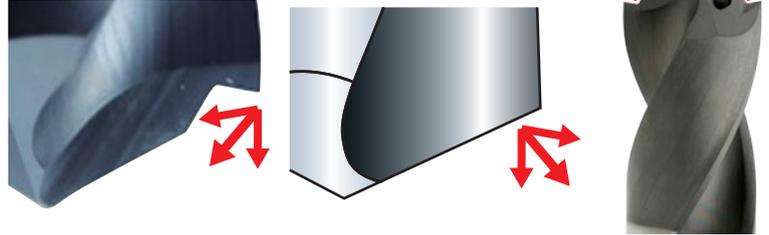
Hole Depth(L/D): ~ 5

Coating : **Diamond/Uncoated**



UNIQUE CUTTING EDGE DESIGN "COUNTER-EDGES"

Controlling cutting force direction



HOLE ACCURACY

Hole exit Aluminum side

MCW



Conventional



<Cutting condition>

Tool : $\phi 11.57$ (0.456 inch)

Work material : CFRP+Al

CFRP (Upper) 31.8 mm (1.25 inch)

Al (Lower) 6.4 mm (0.25 inch)

Cutting speed : 100 m/min (328 SFM)

Feed : CFRP 0.15 mm/rev (0.006 IPR)

Al 0.05 mm/rev (0.002 IPR)

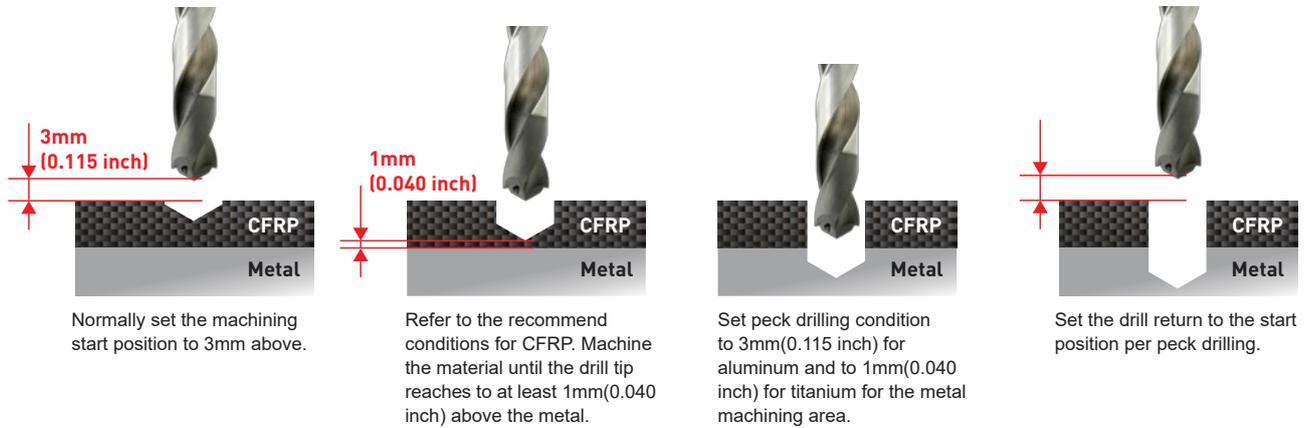
Peck feed : Al 0.25mm (0.01 inch)

Cutting mode : Internal air

Machine : CNC Machine

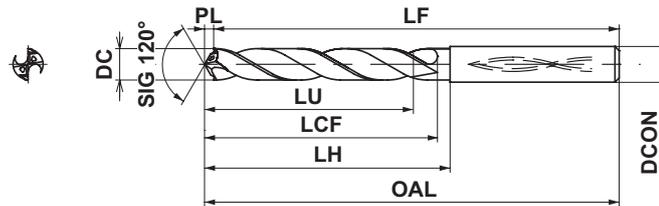


PECK MACHINING METHOD (APPLICABLE FOR MCT AND MCW)



STOCK LIST

	3<DC≤6	6<DC≤10	10<DC≤18	18<DC≤20
	0	0	0	0
	-0.018	-0.022	-0.027	-0.033
	0	0	0	0
	-0.008	-0.009	-0.011	-0.013



Hole Dia.		Drill Dia.		Hole Depth	Order Number	Grade		Dimensions (mm)						
AWG *	inch	DC (mm)	inch	(L/D)		HT10	DD210	LU	LCF	LH	OAL	LF	PL	DCON
-	1/4	6.38	.251	5	MCW0638X05S070	<input type="checkbox"/>	<input type="checkbox"/>	33.7	52	52	92	90.2	1.8	7
-	3/8	9.55	.375	5	MCW0955X05S100	<input type="checkbox"/>	<input type="checkbox"/>	50.6	73	73	119	116.2	2.8	10

*AWG : American Wire Gage

RECOMMENDED CUTTING CONDITIONS

Work Material				CFRP			
Dia. DC (inch)	Dia. DC (mm)	Cutting speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)		IPR	
.251	6.38	100	328	0.15 (0.10—0.20)		0.006 (0.004-0.008)	
.375	9.55						

Work Material		Aluminum Alloy (Si<5%) A6061, A7075 etc.				Titanium Alloy Ti-6Al-4V etc.					
Dia. DC (inch)	Dia. DC (mm)	Cutting speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)	IPR	Peck machining (mm)	Cutting speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)	IPR	Peck machining (mm)
.251	6.38	100	328	0.15 (0.10—0.20)	0.006 (0.004-0.008)	3	15	50	0.02 (0.01—0.03)	0.0008 (0.0004-0.001)	1
.375	9.55										

- 1) This condition is for when internal air or mist is used.
- 2) We recommend to divide cutting conditions in each work materials.

: Non stock, produced to order only.

DRILLING TOOLS for Aramid

MCK

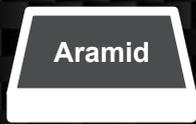
(Specialized)

The MCK cutting edge with V-shaped grooves realizes high quality hole machining on Aramid fiber materials.

Diameter : $\phi 2.5-13$

Hole Depth(L/D): ~ 5

Coating : Uncoated

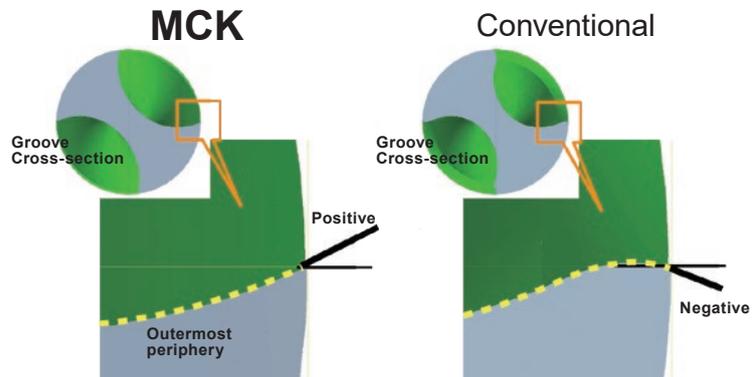


CANDLE POINT



HIGHLY POSITIVE RAKE FLUTES

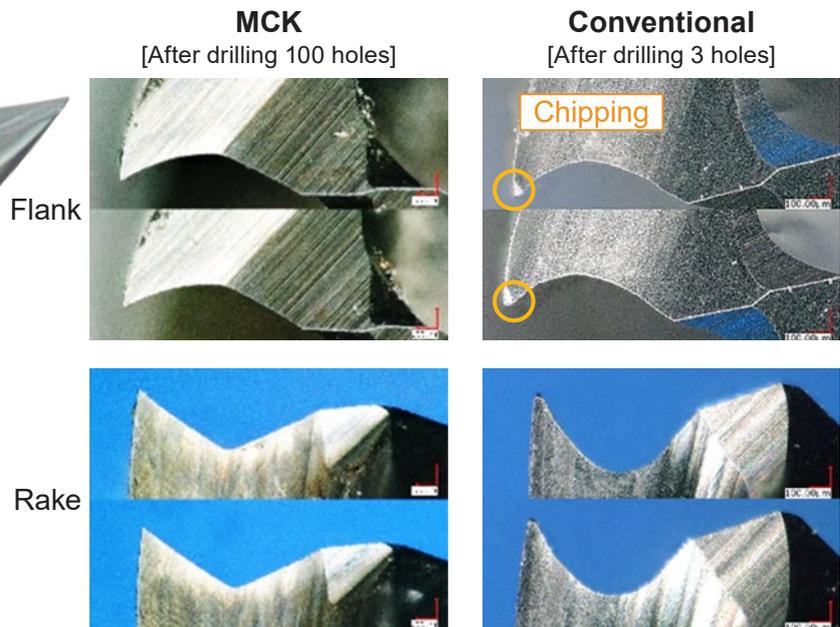
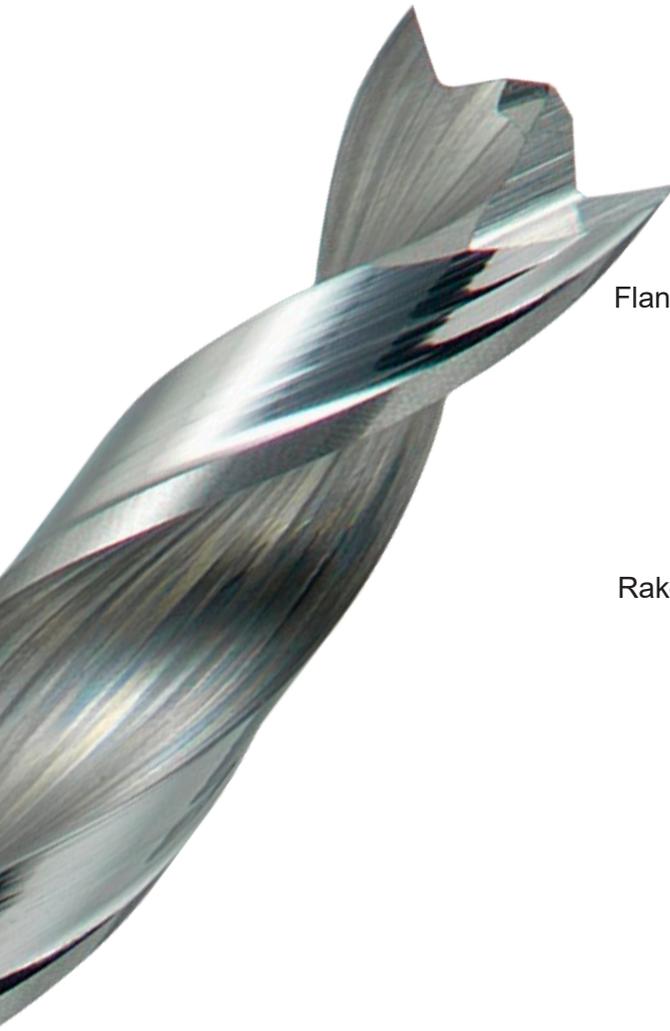
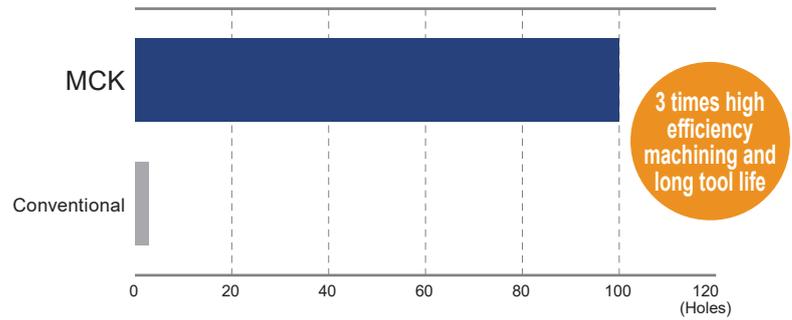
Highly positive rake angle in the vertical direction to the rotation axis minimizes uncut fiber and delamination.



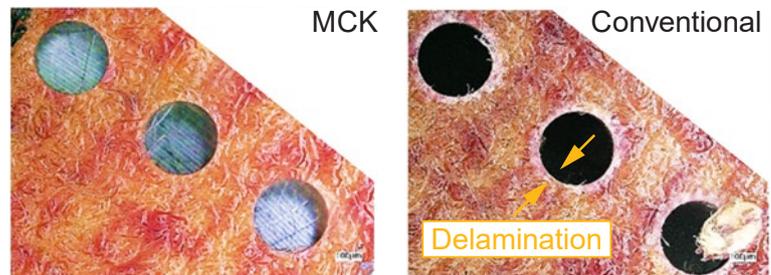
<Cutting condition>

Tool : $\phi 2.5$ (#40)
 Work material : Aramid 4 mm (0.16 inch)
 Cutting speed : 60 m/min (197 SFM)
 Feed : 0.03 mm/rev (0.001 IPR)
 Cutting mode : Dry cutting
 Machine : CNC Machine

TOOL LIFE



HOLE ACCURACY (EXIT)



RECOMMENDED CUTTING CONDITIONS

Work Material	Aramid				
	Dia. DC (mm)	Cutting Speed (m/min)	SFM	Feed (Min.—Max.) (mm/rev)	IPR
2.5—13	30—80	100—265	0.02—0.1	0.0008—0.004	

DRILLING TOOLS for CFRP

MCCH

The tough carbide substrate for hand tools prevents sudden breakages and maintains high quality holes. The double angle design controls the thrust and enables a stable cutting speed even in hand tool machining.

Diameter : $\varnothing 2.5-13$

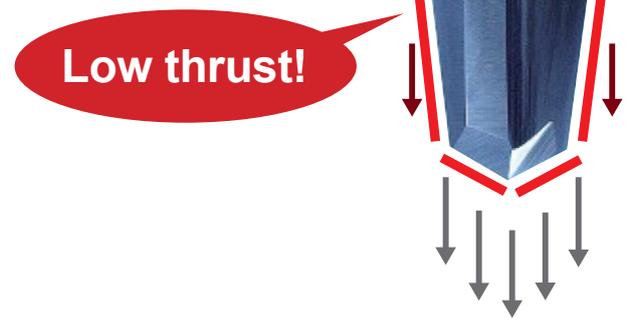
Hole Depth(L/D): ~ 5

Coating : **Uncoated**



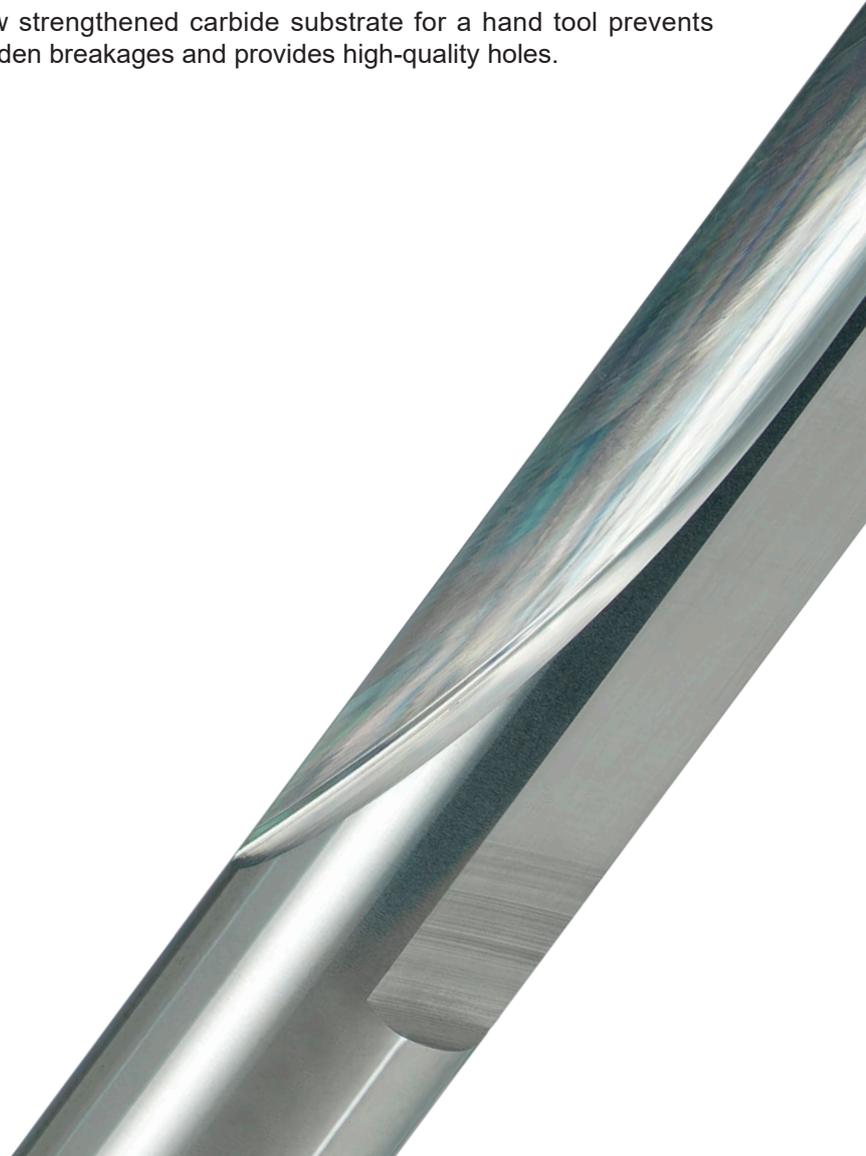
DOUBLE ANGLE

The double angle design controls the thrust and enables a stable cutting speed even in hand tool machining.



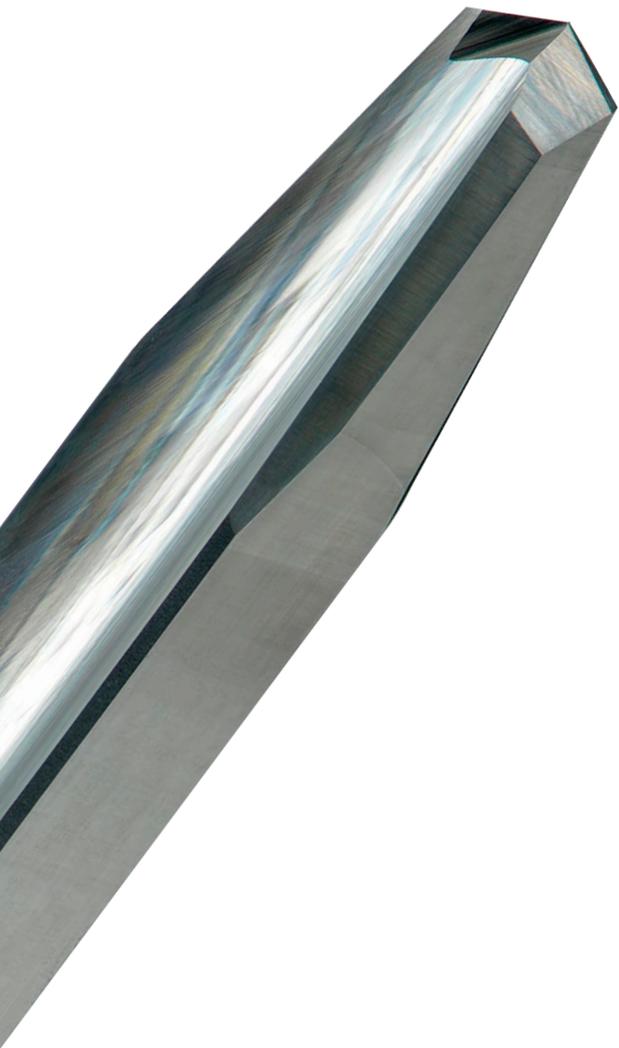
NEW GRADE DT2030

New strengthened carbide substrate for a hand tool prevents sudden breakages and provides high-quality holes.

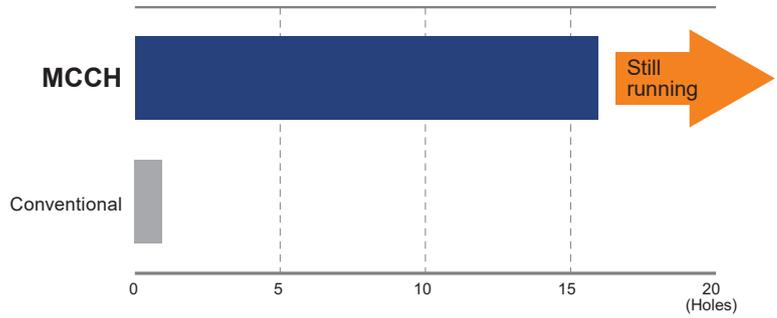


<Cutting condition>

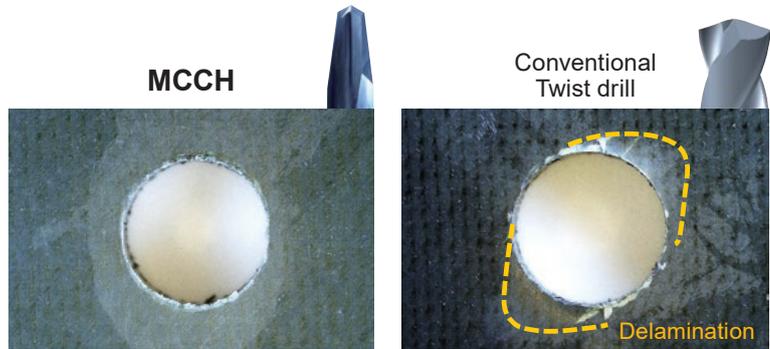
Tool : $\phi 4.1$ (#20)
 Work material : CFRP 4mm (0.16 inch)
 Cutting mode : Dry cutting
 Machine : Hand Tool



TOOL LIFE

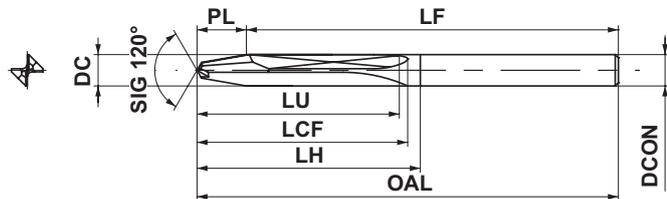


HOLE ACCURACY (EXIT)



STOCK LIST

	1 ≤ DC ≤ 6	3 < DC ≤ 6	6 < DC ≤ 10	10 < DC ≤ 18	18 < DC ≤ 20
0	0	0	0	0	0
-0.014	-0.018	-0.022	-0.027	-0.033	
h6	0	0	0	0	0
-0.006	-0.008	-0.009	-0.011	-0.013	



Hole Dia.		Drill Dia.		Hole Depth	Order Number	Grade	Dimensions (mm)						
AWG*	inch	DC (mm)	inch	(L/D)			DT2030	LU	LCF	LH	OAL	LF	PL
#40	—	2.5	.0985	15	MCCH0250X15S030	●	42.1	48	50	100	95.4	4.6	3
#30	—	3.26	.1285	10	MCCH0326X10S040	●	38.6	48	50	100	94.0	6.0	4
#20	—	4.1	.1615	8	MCCH0410X08S050	●	40.3	48	50	100	92.5	7.5	5
#11	—	4.86	.1915	5	MCCH0486X05S050	●	33.2	48	50	100	91.1	8.9	5
—	1/4	6.38	.251	3	MCCH0638X03S070	●	30.8	48	50	100	88.3	11.7	7
—	3/8	9.55	.375	2	MCCH0955X02S100	●	36.6	48	50	100	82.5	17.5	10

*AWG : American Wire Gage

● : Inventory maintained in Japan.

DRILLING TOOLS for CFRP/Al stack

MCAH

The tough carbide substrate for hand tools prevents sudden breakages and produces highly reliable quality hole machining. The combination of the flute shape and optimal helix angle ensures compatibility of the aluminum chip dividing and discharging. This leads to stable hole-making even in CFRP and aluminum stack material.

Diameter : $\phi 2.5-13$
Hole Depth(L/D): ~ 5
Coating : **Uncoated**



DESIGN FOR CFRP/AL STACK MATERIALS

The combination of the flute shape and optimal twisting ensures compatibility of the aluminum chip dividing and discharging.

NEW GRADE DT2030

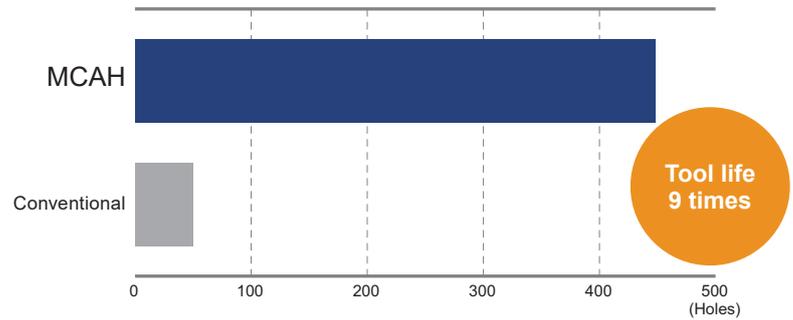
New strengthened carbide substrate for a hand tool prevents sudden breakages and provides high-quality holes.



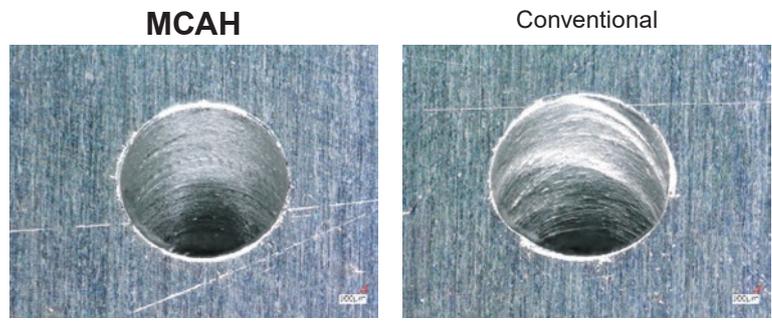
<Cutting condition>

Tool : $\phi 4.1$ (#20)
 Work material : CFRP 10mm (0.40 inch)
 Al 5mm (0.20 inch)
 Cutting mode : Dry cutting
 Machine : Hand Tool

TOOL LIFE

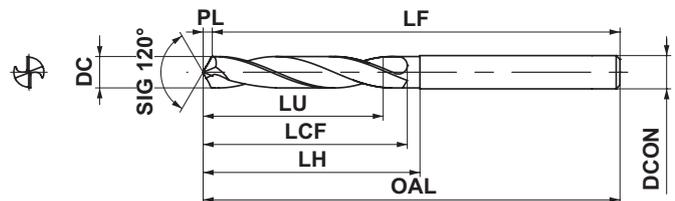


HOLE ACCURACY (AI:EXIT)



STOCK LIST

	1 ≤ DC ≤ 3	3 < DC ≤ 6	6 < DC ≤ 10	10 < DC ≤ 18	18 < DC ≤ 20
	0	0	0	0	0
	-0.014	-0.018	-0.022	-0.027	-0.033
	0	0	0	0	0
	-0.006	-0.008	-0.009	-0.011	-0.013



Hole Dia. AWG*	Drill Dia.		Hole Depth (L/D)	Order Number	Grade	Dimensions (mm)							
	inch	DC (mm)				inch	DT2030	LU	LCF	LH	OAL	LF	PL
#40	—	2.5	.0985	15	MCAH0250X15S030	●	38.2	50	50	100	99.3	0.7	3
#30	—	3.26	.1285	15	MCAH0326X15S040	●	49.8	50	50	100	99.1	0.9	4
#20	—	4.1	.1615	10	MCAH0410X10S050	●	42.2	50	50	100	98.8	1.2	5
#11	—	4.86	.1915	8	MCAH0486X08S050	●	40.3	50	50	100	98.6	1.4	5
—	1/4	6.38	.251	5	MCAH0638X05S070	●	33.7	50	50	100	98.2	1.8	7
—	3/8	9.55	.375	3	MCAH0955X03S100	●	31.5	50	50	100	97.2	2.8	10

* AWG : American Wire Gage

● : Inventory maintained in Japan.

DRILLING TOOLS for Al, CFRP, CFRP/Al stack, CFRP

MCN

(Specialized)

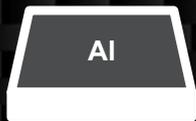
MCN is designed for controlling aluminum chip flow not to occur chip packing and welding of the cutting edge.

MCN is a versatile drill, it also applied to CFRP etc. This produces highly reliable quality hole machining.

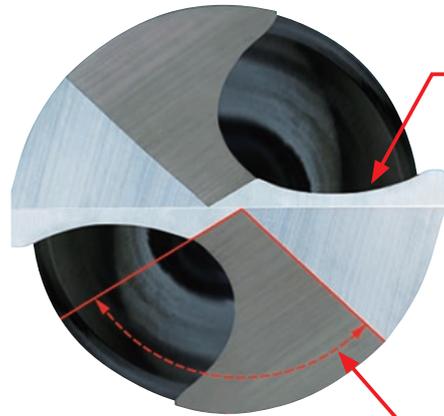
Diameter : $\phi 2.5-20$

Hole Depth(L/D): ~ 5

Coating : Uncoated



STRAIGHT CUTTING EDGES



WAVY CUTTING EDGE

The wave edge design achieves a sharp peripheral edge cutting performance with a strong initial cutting point near the centre.

WEB thinning pocket

Large thinning pocket for smooth evacuation of the chips prevents welding of the cutting edge.



Indexable drill

(Specialized)

The indexable drill designed for drilling CFRP and CFRP/ Metal realizes high quality hole machining. This can be designed to be assembled to a drill unit without an threaded adapter.

Diameter : $\phi 10-18.4$
Hole Depth(L/D): ~ 5
Coating : **Uncoated**



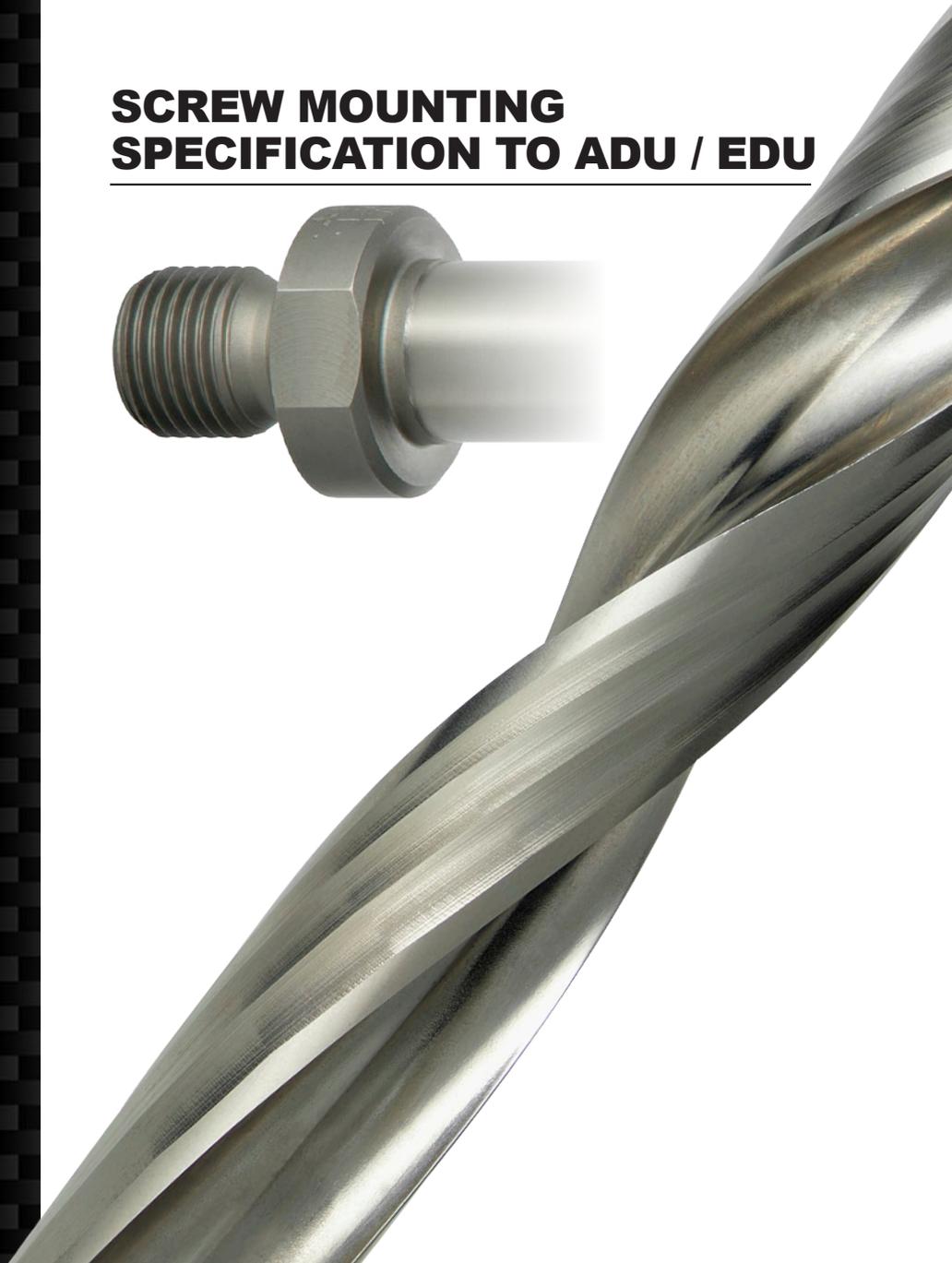
BODY

DURABLE BODY

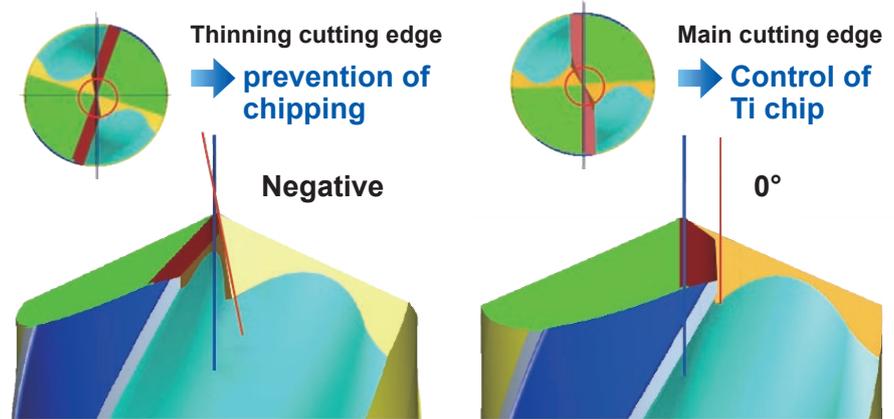
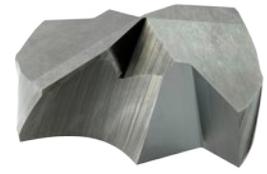
Contact prevention specification between holder and guide bush



SCREW MOUNTING SPECIFICATION TO ADU / EDU



INSERT COMBINATION OF VARIABLE RAKE FACE



HOLE ACCURACY

Entrance (CFRP)



Fine !

Exit (Ti-6Al-4V)



Small burr !

...25 holes drilling

<Cutting condition>

- Tool : $\phi 15.7$ (5/8 inch)
- Work material : CFRP (Upper) 10 mm (0.39 inch)
Ti (Lower) 5 mm (0.20 inch)
- Cutting speed : 13 m/min (44 SFM)
- Feed : 0.05 mm/rev (0.002 IPR)
- Cutting mode : Internal
- Machine : Pneumatic (attached step unit)

RECOMMENDED CUTTING CONDITIONS

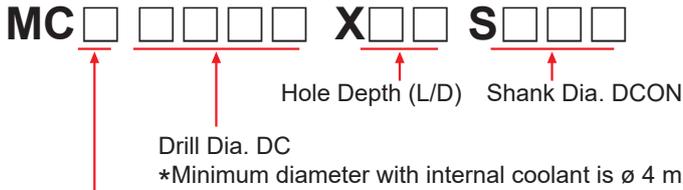
Work Material	CFRP				Aluminum Alloy(Si<5%) A6061, A7075 etc.				Titanium Alloy Ti-6Al-4V etc.			
	Dia. DC (mm)	Cutting Speed (m/min)	SFM	Feed (Min. - Max.) (mm/rev)	IPR	Cutting Speed (m/min)	SFM	Feed (Min. - Max.) (mm/rev)	IPR	Cutting Speed (m/min)	SFM	Feed (Min. - Max.) (mm/rev)
10-18.4	50-100	165-330	0.05-0.15	0.002-0.006	50-120	165-400	0.05-0.30	0.002-0.012	10-20	30-65	0.05-0.10	0.002-0.004

DRILLING (Specialized)

How to place order of Specialized drills

Request sizes other than those in the inventory by inserting the code and numerical value in blanks of the following model numbers. Contact our sales department for details on the dimensions.

Order number



Applications

- C : CNC Machine / CFRP
- A : CNC Machine / CFRP + AI
- T : CNC Machine / CFRP + Ti
- W : CNC Machine / CFRP and stack material high precision
- CH : Hand tool / CFRP
- AH : Hand tool / CFRP + AI
- K : CNC machine / Aramid
- R : CNC machine / CFRP (High efficiency processing)

< Example >

Hole Depth (L/D)

- L/D2 → X02
- L/D10 → X10

Shank Dia. DCON

- ϕ 3 mm → S030
- ϕ 10 mm → S100

*For inch sizes please convert to metric (1" = 25.4 mm)

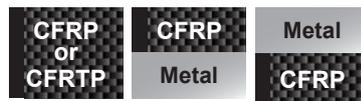
Work material

Type

- CFRP: Thermosetting and thermoplasticity
- Type of reinforcing fiber
- Metal: Aluminum or titanium, etc.

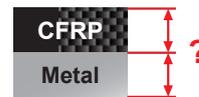
Combination

- CFRP or CFRTTP
- CFRP + stack materials (aluminum or titanium)
- Lap joint method



Other

- Thickness for each work material
- Affixture of film



Equipment

Type

- CNC Machine
- Hand Tool
- Pneumatic

Coolant

- Internal through
- Air, MQL and dry, etc.



Hole Quality

- Required hole diameter (upper and lower limit of tolerance)
- Surface roughness of the hole inner wall
- Metal burr height
- CFRP and metal hole diameter gap



Inquiry Form example of Step drill (Specialized)

Dimensions

Work Material:

Hole
 Depth
 Dia.
 Tol.

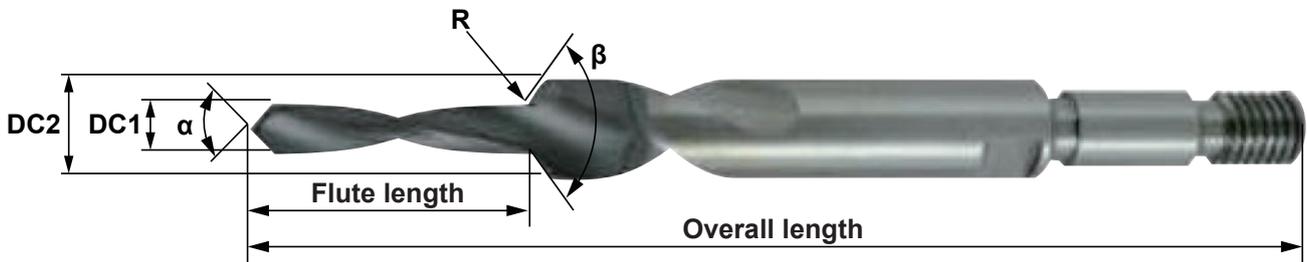
Tool (DC1)
 Dia.
 Tol.

Shank
 Dia.
 Tol.

Coating : Diamond
 DLC
 PVD coated
 None coated

Tool (DC2)
 Dia.
 Tol.

Shank : Cylindrical
 Threaded
 Notch
 Other
 Threaded :
 Size



Point :
 Angle α

Step
 Angle β
 Tol.

Corner
 R Dia.
 Tol.

Flute :
 Length

Overall :
 Length

Coolant : External / Internal

Comments:

Note) Please contact us of each area for any specification.

MILLING TOOLS for CFRP, CMC

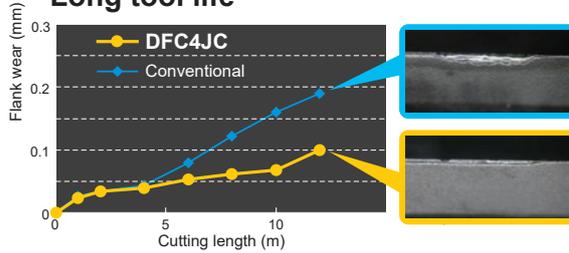
DFC4JC

For finishing

The low resistance in the axial direction with low helix angle reduces delamination and burrs when machining CFRP.

GEOMETRY FOR CFRP MACHINING

Long tool life



End mill	DFC4JCD1000(φ10)
Work material	CFRP(Thick: 5.3mm)
Revolution	6400min ⁻¹ (200m/min)
Feed rate	800mm/min (0.03mm/tooth)
Coolant mode	Air blow

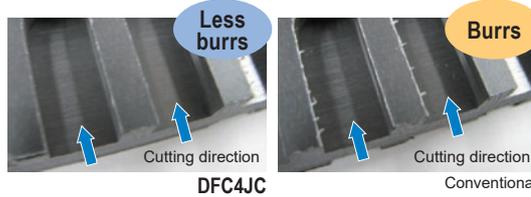
DFC4JC

DFCJRT

For efficient machining

The cross-nick type cutting edge allows high efficiency machining due to lower cutting resistance and reduced temperatures.

Excellent surface finish



End mill	DFC4JCD1000(φ10)
Work material	CFRP(Thick: 6mm)
Revolution	6000min ⁻¹ (188m/min)
Feed rate	750mm/min(0.03mm/tooth)
Coolant mode	Air blow

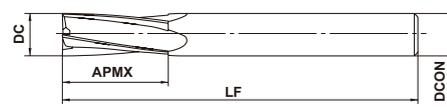
PCD

(Specialized)

The spiral and multi-flute geometry allows long tool life and high efficiency machining of CMC (Ceramic Matrix Composite).

DFC4JC

End mill, Semi long cut length, 4 flute, for CFRP



h6	6 ≤ DC ≤ 12		
	0 - 0.03		
	DCON=6	8 ≤ DCON ≤ 10	DCON=12
	0 - 0.008	0 - 0.009	0 - 0.011

Order Number	DC	APMX	LF	DCON	Number of Flutes	Stock
DFC4JCD0600	6	20	70	6	4	●
DFC4JCD0800	8	30	80	8	4	●
DFC4JCD1000	10	30	90	10	4	●
DFC4JCD1200	12	30	100	12	4	●

RECOMMENDED CUTTING CONDITIONS

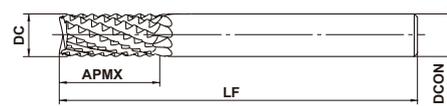
Work material	CFRP		
	Dia. DC (mm)	Revolution (min ⁻¹)	Feed rate (mm/min)
6		11000	950
8		8000	780
10		6400	700
12		5300	650

Please contact Mitsubishi Materials for geometries and through coolant types other than standard.

- 1) Cutting conditions may differ considerably due to the kind of CFRP, the rigidity of the machine, or the clamping and geometry of the workpiece. Please use the left table as a standard starting point.
- 2) When high machining accuracy is needed, or large burrs or delamination occurs, we recommend reducing the feed rate.
- 3) When the depth of cut is greater than 0.8DC, we recommend reducing the feed rate.
- 4) Please take precautions against dust.

DFCJRT

Cross-nick type end mill, Semi long cut length, for CFRP



h6	DCON=6	8 ≤ DCON ≤ 10	DCON=12
	0 - 0.008	0 - 0.009	0 - 0.011

Order Number	DC	APMX	LF	DCON	Number of Flutes	Stock
DFCJRTD0600	6	20	70	6	10	●
DFCJRTD0800	8	30	80	8	10	●
DFCJRTD1000	10	30	90	10	12	●
DFCJRTD1200	12	30	100	12	12	●

RECOMMENDED CUTTING CONDITIONS

Work material	CFRP		
	Dia. DC (mm)	Revolution (min ⁻¹)	Feed rate (mm/min)
6		11000	1200
8		8000	1000
10		6400	900
12		5300	850

Please contact Mitsubishi Materials for geometries and through coolant types other than standard.

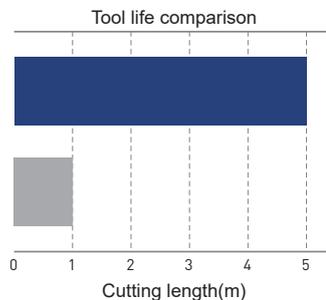
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- 2) When high machining accuracy is needed, or large burrs or delamination occurs, we recommend reducing the feed rate.
- 3) When the depth of cut is greater than 0.8DC, we recommend reducing the feed rate.
- 4) Please take precautions against dust.

PCD (Specialized) Endmill Spiral Multi-flute, for CMC



PCD endmill
8 flutes, Helix, ø6xR1

Conventional
4 flutes, Straight, ø6xR0.4



Tool	Wear photo
MMC at 2m	 Wear width 0.15mm
Conventional at 1m	 Wear width 0.3mm

Cutting condition

End mill	ø6mmxR1(Specialized)
Work material	CMC(SiC)
Cutting speed	5,308min ⁻¹ (100m/min)
Feed rate	0.010(mm/tooth)
Depth of cut	ap1, ae3.0
Coolant	External Air
Machine	Horizontal/BT40

● : Inventory maintained in Japan.

INDEXABLE MILLING TOOLS for CFRP

FMAX

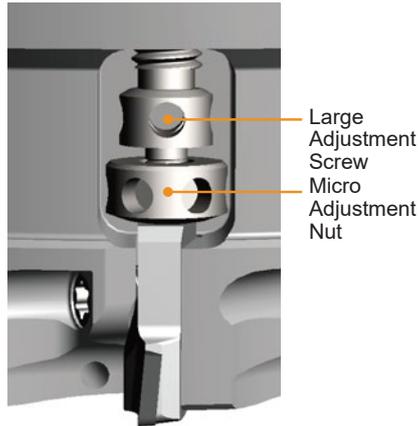
The FMAX high feed cutter, combining of a special alloy steel and aluminum body ensures rigidity, while being light weight, with a fine pitch setting allows it to be used effectively for high efficiency machining of CFRP.

Diameter : $\phi 40-160$

CFRP/
CFRTP

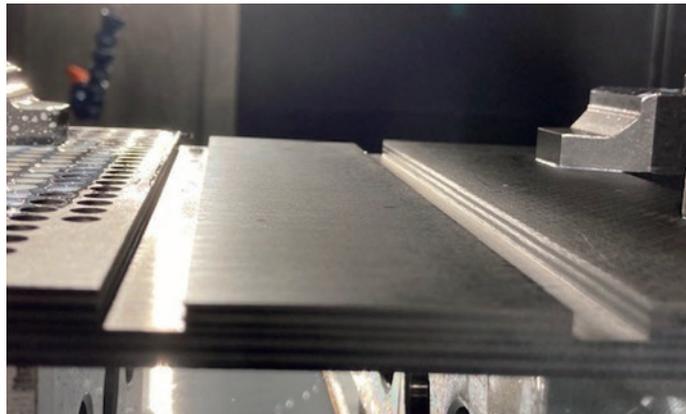
HIGH PRECISION, EASY SETTING

The combination of both a large and micro screw provides precise run-out adjustment and for adjusting new or re-grinding inserts (5 μm or better).



$\phi 80 \sim 160$ (Aluminum + Steel)

Cutting Conditions	Work Material	CFRP
	Holder	FMAX-050A10R
	Insert	GOER1404PXFR2(MD220)
	Cutting Speed vc	3927 m/min (Conventional 3141) (12,884 SFM)
	Revolution n	10,000 min^{-1} (Conventional 8000) (10,000 RPM)
	Feed per Tooth fz	0.09 mm/t. (.004 IPT)
	Table Feed vf	18,000 mm/min (Conventional 15840) (708.661 IPM)
	Depth of Cut ap	0.5 mm (.02 inch)
Width of Cut ae	—	
Cutting Mode	Wet Cutting	
Machine	Vertical MC (BT30)	



No burr !

ø40~63 (Steel body)



Shape	Order Number	MD220	MD2030	Dimensions (mm)						Geometry
				L	LE	W1	S	BS	RE	
General Purpose	GOER1404PXFR2	●	●	14.0	5.0	9.0	4.2	2.0	0.4	
	GOER1408PXFR2	●	●	14.0	5.0	9.0	4.2	2.0	0.8	
Long Edge	GOER1408PXFR2-8	●		14.0	8.0	9.0	4.2	2.0	0.8	



ø100,125
(For Compact and Smaller Machining Centres)

Fig.1

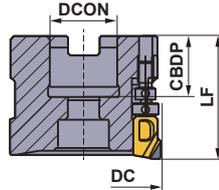


Fig.2

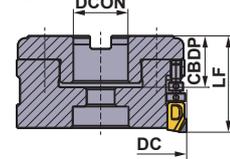


Fig.3

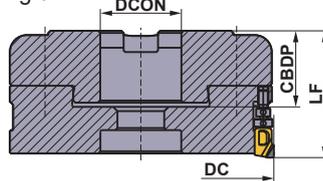
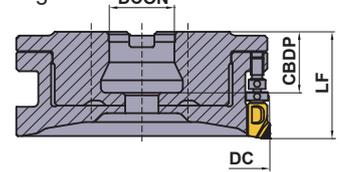


Fig.4



■ ARBOR TYPE

KAPR: 90°
GAMP: +5° GAMP: -6° - -3°

DC (mm)	Order Number	Stock	Coolant Hole	Number of Teeth	Dimensions (mm)		CDBP	WT (kg)	RPMX (min ⁻¹)	Fig.
					LF	DCON				
40	FMAX-040A04R	●	○	4	40	16	18	0.24	30000	1
40	FMAX-040A06R	●	○	6	40	16	18	0.23	30000	1
50	FMAX-050A08R	●	○	8	40	22	20	0.37	30000	1
50	FMAX-050A10R	●	○	10	40	22	20	0.35	30000	1
63	FMAX-063A10R	●	○	10	40	22	20	0.67	27000	1
63	FMAX-063A12R	●	○	12	40	22	20	0.66	27000	1
80	FMAX-080B14R	●	○	14	45	27	24	1.08	24500	2
100	FMAX-100B18R	●	○	18	50	32	32	1.81	22000	3
125	FMAX-125B24R	●	○	24	60	40	36	3.26	19600	3
80	FMAXR08010C	●	○	10	45	25.4	24	1.11	24500	2
80	FMAXR08014C	●	○	14	45	25.4	24	1.09	24500	2
100	FMAXR10012D	●	○	12	50	31.75	32	1.85	22000	3
100	FMAXR10018D	●	○	18	50	31.75	32	1.81	22000	3
125	FMAXR12516E	●	○	16	60	38.1	36	3.33	19600	3
125	FMAXR12524E	●	○	24	60	38.1	36	3.27	19600	3
160	FMAXR16016D	●	○	16	63	31.75	38	3.30	10000	2
160	FMAXR16024D	●	○	24	63	31.75	38	3.39	10000	2
100	FMAXR10010CLW	●	○	10	42	25.4	24	1.06	22000	4
100	FMAXR10016CLW	●	○	16	42	25.4	24	1.11	22000	4
125	FMAXR12514CLW	●	○	14	42	25.4	24	1.44	19600	4
125	FMAXR12520CLW	●	○	20	42	25.4	24	1.48	19600	4

For the details of dimensions , please refer to Tools news B216G. ● : Inventory maintained in Japan.

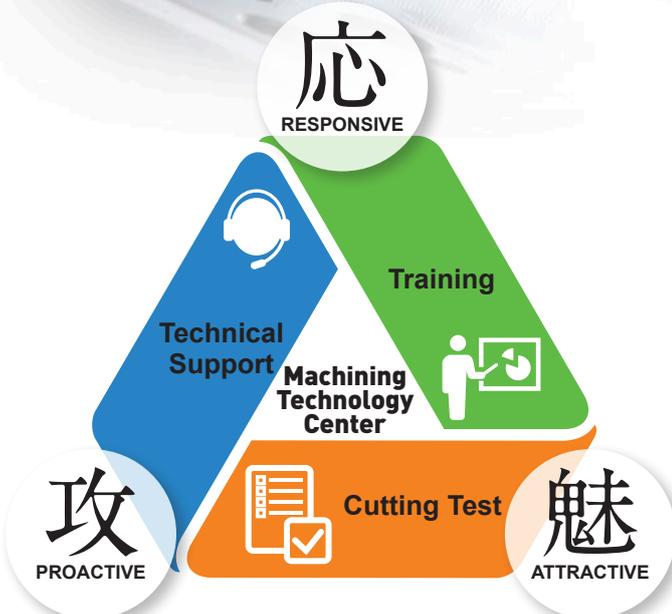


YOUR GLOBAL CRAFTSMAN STUDIO

RESPONSIVE, ATTRACTIVE, PROACTIVE

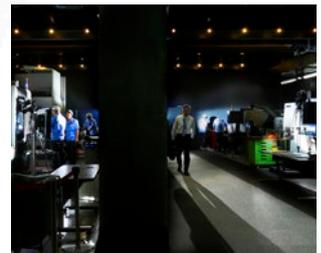
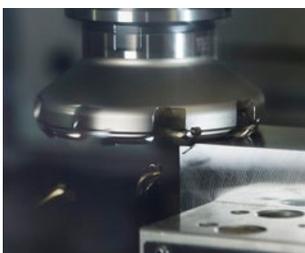
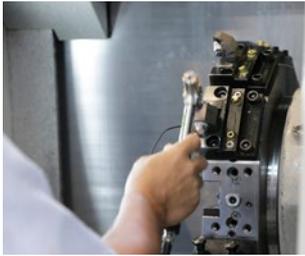
Mitsubishi Materials Corporation, Metalworking Solutions Company, offers a "Comprehensive Craftsman Studio" which addresses the individual needs and requirements of our customers' in order to make their business successful. Here the Machining Technology Center is the front-line base. It is fully equipped with advanced machines, measuring instruments, extensive cutting data, knowledge, technologies as well as having a team of highly-experienced technical staff members. All of which allows Mitsubishi Materials Corporation to offer the best solution and services for our valued customers.

We try answering questions and demands from customers around the world by providing detailed solutions to meet our customer's expectations.



We identify the potential needs of customers and develop innovative tools to cultivate markets to widen future business possibilities.

Showing and demonstrating. Attractive events and practical seminars present the new possibilities in machining which evoke a feeling of curiosity.



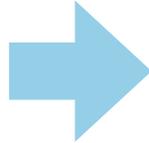
Strengthening of total tooling solutions for our cutting tools

Direction of Research & Development

Base for developing of New Products

Responding to the common needs developing of new and standard tools.

- Proposal for machining technology.
- Proposal for process improvement.
- Independent development.



Base for providing Solutions

Responding to the needs of our customers. Research on advanced machining technology and proposals for exclusively developed tools.

- Support for setting up new machining process line.
- Direct proposal for process improvement.
- Cooperated development with customers.
- Tooling proposal in collaboration with machine tool builders.

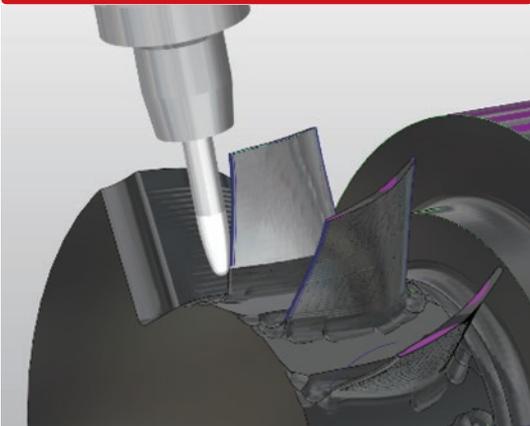
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- Machining Technology Center (Machining technology for next generation, education)
- R & D centers (at our 3 main manufacturing plants: Basic technology, Product development)
- Central Research Institute (Development base, Analysis and Evaluation, CAE)
- Open Innovation
- Human Resources Development (Globalization, Diversification)

Providing solutions applying analysis

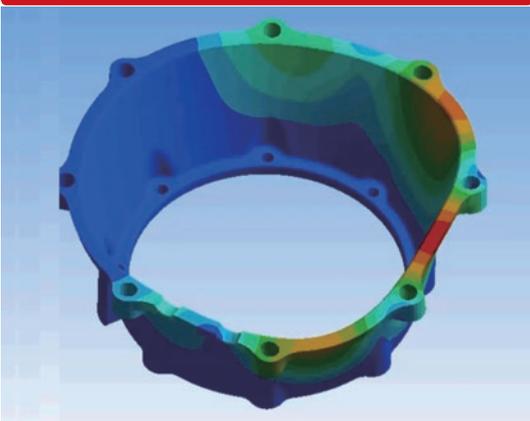
Tool path simulation by CAM

Optimization of machining method



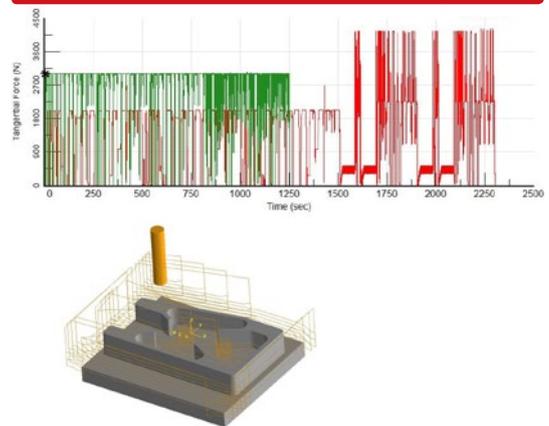
Analysis of work material rigidity and vibration

Optimization of clamping system



Analysis of cutting resistance

Optimization of Cutting resistance



Analysis of chip shape

Optimization of chip control



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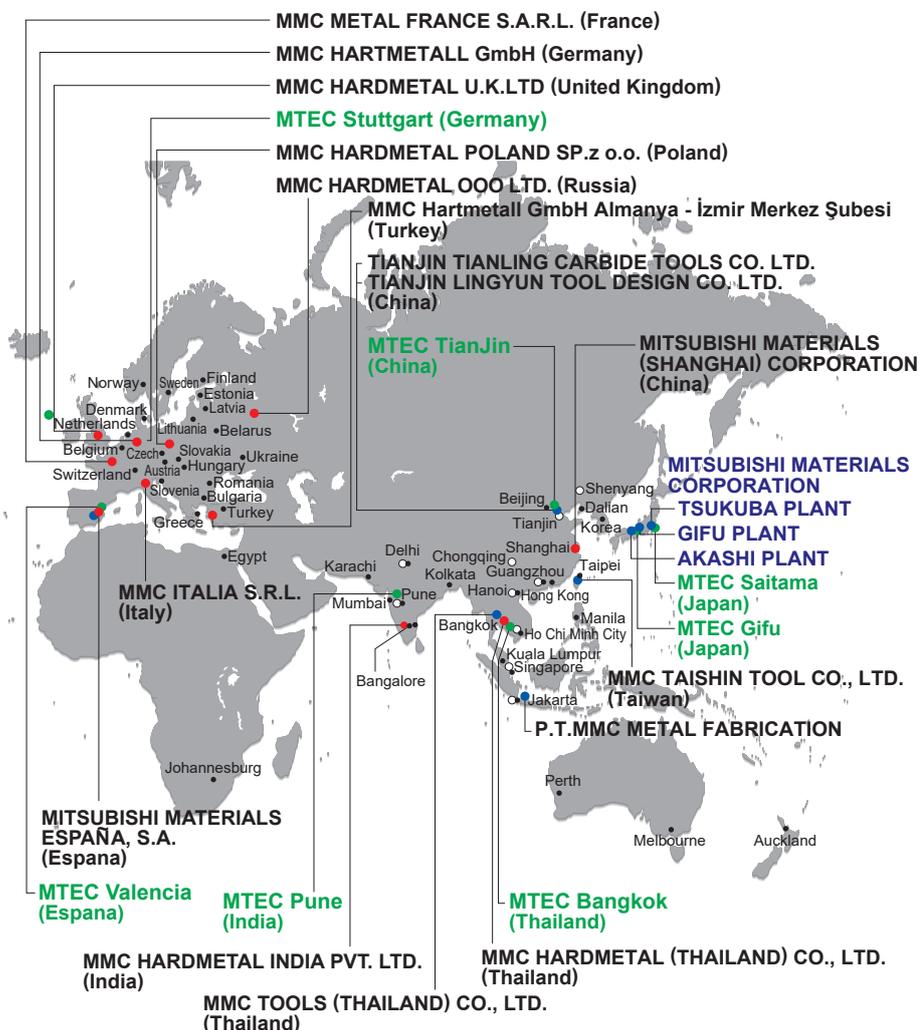
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