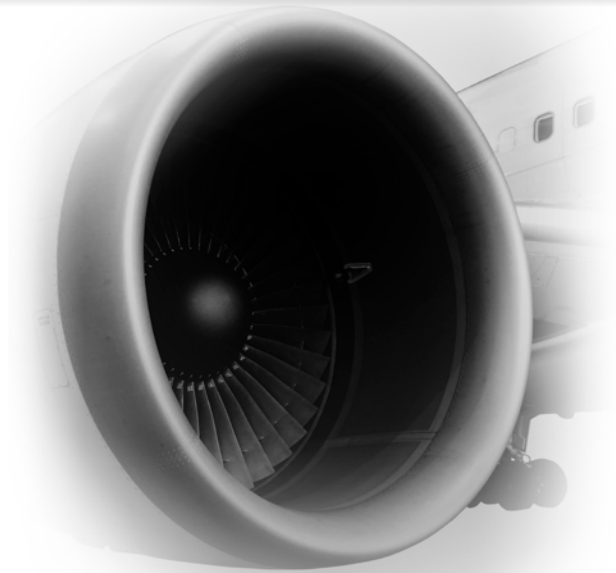


# AEROSPACE APPLICATIONS



# ENGINE



# LANDING GEAR



# AIRFRAME



## ENGINE

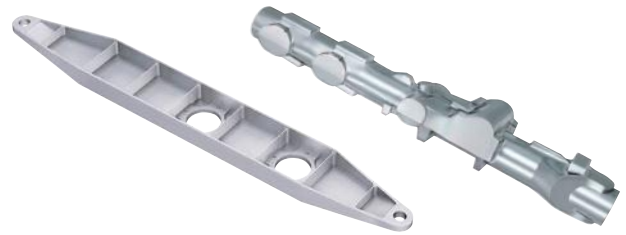
FAN CASE .....	5
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TURBINE DISK .....	12
BLISK .....	20
LPT BLADE .....	27
COMBUSTION CASE .....	29
SHAFT .....	38

GEAR BOX .....	42
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## LANDING GEAR

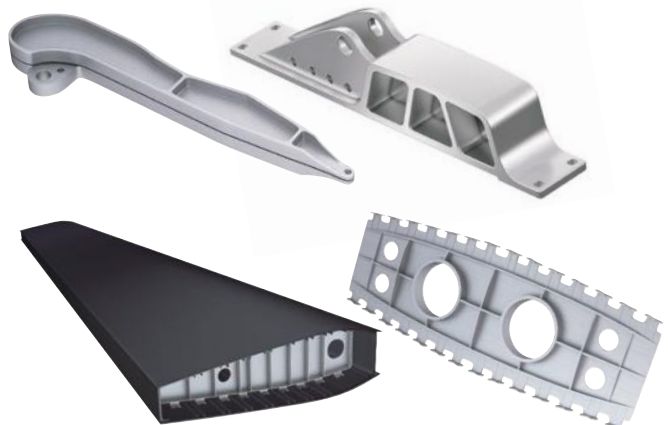
BEAM .....	45
MAIN CYLINDER .....	49



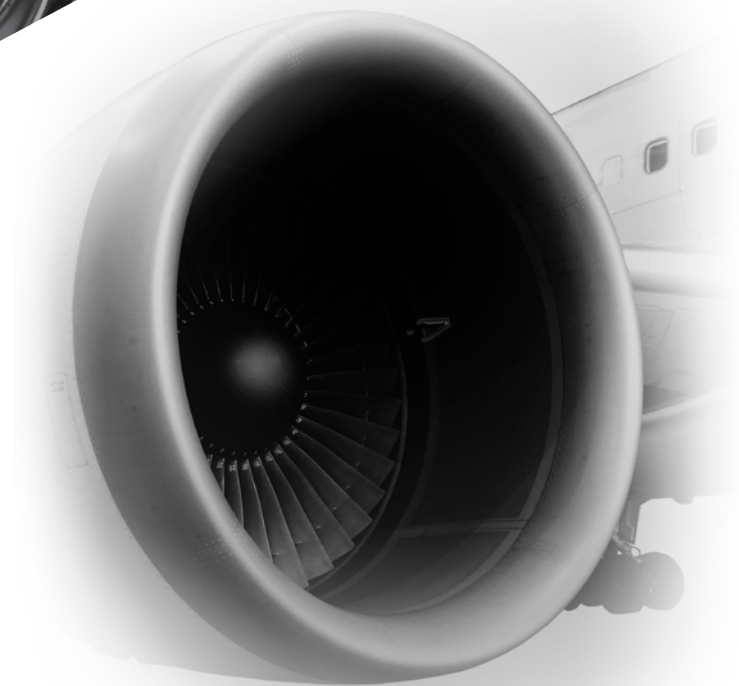
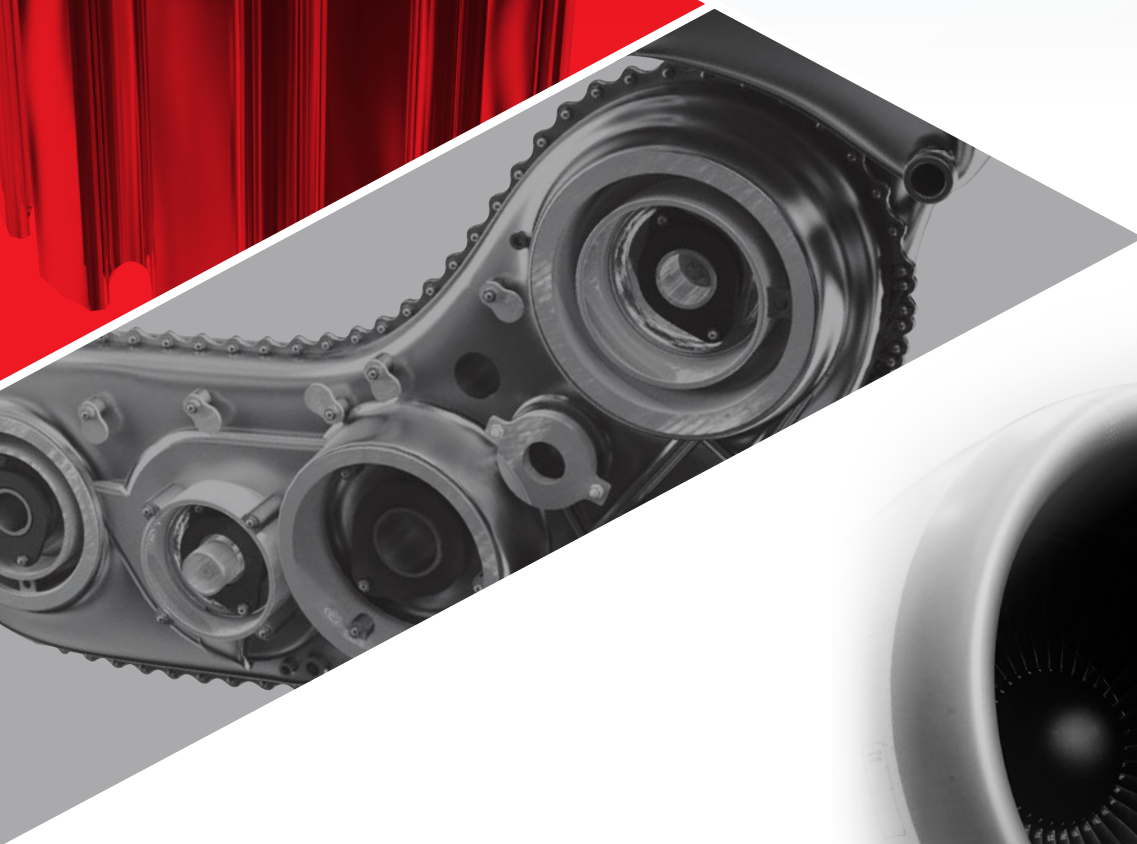
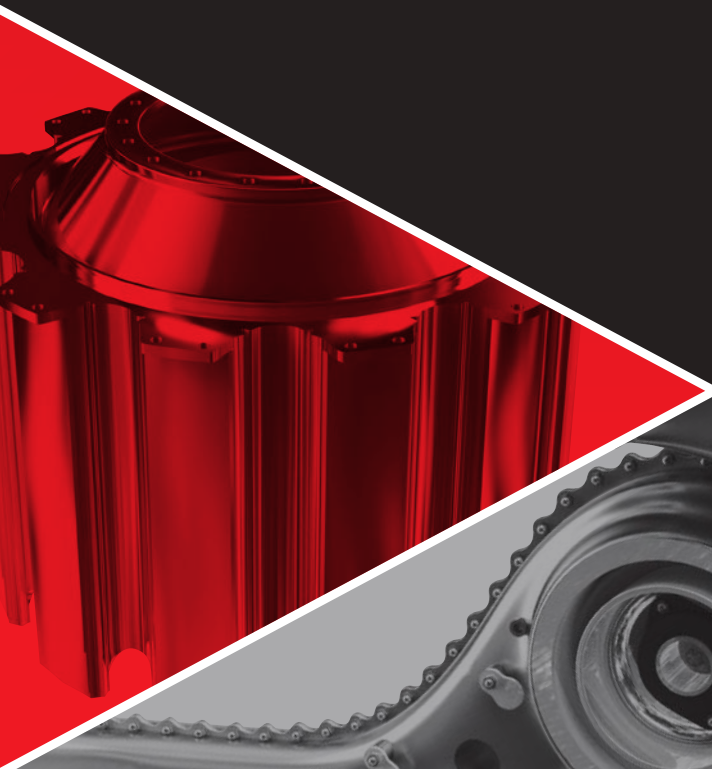
## AIRFRAME

BODY .....	55
FLAP TRACK .....	59
PYLON .....	62
SHACKLE .....	65
HINGE .....	66
WING .....	69

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# ENGINE



04-43



# ENGINE FAN CASE

[Titanium Alloy]

MT90 series is specifically designed for machining of titanium alloys.

MT9005: Unmatched heat and plastic deformation resistance leading to superior wear resistance for high speed machining applications.

MT9015: The first recommendation for turning of titanium alloys offers a good balance of both wear and fracture resistance.



B134G  
[Metric]



B214G  
[Metric]



B214A  
[Imperial]

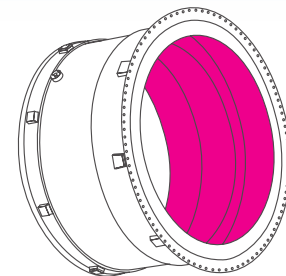


**HSK-T** Tools

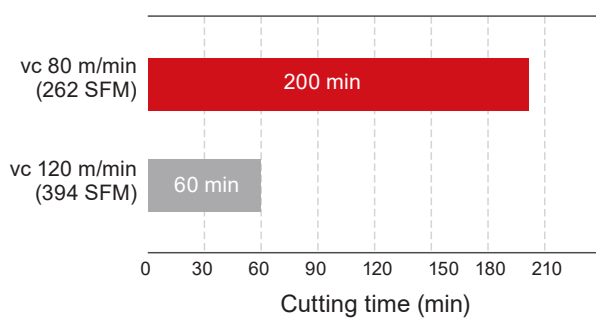
**PSC** Tools  
[Specialized]

**MT90** series

Holder	H63TH-DCLNR-DX12
Insert (Grade)	CNMG120408-LS (MT9015)
Work Material	Ti-6Al-4V
Cutting Speed	vc 80, 120 m/min (262, 394 SFM)
Feed	f 0.15 mm/rev (.006 IPR)
Depth of Cut	ap 0.25 mm (.010 inch)
Coolant	Wet (Emulsion)



Internal turning



# ENGINE FAN CASE



P715G  
[Metric]

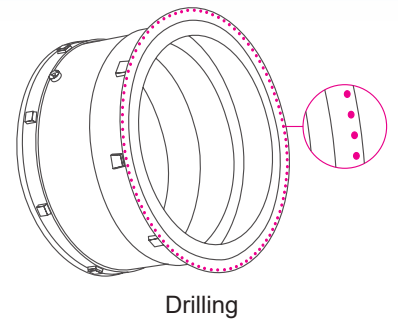
[CFRP/Aluminum Alloy]

The MCA drill series adapts a geometry that improves the aluminum chip disposal, thus preventing damage to the CFRP layer. It also reduces the gap in hole size between the interface of the aluminum and CFRP layer.

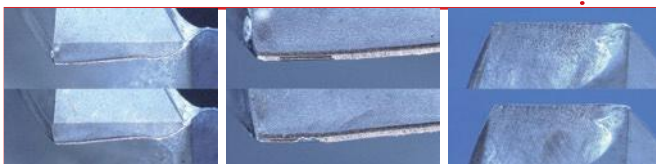
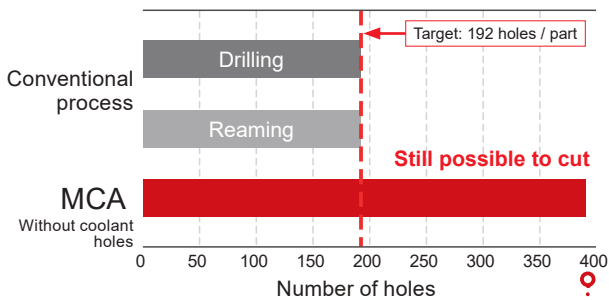


**MCA**

Drill (Grade)	ø7.976 mm (.314 inch) (DD2110) [Specialized]
Work Material	[CFRP] 13.2 mm (.52 inch)
	[Al] 4 mm (.157 inch)
Cutting Speed	vc 125 m/min (410 SFM), n 4,991 min <sup>-1</sup>
Feed	[CFRP] f 0.10 mm/rev (.004 IPR), vf 499 mm/min (19.65 IPM)
	[Al] f 0.20 mm/rev (.008 IPR), vf 998 mm/min (39.30 IPM)
Coolant	Dry (External air)



Drilling



Cutting edges after drilling 390 holes



B060G  
[Metric]

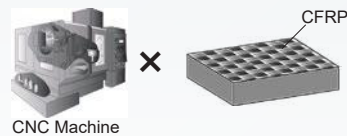
# ENGINE FAN CASE

[CFRP]

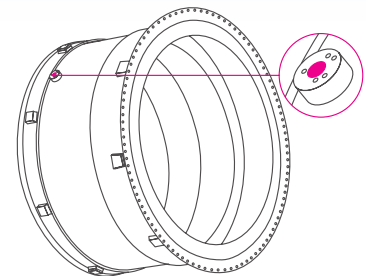
This special TAW adopts a similar cutting edge geometry as the MCA drill that prevents burr development when machining of CFRP materials.  
The TAW insert uses a CVD diamond coating that results in longer tool life.



**TAW**



Holder	TAWMN2500S32
Insert (Grade)	ø25 mm (.984 inch) CVD diamond coated insert [Specialized]
Work Material	CFRP
Cutting Speed	vc 100 m/min (328 SFM), n 1,274 min <sup>-1</sup>
Feed	f 0.06 mm/rev (.002 IPR), vf 76.44 mm/min (3.01 IPM)
Hole Depth	13 mm (.512 inch)
Coolant	Dry (External air)
Machine	Vertical M/C (HSK-A63)

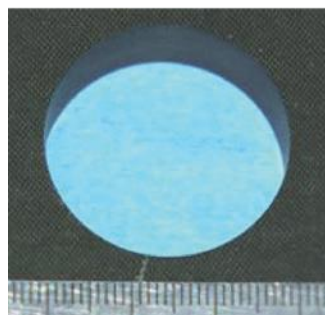


Drilling

Entrance



Exit



# ENGINE FAN DISK

[Titanium Alloy]

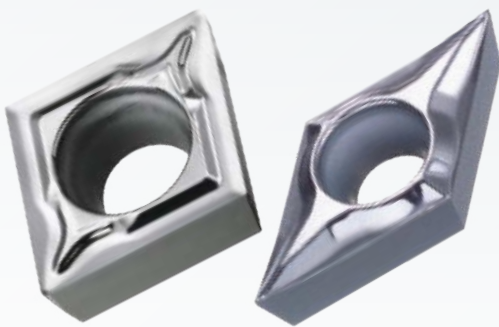
MT90 series is specifically designed for machining of titanium alloys.  
 MT9005: Unmatched heat and plastic deformation resistance leading to superior wear resistance for high speed machining applications.  
 MT9015: The first recommendation for turning of titanium alloys offers a good balance of both wear and fracture resistance.  
 There are also polish finished insert types that offer increased welding resistance leading to further tool life.



B214G  
[Metric]



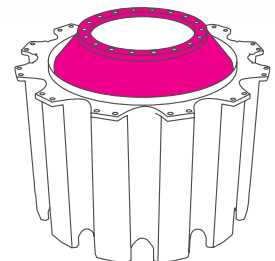
B214A  
[Imperial]



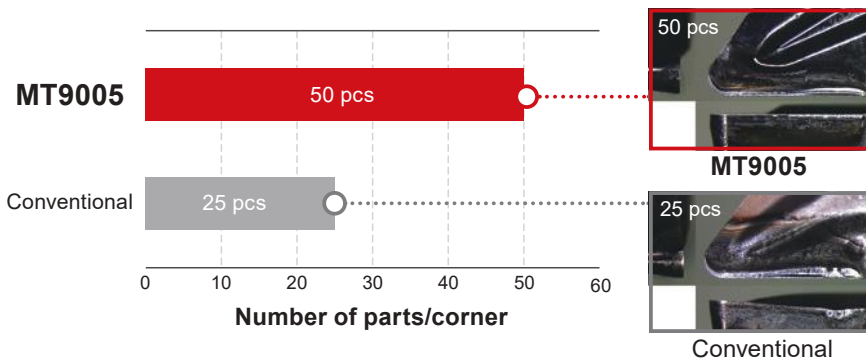
**MT90** Series



Insert (Grade)	DCGT11T304-LS-P (MT9005)
Work Material	Ti-6Al-4V
Cutting Speed	vc 80 m/min (262 SFM)
Feed	f 0.05 mm/rev (.002 IPR)
Depth of Cut	ap 3.0 mm (.118 inch)



External and face turning







B230G  
[Metric]



B230A  
[Imperial]

# ENGINE FAN DISK

[Titanium Alloy]

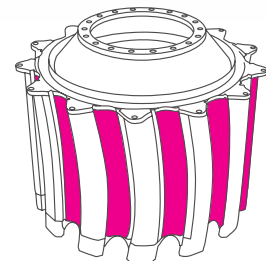
Center through coolant combined with the use of irregular helix that prevents chatter leads to high efficiency machining of titanium alloys while maintaining effective chip disposal.



**SMART MIRACLE  
VQT5MVRB**



End mill	VQT5MVRB160R300N048C
Work Material	Ti-6Al-4V
Cutting Speed	vc 60 m/min (197 SFM) , n 1,200 min <sup>-1</sup>
Feed	fz 0.11 mm/tooth (.004 IPT), vf 660 mm/min (25.984 IPM)
Depth of Cut	ap 16 mm (.63 inch), ae 16 mm (.63 inch) (Slot milling)
Overhang Length	48 mm (3D) (1.89 inch)
Coolant	Wet (Emulsion)
Machine	Vertical M/C (BT50)



Slotting

## High efficiency slotting milling tool life test

**Conventional** 6 slot : Break



**VQT5MVRB** 18 slot : Chipping



# ENGINE FAN DISK

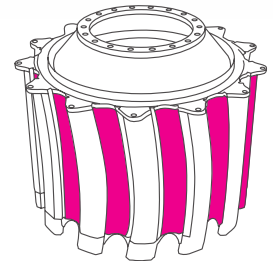
[Titanium Alloy]

Center through coolant combined with the use of irregular helix that prevents chatter leads to high efficiency machining of titanium alloys while maintaining effective chip disposal.



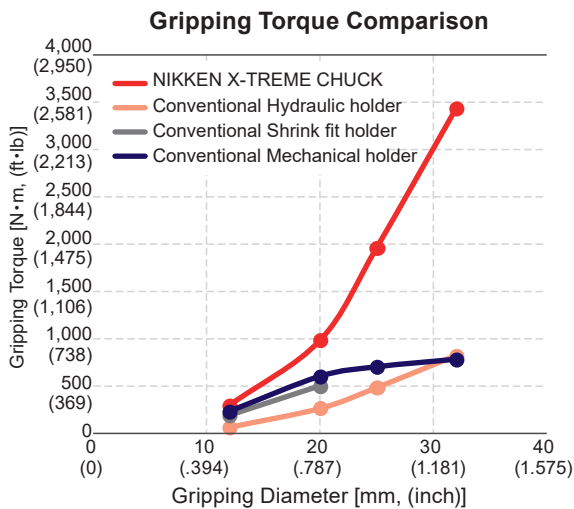
**Roughing End mill**  
[Specialized]

The flat is ground in accordance with NIKKEN X-TREME CHUCK, the mechanism prevents end mill from pulling out. X-TREME CHUCK is supplied from NIKKEN KOSAKUSHO WORKS, LTD.



Slotting

End mill	ø25 mm (.984 inch) , R3.0 mm (.118 inch), Z=6
Work Material	Ti-6Al-4V
Cutting Speed	vc 45 m/min (148 SFM), n 573 min <sup>-1</sup>
Feed	fz 0.07 mm/tooth (.003 IPT), vf 241 mm/min (9.49 IPM)
Depth of Cut	ap 50 mm (1.969 inch), 2D Slot milling
Overhang Length	75 mm (3D) (2.953 inch)
Machine	Vertical M/C (BT50)



**MRR : 300 cm<sup>3</sup>/min  
(18.3 in<sup>3</sup>/min)**



B256G  
[Metric]



B256A  
[Imperial]

# ENGINE FAN DISK

[Titanium Alloy]

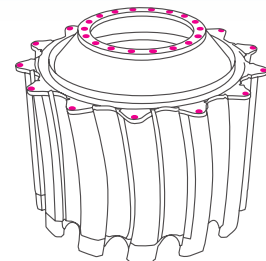
The DSA solid carbide drill series employs a geometry and coating that prevents heat generation when machining, preventing work hardening, maintaining hole quality and providing longer tool life.



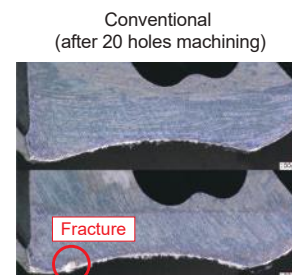
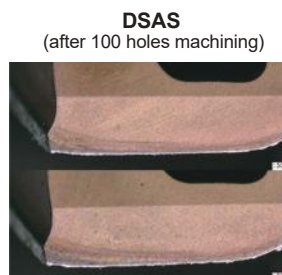
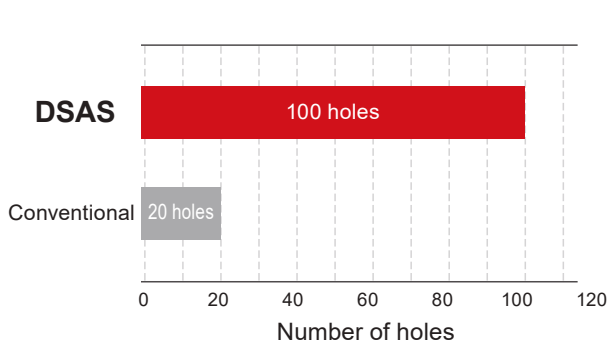
**DSA**



Drill (Grade)	DSAS0700X03S080 (DP9020)
Work Material	Ti-6Al-4V
Cutting Speed	vc 40 m/min (131 SFM), n 1,820 min <sup>-1</sup>
Feed	f 0.15 mm/rev (.006 IPR), vf 273 mm/min (10.7 IPM)
Hole Depth	10 mm (.394 inch) (Through hole)
Coolant	Wet {Emulsion [Internal (10%)]}
Machine	Vertical M/C



Drilling





B214G  
[Metric]



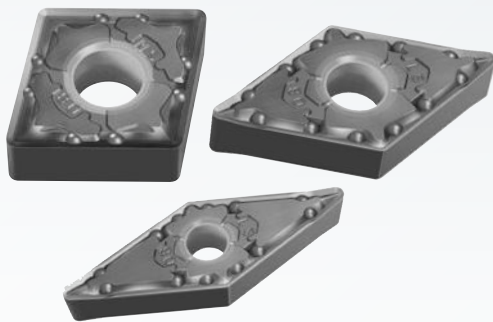
B214A  
[Imperial]

# ENGINE TURBINE DISK

[Titanium Alloy]

MT90 series is specifically designed for machining of titanium alloys.  
 MT9005: Unmatched heat and plastic deformation resistance leading to superior wear resistance for high speed machining applications.

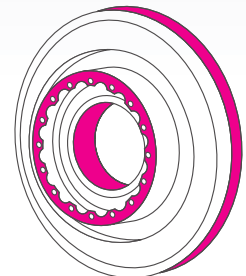
MT9015: The first recommendation for turning of titanium alloys offers a good balance of both wear and fracture resistance.



**MT90** Series

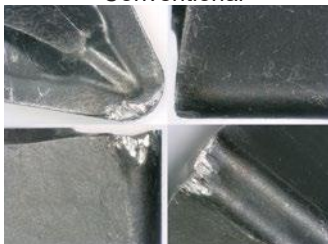


Holder	DDJNL2525M15
Insert (Grade)	DNMG150408-LS (MT9015)
Work Material	Ti-6Al-2Sn-4Zr-6Mo
Cutting Speed	vc 50 m/min (164 SFM)
Feed	f 0.15 mm/rev (.006 IPR)
Depth of Cut	ap 1.0 mm (.039 inch)
Coolant	Wet
Machine	CNC Lathe



External, internal and face turning

Conventional



VB 0.63 mm (.025 inch)

MT9015



VB 0.08 mm (.003 inch)



# ENGINE TURBINE DISK

[Heat Resistant Superalloy]

The MP90 series use “Al-rich Technology”, this leads to the coating to be able to maintain high hardness and stability. The result of which results in improving wear and welding resistance when machining HRSA materials.



B134G  
[Metric]



B214G  
[Metric]



B214A  
[Imperial]



**HSK-T Tools**

**PSC Tools**  
[Specialized]

**MT90 series**

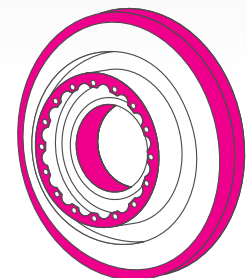


<MP9015>

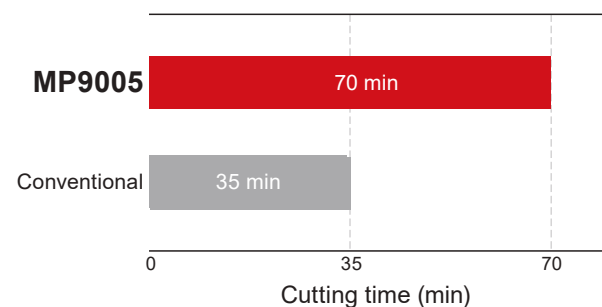
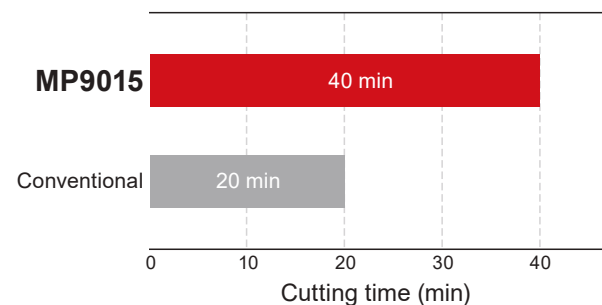
Holder	DCLNL3225P12
Insert (Grade)	CNMG120408-MS (MP9015)
Work Material	Inconel 718
Cutting Speed	vc 40 m/min (131 SFM)
Feed	f 0.2 mm/rev (.008 IPR)
Depth of Cut	ap 2 mm (.079 inch)
Coolant	Wet (Emulsion)

<MP9005>

Holder	DCLNL3225P12
Insert (Grade)	CNMG120408-LS (MP9005)
Work Material	Inconel 625
Cutting Speed	vc 50 m/min (164 SFM)
Feed	f 0.15 mm/rev (.006 IPR)
Depth of Cut	ap 0.5 mm (.02 inch)
Coolant	Wet (Emulsion)



External, internal and face turning





B134G  
[Metric]



B036A  
[Imperial]

# ENGINE TURBINE DISK

[Heat Resistant Superalloy]

The US905 CVD coated grade is suitable for medium though to high speed machining application of nickel based alloys.



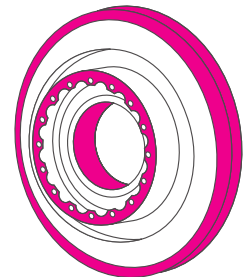
**HSK-T** Tools



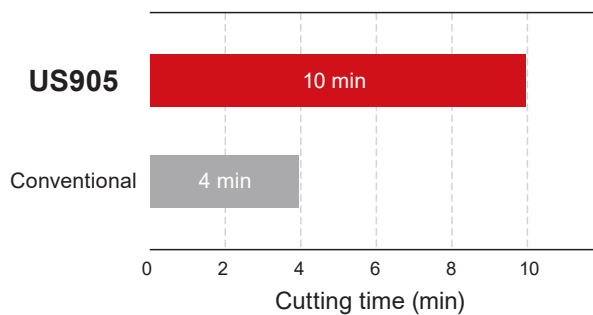
**US905**



Holder	H63TH-PRDCN-H12
Insert (Grade)	RCMX1204M0 (US905)
Work Material	Inconel 718
Cutting Speed	vc 100 m/min (328 SFM)
Feed	f 0.15 mm/rev (.006 IPR)
Depth of Cut	ap 0.5 mm (.02 inch)
Coolant	Wet (Emulsion)



External, internal and face turning





B231G  
[Metric]



B075A  
[Imperial]

# ENGINE TURBINE DISK

[Heat Resistant Superalloy]

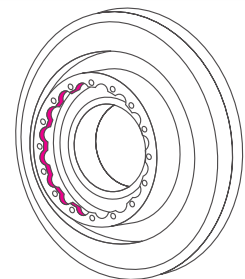
The VF series end mills can be effectively used for scallop machining where it is important to have a tool that offers high heat and wear resistance as well as offering effective chip disposal.



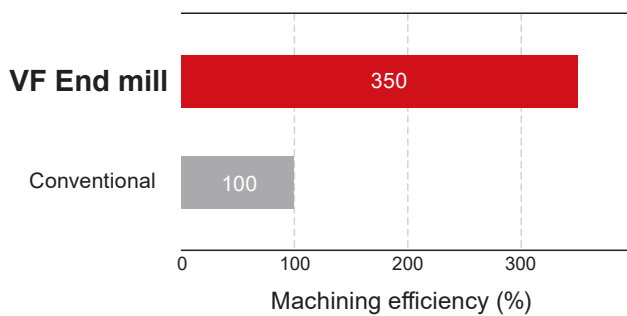
**VF End mill**



End mill	ø12 mm (.472 inch), Z=9 [Specialized]
Work Material	Inconel 718
Cutting Speed	vc 20 m/min (66 SFM), n 530 min <sup>-1</sup>
Feed	fz 0.04 mm/tooth (.002 IPT), vf 191 mm/min (7.52 IPM)
Depth of Cut	ap 3.0 mm (.118 inch), ae 1.0 mm (.039 inch)



Scallop machining





B256G  
[Metric]



B256A  
[Imperial]

# ENGINE TURBINE DISK

[Heat Resistant Superalloy]

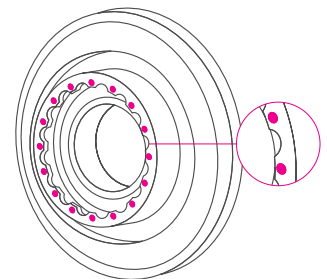
The DSA solid carbide drill series employs a geometry and coating that prevents heat generation when machining, preventing work hardening, maintaining hole quality and providing longer tool life.



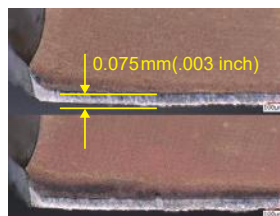
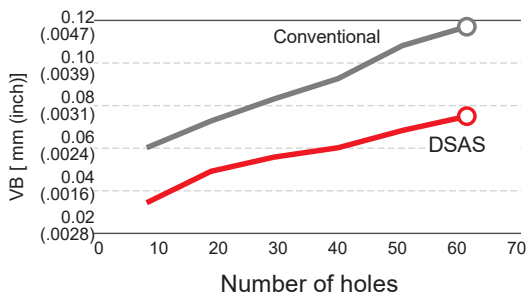
**DSA**



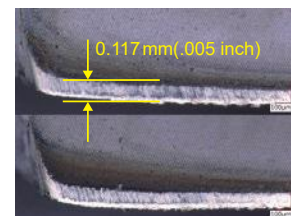
Drill (Grade)	DSAS0700X03S080 (DP9020)
Work Material	Inconel 718
Cutting Speed	vc 15 m/min (49 SFM), n 682 min <sup>-1</sup>
Feed	f 0.1 mm/rev (.004 IPR), vf 68.2 mm/min (2.69 IPM)
Hole Depth	12 mm (.472 inch) (Through hole)
Coolant	Wet [WSO (Internal)]
Machine	Vertical M/C



Drilling



**DSAS**



Conventional





B256G  
[Metric]



B256A  
[Imperial]

# ENGINE TURBINE DISK

[Heat Resistant Superalloy]

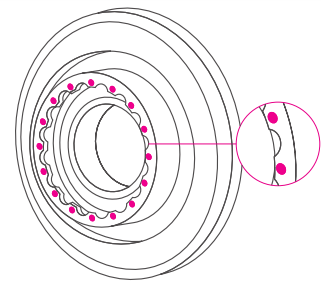
The DSA solid carbide drill series employs a geometry and coating that prevents heat generation when machining, preventing work hardening, maintaining hole quality and providing longer tool life.



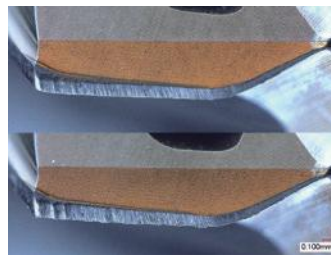
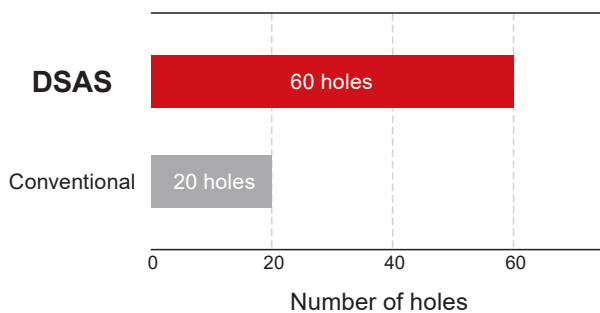
**DSA**



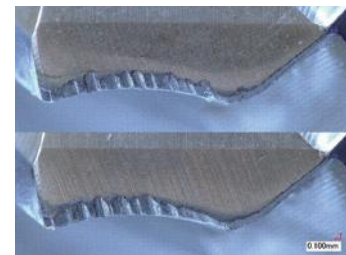
Drill (Grade)	DSAS0580X03S060 (DP9020)
Work Material	RENE 41
Cutting Speed	vc 23.6 m/min (77 SFM), n 1,296 min <sup>-1</sup>
Feed	f 0.05 mm/rev (.002 IPR), vf 64.8 mm/min (2.55 IPM)
Hole Depth	12 mm (.472 inch) (Through hole)
Coolant	Wet (Internal)



Drilling



**DSAS**  
(60 holes)



Conventional  
(20 holes)



B200G  
[Metric]



B200A  
[Imperial]

# ENGINE TURBINE DISK

[Heat Resistant Superalloy]

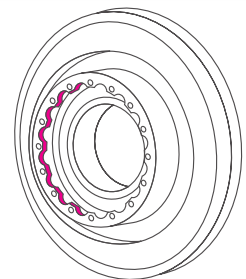
The iMX exchangeable head end mill series is suitable for applications where the axial depth of cut is limited. The series employs high wear resistance tool grades and a selection of number of teeth variations enabling an increase in machining efficiency and longer tool life.



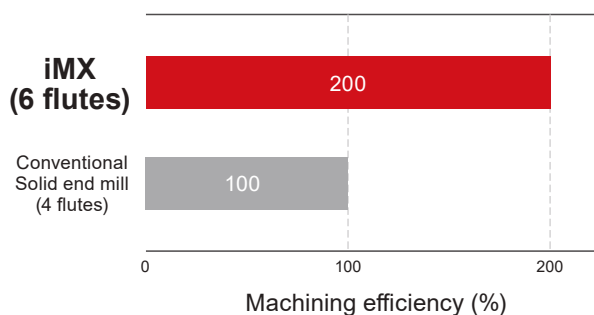
**iMX**



Holder	IMX12-U12N017L080C
Head (Grade)	IMX12C6HV120R10012 (EP7020)
Work Material	RENE 41 (HRC33)
Cutting Speed	vc 40 m/min (131 SFM), n 1,060 min <sup>-1</sup>
Feed	fz 0.035 mm/tooth(.0014 IPT), vf 220 mm/min (8.7 IPM)
Depth of Cut	ap 4 mm (.1575 inch), ae 2 mm (.0787 inch)
Coolant	Wet (Emulsion)
Machine	Vertical M/C



Scallop machining



# ENGINE TURBINE DISK

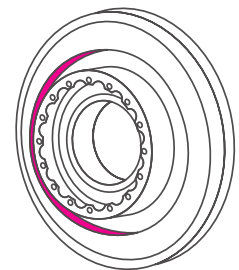
[Heat Resistant Superalloy]

When machining of nickel based alloys, the reliable clamping mechanism of GY system makes it possible to machine with high productivity. MP9000 series are added in GY inserts.

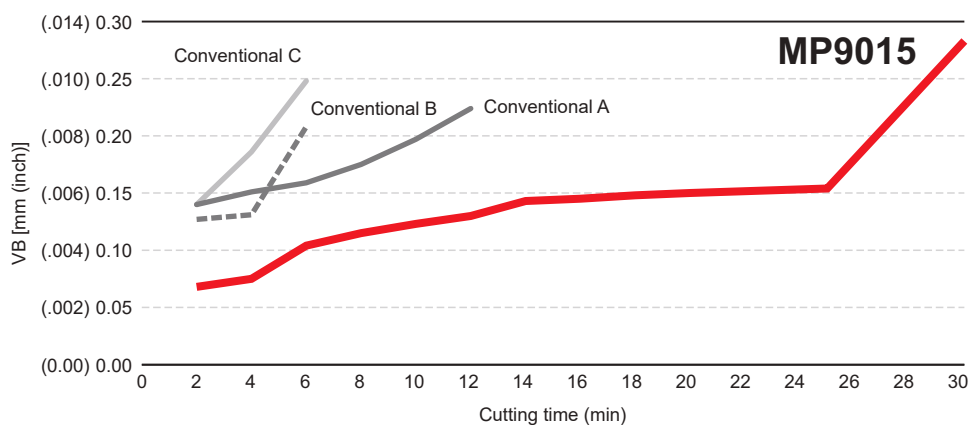


**GY**

Holder (Modular)	GYHR2525M00-M25R (GYM25RA-F12)
Insert (Grade)	GY2M0300F150F150N-BM (MP9015)
Work Material	Inconel 718
Cutting Speed	vc 50 m/min (164 SFM)
Feed	f 0.05 mm/rev (.002 IPR)
Depth of Cut	ap 1 mm (.04 inch)
Coolant	Wet



Copy Turning



# ENGINE BLISK

[Heat Resistant Superalloy]

The MP90 series use “Al-rich Technology”, this leads to the coating to be able to maintain high hardness and stability. Additionally, even for applications where the cutting depth exceeds the corner radii high cutting edge stability can be maintained.



B214G  
[Metric]



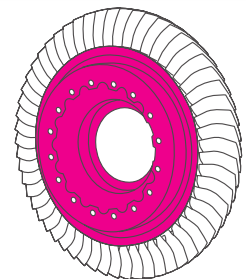
B214A  
[Imperial]



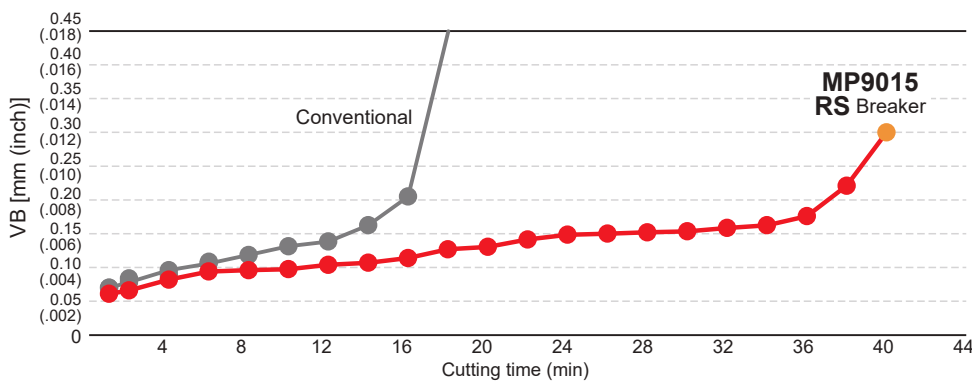
**MP90 Series**



Inserts (Grade)	CNMG120408-RS (MP9015)
Work Material	Inconel 718
Cutting Speed	vc 40 m/min (131 SFM)
Feed	f 0.2 mm/rev (.008 IPR)
Depth of Cut	ap 2.0 mm (.08 inch)
Coolant	Wet



External, internal and  
face turning



Conventional  
18 min



MP9015 RS Breaker  
40 min





B197G  
[Metric]



B197A  
[Imperial]

# ENGINE BLISK

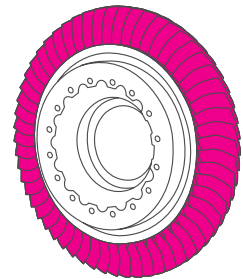
[Heat Resistant Superalloy]

The SMART MIRACLE series can also be effectively used for trochoidal machining applications. General slotting applications high heat and chip disposal can be problematic, using the trochoidal machining method possible to increase both speed and feed while maintaining stable tool life.

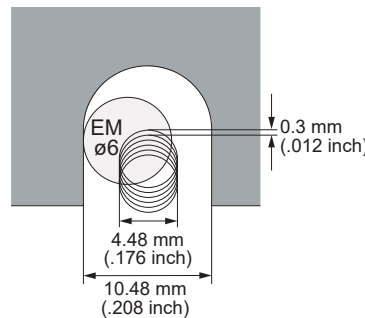
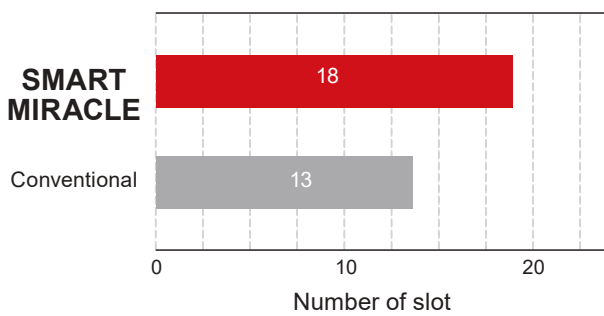


## SMART MIRACLE VQ End mill

End mill	VQMHRBD0600R050
Work Material	Inconel 718
Cutting Speed	vc 120 m/min (394 SPM), n 6,366 min <sup>-1</sup>
Feed	f 0.15 mm/rev (.006 IPR), vf 3,820 mm/min (150.394 IPM)
Slot depth	10 mm (.394 inch)
Coolant	Wet [WSO (External)]
Machine	Horizontal M/C (HSK-A100)



Rough milling



# ENGINE BLISK

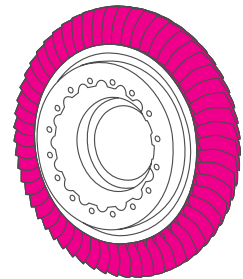
[Heat Resistant Superalloy]

VQN end mills in SMART MIRACLE series are dedicated tools to machine heat resistant superalloys, optimized coating on suitable edge geometry realizes high feed milling.

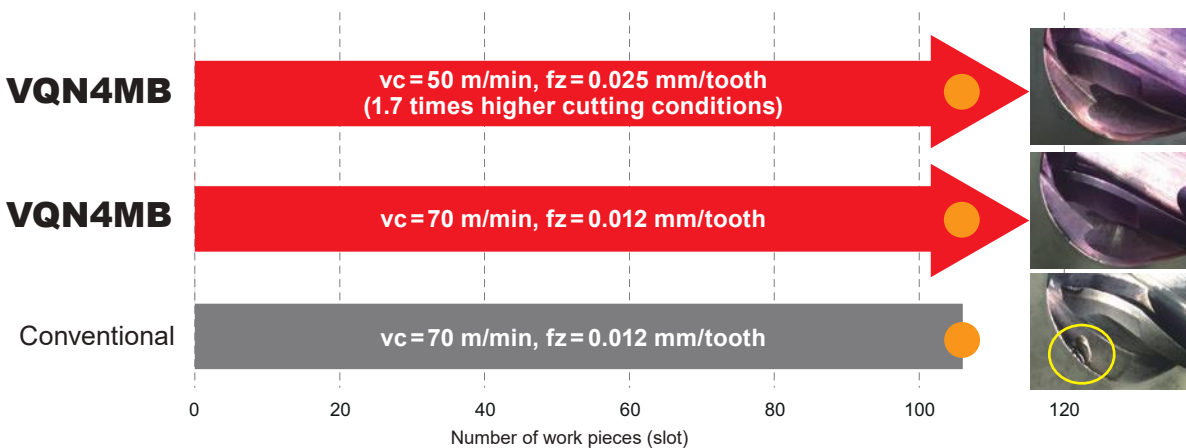


## SMART MIRACLE VQN End mill

End mill	VQN4MBR0500
Work Material	Inconel 718
Cutting Speed	vc 50 m/min (164 SFM), n 1,592 min <sup>-1</sup> vc 70 m/min (230 SFM), n 2,229 min <sup>-1</sup>
Feed	fz 0.025 mm/tooth (.001 IPT) fz 0.012 mm/tooth (.0005 IPT)
Depth of Cut	Wet [Emulsion (External)]
Machine	5-axis M/C



Profile milling





B197G  
[Metric]



B197A  
[Imperial]

# ENGINE BLISK

[Heat Resistant Superalloy]

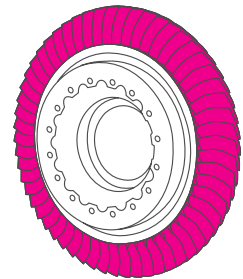
Due to low thermal conductivity and ease of work hardening, it is necessary to have a cutting edge geometry and coating that can reduce these problems. The SMART MIRACLE vibration control end mill series offers such a solution, this series also uses a variable pitch design that also prevents vibrations from occurring further extending tool life.



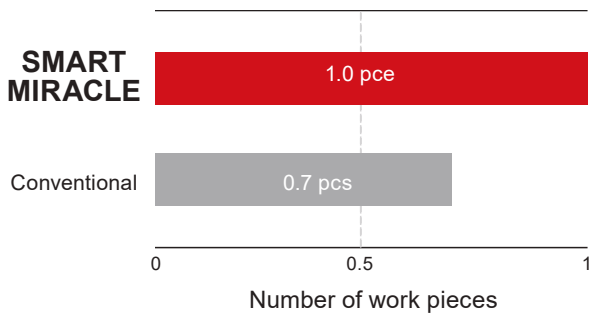
## SMART MIRACLE

Taper ball nose end mill  
[Specialized]

End mill	ø6 mm (.236 inch), R3.0 mm (.118 inch), Z=4
Work Material	Inconel 718
Cutting Speed	vc 113 m/min (371 SFM), n 6,000 min <sup>-1</sup>
Feed	fz 0.06 mm/tooth (.002 IPT), vf 1,440 mm/min (56.693 IPM)
Depth of Cut	ap 0.4 mm (.016 inch), ae 0.5 mm (.02 inch)
Coolant	Wet (Emulsion)



Finish profile milling



# ENGINE BLISK

[Titanium Alloy]

MT90 series is specifically designed for machining of titanium alloys.  
 MT9005: Unmatched heat and plastic deformation resistance leading to superior wear resistance for high speed machining applications.

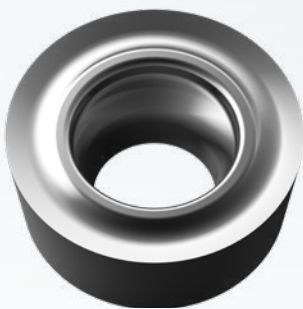
MT9015: The first recommendation for turning of titanium alloys offers a good balance of both wear and fracture resistance.



B214G  
[Metric]



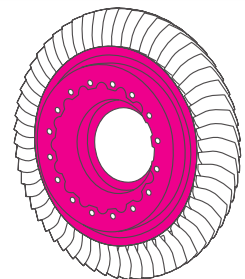
B214A  
[Imperial]



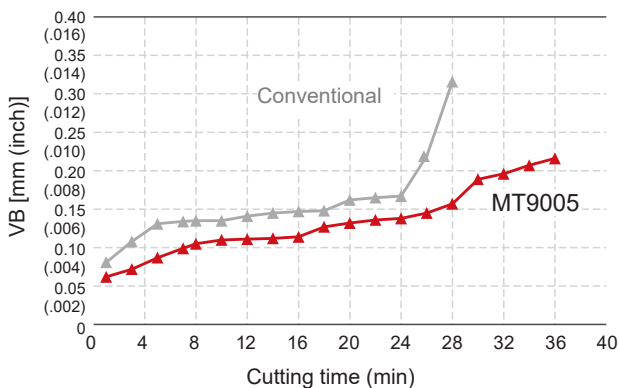
**MT90** Series



Insert (Grade)	RCMT1204M0 (MT9005)
Work Material	Ti-6Al-4V
Cutting Speed	vc 80 m/min (262 SFM)
Feed	f 0.3 mm/rev (.012 IPR)
Depth of Cut	ap 1.0 mm (.039 inch)
Coolant	Wet



External, internal and face turning



Cutting time : 28 min





B200G  
[Metric]



B200A  
[Imperial]

# ENGINE BLISK

[Titanium Alloy]

The iMX series offers a roughing radius corner type that is suitable for effectively machining out the root between the blades. The corner radius employed ensures that the fillets at the base of the root can also be effectively machined. The nicked roughing edge in use together with the through coolant ensures effective chip disposal.

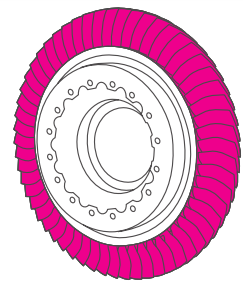


**iMX**

**Roughing Radius head**



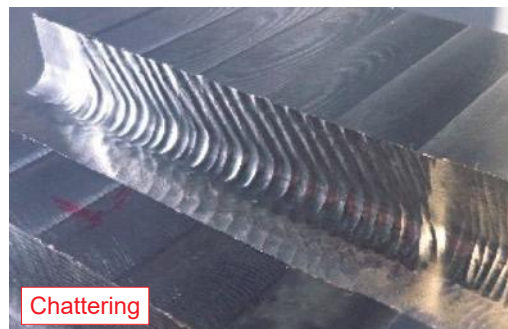
Head (Grade)	IMX16RC4F160R30016C (EP7020)
Work Material	Ti-6Al-4V
Cutting Speed	vc 40 m/min (131 SFM), n 796 min <sup>-1</sup>
Feed	fz 0.08 mm/tooth (.003 IPT), vf 255 mm/min (10.04 IPM)
Depth of Cut	ap 8 mm (.315 inch), ae 16 mm (.630 inch) (Slotting)
Overhang Length	64 mm (4D) (2.52 inch)
Coolant	Wet [Emulsion (External)]
Machine	Vertical M/C



Slotting



**iMX Roughing Radius**



Conventional



B232G  
[Metric]



B232A  
[Imperial]

# ENGINE BLISK

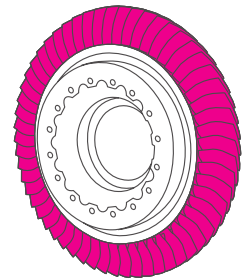
[Titanium Alloy]

The tangential barrel end mill, offering a full 3-flute center cutting edge to improve chip disposal, in combination with an irregular pitched 6-flute peripheral cutting edge enables efficient machining of the blisk rotors. Due to the tangential form peripheral cutting edge it is possible to increase pick feed leading to increased machining efficiency.

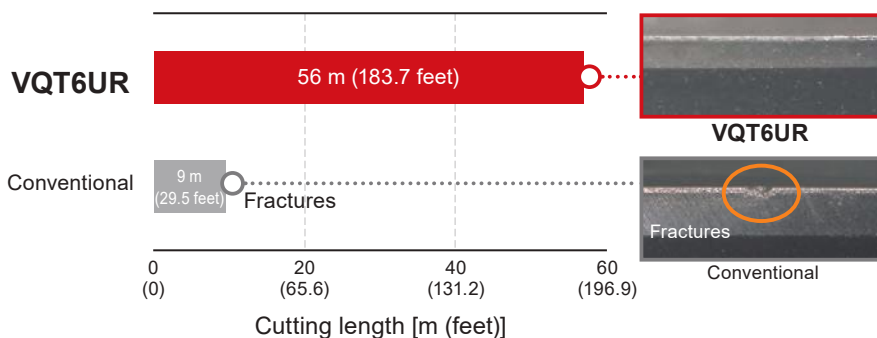


## SMART MIRACLE VQT6UR

End mill	VQT6URR020R085S10
Work Material	Ti-6Al-4V
Spindle Speed	n 2,546 min <sup>-1</sup>
Feed	fz 0.03 mm/tooth (.001 IPT)
Depth of Cut	ap 4.0 mm (.157 inch), ae 0.3 mm (.012 inch)
Tilt Angle	8°
Overhang Length	40 mm (1.575 inch)
Coolant	Wet [Emulsion (External)]
Machine	5-axis M/C (HSK-A63)



Finish profile milling





B197G  
[Metric]



B197A  
[Imperial]

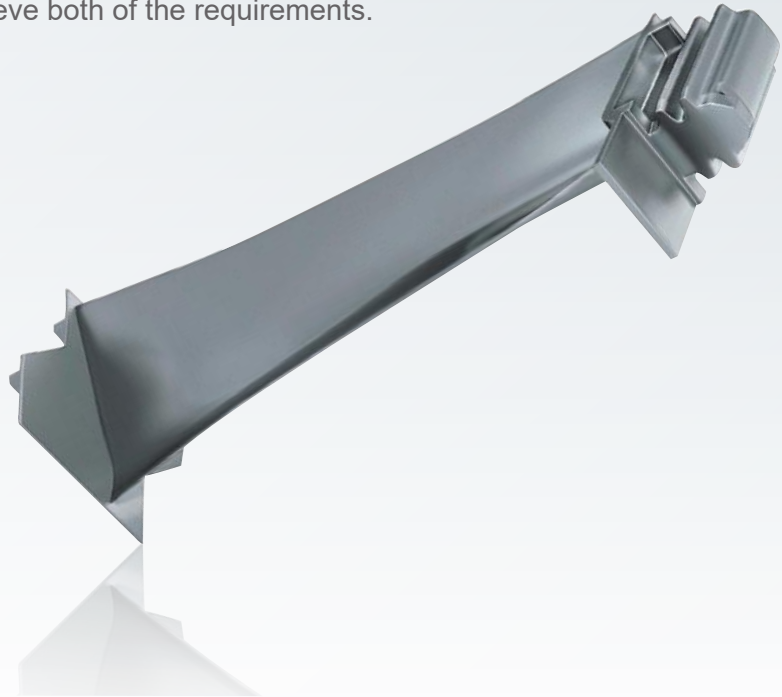
# ENGINE LPT-BLADE

[Titanium aluminum Alloy]

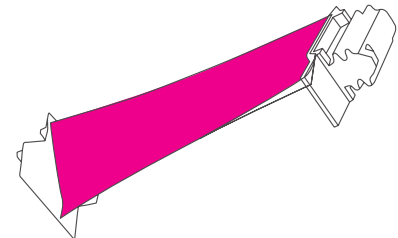
Titanium-Aluminum alloys which have low thermal conductivity leads to extreme heat buildup around the cutting edge, thus making it necessary to effectively reduce heat generation and maintain high chip disposal. The SMART MIRACLE end mill series offers a sharp cutting edge geometry and a smooth coating layer that can achieve both of the requirements.



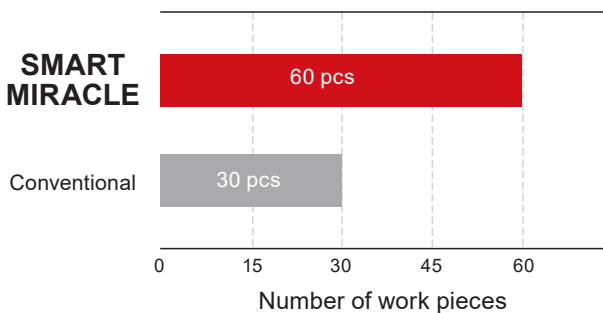
**SMART MIRACLE  
VQ End mill**



End mill	VQMHVRBD1200R100
Work Material	Titanium-Aluminum Alloy
Cutting Speed	vc 60 m/min (197 SFM), n 1,592 min <sup>-1</sup>
Feed	fz 0.08 mm/tooth (.003 IPT), vf 509 mm/min (20.039 IPM)
Depth of Cut	ap 2 mm (.079 inch), ae 1 mm (.039 inch)
Coolant	Wet (Emulsion)



Profile milling



# ENGINE

# Several parts made from CMC



P715G  
[Metric]

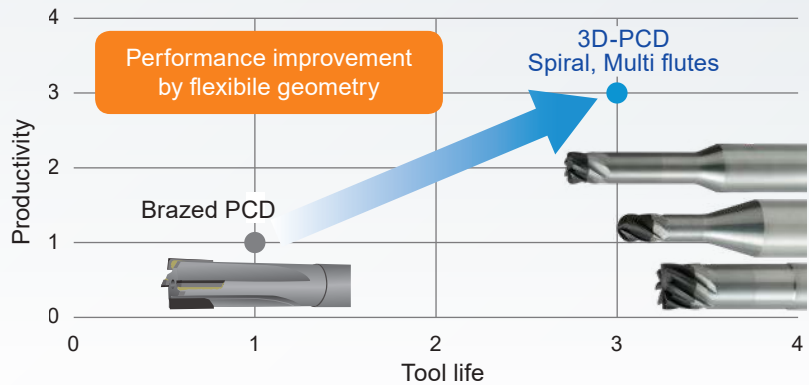
[Ceramic Matrix Composite]

PCD end mills offers a hard cutting edge that can maintain sharpness making it a solution for improving tool life when machining CMC (Ceramic Matrix Composites) materials, which are used for applications in high performance aviation engines due to its high heat resistance, high toughness and light weight.

Spiral multi flutes make it possible to machine with high efficiency compared to brazed PCD end mill. PCD end mill also provides excellent cutting performance when machining abrasive materials such as CFRP, MMC (Metal Matrix Composites).



**3D-PCD End mill**  
[Specialized]



End mill	ø6 mm (.236 inch) × R1.0 mm (.039 inch)
Work Material	CMC (SiC-SiC) , 50 × 50 × 10 mm (1.97 × 1.97 × .39 inch)
Cutting Speed	vc 100 m/min (328 SFM), n 5,308 min <sup>-1</sup>
Feed	3D-PCD fz 0.01 mm/tooth (.0004 IPT), vf 424 mm/min (16.7 IPM) Brazed PCD fz 0.01 mm/tooth (.0004 IPT), vf 212 mm/min (8.35 IPM)
Depth of Cut	ap 1 mm (.039 inch), ae 3 mm (.118 inch)
Coolant	Air blow & Dust collector

## 3D-PCD

ø6 mm (.236 inch) × R1.0 mm (.039 inch)  
8 flutes

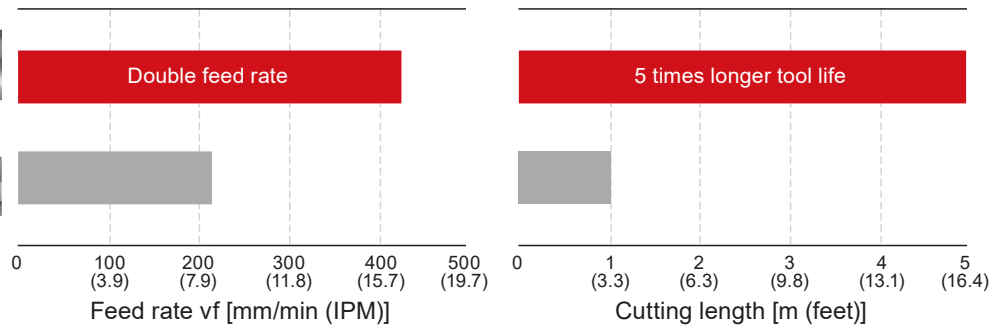
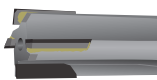


Double feed rate

5 times longer tool life

## Conventional Brazed PCD

ø6 mm (.236 inch) × R0.4 mm (.016 inch)  
4 flutes







B055G  
[Metric]



B055A  
[Imperial]

# ENGINE COMBUSTION CASE

[Heat Resistant Superalloy]

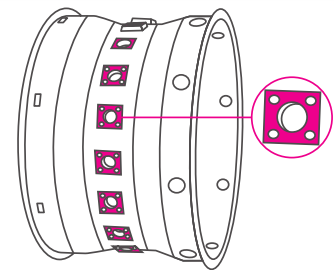
When machining of nickel based alloys problems such as low thermal conductivity and ease in work-hardening are prominent problems. In order to overcome these problems the APX series is designed with a suitable cutting edge geometry and comes in an array to effective tool grades to meet this demand.



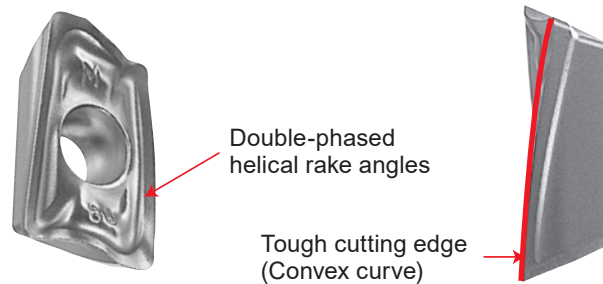
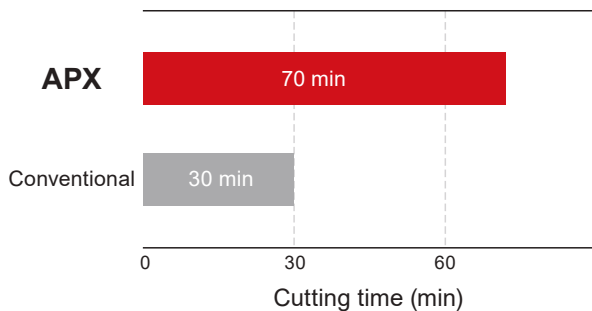
APX



Holder	APX3000-050A07RA
Insert (Grade)	AOMT123620PEER-M (MP9130)
Work Material	Inconel 718
Cutting Speed	vc 30 m/min (98 SFM), n 190 min <sup>-1</sup>
Feed	fz 0.03 mm/tooth (.001 IPT), vf 40 mm/min (1.575 IPM)
Depth of Cut	ap 1 mm (.039 inch), ae 40 mm (1.575 inch)
Coolant	Wet (Emulsion)



Face milling



# ENGINE COMBUSTION CASE

[Heat Resistant Superalloy]

The MP9140 tool grade offers extremely high cutting edge stability and fracture resistance. The ARP type tool in combination with MP9140 ensures a stable cutting even for demanding roughing applications.



B222G  
[Metric]



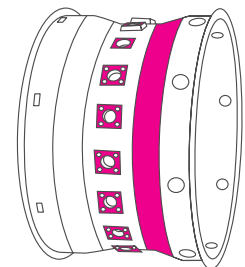
B222A  
[Imperial]



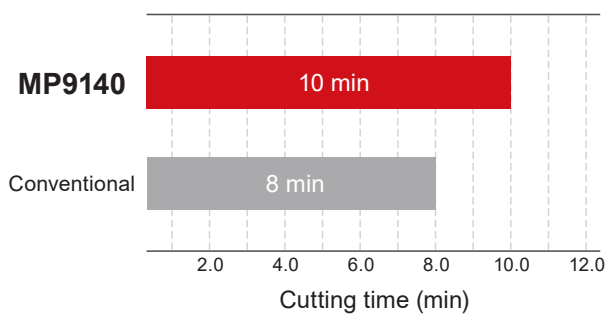
**ARP**



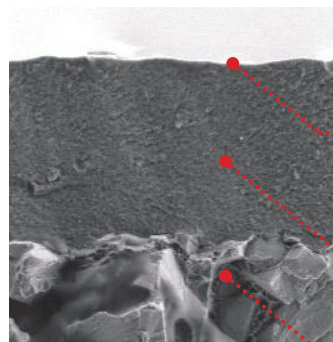
Holder	ARP6P-050A05AR
Insert (Grade)	RPMT1248M0E4-M2 (MP9140)
Work Material	Inconel 718
Cutting Speed	vc 44 m/min (144 SFM), n 280 min <sup>-1</sup>
Feed	fz 0.12 mm/tooth (.005 IPT), vf 168 mm/min (6.614 IPM)
Depth of Cut	ap 3.0 mm (.118 inch), ae 50 mm (1.969 inch)
Coolant	Wet
Machine	5-axis vertical M/C



Face and profile milling



MP9140 has excellent welding resistance due to smoothed surface



Smooth surface are excellent in proving welding resistance.

The high Al-rich AlTiN coating succeeds in dramatically improving wear and heat resistance.

Special cemented carbide substrate with improved fracture resistance.



B028G  
[Metric]



B028A  
[Imperial]

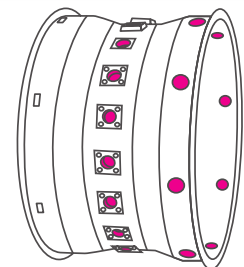
# ENGINE COMBUSTION CASE

[Heat Resistant Superalloy]

The MP9140 tool grade offers extremely high cutting edge stability and fracture resistance. The AJX type tool in combination with MP9140 ensures a stable cutting even for demanding roughing applications.

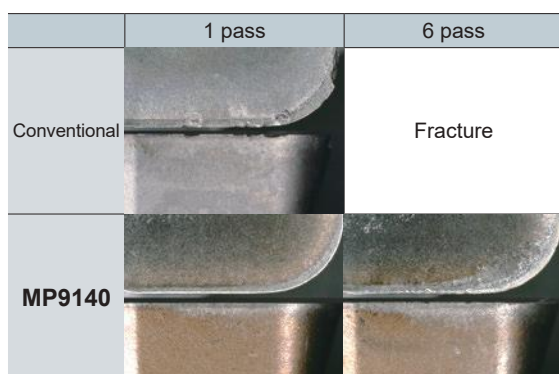


**AJX**



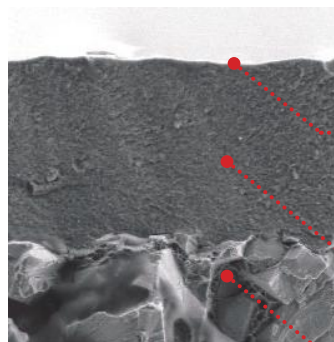
Helical milling

Holder	AJX12-050A04R
Insert (Grade)	JDMT120423ZDER-JL (MP9140)
Work Material	Inconel 718
Cutting speed	vc 40 m/min (131 SFM), n 255 min <sup>-1</sup>
Feed	fz 0.3 mm/tooth (.012 IPT), vf 306 mm/min (12.04 IPM)
Hole Diameter	ø87 mm (3.43 inch)
Overhang Length	250 mm (9.843 inch)
Coolant	Wet [WSO (15-17%)]



**Cutting length : 6 times**

MP9140 has excellent welding resistance due to smoothed surface



**Smooth surface are excellent in proving welding resistance.**

**The high Al-rich AlTiN coating succeeds in dramatically improving wear and heat resistance.**

**Special cemented carbide substrate with improved fracture resistance.**



B228G  
[Metric]



B228A  
[Imperial]

# ENGINE COMBUSTION CASE

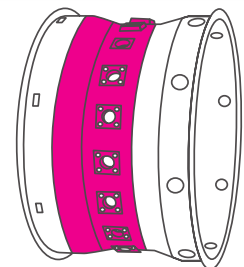
[Heat Resistant Superalloy]

Nickel based alloys, such as Inconel 718, tend to reduce hardness at temperatures exceeding 800 °C. At this temperature range, where the work piece is slightly softer, it is possible to effectively use ceramic end mills for high feed and speed applications.



## CERAMIC End mill

End mill	CE6SRBD1000R100
Work Material	Inconel 718 (HRC45)
Depth of Cut	ap 7.0 mm (.276 inch), ae 1.0 mm (.039 inch)
Overhang Length	20 mm (.787 inch)
Coolant	Ceramic : Dry (External air), Carbide end mill : Wet (External)



Profile milling

Before cutting		After cutting (12 m / 39.4 feet)	
		Edge	Corner
<b>CE6SRB</b>			
	Cutting Speed : 600 m/min (1,969 SFM), n 19,098 min <sup>-1</sup>  Feed : 6,875 mm/min (270.669 IPM)		
Carbide end mill (6 flutes)			
	Cutting Speed : 60 m/min (197 SFM), n 1,910 min <sup>-1</sup>  Feed : 688 mm/min (27.087 IPM)		





B214G  
[Metric]

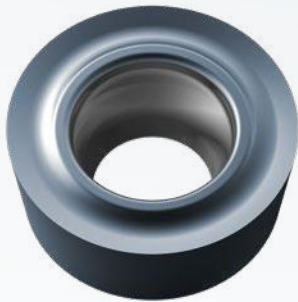


B214A  
[Imperial]

# ENGINE COMBUSTION CASE

[Heat Resistant Superalloy]

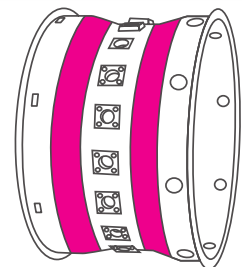
The MP90 series use “Al-rich Technology”, this leads to the coating to be able to maintain high hardness and stability. Offering increased wear and welding resistance for applications with heat resistant superalloys.



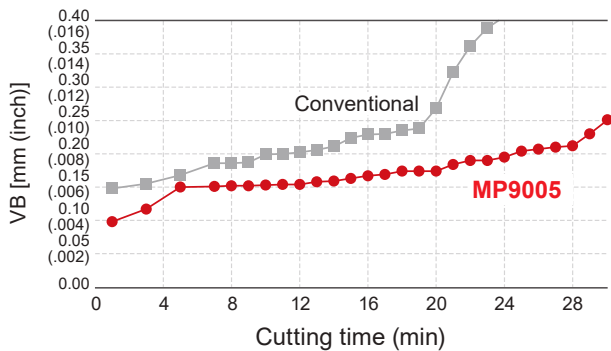
**MP90** Series



Insert (Grade)	RCMT1204M0 (MP9005)
Work Material	Inconel 718
Cutting Speed	vc 50 m/min (164 SFM)
Feed	f 0.3 mm/rev (.012 IPR)
Depth of Cut	ap 1.0 mm (.039 inch)
Coolant	Wet



External turning



Cutting time : 20 min

# ENGINE COMBUSTION CASE

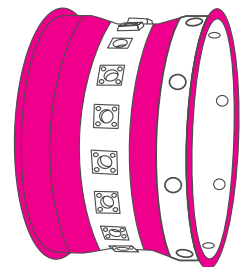
[Heat Resistant Superalloy]

New GBi59-CBN is a dedicated grade for machining of heat resistant superalloys, GBi59 used together with a high pressure coolant holder can be effectively applied to high speed finishing applications of nickel based alloys, the solution enables productivity to be increased remarkably.

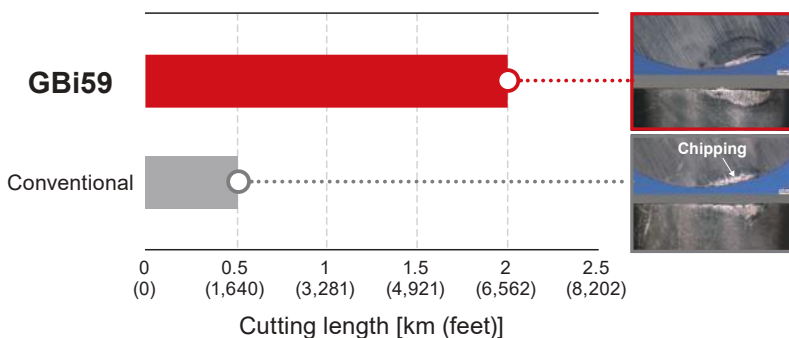


**GBi59 (CBN)**  
[Specialized]

Holder	High pressure coolant holder [Specialized]
Insert (Grade)	DNGA150412 (GBi59) [Specialized]
Work Material	Inconel 718
Cutting Speed	vc 350 m/min (1,148 SFM)
Feed	f 0.15 mm/rev (.006 IPR)
Depth of Cut	ap 0.15 mm (.006 inch)
Coolant	Wet [7 MPa (1,015 PSI)]
Machine	5-axis Mill-Turn Machine



External and face turning



B202G  
[Metric]B202A  
[Imperial]

# ENGINE COMBUSTION CASE

[Heat Resistant Superalloy]

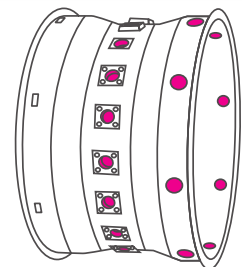
For drilling applications of nickel based alloys, it is necessary to have a reliable cutting edge to prevent chipping. The MVX indexable drill series uses a geometry that ensures cutting edge stability and sharpness so as to maintain hole quality.



**MVX**



Holder	MVX3000X2F32
Insert (Grade)	SOMX084005-UM (VP15TF) (Outer + Inner)
Work Material	Inconel 718 (HRC38)
Cutting Speed	vc 30 m/min (98 SFM), n 318 min <sup>-1</sup>
Feed	f 0.08 mm/rev (.003 IPR), vf 25.44 mm/min (1.002 IPM)
Hole depth	26 mm (1.024 inch) (blind hole)
Coolant	Wet [Emulsion (5%)]



Drilling

After 5 holes VB 0.096 mm (.004 inch)



Outer insert



Inner insert

# ENGINE COMBUSTION CASE



B256G  
[Metric]



B256A  
[Imperial]

[Heat Resistant Superalloy]

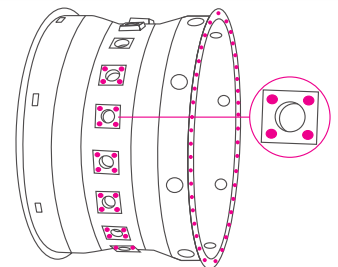
The DSA solid carbide drill series employs a geometry and coating that prevents heat generation when machining, preventing work hardening, maintaining hole quality and providing longer tool life.



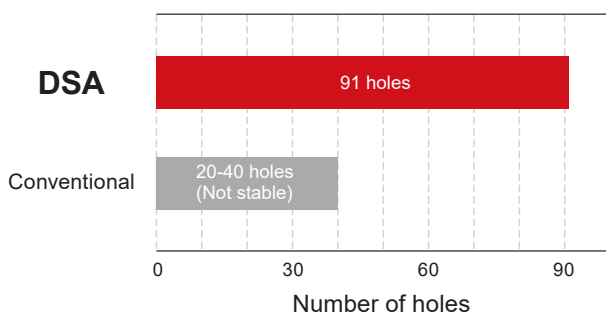
**DSA**



Drill (Grade)	DSAS0400X03S060 (DP9020)
Work Material	Inconel 718
Cutting Speed	vc 20 m/min (66 SFM), n 1,592 min <sup>-1</sup>
Feed	f 0.06 mm/rev (.002 IPR), vf 95.5 mm/min (3.761 IPM)
Hole Depth	12 mm (.472 inch)
Coolant	Wet (Internal)
Machine	5-axis vertical M/C



Drilling





# ENGINE COMBUSTION CASE

[Heat Resistant Superalloy]

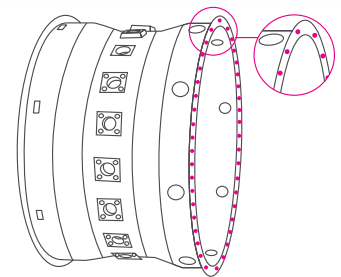
The DSA step drill without coolant holes and tool grade was able to maintain the required hole tolerance even after 120 holes, possible to achieve high quality hole finishing.



**DSA step drill**  
[Specialized]

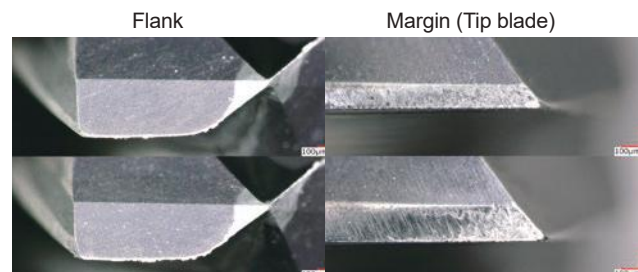
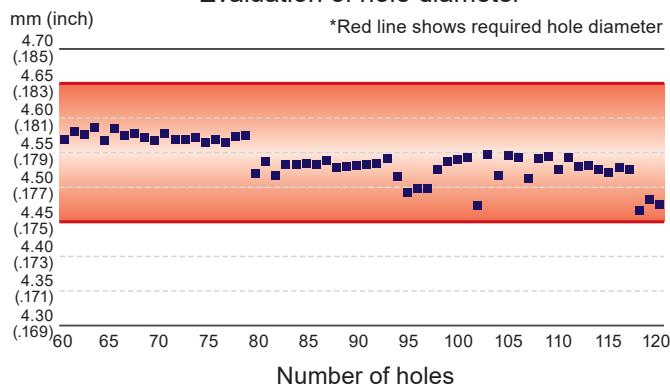


Drill (Grade)	ø4.6 mm (.181 inch) (PVD coated carbide)
Work Material	HASTELLOY X
Cutting Speed	vc 10 m/min (33 SFM), n 707 min <sup>-1</sup>
Feed	f 0.06 mm/rev (.002 IPR), vf 42.42 mm/min (1.67 IPM)
Hole Depth	1.5 mm (.059 inch) (Through hole)



Hole finishing

Evaluation of hole diameter





B214G  
[Metric]

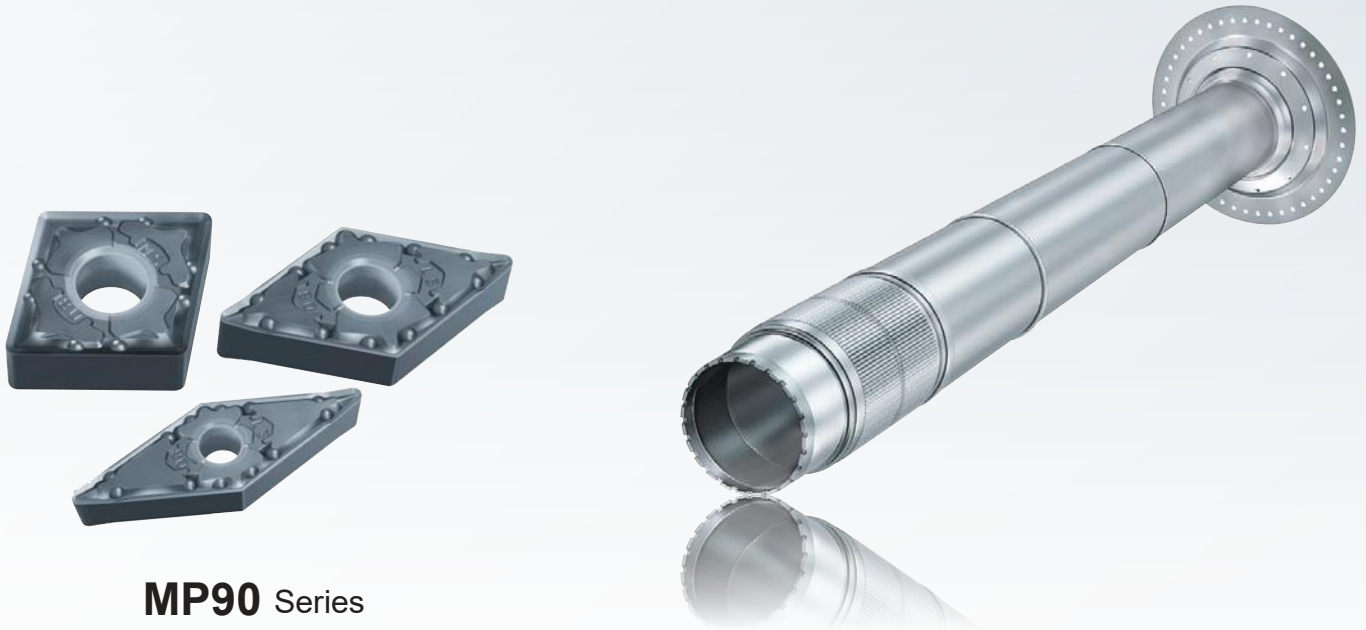


B214A  
[Imperial]

# ENGINE SHAFT

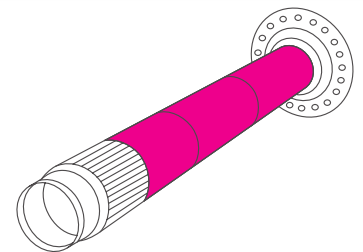
[Maraging Steel]

The MP90 series use “Al-rich Technology”, this leads to the coating to be able to maintain high hardness and stability. Even when machining of hardened maraging steel high wear and welding resistance can be achieved.

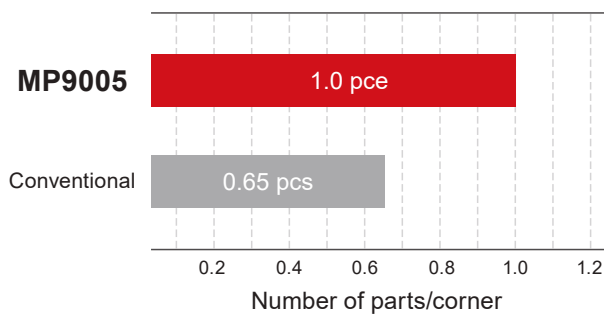


**MP90 Series**

Insert (Grade)	SNMG120408-MS (MP9005)
Work Material	Maraging steel (HRC55)
Cutting Speed	vc 70 m/min (230 SFM)
Feed	f 0.4 mm/rev (.0157 IPR)
Depth of cut	ap 3.0 mm (.1181 inch)
Coolant	Wet (Internal)
Machine	Multi-axis Machine



External turning





B093G  
[Metric]

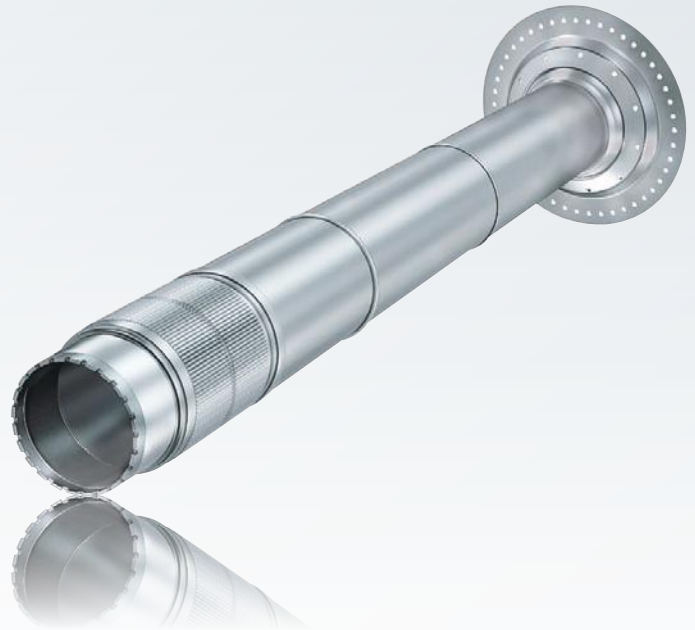
# ENGINE SHAFT

[Maraging Steel]

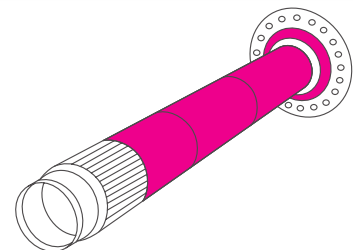
The MBC020 is a general purpose coated CBN grade suitable for continuous through to light interrupted machining. The combination of a stable cutting edge geometry and the MIRACLE coating makes it possible to provide longer tool life even when machining hardened maraging steel.



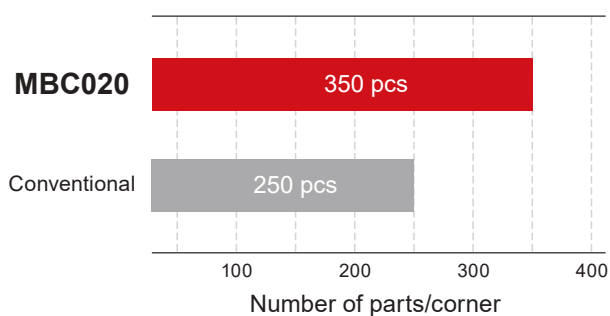
**MBC020**



Insert (Grade)	NP-DCGW11T304GA2 (MBC020)
Work Material	Maraging steel (HRC58)
Cutting Speed	vc 30 m/min (98 SFM)
Feed	f 0.05 mm/rev (.0020 IPR)
Depth of Cut	ap 0.1 mm (.0039 inch)
Coolant	Wet (External)
Machine	CNC Lathe



External and  
face turning





B214G  
[Metric]

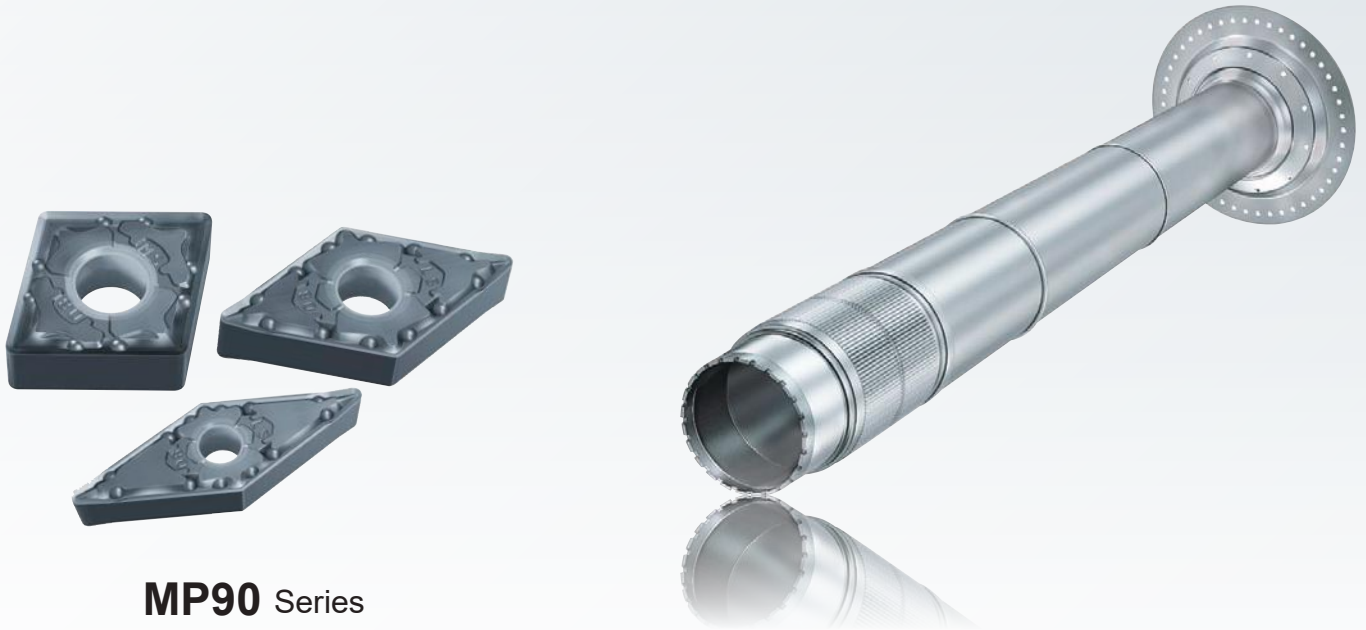


B214A  
[Imperial]

# ENGINE SHAFT

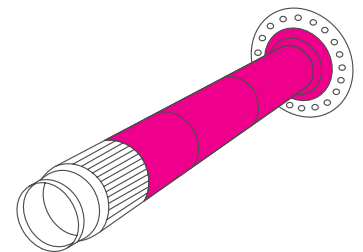
[Heat Resistant Superalloy]

The MP90 series use “Al-rich Technology”, this leads to the coating to be able to maintain high hardness and stability. Offering increased wear and welding resistance for applications with heat resistant superalloys.

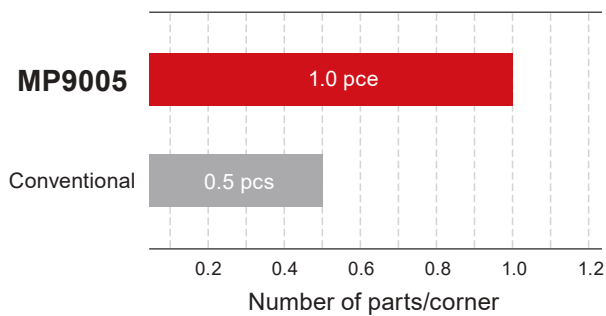


**MP90 Series**

Insert (Grade)	VNMG160408-LS (MP9005)
Work Material	Inconel 718
Cutting Speed	vc 50 m/min (164 SFM)
Feed	f 0.1 mm/rev (.0039 IPR)
Depth of Cut	ap 0.5 mm (.002 inch)
Coolant	Wet (Internal)
Machine	CNC Lathe



External and  
face turning







B253G  
[Metric]

# ENGINE SHAFT

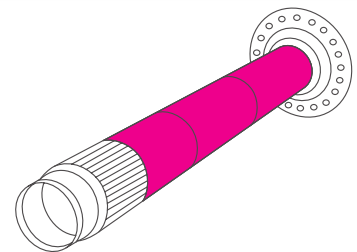
[Heat Resistant Superalloy]

For applications with heat resistance alloys by reducing the cutting edge temperature it can be possible to increase the cutting edge tool life. The JT tool holder is a high pressure coolant system that can be used for machining of heat resistant superalloys.



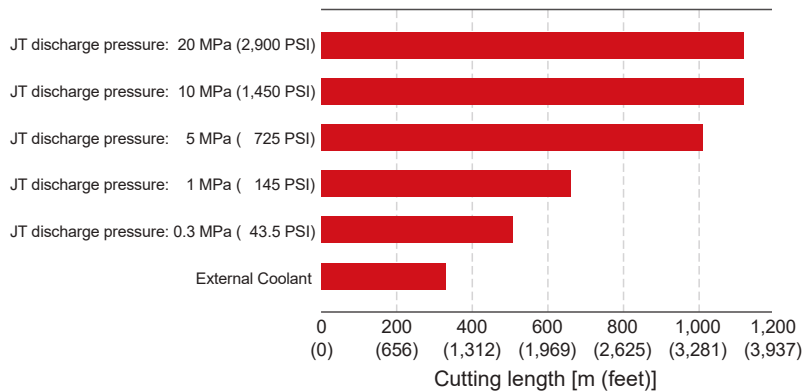
**JT Holder**  
[Specialized]

Holder	PSC50-DCJNR
Insert (Grade)	CNMG120408-MJ (US905)
Work Material	Inconel 718
Cutting Speed	vc 150 m/min (492 SFM)
Feed	f 0.1 mm/rev (.004 IPR)
Depth of Cut	ap 0.3 mm (.012 inch)
Coolant	Wet (Emulsion)



External turning

Pressure and cutting length



# ENGINE GEAR BOX

[Aluminum Alloy]

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 aluminum alloys and other non-ferrous metals.



B216G  
[Metric]

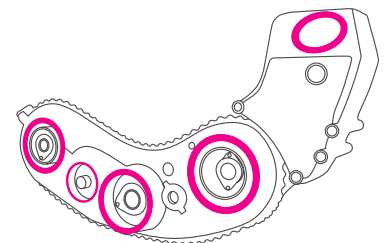


B216A  
[Imperial]

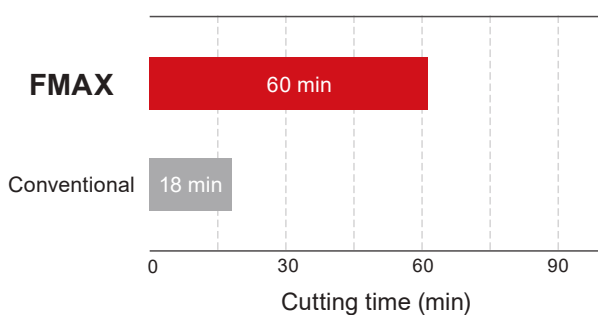


## FMAX

Holder	FMAX-050A08R
Insert (Grade)	GOER1401ZXFR2 (MD220)
Work Material	Aluminum Die-casting
Cutting Speed	vc 1,099 m/min (3,606 SFM), n 7,000 min <sup>-1</sup>
Feed	fz 0.06 mm/tooth (.0025 IPT), vf 3,360 mm/min (132 IPM)
Depth of cut	ap 0.3 mm (.0118 inch), ae 20-30 mm (.787-1.1811 inch)
Coolant	Wet (Internal)
Machine	Vertical M/C (HSK-A63)



Face milling





B040G  
[Metric]



LJ340A  
[Imperial]

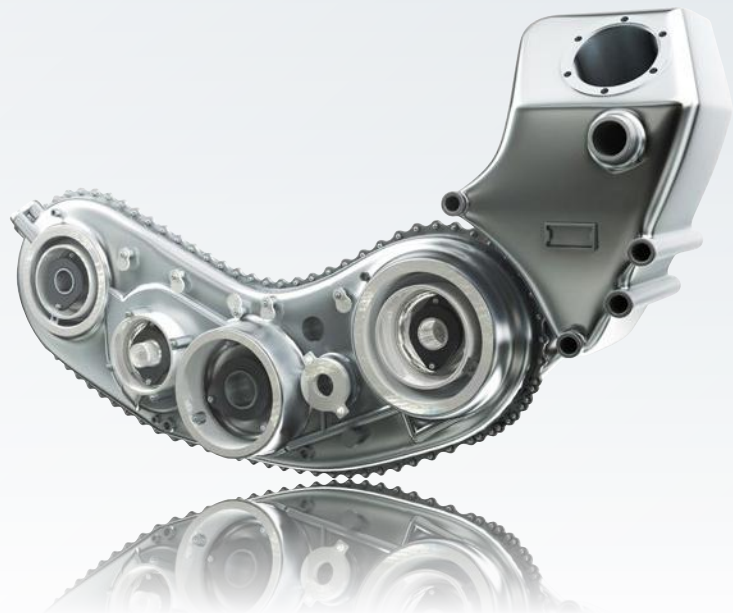
# ENGINE GEAR BOX

[Aluminum Alloy]

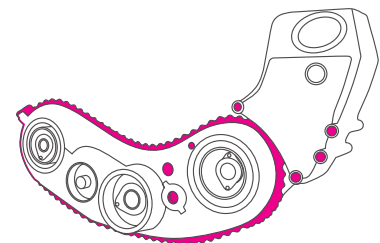
The MAS drill, adopting a 10° helix, ensures effective chip disposal properties making it suitable for high speed and feed applications. Compared to conventional drills possible to increase machining efficiency and tool life.



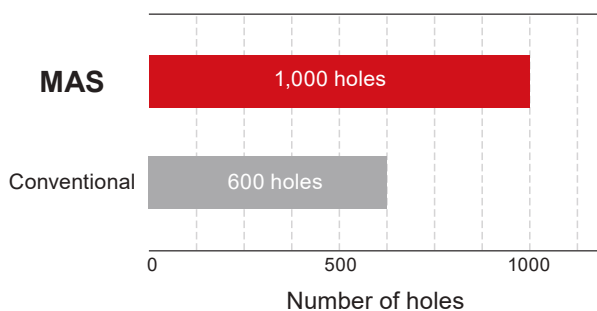
**MAS**



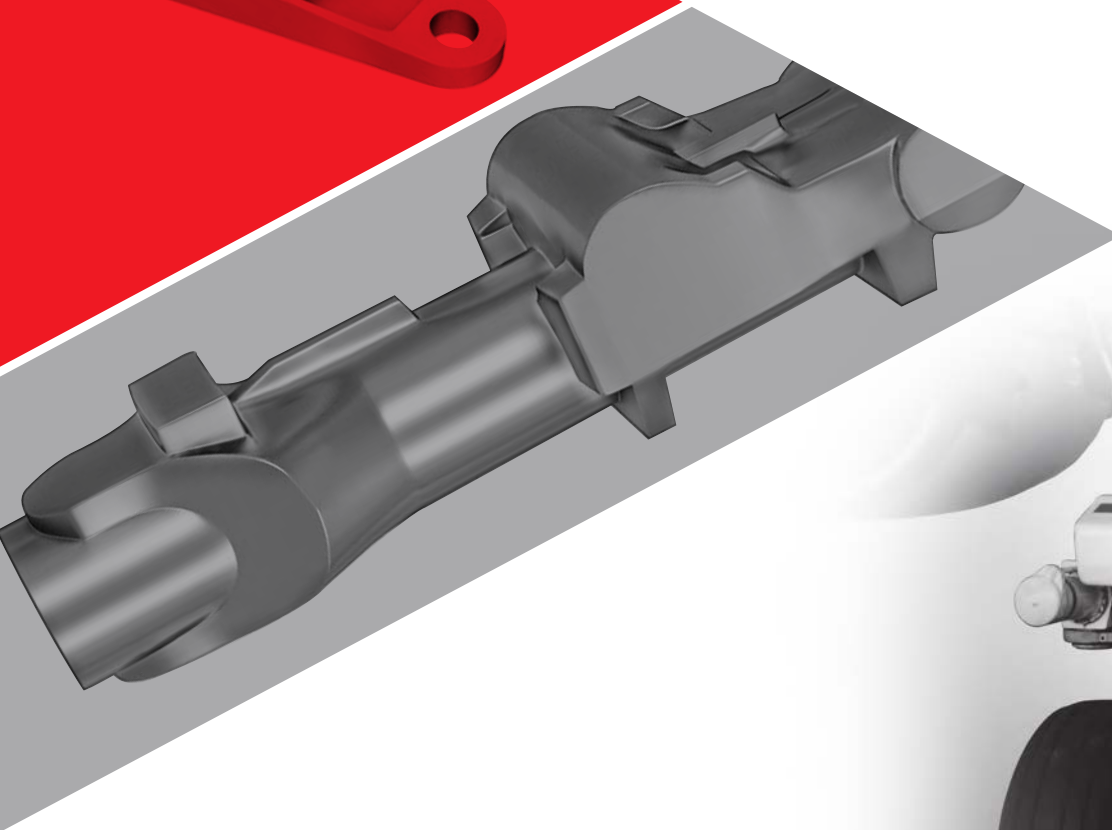
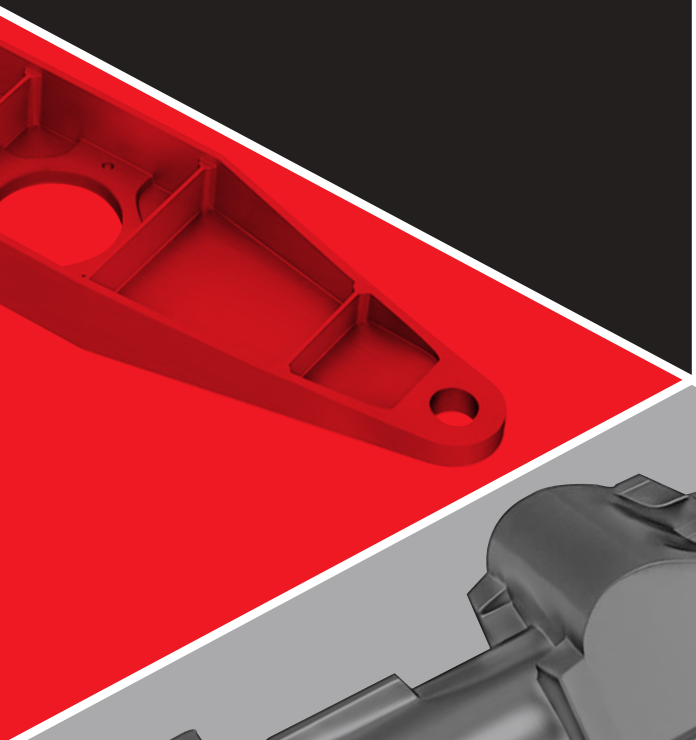
Drill (Grade)	MAS0850MB (HT110)
Work Material	Aluminum Die-casting
Cutting Speed	vc 160 m/min (525 SFM), n 5,995 min <sup>-1</sup>
Feed	f 0.2 mm/rev (.008 IPR), vf 1,200 mm/min (47.244 IPM)
Hole depth	10 mm (.394 inch) (Through hole)
Coolant	Wet (Internal)
Machine	Horizontal M/C (HSK-A100)



Drilling



# LANDING GEAR



44-53



B055G  
[Metric]B055A  
[Imperial]

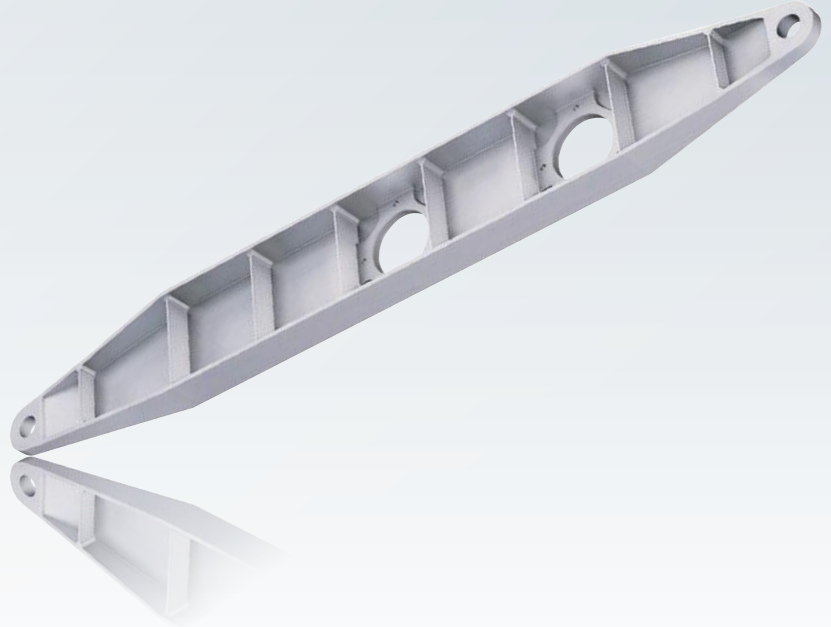
# LANDING GEAR BEAM

[Titanium Alloy]

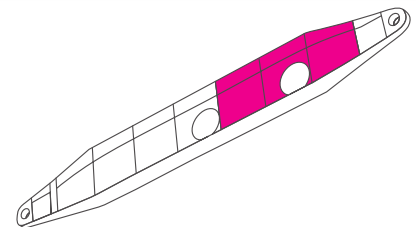
When rough machining of titanium alloys, chipping and fracture problems related to chip form are common. The APX series employs inserts with a curved cutting edge to assist in reducing cutting resistance and rigid tool body with through coolant to achieve stable machining



**APX**

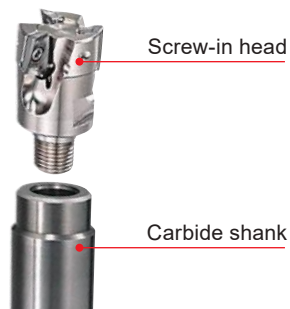


Holder (Screw-in arbor)	APX3000R254M12A35 (SC25M12S125SW)
Insert (Grade)	AOMT123620PEER-M (MP9120)
Work Material	Ti-6Al-4V
Cutting Speed	vc 40 m/min (131 SFM), n 510 min <sup>-1</sup>
Feed	fz 0.08 mm/tooth (.003 IPT), vf 160 mm/min (6.299 IPM)
Depth of Cut	ap 6 mm (.236 inch), ae 25 mm (.984 inch)
Coolant	Wet (Emulsion)



Rough pocket milling

Cutting time : 85 min



# LANDING GEAR BEAM



B200G  
[Metric]



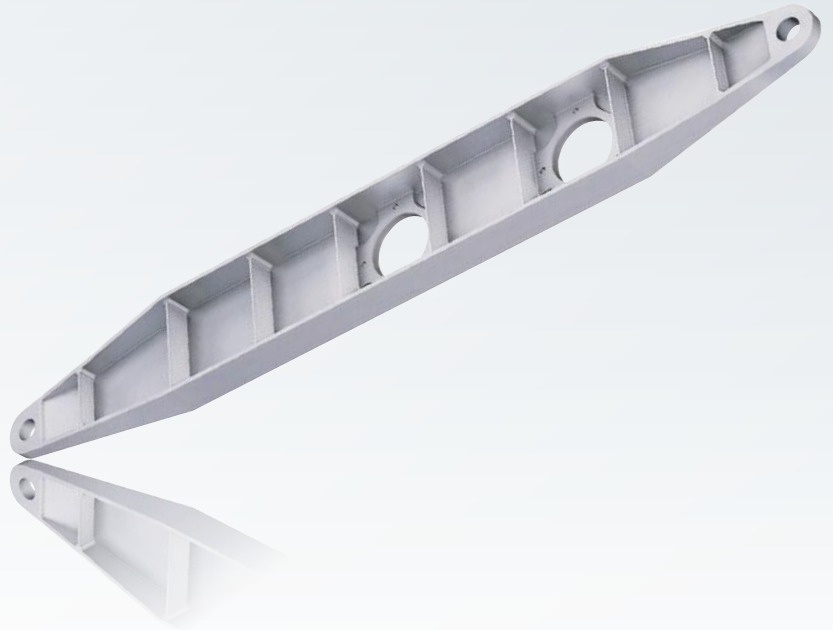
B200A  
[Imperial]

[Titanium Alloy]

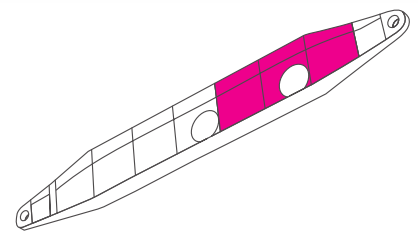
When rough machining of titanium alloys, due to the type of chips generated, problems relating to vibration can occur easily. To prevent these problems the iMX series also has a range of exchangeable heads that offer vibration resistance properties while maintaining effective chip evacuation leading to stable machining.



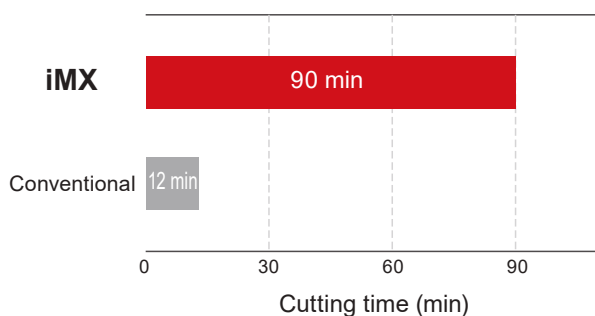
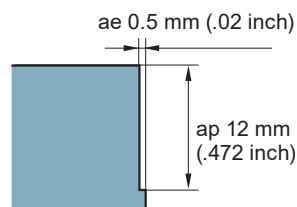
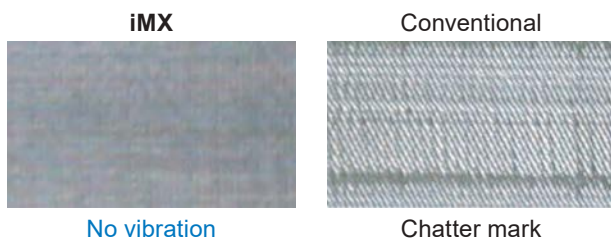
**iMX**



Holder	IMX16-U16N056L110C
Head (Grade)	IMX16C10HV160R10016 (EP7020)
Work Material	Ti-6Al-4V
Cutting Speed	vc 150 m/min (492 SFM), n 3,000 min <sup>-1</sup>
Feed	fz 0.05 mm/tooth (.002 IPT), vf 1,500 mm/min (59.055 IPM)
Depth of Cut	ap 12 mm (.472 inch), ae 0.5 mm (.020 inch)
Coolant	Wet [Emulsion (External)]



Finish pocket milling





B200G  
[Metric]



B200A  
[Imperial]

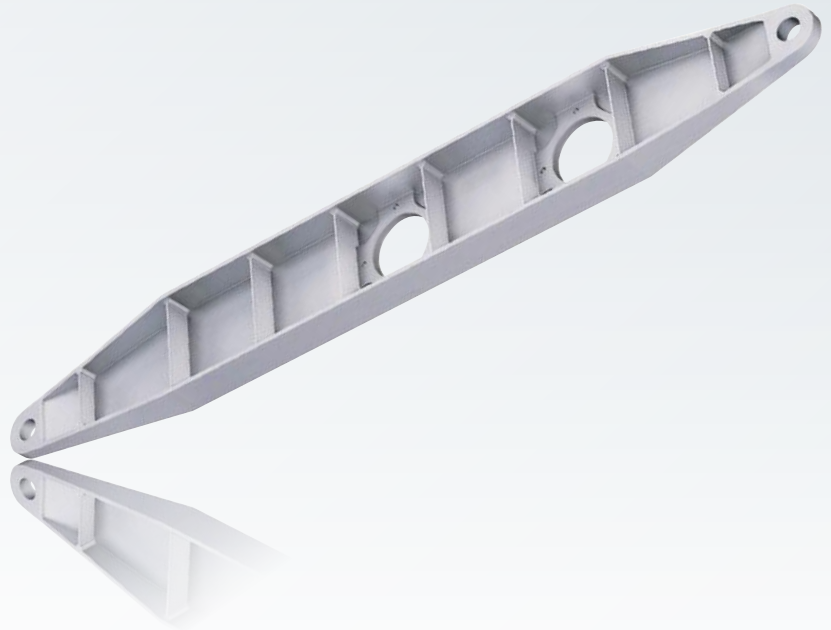
# LANDING GEAR BEAM

[Titanium Alloy]

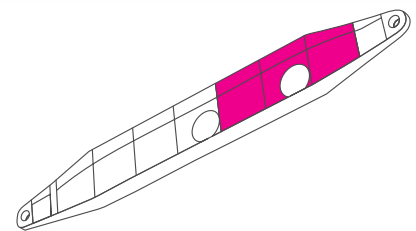
When rough machining of titanium alloys, due to the type of chips generated, problems relating to vibration can occur easily. To prevent these problems the iMX series also has a range of exchangeable heads that offer vibration resistance properties making it possible for applications that require long overhang.



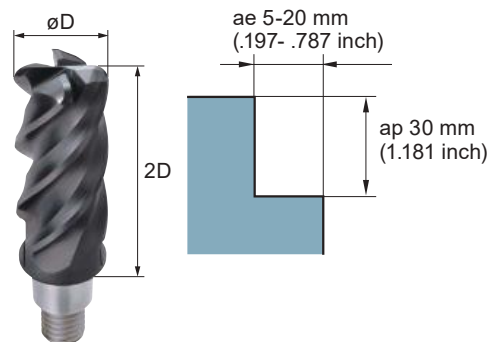
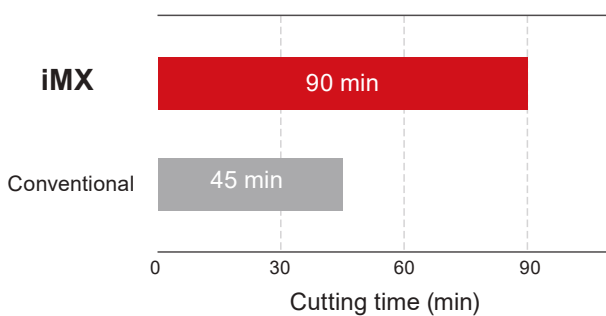
**iMX**



Holder	IMX20-U20N070L130C
Head (Grade)	IMX20C4HV200R10040 (EP7020)
Work Material	Ti-5Al-5Mo-5V-3Cr
Cutting Speed	vc 38 m/min (125 SFM), n 600 min <sup>-1</sup>
Feed	fz 0.04 mm/tooth (.002 IPT), vf 96 mm/min (3.78 IPM)
Depth of Cut	ap 30 mm (1.181 inch), ae 5-20 mm (.197-.787 inch)
Overhang Length	125 mm (4.92 inch)
Coolant	Wet [Emulsion (External)]



Finish pocket milling



B222G  
[Metric]B222A  
[Imperial]

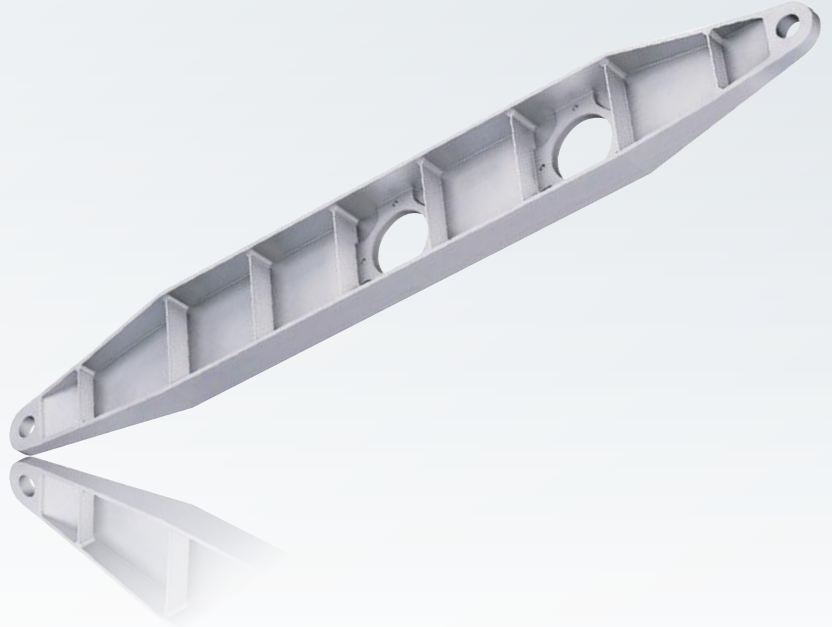
# LANDING GEAR BEAM

[Precipitation Hardening Stainless Steel]

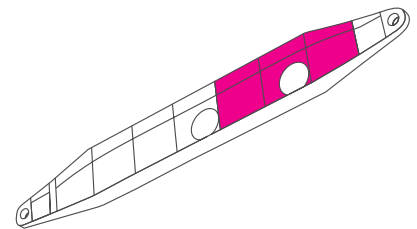
When machining of precipitation hardening stainless steel such as 15-5PH, chipping or fracturing of cutting edge can occur easily. The ARP used together with MP7130 achieves stable cutting for 15-5PH due to the suitable cutting edge and effective coating.



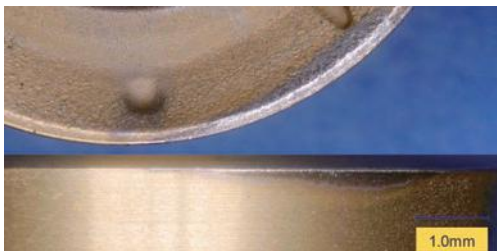
**ARP**



Holder	ARP5PR3204SA32M
Insert (Grade)	RPHT1040M0E4-M (MP7130)
Work Material	15-5PH
Cutting Speed	vc 70 m/min (230 SFM), n 697 min <sup>-1</sup>
Feed	fz 0.48 mm/tooth (.019 IPT), vf 1,338 mm/min (53 IPM)
Depth of Cut	ap 1.5 mm (.059 inch), ae 20 mm (.787 inch)



Pocket milling



Cutting time: 10 min



B238G  
[Metric]B238A  
[Imperial]

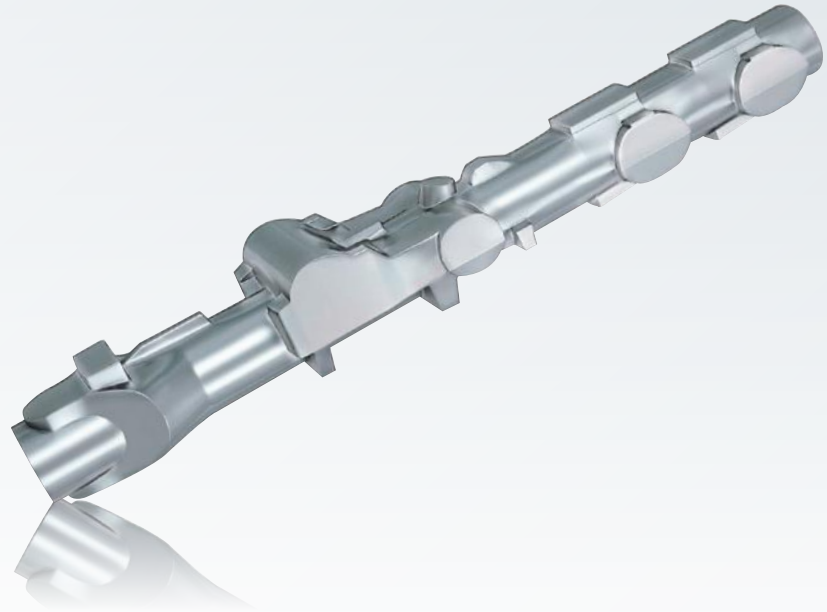
# LANDING GEAR MAIN CYLINDER

[Titanium Alloy]

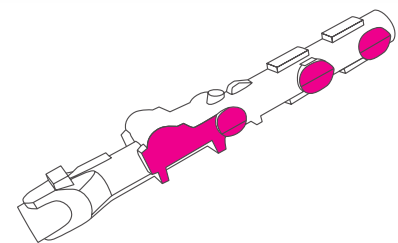
When rough machining of titanium alloys, due to the type of chips generated, problems relating to vibration can occur easily. If the tool has low rigidity abnormal damage such as chipping can occur easily. Therefore to resolve this problem the ASPX was designed to offer high tool rigidity in combination with irregular pitch angles. The inserts used also result in a smooth cutting action reducing overall cutting resistance.



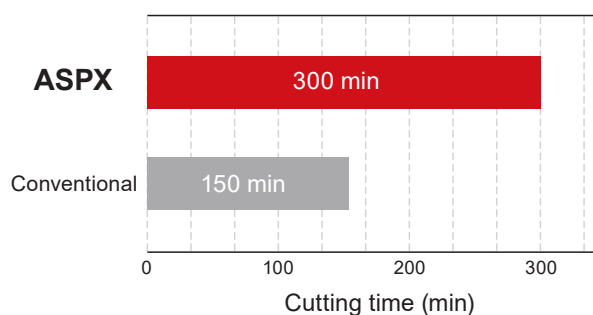
**ASPX**



Holder	ø63 mm (2.480 inch), Z=4, HSK-A100 [Specialized]
Insert (Grade)	JPGX1404120PPER-JM / SPGX1204100PPER-JM (MP9140)
Work Material	Ti-5Al-5V-5Mo-3Cr
Cutting Speed	vc 30 m/min (98 SFM), n 150 min <sup>-1</sup>
Feed	fz 0.10 mm/tooth (.004 IPT), vf 60 mm/min (2.362 IPM)
Depth of Cut	ap 60 mm (2.362 inch), ae 15 mm (.591 inch)
Coolant	Wet
Machine	Horizontal M/C (HSK-A100)



Rough side milling





B197G  
[Metric]

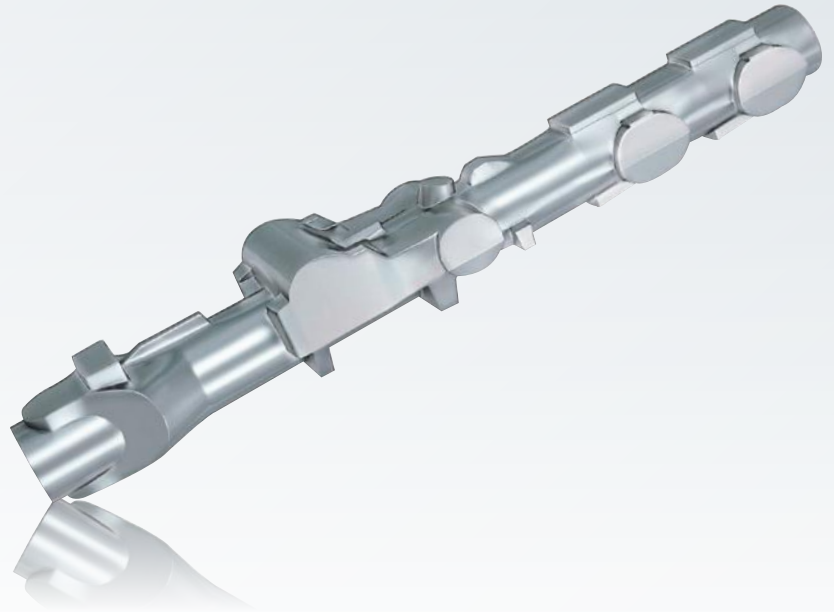


B197A  
[Imperial]

# LANDING GEAR MAIN CYLINDER

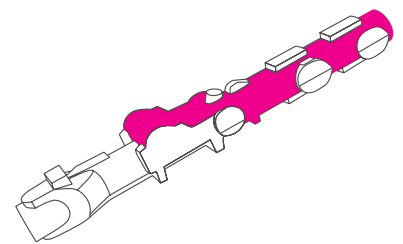
[Titanium Alloy]

When rough machining of titanium alloys, due to the type of chips generated, problems relating to vibration can occur easily. To prevent these problems the SMART MIRACLE vibration control end mill series was developed. This series uses irregular pitch and a newly developed radius geometry to overcome the problems related to vibration.

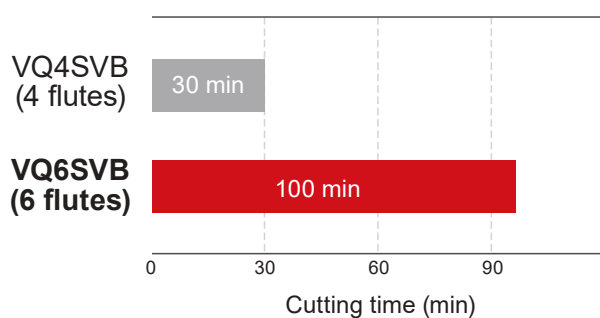


**SMART MIRACLE  
VQ End mill**

End mill	VQ4SVBR0600, VQ6SVBR0600 [Specialized]
Work Material	Ti-10V-2Fe-3Al
Cutting Speed	vc 200 m/min (656 SFM), n 5,300 min <sup>-1</sup>
Feed	vf 1,590 mm/min (62.598 IPM)
Depth of Cut	ap 1.0 mm (.039 inch), ae 0.5 mm (.020 inch)
Coolant	Wet (Emulsion)



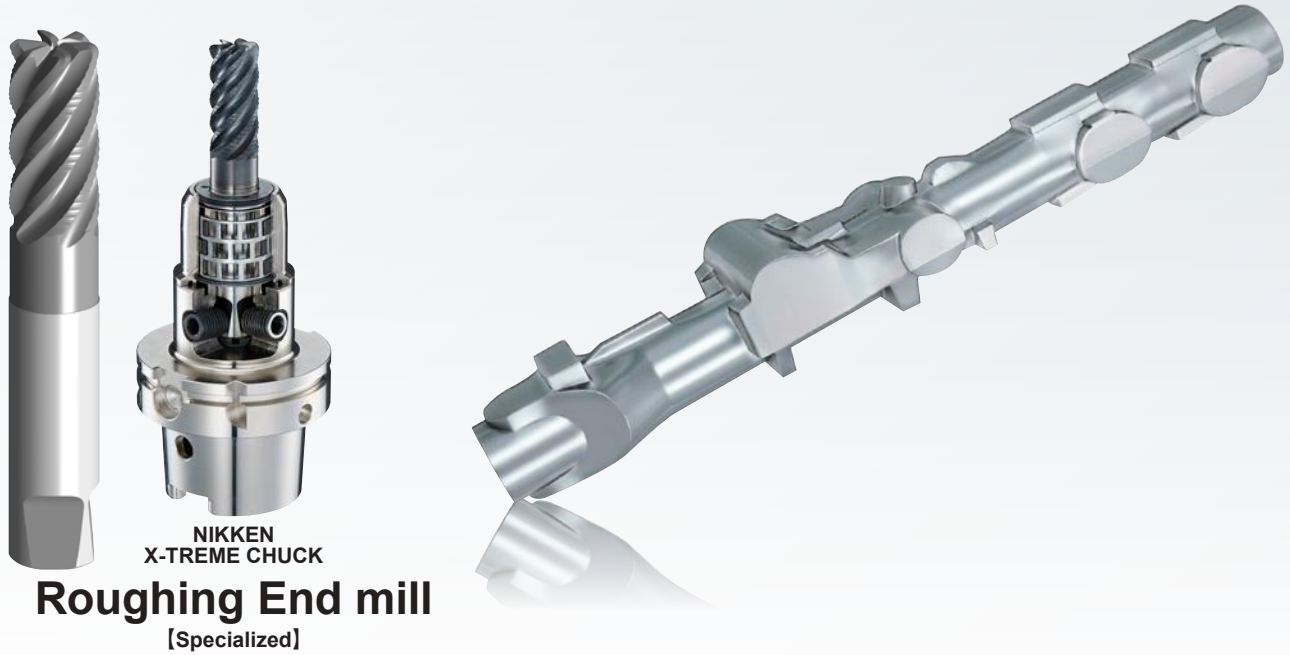
Finish profile milling



# LANDING GEAR MAIN CYLINDER

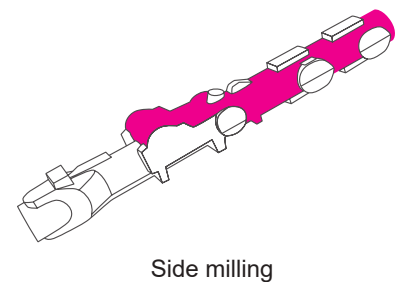
[Titanium Alloy]

When rough machining of titanium alloys, especially when using large-diameter end mills, the cutting forces generated often causes the end mill to be pulled out of the tool holder. To prevent this, the roughing end mill employs a roughing cutting edge to reduce cutting resistance and also adapts a locking system within the tool holder. Thus making it possible to achieve stable high-efficiency machining.



The flat is ground in accordance with NIKKEN X-TREME CHUCK, the mechanism prevents end mill from pulling out. X-TREME CHUCK is supplied from NIKKEN KOSAKUSHO WORKS, LTD.

End mill	ø20 mm (.787 inch), R0.5 mm (.020 inch), Z=5
Work Material	Ti-6Al-6V-2Sn (HRC40)
Cutting Speed	vc 35 m/min (115 SFM), n 557 min <sup>-1</sup>
Feed	fz 0.06 mm/tooth (.002 IPT), vf 167 mm/min (6.57 IPM)
Depth of Cut	ap 12-20 mm (.472 inch- .787 inch), ae 13-20 mm (.512 inch- .787 inch)
Machine	Horizontal M/C (HSK-A100)



**Roughing End mill**  
ø 20 mm (.787 inch), Z=5

69 cm<sup>3</sup>/min (4.2 in<sup>3</sup>/min)  
(Cycle time 8 min)

Conventional  
High feed emdmill  
ø 25 mm (.984 inch), Z=4

13 cm<sup>3</sup>/min (.79 in<sup>3</sup>/min)  
(Cycle time 40 min)

0 20 40 60 80  
(1.22) (2.44) (3.66) (4.88)

Material Removal Rate [cm<sup>3</sup>/min (in<sup>3</sup>/min)]

# LANDING GEAR MAIN CYLINDER

[Titanium Alloy]

When rough machining of titanium alloys, due to the type of chips generated, problems relating to vibration can occur easily. If the tool has low rigidity abnormal damage such as chipping can occur easily. Therefore to resolve this problem the ASPX was designed to offer high tool rigidity in combination with irregular pitch angles. The inserts used also result in a smooth cutting action reducing overall cutting resistance.



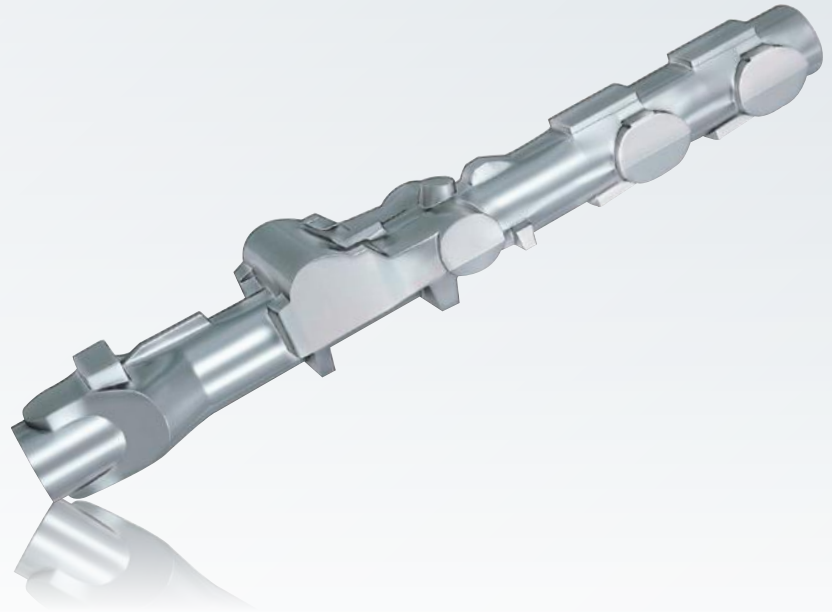
B238G  
[Metric]



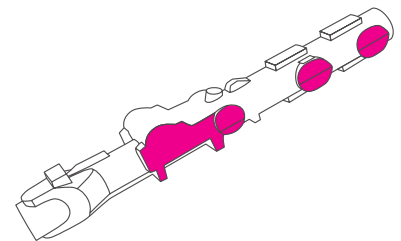
B238A  
[Imperial]



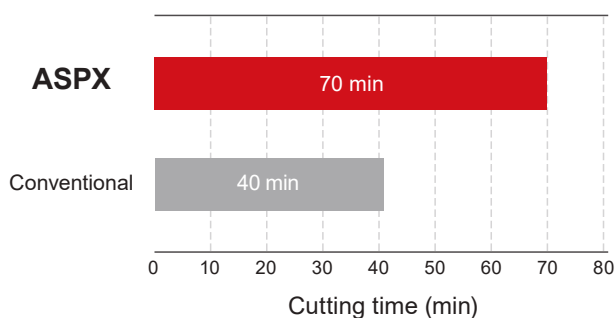
**ASPX**



Holder	ASPX4-080A05A075RA35
Insert (Grade)	JPGX1404120PPER-JM / SPGX1204100PPER-JM (MP9140)
Work Material	Ti-10V-2Fe-3Al
Cutting Speed	vc 33 m/min (108 SFM), n 131 min <sup>-1</sup>
Feed	fz 0.07 mm/tooth (.003 IPT), vf 45.9 mm/min (1.81 IPM)
Depth of Cut	ap 70 mm (2.756 inch), ae 25 mm (.984 inch)
Machine	Vertical M/C (HSK-A100)



Side milling







B135G  
[Metric]

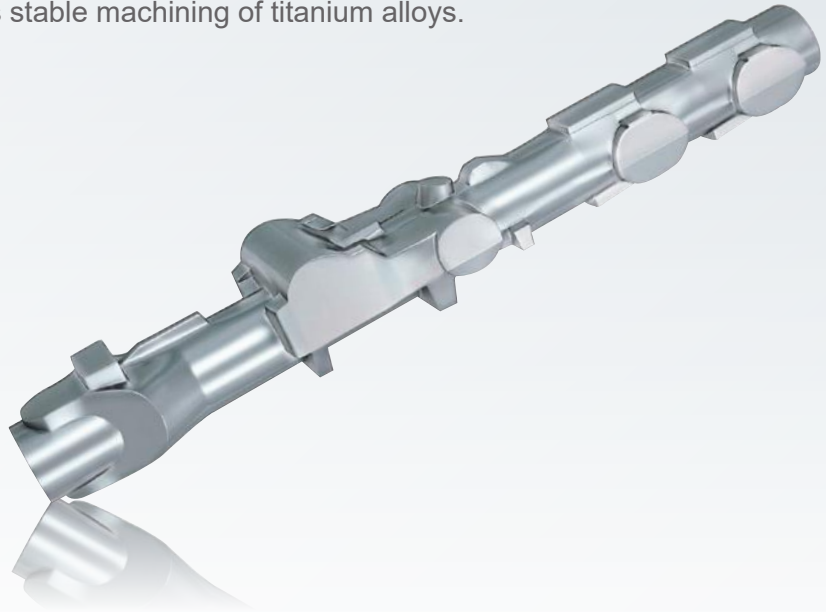
# LANDING GEAR MAIN CYLINDER

[Titanium Alloy]

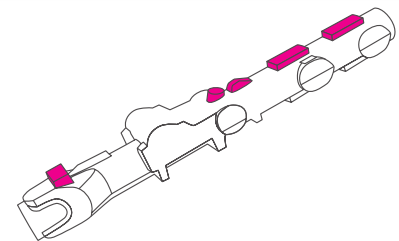
When machining titanium alloys, the heat generated during machining localizes around the cutting edge due to the low thermal conductivity of the material. This can result in welding problems making it is necessary to prevent heat generation by removing the chips effectively. The MNS drill range is designed to increase the cooling effect and to effectively discharge the chips via a unique flute geometry resulting in stable machining of titanium alloys.



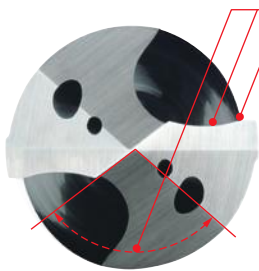
MNS



Drill (Grade)	MNS0600X20DB (TF15)
Work Material	Ti-6Al-4V
Cutting Speed	vc 30 m/min (98 SFM), n 1,592 min <sup>-1</sup>
Feed	f 0.06 mm/rev (.002 IPR), vf 95.52 mm/min (3.76 IPM)
Hole Depth	120 mm (4.724 inch)
Coolant	Wet {Emulsion [3 MPa (435 PSI)]}

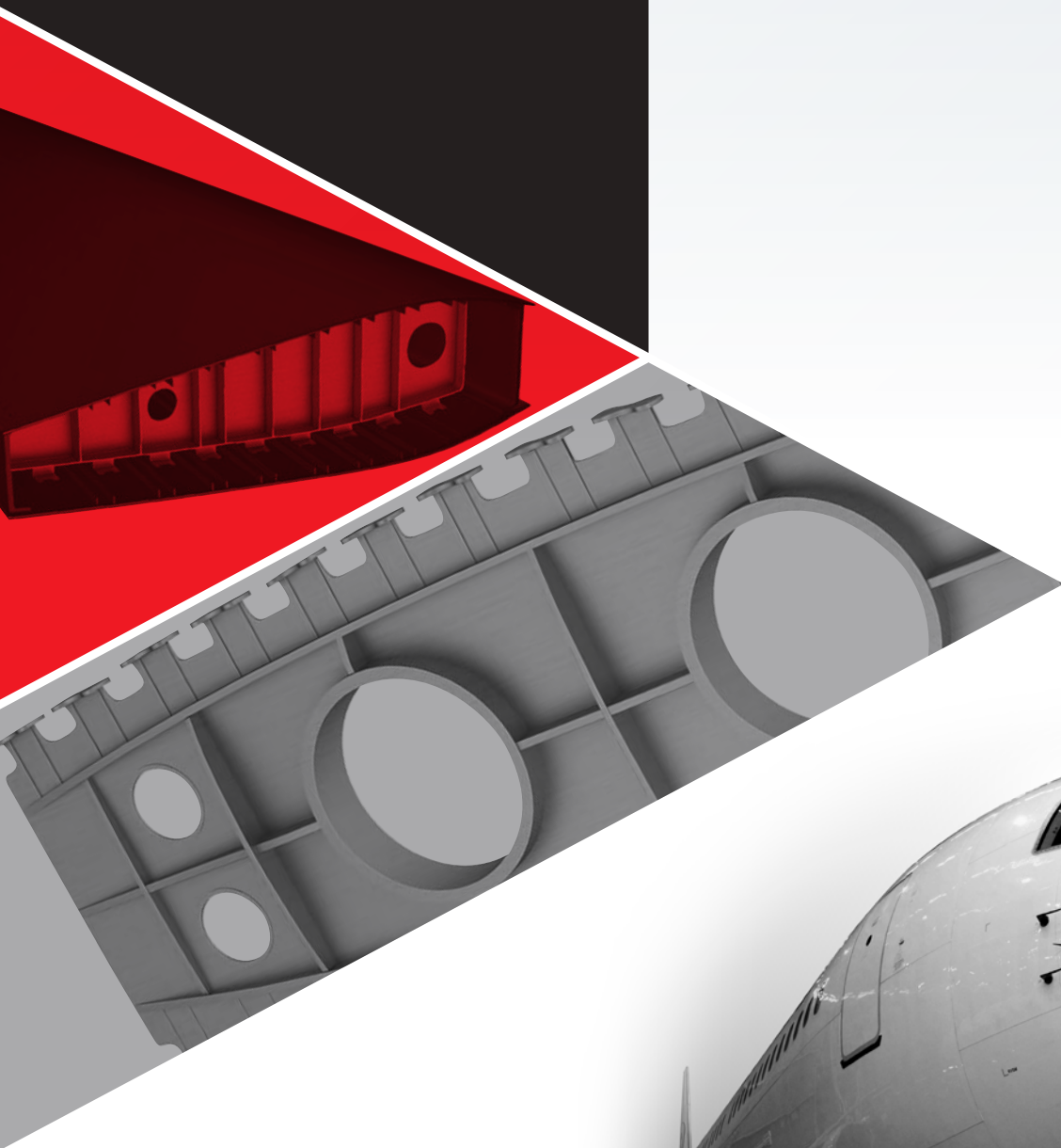


Drilling



**Stable machining can be achieved due to effective cooling and chip evacuation.**

# AIRFRAME



54-79

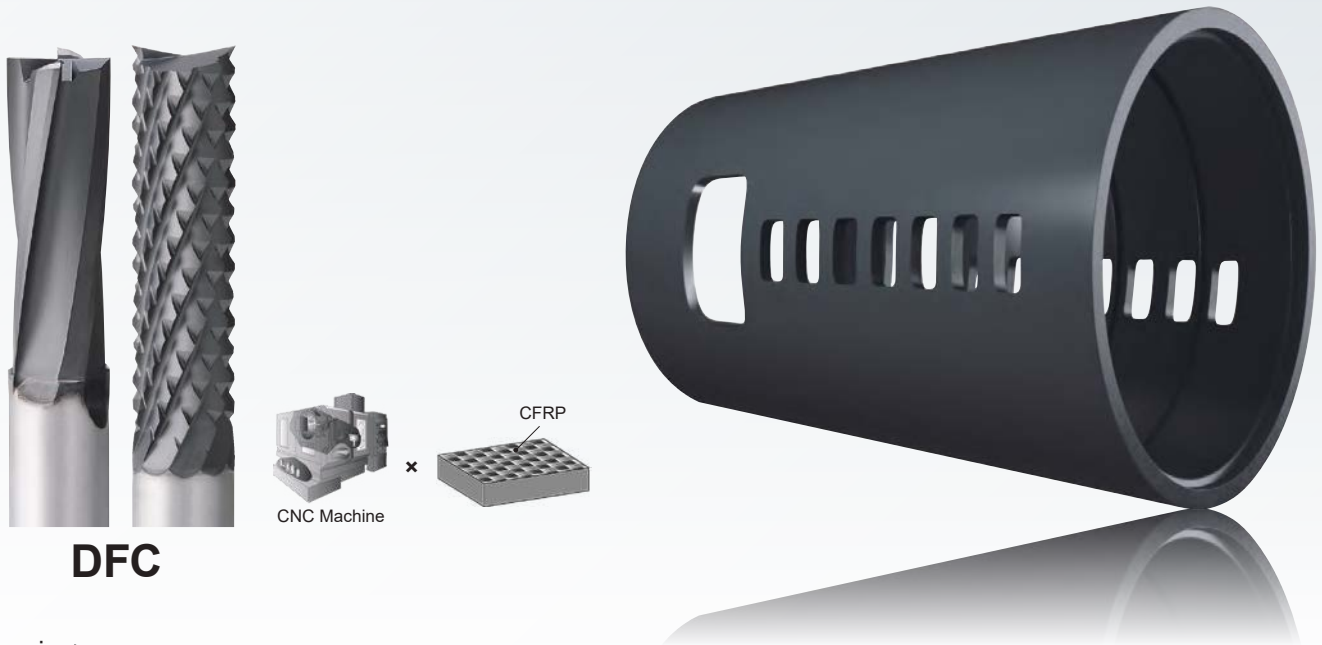
# AIRFRAME BODY

[CFRP]



P715G  
[Metric]

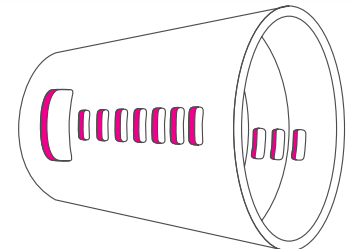
When machining CFRP tool life is generally short due to the high strength of the carbon fibers. Other problems such as delamination and burrs can easily contribute to short tool life. The DFC end mill range employs a CVD diamond coating and a cutting edge geometry that prevents these problems and prolongs tool life.



**DFC**

## <Trimming>

End mill	DFC4JCD1000
Work Material	CFRP
Cutting Speed	vc 188 m/min (617 SFM), n 6,000 min <sup>-1</sup>
Feed	fz 0.03 mm/tooth (.001 IPT), vf 720 mm/min (28 IPM)
Depth of Cut	ap 5 mm (.197 inch), ae 10 mm (.394 inch)
Coolant	Dry (External air)



Trimming

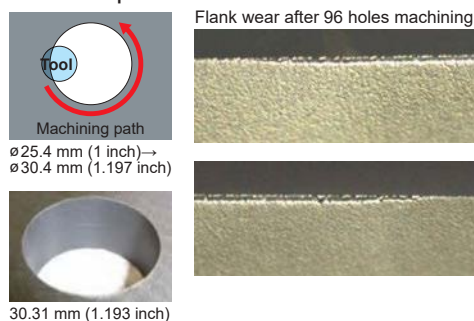
## <Hole Expansion>

End mill	DFC4JCD1200
Work Material	CFRP
Cutting Speed	vc 90 m/min (295 SFM), n 2,390 min <sup>-1</sup>
Feed	fz 0.04 mm/tooth (.002 IPT), vf 382 mm/min (15.039 IPM)
Depth of Cut	ap 18 mm (.709 inch), ae 2.0 mm (.079 inch) & 0.5 mm (.02 inch)
Coolant	Dry (External air)

## <Trimming>



## <Hole Expansion>



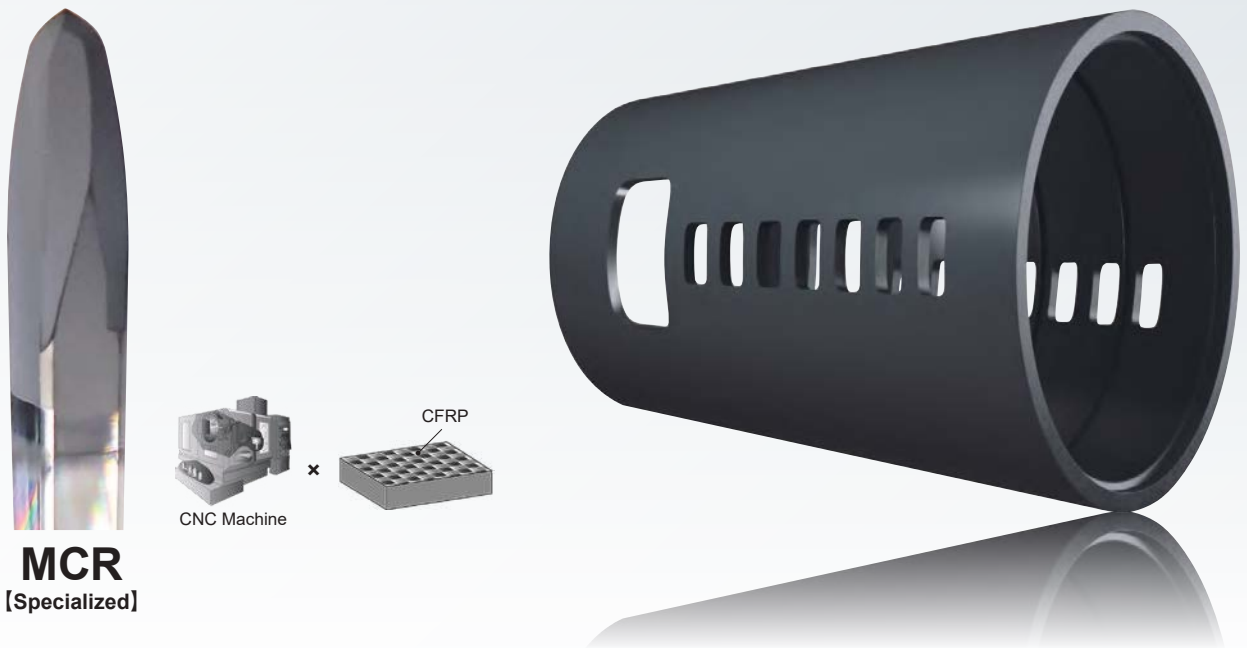
# AIRFRAME BODY

[CFRP]



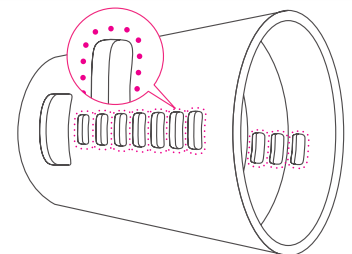
P715G  
[Metric]

The MCR employs a special radial cutting edge that can prevent burr development and delamination when drilling CFRP materials. Depending on the application possible to machining more than 5,000 holes while maintaining high tolerances.

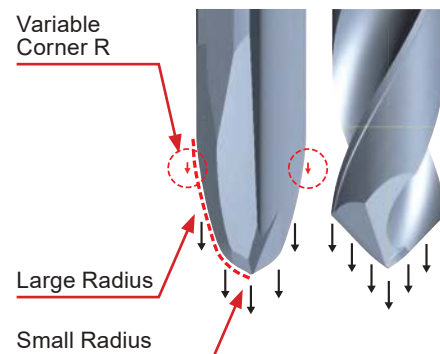
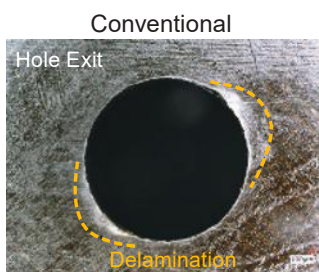


**MCR**  
[Specialized]

Drill	ø6.12 mm (.241 inch)
Work Material	CFRP
Cutting Speed	vc 80.7 m/min (265 SFM), n 4,200 min <sup>-1</sup>
Feed	f 0.085 mm/rev (.003 IPR), vf 357 mm/min (14.06 IPM)
Coolant	Dry (External air)



Drilling





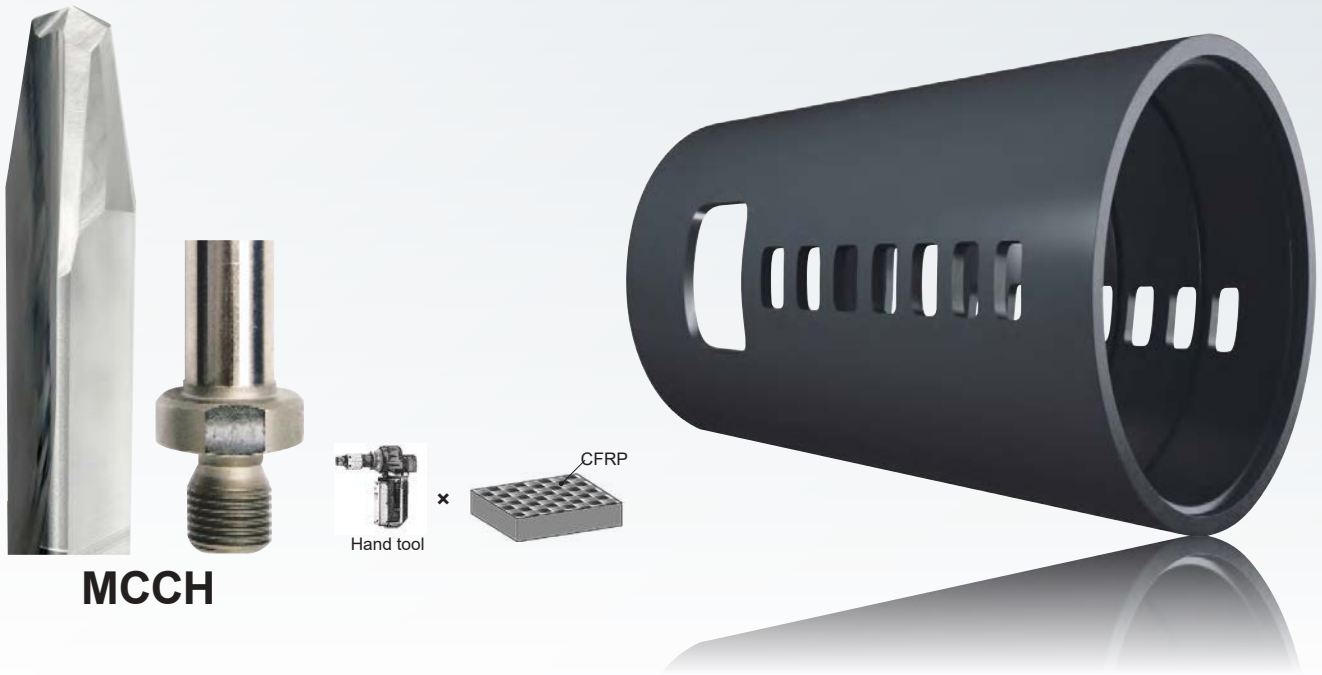
# AIRFRAME BODY

[CFRP]



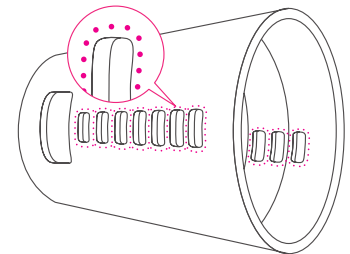
P715G  
[Metric]

The MCCH hand tool uses a hard substrate with enhanced strength that prevents sudden breakages while maintaining high-quality holes. The double angle design reduces thrust and enables a stable cutting speed.

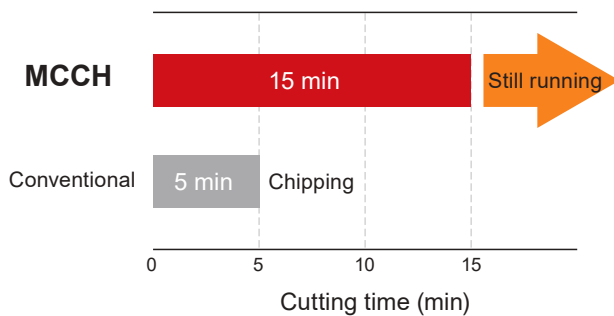


**MCCH**

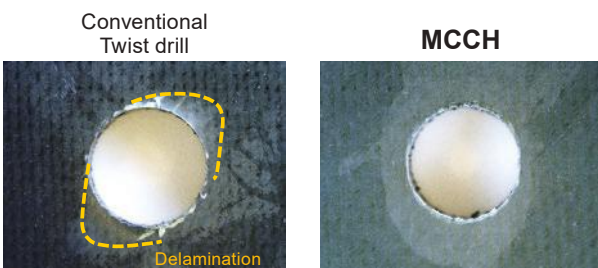
Drill (Grade)	ø6.38 mm (.251 inch) (DT2030) [Specialized]
Cutting Speed	vc 20 m/min (65.65 SFM), n 1,000 min <sup>-1</sup>
Feed	Manual



Drilling



### <Comparison of machined surface finish>



# AIRFRAME BODY



P715G  
[Metric]

[Aramid]

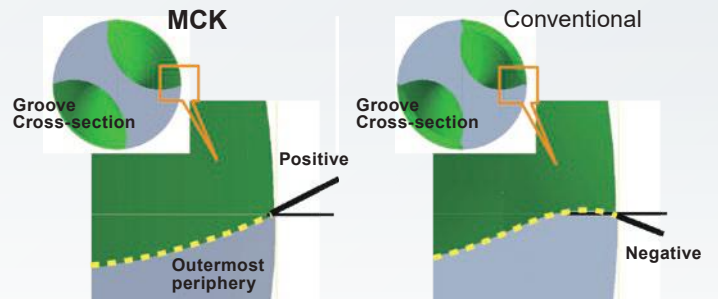
The cutting edge of MCK is optimally designed as V-shaped geometry, it realizes high quality hole machining for Aramid fiber materials. It reduces burrs and delamination.



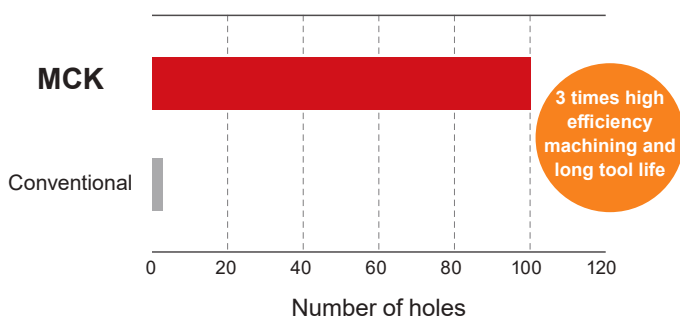
**MCK**  
[Specialized]



### <Highly Positive Rake Flutes>



Drill	ø2.5 mm (#40)
Work Material	Aramid, thickness 4 mm (.16 inch)
Cutting Speed	vc 60 m/min (197 SFM), n 7,643 min <sup>-1</sup>
Feed	f 0.03 mm/rev (.001 IPR)
Coolant	Dry
Machine	CNC M/C



### <The hole (Exit) after drilling>





B222G  
[Metric]



B222A  
[Imperial]

# AIRFRAME FLAP TRACK

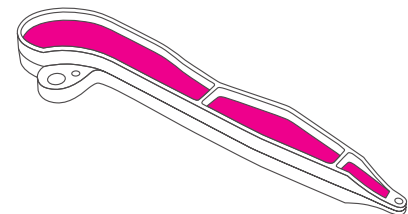
[Titanium Alloy]

When rough machining of titanium alloys, chipping and fracture problems related to chip form are common. The ARP series inserts are available with 3 breaker geometries and MP9130 tool grade which is suitable for titanium alloys machining. This combination results in stable machining when carrying out roughing and finishing applications.

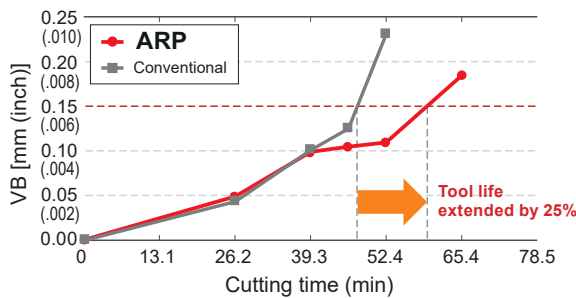


ARP

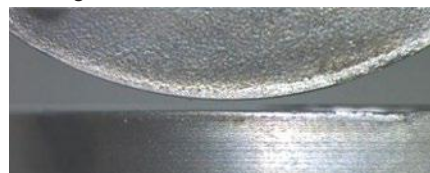
Holder	ARP5PR3204SA32M
Insert (Grade)	RPHT1040M0E4-L (MP9130)
Work Material	Ti-6Al-4V
Cutting Speed	vc 50 m/min (164 SFM), n 498 min <sup>-1</sup>
Feed	fz 0.1 mm/tooth (.004 IPT), vf 199 mm/min (7.84 IPM)
Depth of Cut	ap 2.5 mm (.098 inch) ae 25 mm (.984 inch)
Coolant	Wet {Emulsion [3 MPa (435 PSI)]}



Side and pocket milling



Cutting Time : 53 min



ARP



Conventional



B116G  
[Metric]



B116A  
[Imperial]

# AIRFRAME FLAP TRACK

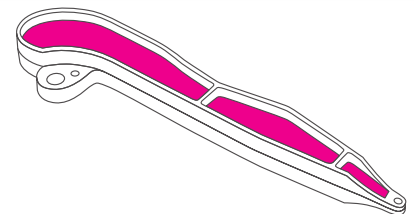
[Titanium Alloy]

When rough machining of titanium alloys, due to the type of chips generated, problems relating to vibration can occur easily. The AXD series with low cutting resistance insert geometry with a dedicated grade, MP9120, can achieve stable machining of titanium alloys.



**AXD**

Holder	AXD4000-050A04RA
Insert (Grade)	XDGX175004PDER-GM (MP9120)
Work Material	Ti-6Al-4V
Cutting Speed	vc 30, 50 m/min (98, 164 SFM)
Feed	fz 0.1 mm/tooth (.004 IPT)
Depth of Cut	ap 2.0 mm (.079 inch), ae 40 mm (1.575 inch)



Side and  
pocket milling

	vc 30 m/min (98 SFM)	vc 50 m/min (164 SFM)
<b>AXD4000</b>		
	Cutting length: 0.8 m (2.6 feet)	Cutting length: 0.4 m (1.3 feet)
Conventional		
	Cutting length : 0.4 m (1.3 feet)	Cutting length : 0.4 m (1.3 feet)





B247G  
[Metric]



B247A  
[Imperial]

# AIRFRAME FLAP TRACK

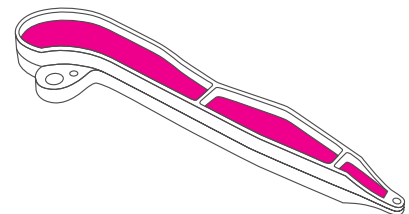
[Titanium Alloy]

When machining titanium alloys, heat generated localizes around the cutting edge, this can result in welding problems. As such it is necessary to prevent heat generation and to remove the chips effectively. The Coolstar series is designed with multiple through coolant hole in the flutes of the tool. This ensures that the coolant is directly delivered to the cutting edge offering effective cooling and improving chip evacuation.

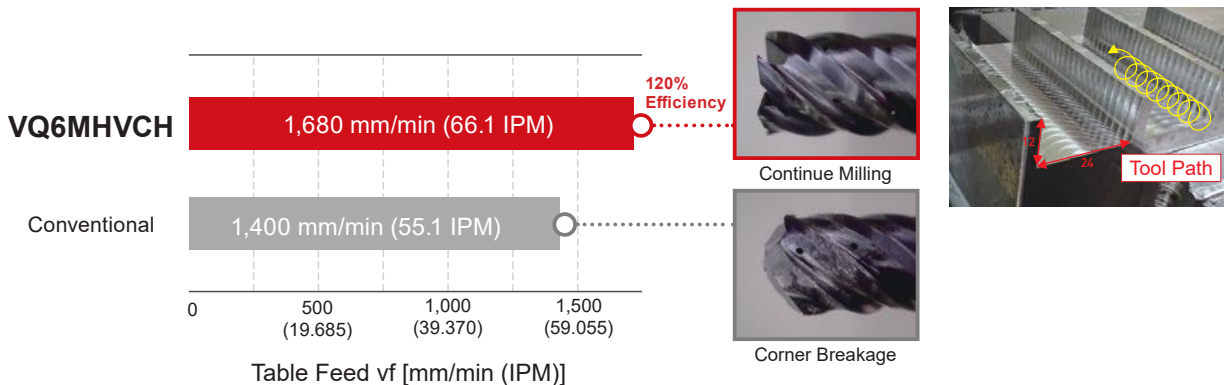


## SMART MIRACLE Coolstar

End mill	VQ6MHVCHD1600
Work Material	Ti-6Al-4V
Cutting Speed	vc 100 m/min (328 SFM), n 2,000 min <sup>-1</sup>
Depth of Cut	ap 12 mm (.472 inch), ae (Trochoid Pitch) 2.4 mm (.094 inch)
Coolant	Wet [Emulsion (Internal)]
Machine	Vertical M/C (BT50)



Side and pocket milling



# AIRFRAME PYLON

[Titanium Alloy]

When rough machining of titanium alloys, due to the type of chips generated, problems relating to vibration can occur easily. If the tool has low rigidity abnormal damage such as chipping can occur easily. Therefore to resolve this problem the ASPX was designed to offer high tool rigidity in combination with irregular pitch angles. The inserts used also result in a smooth cutting action reducing overall cutting resistance.



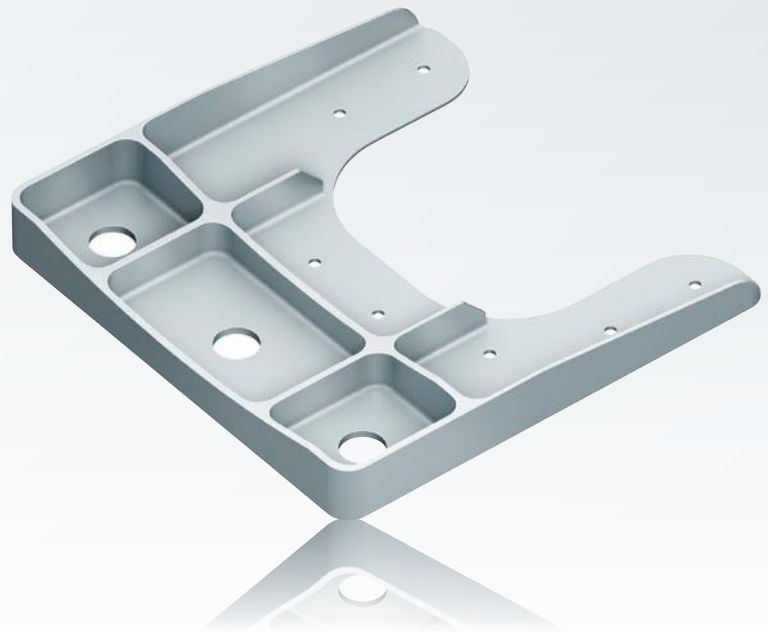
B238G  
[Metric]



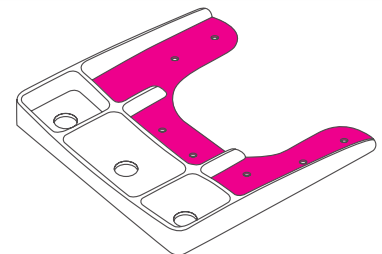
B238A  
[Imperial]



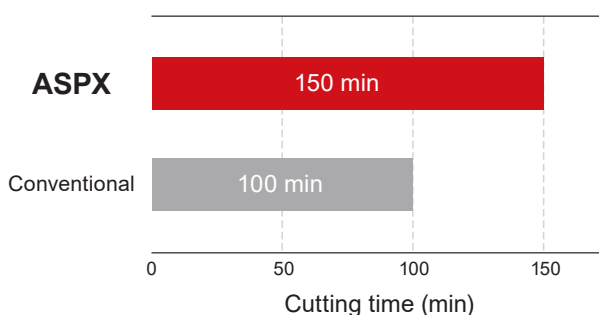
**ASPX**



Holder	ASPX4-063A04A064RA24
Insert (Grade)	JPGX1404120PPER-JM/SPGX1204100PPER-JM (MP9140)
Work Material	Ti-6Al-4V
Cutting Speed	vc 55 m/min (180 SFM), n 280 min <sup>-1</sup>
Feed	fz 0.12 mm/tooth (.005 IPT), vf 135 mm/min (5.31 IPM)
Depth of Cut	ap 25-60 mm (.984-2.362 inch), ae 10-45 mm (.394-1.772 inch)
Coolant	Wet {Emulsion [10 MPa (1,450 PSI)]}



Side and pocket milling

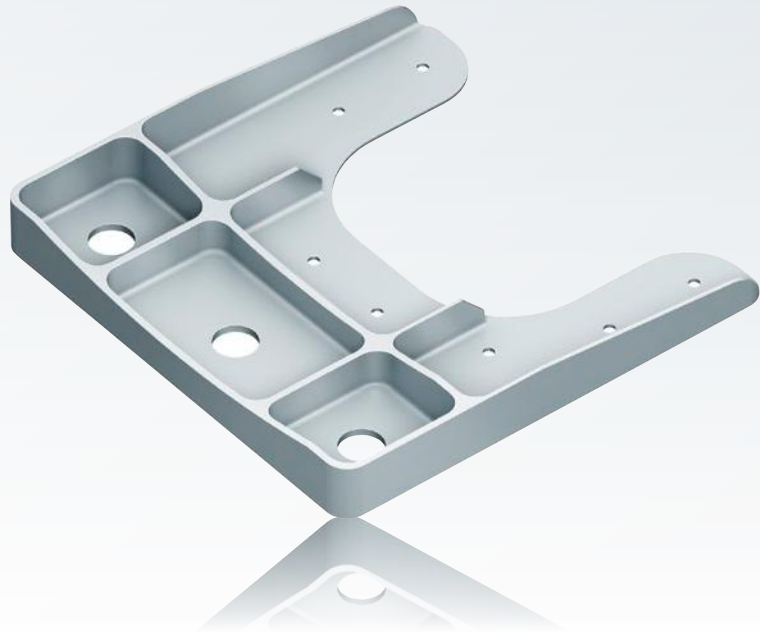


B232G  
[Metric]B232A  
[Imperial]

# AIRFRAME PYLON

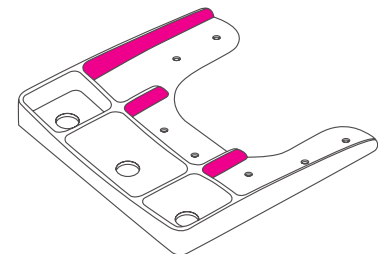
[Titanium Alloy]

The tangential barrel end mill, offering a full 3 flute center cutting edge to improve chip disposal, in combination with an irregular pitched 6 flute peripheral cutting edge enables efficient finish-machining of the pylons. Due to the tangential form peripheral cutting edge it is possible to increase pick feed leading to increased machining efficiency.

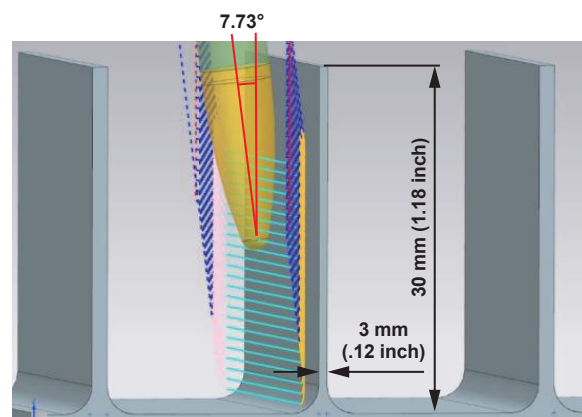
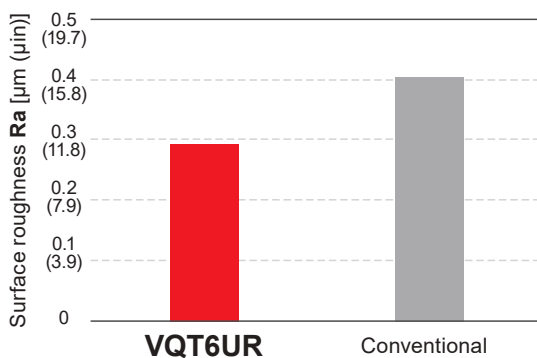


## SMART MIRACLE VQT6UR

End mill	VQT6URR020R085S10
Work Material	Ti-6Al-4V
Spindle Speed	n 2,546 min <sup>-1</sup>
Feed	fz 0.03 mm/tooth (.001 IPT)
Depth of Cut	ap 1.5 mm (.06 inch), ae 0.3 mm (.012 inch)
Tilt Angle	7.73°
Coolant	Wet [Emulsion (External)]
Machine	5-axis M/C (HSK-A63)



Finish side milling





B202G  
[Metric]



B202A  
[Imperial]

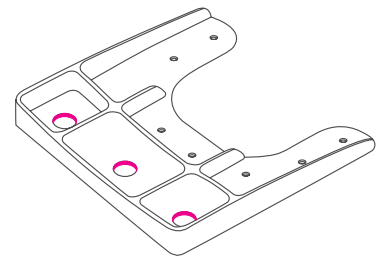
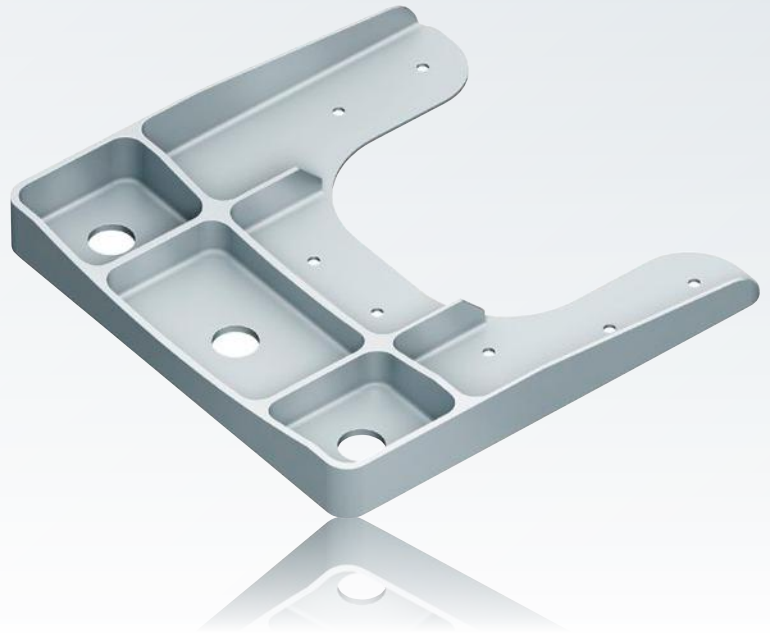
# AIRFRAME PYLON

[Titanium Alloy]

When machining titanium alloy heat generated localizes around the cutting edge. The MVX drill achieves good chip evacuation and long tool life by the combination of the high rake geometry and specific grade offering high fracture resistance.

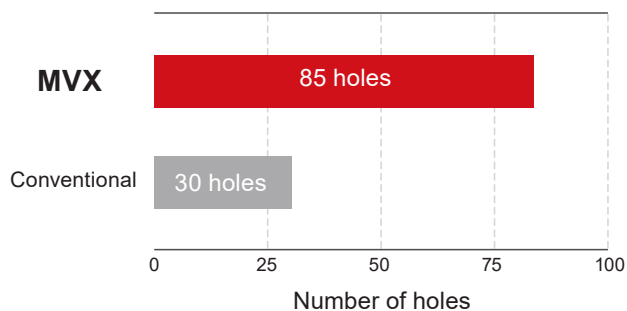


**MVX**



Drilling

Holder	MVX1800X3F25
Insert (Grade)	SOMX063005-US (VP15TF) (Outer + Inner)
Work Material	Ti-6Al-4V
Cutting Speed	40 m/min (131.2 SFM), n 707 min <sup>-1</sup>
Feed	f 0.105 mm/rev (.0041 IPR), vf 74.2 mm/min (2.92 IPM)
Hole Depth	22 mm (.866 inch)
Coolant	Wet [WSO (External + Internal)]
Machine	Vertical M/C (BBT40)







B028G  
[Metric]



B028A  
[Imperial]

# AIRFRAME SHACKLE

[Titanium Alloy]

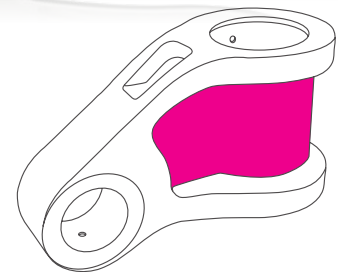
When titanium alloys machining, the chips developed are saw-tooth type chips due to the varying cutting resistance when machining. For high feed roughing applications this can result in chipping of the cutting edge. To prevent this kind of problem from occurring the JL breaker, that has a sharp cutting edge to reduce overall cutting resistance and MP9140 which offers extremely high cutting edge stability and fracture resistance is employed. This combination results in stable high feed roughing becoming possible.



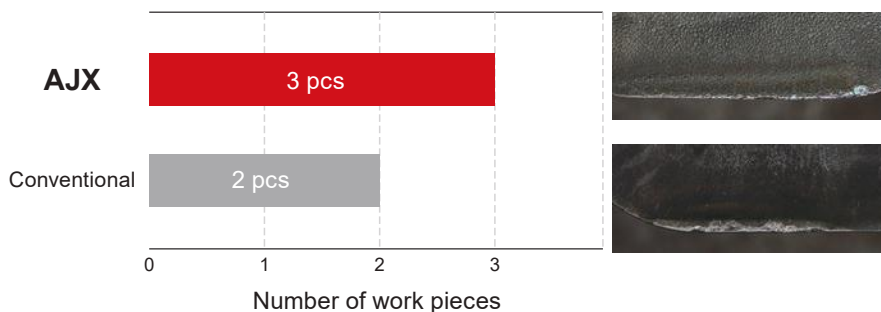
**AJX**



Holder	AJX12R322SA32S
Insert (Grade)	JDMT120423ZDER-JL (MP9140)
Work Material	Ti-6Al-4V
Cutting Speed	vc 50 m/min (164 SFM), n 500 min <sup>-1</sup>
Feed	fz 0.6 mm/tooth (.024 IPT), vf 600 mm/min (23.6 IPM)
Depth of Cut	ap 1 mm (.039 inch), ae 20-32 mm (.79-1.26 inch)
Coolant	Wet (Emulsion)



Face and side milling



B230G  
[Metric]B230A  
[Imperial]

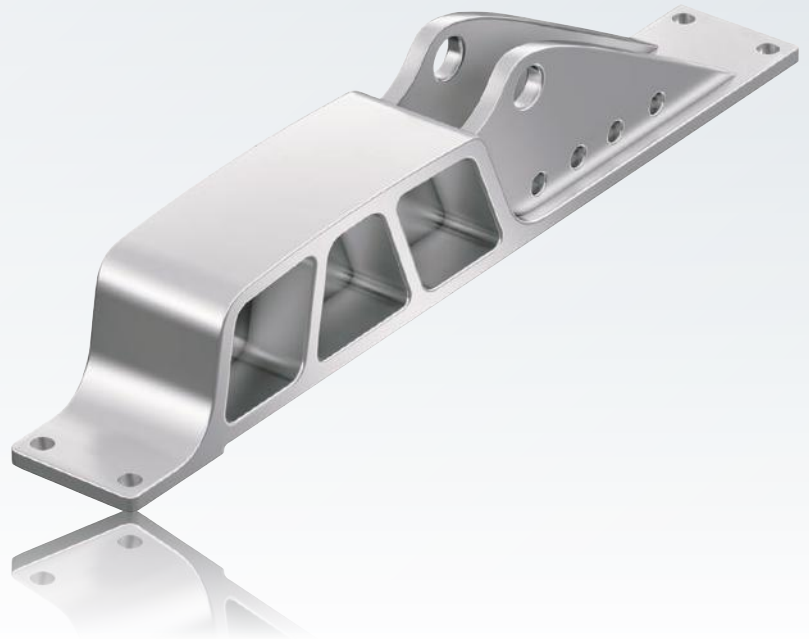
# AIRFRAME HINGE

[Titanium Alloy]

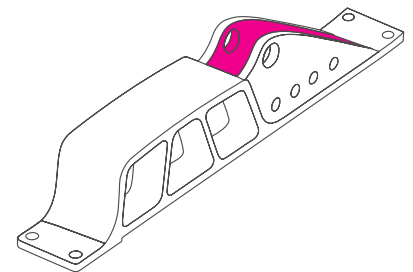
Center through coolant combined with the use of irregular helix that prevents chatter leads to high efficiency machining of titanium alloys while maintaining effective chip disposal.



## SMART MIRACLE VQT5MVRB



End mill	VQT5MVRB250R400N075C
Work Material	Ti-6Al-4V
Cutting Speed	vc 50 m/min (164 SFM), n 636 min <sup>-1</sup>
Feed	fz 0.065 mm/tooth (.0026 IPT), vf 206 mm/min (8.11 IPM)
Depth of Cut	ap 50 mm (1.969 inch), ae 25 mm (.984 inch) (Slot)
Overhang Length	75 mm (3D) (2.953 inch)
Coolant	Wet [Emulsion (External + Internal)]
Machine	Vertical M/C (BT50)



Slotting



Machined Surface

Deep depths of cut can shorten machining time. Irregular helix flutes allow surfaces to be finished with excellent quality.

B250G  
[Metric]B250A  
[Imperial]

# AIRFRAME HINGE

[Precipitation Hardening Stainless Steel]

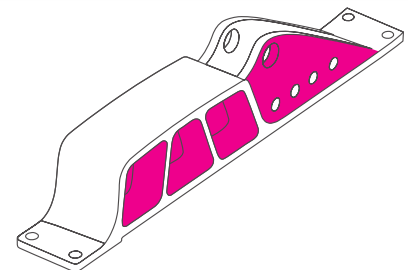
15-5PH is often used for components in the aerospace industry. It has high strength and as such chipping and fracturing of the cutting edge can easily occur. The VPX series has a number of insert geometries and coated tool grades to ensure stable machining can be achieved.



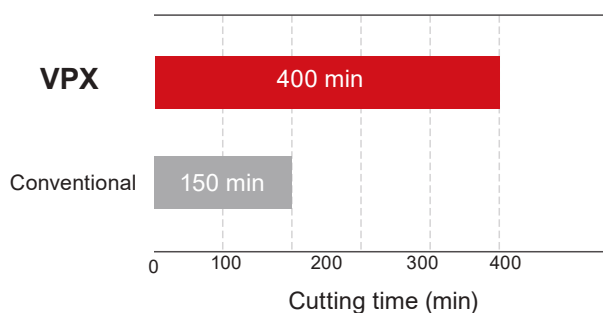
**VPX**



Holder	VPX200R3004SA25S
Insert (Grade)	LOGU0904080PNER-M (MP9130)
Work Material	15-5PH
Cutting Speed	vc 40 m/min (131 SFM), n 425 min <sup>-1</sup>
Feed	fz 0.06 mm/tooth (.0024 IPT), vf 102 mm/min (4.016 IPM)
Depth of Cut	ap 1.8 mm (.071 inch), ae 20 mm (.787 inch)
Coolant	Wet (Emulsion)



Shoulder milling





B180G  
[Metric]



B180A  
[Imperial]

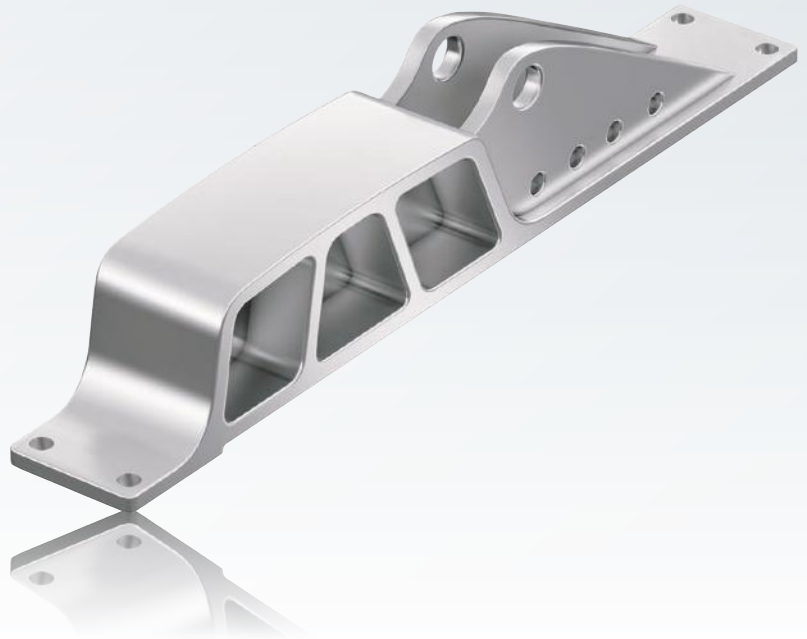
# AIRFRAME HINGE

[Precipitation Hardening Stainless Steel]

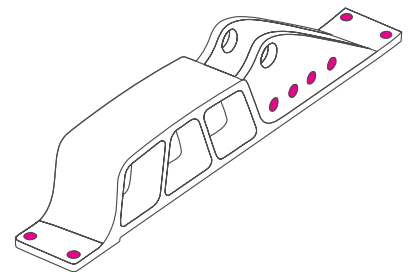
When machining high strength stainless steel, chipping and fracturing of the cutting edge can occur easily. For drilling applications, the MMS drill employs a suitable cutting edge geometry and coating in order to achieve stable machining.



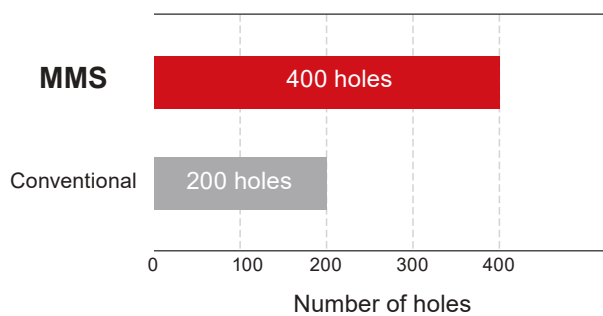
**MMS**



Drill (Grade)	MMS0800X3DB (DP7020)
Work Material	15-5PH (HRC42)
Cutting Speed	vc 100 m/min (328 SFM), n 3,980 min <sup>-1</sup>
Feed	f 0.2 mm/rev (.008 IPR), vf 796 mm/min (31.3 IPM)
Hole Depth	24 mm (.945 inch) (Through hole)
Coolant	Wet (Emulsion)



Drilling





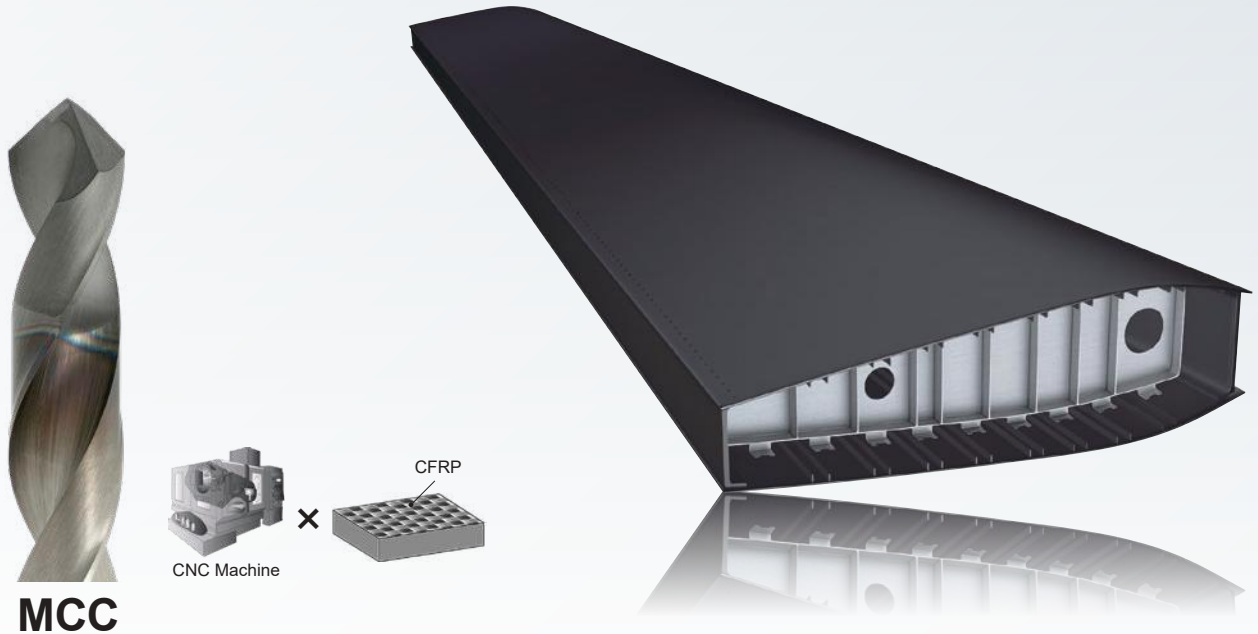
# AIRFRAME WING



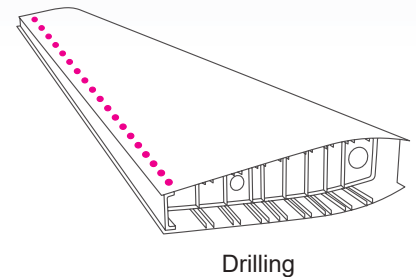
P715G  
[Metric]

[CFRP]

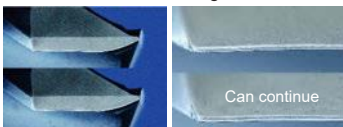
The MCC drill employs a 90° point angle so that it reduces the thrust when drilling is conducted. This reduction in thrust prevents delamination and also improves the tolerance of the drilled holes.



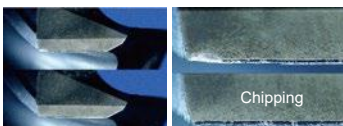
Drill (Grade)	ø6.55 mm (.258 inch) (DD2105) [Specialized]
Work Material	CFRP
Cutting Speed	vc 120 m/min (394 SFM), n 5,840 min <sup>-1</sup>
Feed	f 0.10 mm/rev (.004 IPR), vf 584 mm/min (23 IPM)
Coolant	Dry (External air)
Machine	Vertical M/C



After 820 holes machining

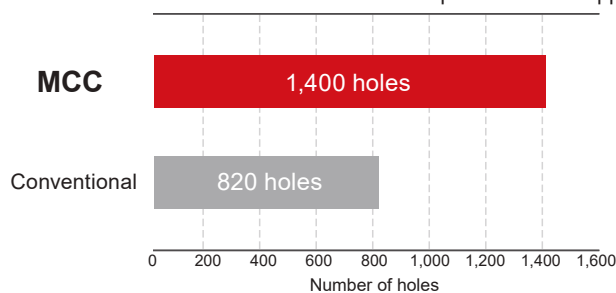


MCC



Conventional

\*The tool life determination depends on the chipping



	306 holes		588 holes		MCC (1,192 holes)
	MCC	Conventional	MCC	Conventional	
Entrance					
Exit					

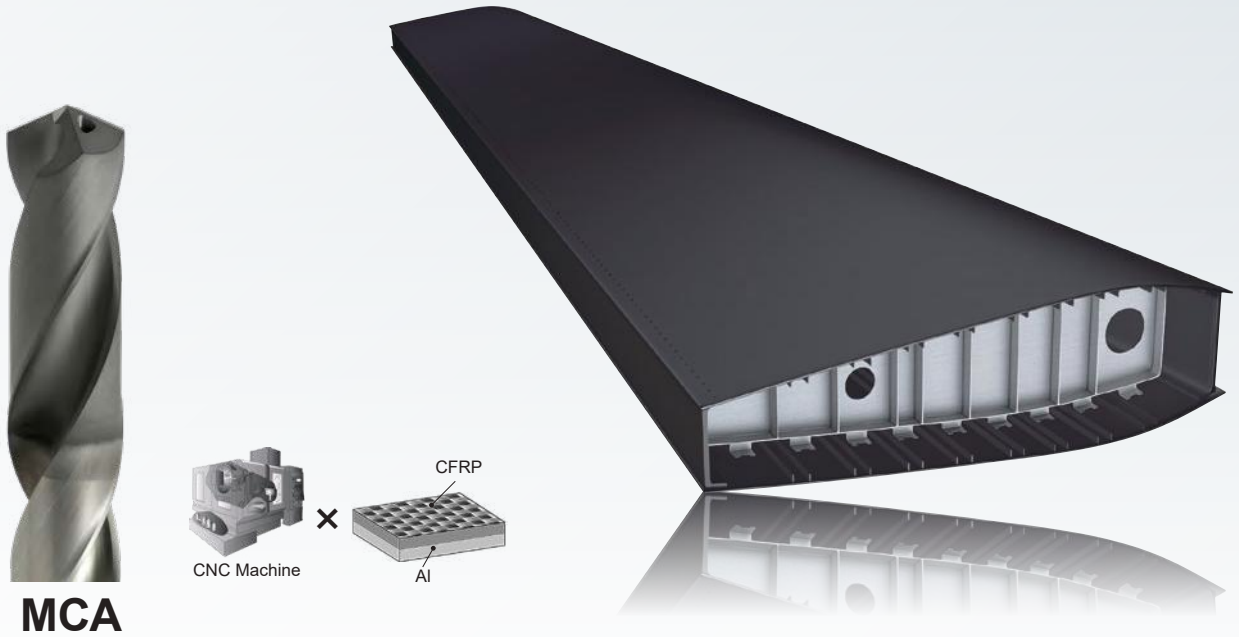
# AIRFRAME WING



P715G  
[Metric]

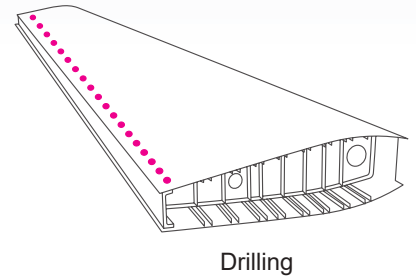
[CFRP/Aluminum Alloy]

The MCA drill employs a unique flute design that prevents the aluminum chips from damaging the finish of the CFRP section, and also reducing the deviation in hole size between the aluminum and CFRP section.

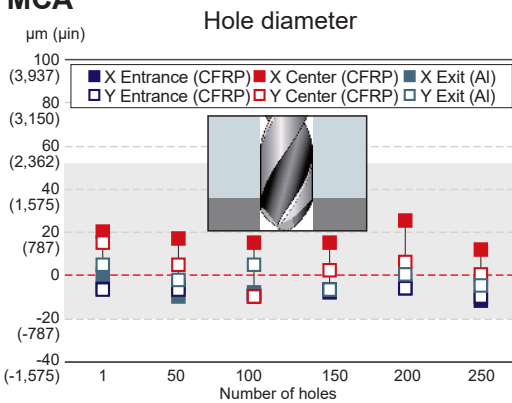


**MCA**

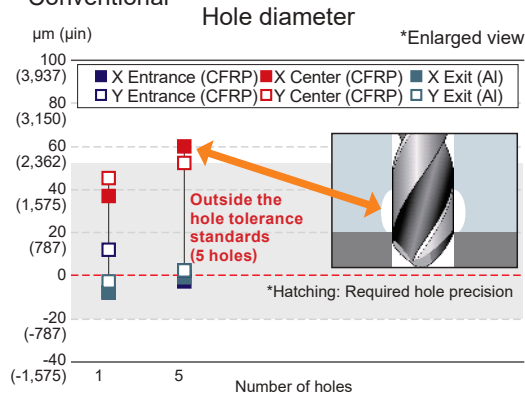
Drill (Grade)	MCA0638X05S070 (DD2110)
Work Material	CFRP + Aluminum Alloy
Cutting Speed	vc 100 m/min (328 SFM), n 5,000 min <sup>-1</sup>
Feed	f 0.15 mm/rev (.006 IPR), vf 750 mm/min (29.5 IPM)
Coolant	Dry (Internal air)
Machine	Vertical M/C



## MCA



## Conventional



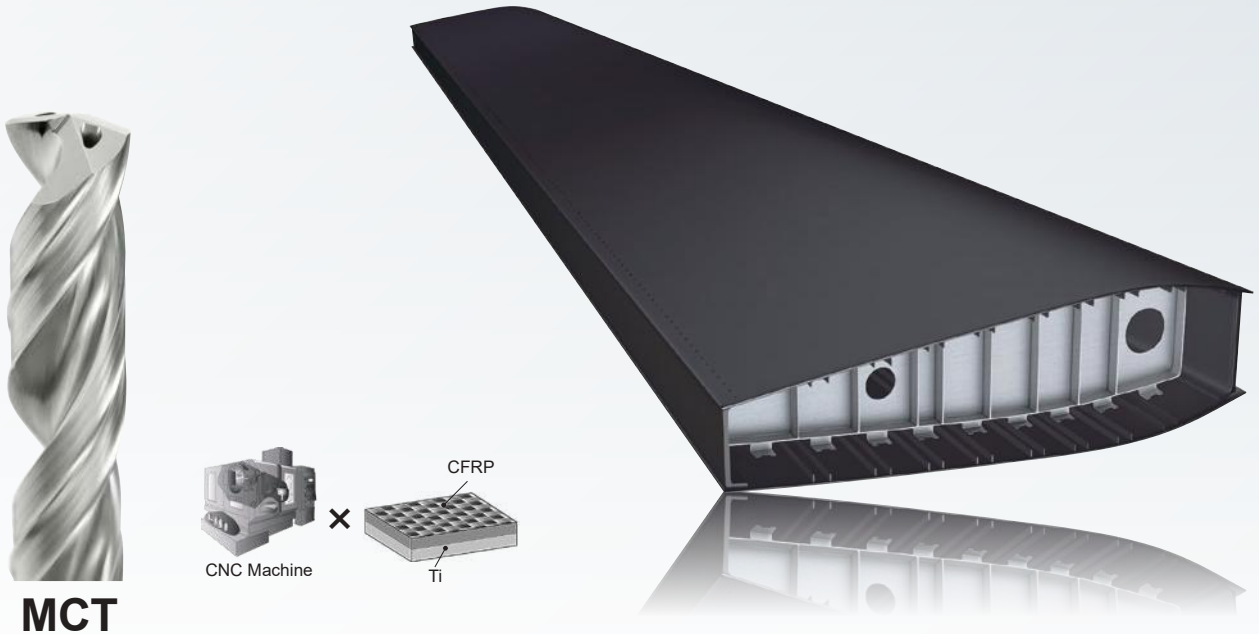
# AIRFRAME WING



P715G  
[Metric]

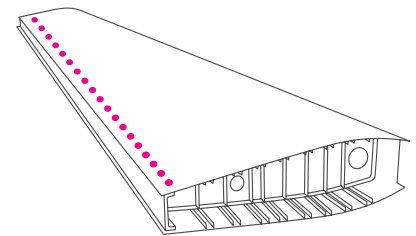
[CFRP/Titanium Alloy]

The MCT drill with its sharp cutting edge geometry is able to reduce heat generation during drilling. Therefore ensuring hole high tolerances when machining CFRP and titanium stack material.

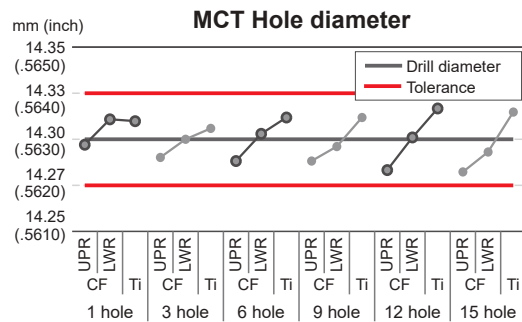
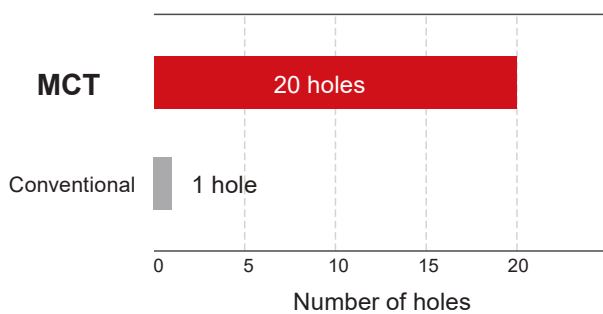


**MCT**

Drill (Grade)	MCT0638X05S070 (TF15)
Work Material	[CFRP] 11 mm (.433 inch) + [Ti-6Al-4V] 5 mm (.197 inch)
Cutting Speed	[CFRP] 60 m/min (197 SFM) [Ti-6Al-4V] 10 m/min (33 SFM)
Feed	[CFRP] 0.10 mm/rev (.004 IPR) [Ti-6Al-4V] 0.05 mm/rev (.002 IPR)
Peck Feed	0.125 mm (.005 inch)
Coolant	Dry (Internal air)



Drilling



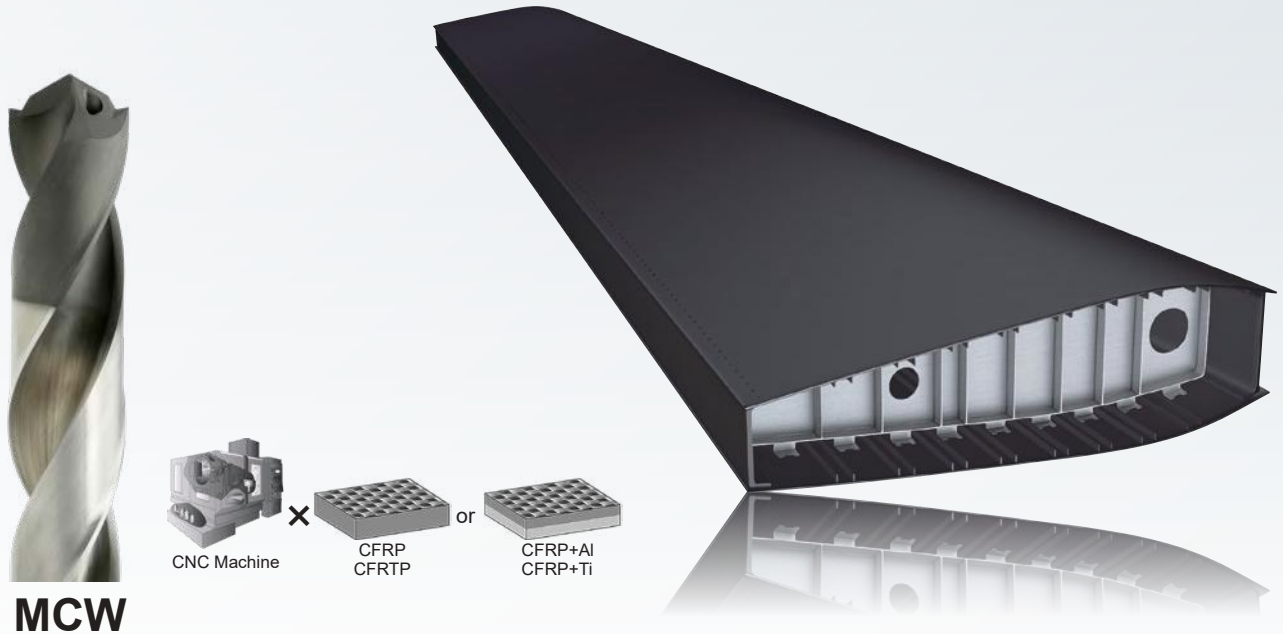
# AIRFRAME WING



P715G  
[Metric]

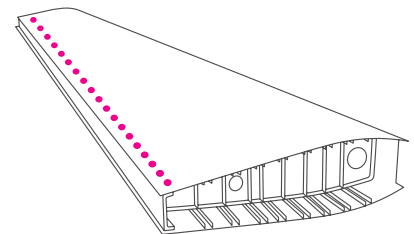
[CFRP, CFRP/Aluminum Alloy, CFRP/Titanium Alloy]

The MCW drill employs a unique cutting edge geometry that controls the chip flow generated at the outer circumference. This minimizes the hole diameter deviation between the stack materials. Additionally due to the unique cutting edge geometry burrs on the exit side of the hole can be prevented.

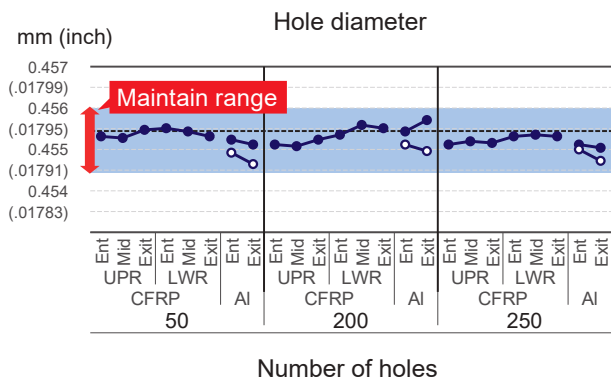


MCW

Drill (Grade)	ø11.57 mm (.456 inch) (DD2110) [Specialized]
Work Material	[CFRP] 31.8 mm (1.252 inch) + [A7075] 6.4 mm (.252 inch)
Cutting Speed	[CFRP] 100 m/min (328 SFM) / [A7075] 100 m/min (328 SFM)
Feed	[CFRP] 0.15 mm/rev (.006 IPR) / [A7075] 0.05 mm/rev (.002 IPR)
Hole Depth	38.2 mm (1.504 inch) (Through hole)
Coolant	Dry (Internal air)



Drilling



### <Comparison of machined surface finish>

Hole exit (aluminum side)



MCW



Conventional



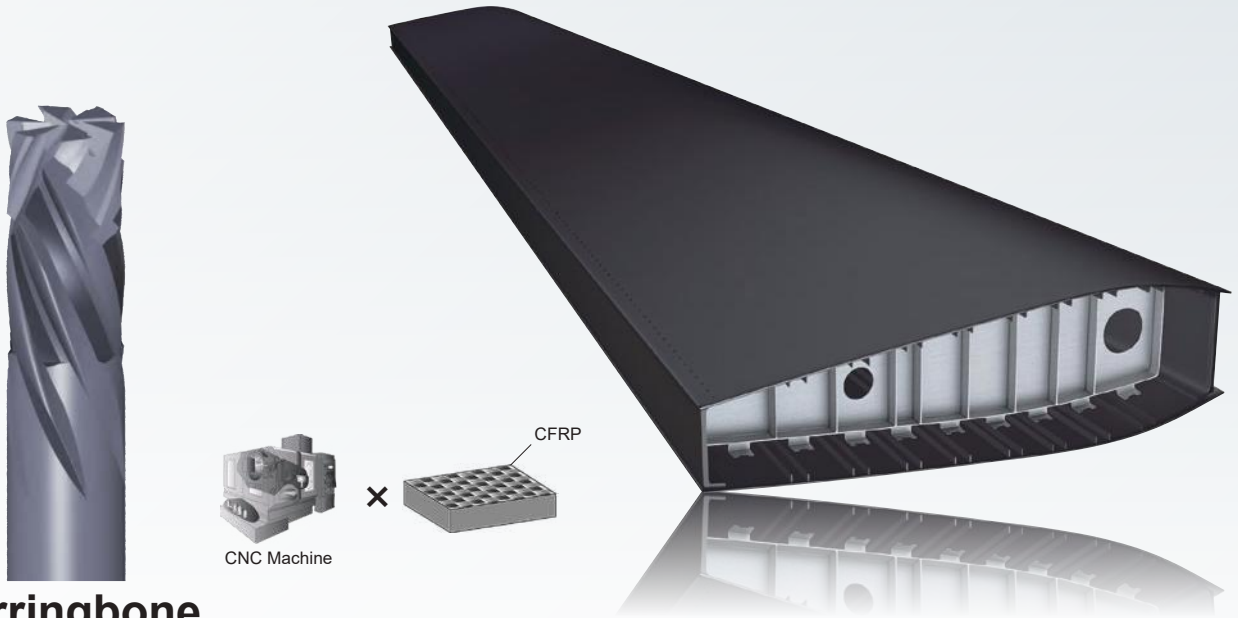
# AIRFRAME WING



P715G  
[Metric]

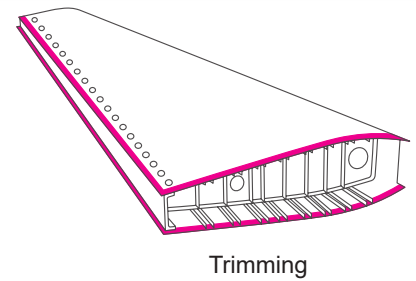
[CFRP]

A herringbone-type end mill using diamond coating can be used to achieve good finished surfaces free of burrs or peeling for trimming application for CFRP machining.



**Herringbone End mill**  
[Specialized]

End mill	CVD diamond coated end mill $\varnothing 10$ mm (.394 inch)
Work Material	CFRP
Cutting Speed	vc 339 m/min (1,112 SFM), n 10,790 min <sup>-1</sup>
Feed	fz 0.02 mm/tooth (.0008 IPT), vf 1,079 mm/min (42.5 IPM)
Overhang Length	40 mm (1.575 inch)
Coolant	Dry (External air)



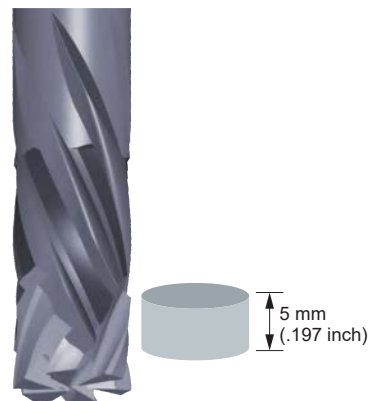
<Comparison of machined surface finish>



Herringbone End mill



Conventional



# AIRFRAME WING

[CFRP]

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

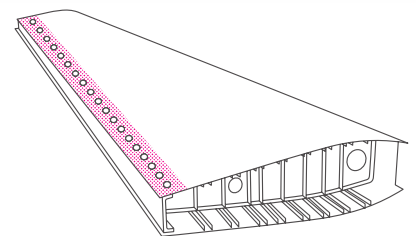


P715G  
[Metric]

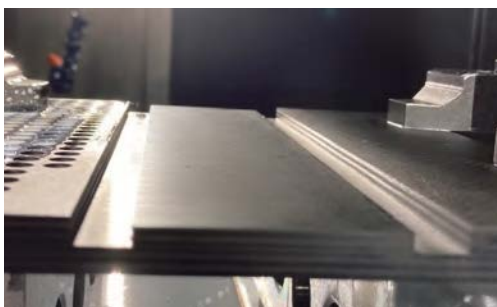


## FMAX

Holder	FMAX-050A10R
Insert (Grade)	GOER1404PXFR2 (MD220)
Work Material	CFRP
Cutting Speed	vc 3,927 m/min (12,884 SFM), n 10,000 min <sup>-1</sup>
Feed	fz 0.09 mm/tooth (.004 IPT) vf 18,000 mm/min (708.661 IPM)
Depth of Cut	ap 0.5 mm (.02 inch)
Coolant	Wet
Machine	Vertical M/C (BT30)



Face milling



**No burr !**

B116G  
[Metric]B116A  
[Imperial]

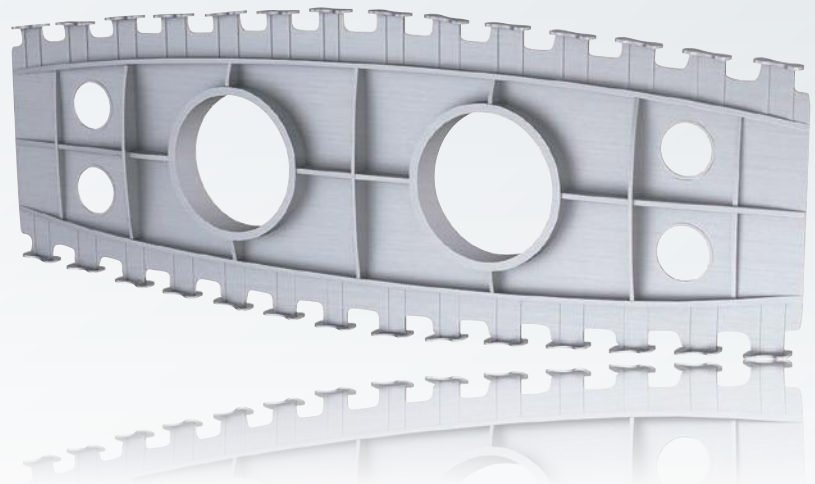
# AIRFRAME WING RIB

[Aluminum Alloy]

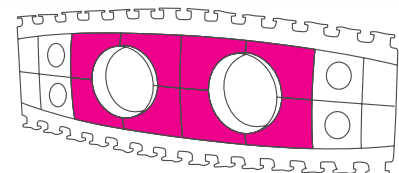
For certain components it is required to machine from block material thus a large volume of chips need to be removed. In order to do this efficiently and effectively a tool with low cutting resistance and exceptional chip disposal is required. The AXD series with its inserts that result in low cutting resistance and improved chip disposal can be effectively used for high speed and efficiency machining.



**AXD**

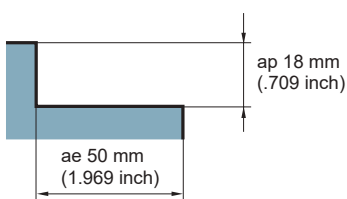


Holder	AXD7000R05003A-H63A
Insert (Grade)	XDGX227030PDFR-GL (TF15)
Work Material	A7075
Cutting Speed	vc 2,830 m/min (9,285 SFM), n 18,000 min <sup>-1</sup>
Feed	fz 0.21 mm/tooth (.008 IPT), vf 11,340 mm/min (446.457 IPM)
Depth of Cut	ap 18 mm (.709 inch), ae 50 mm (1.969 inch)
Coolant	Wet (Emulsion)

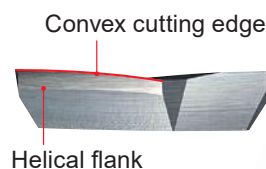


Face and pocket milling

Avoids poor wall surface finishes because the tool is designed to interpolate corners of the pocket, thereby preventing vibration.



**Low cutting  
resistance**



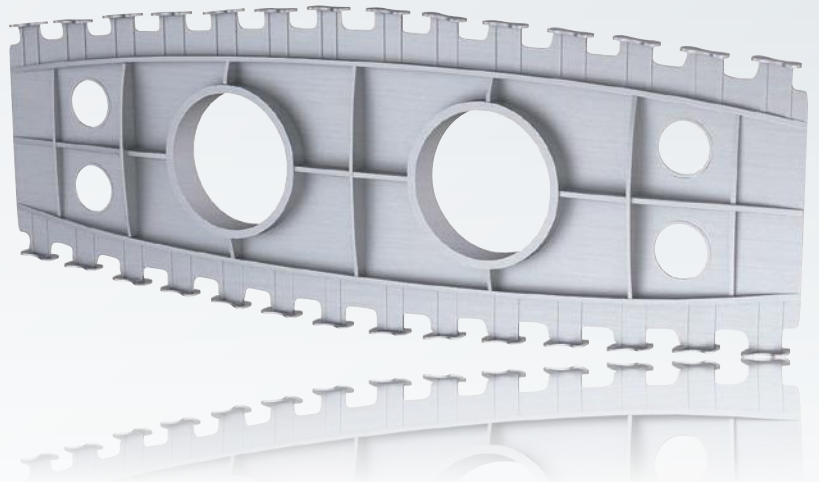
Helical flank



# AIRFRAME WING RIB

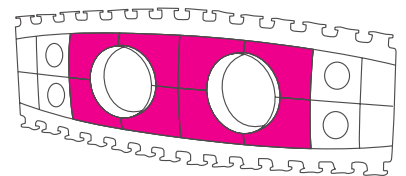
[Aluminum Alloy]

The Alimaster series employs a unique cross section geometry and spiral coolant holes that enables effective chip disposal properties, so that it can be used to machine with higher speeds and increased efficiency.



*New* **Alimaster**

End mill	A3SA120N36C
Work Material	A7050
Cutting Speed	vc 100 m/min (328 SFM), n 2,654 min <sup>-1</sup>
Feed	fz 0.32-0.44 mm/tooth (.013-017 IPT)
Depth of Cut	ap 12 mm (.47inch), ae 12 mm (.47 inch)
Coolant	Wet (Emulsion)



Face and pocket milling

fz mm/tooth

**0.32**

**0.38**

**0.44**



Good surface finish on the wall

*New* **Alimaster**

Conventional



End mill was broken





B200G  
[Metric]



B200A  
[Imperial]

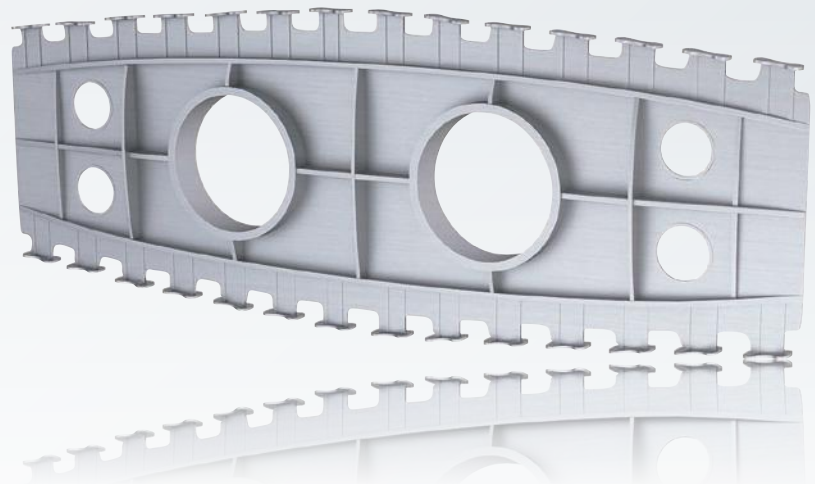
# AIRFRAME WING RIB

[Aluminum Alloy]

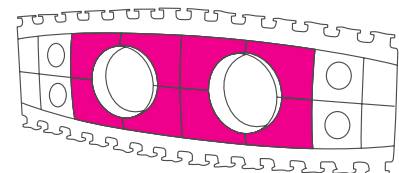
The iMX indexable heads specific for machining aluminum alloys employs a large rake and polished cutting edges to provide a sharp cutting edge to reduce cutting resistance and to prevent problems relating to welding.



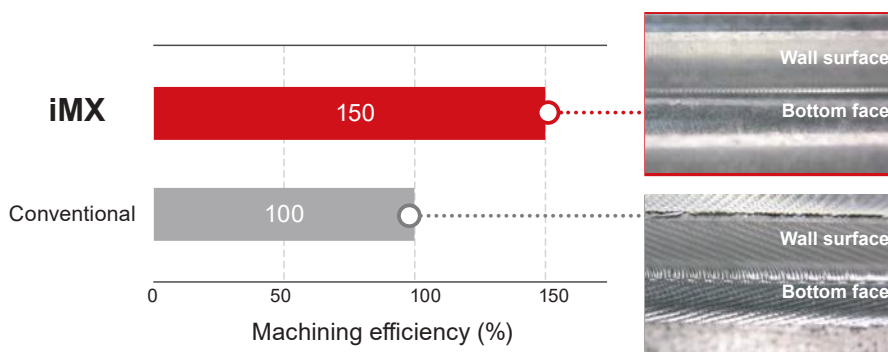
**iMX**



Holder	IMX10-U10N014L070C
Head (Grade)	IMX10S3A10008 (ET2020)
Work Material	A7075
Cutting Speed	vc 408 m/min (1,339 SFM), n 13,000 min <sup>-1</sup>
Feed	fz 0.12 mm/tooth (.005 IPT), vf 4,680 mm/min (184.252 IPM)
Depth of Cut	ap 5 mm (.197 inch), ae 10 mm (.394 inch)
Overhang Length	35 mm (1.378 inch)
Coolant	Wet (Emulsion)



Face and pocket milling







B200G  
[Metric]



B200A  
[Imperial]

# AIRFRAME WING RIB

[Aluminum Alloy]

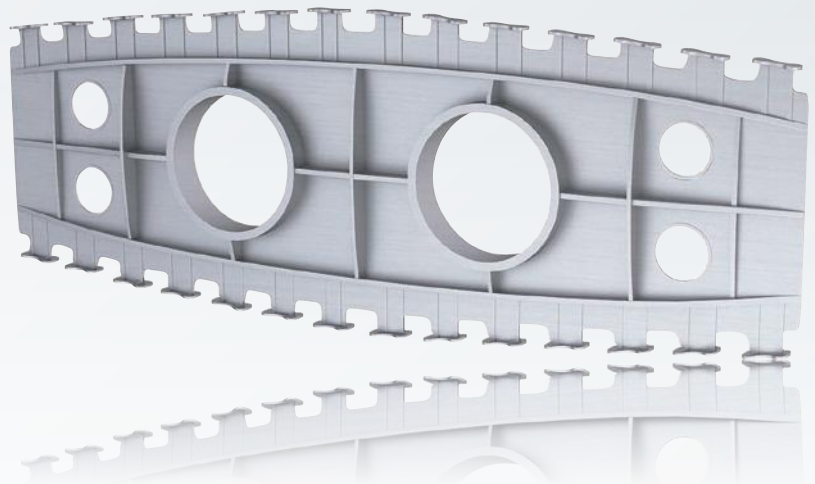
The iMX indexable head with a roughing geometry can reduce cutting resistance and achieve larger Material Removal Rate (MRR) than conventional cutting edge type tools.



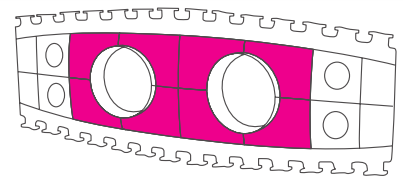
**iMX**

**Roughing Radius head**

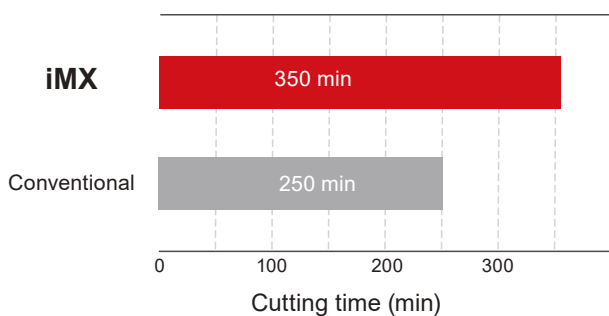
[Specialized]



Head	ø25 mm (.984 inch), R3.0 mm (.118 inch), Z=3
Work Material	A7050
Cutting Speed	vc 2,120 m/min (6,955 SFM), n 27,000 min <sup>-1</sup>
Feed	fz 0.173 mm/tooth (.007 IPT), vf 14,000 min (551.2 IPM)
Depth of Cut	ap 35 mm (1.378 inch), ae 17 mm (.669 inch)
Coolant	MQL
Machine	5-axis M/C (HSK-A63)



Pocket milling





B116G-F  
[Metric]



B116A-F  
[Imperial]

# AIRFRAME WING RIB

[Aluminum Alloy]

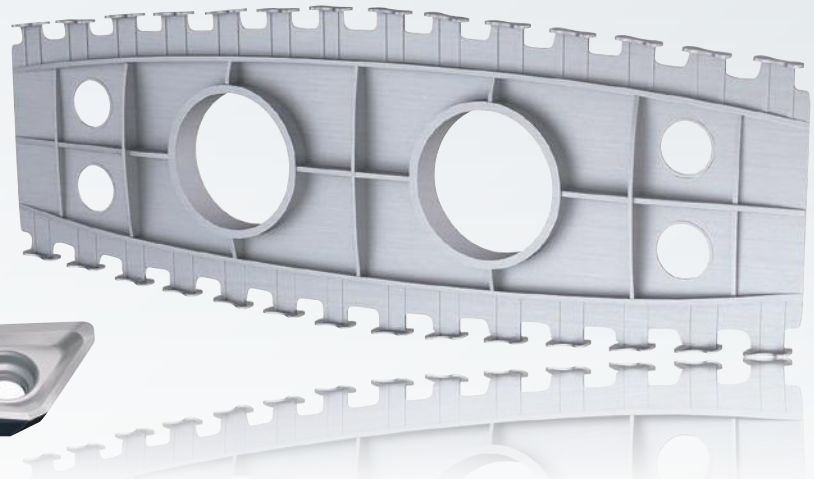
When processing aluminum alloys, it is important to try to improve the Material Removal Rate (MRR). The AXD4000A achieves high-efficiency machining, especially on high-speed, high-power spindle machines for aluminum machining. (Over 20,000 min<sup>-1</sup> spindle speed and over 80 kW spindle power). MT2010 grade is recommended for high-speed machining of aluminum-lithium-alloy and A7075, etc.



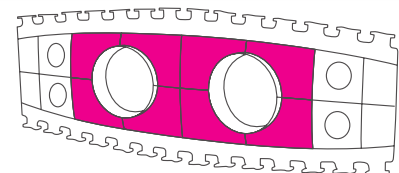
**AXD4000A**



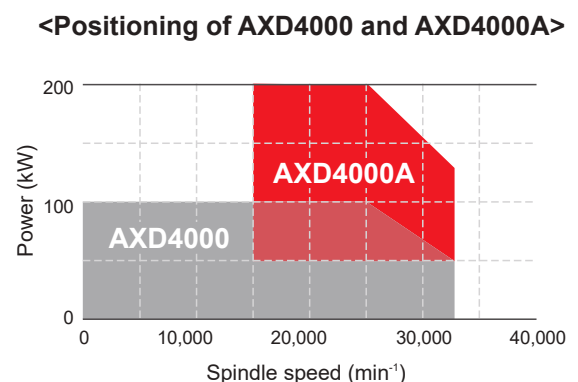
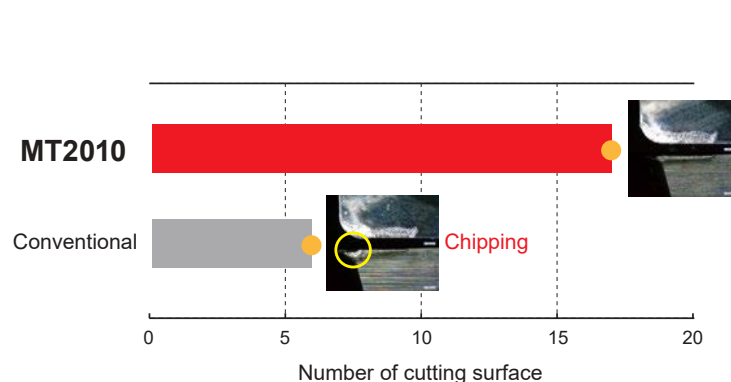
**MT2010**



Holder	AXD4000A-050A04RD
Insert (Grade)	XDGX175004PDFR-GM (MT2010)
Work Material	Aluminum-lithium-alloy
Cutting Speed	vc 5,181 m/min (16,998 SFM), n 33,000 min <sup>-1</sup>
Feed	fz 0.15 mm/tooth (.006 IPT)
Depth of Cut	ap 1.5 mm (.06 inch), ae 39 mm (1.54 inch)
Coolant	Wet
Machine	High speed and high power 5-axis M/C



Face and pocket milling



# Cutting tool family for Composite



**MC**  
[Leaflet P715G]



**Specialized Drill**  
for M/C  
for ADU/EDU  
for Hand tool  
Countersink  
[Leaflet P715G]



**DFC**  
[TOOL NEWS B189G]



**3D-PCD** End mill  
[Leaflet P715G]



**FMAX**  
[TOOL NEWS B216G]

# Cutting tool family for Titanium alloy



**SMART  
MIRACLE**  
VQ End mill  
[TOOL NEWS B197G]



**SMART  
MIRACLE**  
Coolstar  
[TOOL NEWS B171G]



**SMART  
MIRACLE**  
VQT6UR  
[TOOL NEWS B232G]



**SMART  
MIRACLE**  
VQT5MVRB  
[TOOL NEWS B230G]



**iMX**  
[TOOL NEWS B200G]



**VPX**  
[TOOL NEWS B250G]



**ASPX**  
[TOOL NEWS B238G]



**AJX**  
[TOOL NEWS B028G]



**ARP**  
[TOOL NEWS B222G]



**APX**  
[TOOL NEWS B055G]



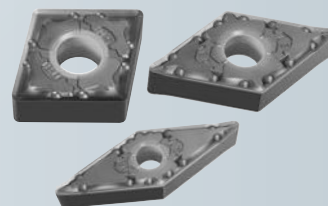
**DSA**  
[TOOL NEWS B256G]



**Roughing** End mill  
[Specialized]



**GY**  
[TOOL NEWS B140G]



**MT90 Series**  
[TOOL NEWS B214G]



# Cutting tool family for HRSA



**JT holder**  
[TOOL NEWS B253G]



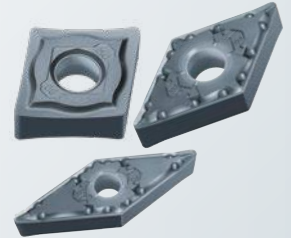
**AJX**  
[TOOL NEWS B028G]



**ARP**  
[TOOL NEWS B222G]



**APX**  
[TOOL NEWS B055G]



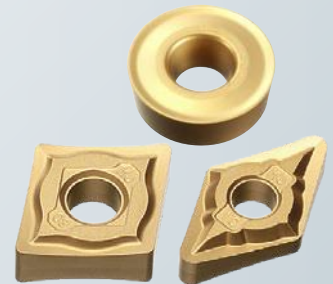
**MP90 Series**  
[TOOL NEWS B214G]



**GBi59/MB730**  
[TOOL NEWS B084G-F]



**GY**  
[TOOL NEWS B140G]



**US905**  
[TOOL NEWS B036G]



**CERAMIC End mill**  
[TOOL NEWS B228G]



**SMART MIRACLE**  
VQ End mill  
[TOOL NEWS B197G]



**SMART MIRACLE**  
VQN End mill



**DSA**  
[TOOLS NEWS B256G]



# Cutting tool family for Aluminum alloy



**AXD**  
[TOOL NEWS B116G]



**APX**  
[TOOL NEWS B055G]



**VPX**  
[TOOL NEWS B250G]



*New*  
**Alimaster**



**AXD4000A /  
MT2010**  
[TOOL NEWS B116G]



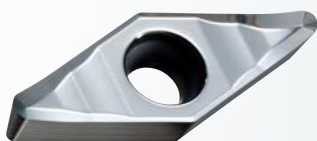
**MVX**  
[TOOL NEWS B202G]



**MAE/MAS**  
[TOOL NEWS B040G]



**MNS**  
[TOOL NEWS B135G]



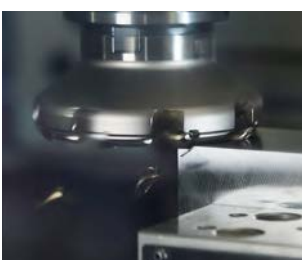
**AZ Breaker**  
[TOOL NEWS B098G]



**FMAX**  
[TOOL NEWS B216G]



**MD220**  
[TOOL NEWS B115G]



YOUR GLOBAL CRAFTSMAN STUDIO

## RESPONSIVE, ATTRACTIVE, PROACTIVE

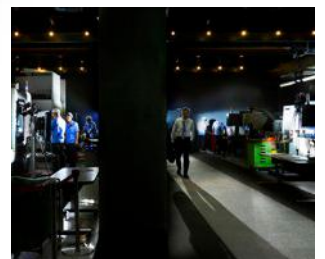
Mitsubishi Materials Corporation, Metalworking Solutions Company, offers a “Comprehensive Craftsman Studio” which addresses the individual needs and requirements of our customers’ in order to make their business successful. Here the Machining Technology Center is the front-line base. It is fully equipped 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.



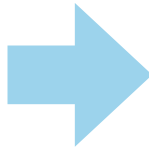
# Strengthening of total tooling solutions for our cutting tools

## 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.

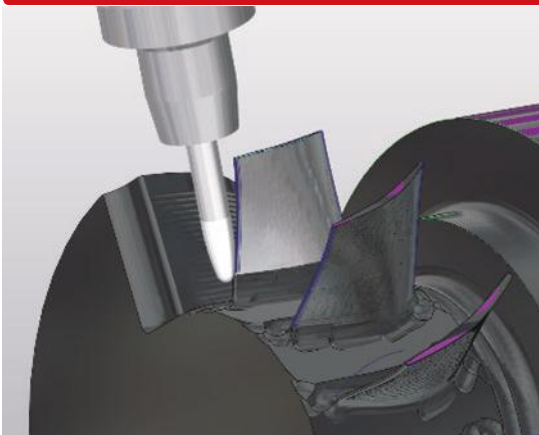
**Driving Force for the Research & Development Base**

- 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

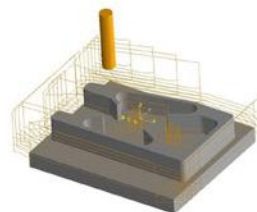
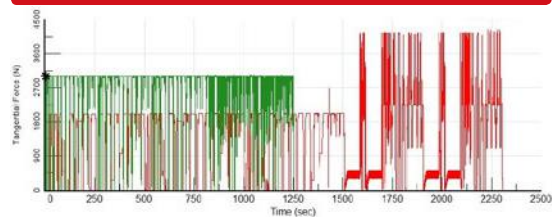
### Tool path simulation by CAM

#### Optimization of machining method



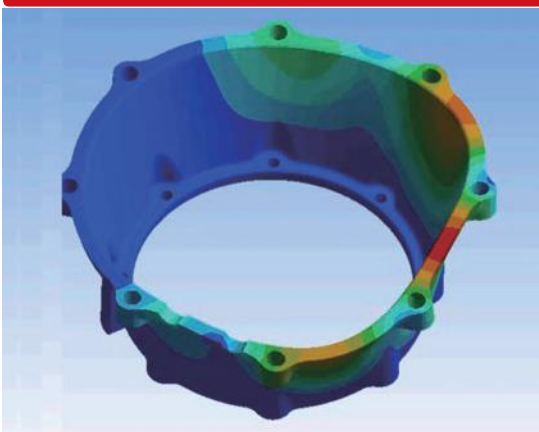
### Analysis of cutting resistance

#### Optimization of Cutting resistance



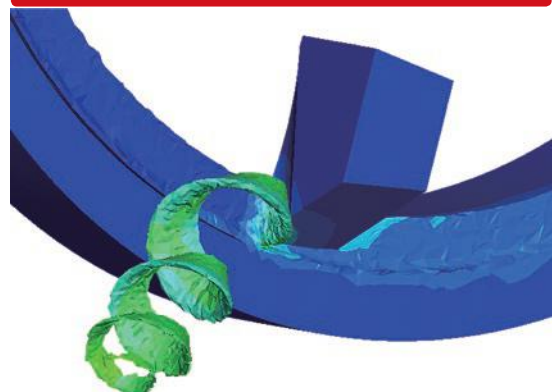
### Analysis of work material rigidity and vibration

#### Optimization of clamping system



### Analysis of chip shape

#### Optimization of chip control





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## Overseas Sales Offices

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**MITSUBISHI MATERIALS CORPORATION**  
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### RUSSIA

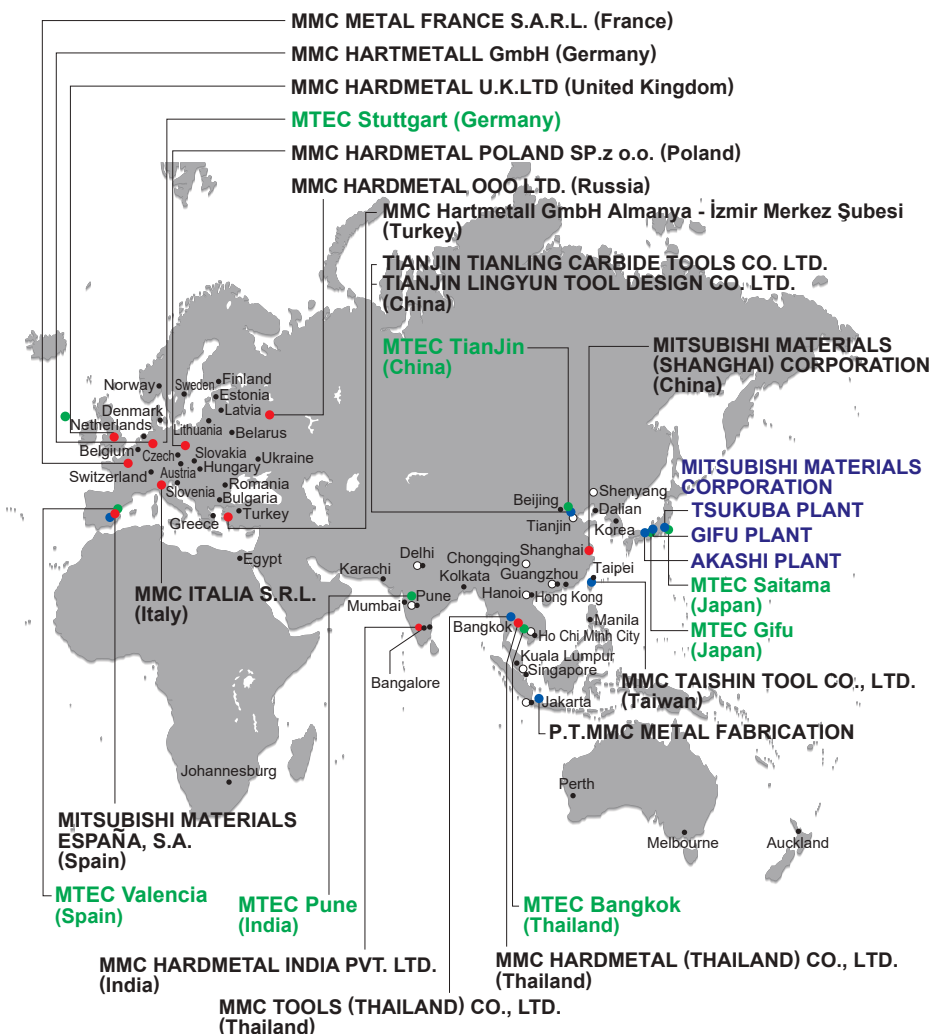
**MMC HARDMETAL OOO LTD.**  
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Moscow, RUSSIA  
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E30, Universal Enterprise Park, No. 1 Si Chi Road, Universities Industrial  
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TEL : +86-22-8371-3922 FAX : +86-22-8371-3855  
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TEL : +66-38-210-728 FAX : +66-38-210-732  
E-mail : mhtmtcec@mmc.co.jp

### MTEC Pune (India)

#### MMC Hardmetal India Pvt Ltd.

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## MITSUBISHI MATERIALS U.S.A. CORPORATION



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## Manufacturing plants in Japan



MITSUBISHI MATERIALS TSUKUBA PLANT (JAPAN)



### QMS.EMS

ISO 9001, ISO 14001  
(JSAQ080) (JSAE036)

The Scope of the Registration:  
Design, Development and  
Production of Cemented  
Carbide Tools and Carbide  
Blanks



MITSUBISHI MATERIALS GIFU PLANT (JAPAN)



### QMS.EMS

ISO 9001, ISO 14001  
(JSAQ094) (JSAE1545)

The Scope of the Registration:  
Design, Development, and  
Production of Cutting Tools,  
Cemented Carbide Blanks,  
and Coated Products



MITSUBISHI MATERIALS AKASHI PLANT (JAPAN)



ISO 9001  
ISO 14001

JQA-2522

JQA-EM0941

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#### Mitsubishi Materials U.S.A. Corporation

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