

AERO-DIANAMICS™ SHAPING PRODUCTIVITY IN AEROSPACE

— *Advanced PCD round tool blanks make possible new geometries which break through the barriers in aerospace tool design.*



THE CFRP REVOLUTION

— *Revolutionary new CFRP composites and stacks drive airframe weight reduction*

CFRP COMPOSITES NOW MAKE UP 50% OF AIRFRAME MATERIALS

For example, Boeing's 787 Dreamliner uses 50% by weight Carbon Fibre Reinforced Polymer (CFRP) composites for fuselage, wings, fin, stabiliser, control surfaces and nacelles. Overall, the use of CFRP in aerospace is forecast to grow by 14% p.a. to 23,000 tonnes by 2020*.

** Aerospace Design & Manufacturing Magazine 2014.*

TRANSFORMING THE ECONOMICS OF AIRCRAFT OPERATIONS

The aerospace industry worldwide is switching to CFRP as airframe weight drives the economics of aircraft operations. Specifically, CFRP enables a series of benefits including:

- Weight reduction for improved emissions and up to 25%* greater fuel efficiency
- High durability for reduced maintenance costs
- High strength allowing higher cabin pressure for greater passenger comfort
- The opportunity to increase payloads

** Boeing Corporation / Airbus.*

MEETING THE CHALLENGE OF MACHINING NEW MATERIALS

Machining these new strong, durable, lightweight and fibrous materials requires new technology. That technology is the new Aero-Dianamics range of Polycrystalline Diamond (PCD) round tools blanks. Aero-Dianamics allows the tool designer to achieve previously impossible geometries that precisely match the customers' milling and drilling applications.

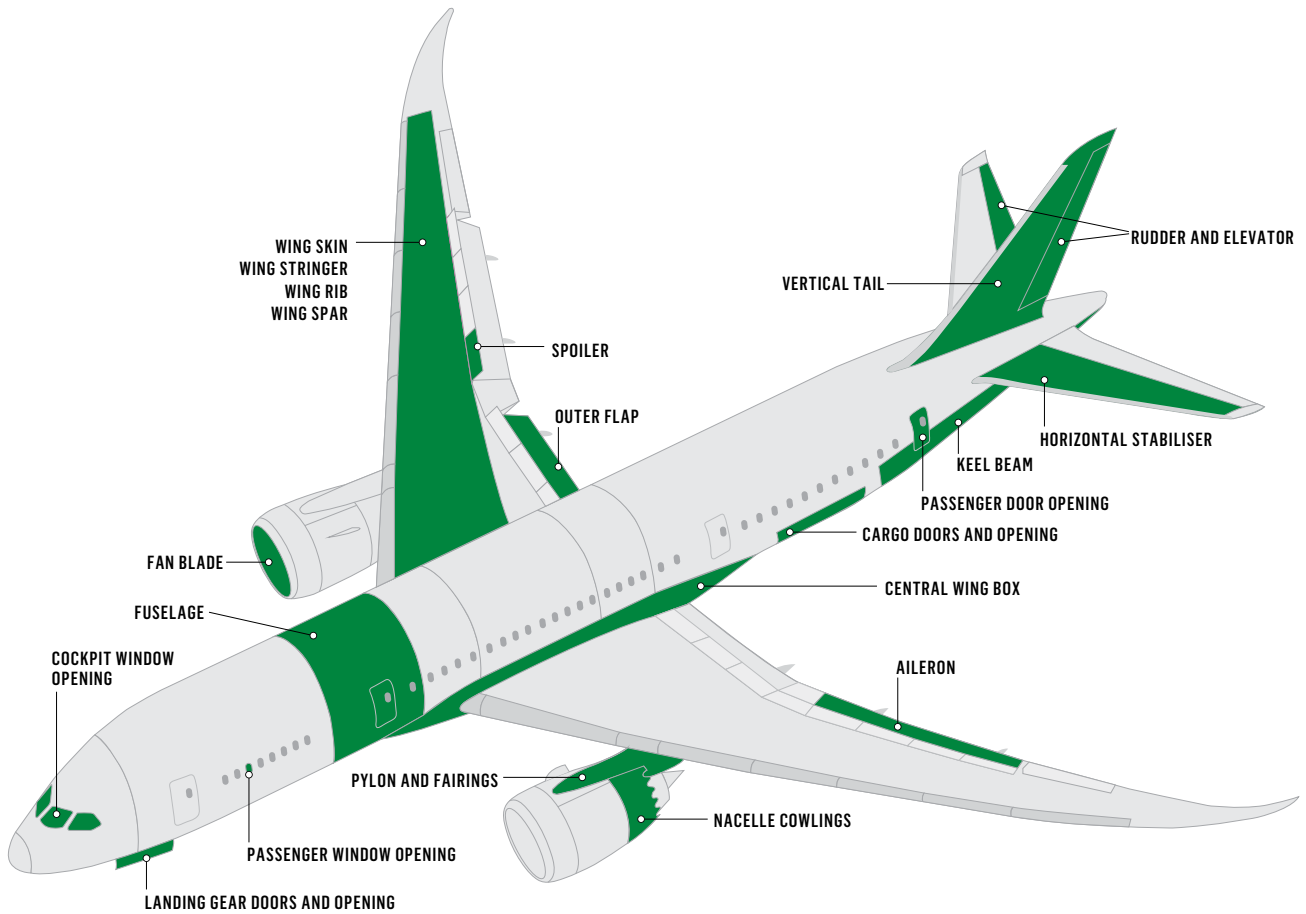
A NEW GENERATION OF PCD TOOLS ACCELERATES PRODUCTION IN CFRP

The ability to mill and drill CFRP faster, more cleanly, at lower temperatures and with lower tool forces means CFRP airframe components can be produced more efficiently and rapidly. And that means finished components can be delivered for assembly with shorter lead times – allowing airplane manufacturers to deliver to customers on shorter schedules.



TOOL DESIGN SET FREE

— *Revolutionary new PCD tool blanks break through barriers in aerospace tool design*



ABOUT THE NEW AERO-DIANAMICS RANGE

Tool designers can now create entirely new PCD tool geometries breaking through the existing barriers in PCD tool design with:

- Freedom of design in flute profiles
- Multiple flutes
- Limitless flute angles and orientations (left/right/compressive)

These next generation composite tooling solutions entirely replace the need for coated tungsten carbide tools for fabricating composite components.

MAIN PRODUCT PORTFOLIOS

Element Six's Aero-Dianamics range has two portfolios - Milling and Drilling. The two portfolios consist of three production-ready product configurations.

AD-DRILLING



CHEVRON



PLANAR

AD-MILLING



HELIX

AERO-DIANAMICS™

AERO-DIANAMICS REVOLUTIONARY DRILLING MATERIALS



UNIQUE PLANAR AD-D3 BLANKS FOR COMPLEX DRILL GEOMETRIES

- Almost infinite flexibility in drill point geometry
- Significantly increased wear resistance over traditional coated carbide drills
- Tool life more than 10* times longer than tungsten carbide drills
- Consistent performance over the tool life
- Greater cutting point flexibility
- PCD physically bonded to substrate, not brazed
- Superior work piece surface finish
- Large rake angles possible for lower tool forces
- Multiple re-sharpenings possible
- Fabrication by either Electro Discharge Machining (EDM) or conventional grinding
- Suitable for drilling CFRP stacked with aluminium and/or titanium

** The University of Birmingham, UK.*



PREMIUM QUALITY CHEVRON PCD INSERTS FOR 2D GEOMETRY TOOLS

- Full and half round disc formats
- EDM cut segments available to order
- Significantly increased wear resistance over coated carbide drills
- Tool life extended 10* times longer than carbide drills

** The University of Birmingham, UK.*



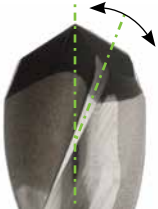
REVOLUTIONARY HELIX AD-M3 BLANKS FOR MILLING TOOLS

- Up to 250* times wear resistance compared with traditional tungsten carbide end mills
- Up to 12* times faster machining speeds
- Helical geometry results in lower tool forces and better chip evacuation
- High thermal conductivity and low coefficient of friction results in less heat build-up and adhesion
- Fast fabrication by EDM
- Sharp PCD edges cut fibres cleanly
- End mills can be reconditioned for even longer tool life

** Modern Machine Shop Magazine.*

BREAKING THROUGH EXISTING BARRIERS IN PCD TOOL DESIGN

AD-DRILLING



HELIX CUTTING ANGLE TO COPE WITH ALL APPLICATION DEMANDS

- Flexibility to optimise design to meet work piece application demands



DUAL ANGLE DRILL POINT GEOMETRY

- Provides flexibility in determining drill cutting points
- Included angles up to 90° can be achieved



MULTIPLE FLUTES

- More flutes result in lower forces, better chip evacuation and faster drilling speeds
- Tool designers not constrained by planar PCD shape
- Provides enhanced design flexibility
- Designers have ultimate choice of Point Angle / Cutting Lips / Chisel Edge / Lip Relief geometries
- Larger PCD layer formats remove the limitations associated with traditional planar PCD sections

AD-MILLING



PRE-DETERMINED FLUTE ANGLE CONFIGURATIONS

- Reduced PCD processing times
- Sharp PCD edges cut fibres cleanly
- More flutes result in increased cuts per rotation
- Helical geometry results in lower tool forces and better chip evacuation

NEW TOOLS ENABLING NEW LEVELS OF PRODUCTIVITY

— The five leaps in tool performance that deliver exponential increases in productivity

1 SUPERIOR WEAR RESISTANCE OVER COATED TUNGSTEN CARBIDE

PCD is the hardest man made material in industrial use. Its wear resistance far exceeds that of tungsten carbide.

2 LONGER TOOL LIFE WITH CONSISTENT PRECISION

The use of PCD extends tool life by a factor of at least 10* times. Moreover it maintains optimum sharpness throughout the life of the tool.

** The University of Birmingham, UK.*

3 FLUTE ANGLES THAT CUT FIBRES MORE CLEANLY

PCD drills and end mills produce consistent hole and edge quality for significantly longer than coated carbide tools.

4 FASTER TOOL OPERATION WITH BETTER TEMPERATURE CONTROL

Tools can run faster with PCD as it has sharper edges and less friction, combined with excellent thermal conductivity. So CFRP stacks with aluminium and titanium can be drilled twice as fast* without the problems associated with the work piece overheating.

** AMRC, Sheffield, UK.*

5 REDUCED RE-WORKING AND DOWNTIME

Long intervals between tool changes and the elimination of time-consuming reworking of holes and edges reduces machine downtime significantly.



THE RESULT IS EXPONENTIAL INCREASES IN PRODUCTIVITY

Revolutionary Aero-Dianamics tool blanks deliver productivity for tool makers by creating semi-finished tool materials and enabling fast fabrication.

They deliver productivity for aerospace customers by dramatically speeding up CFRP component production.

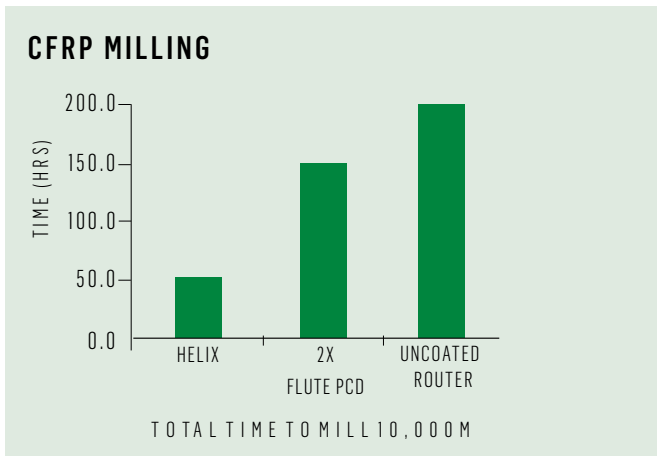
DELIVERING AN ATTRACTIVE COST OF OWNERSHIP SOLUTION

Aero-Dianamics has been shown to be a proven cost effective solution for machining the latest generation of composite materials.

Representative examples are outlined below. Results are taken from current testing, with further tests ongoing. More information available upon request.

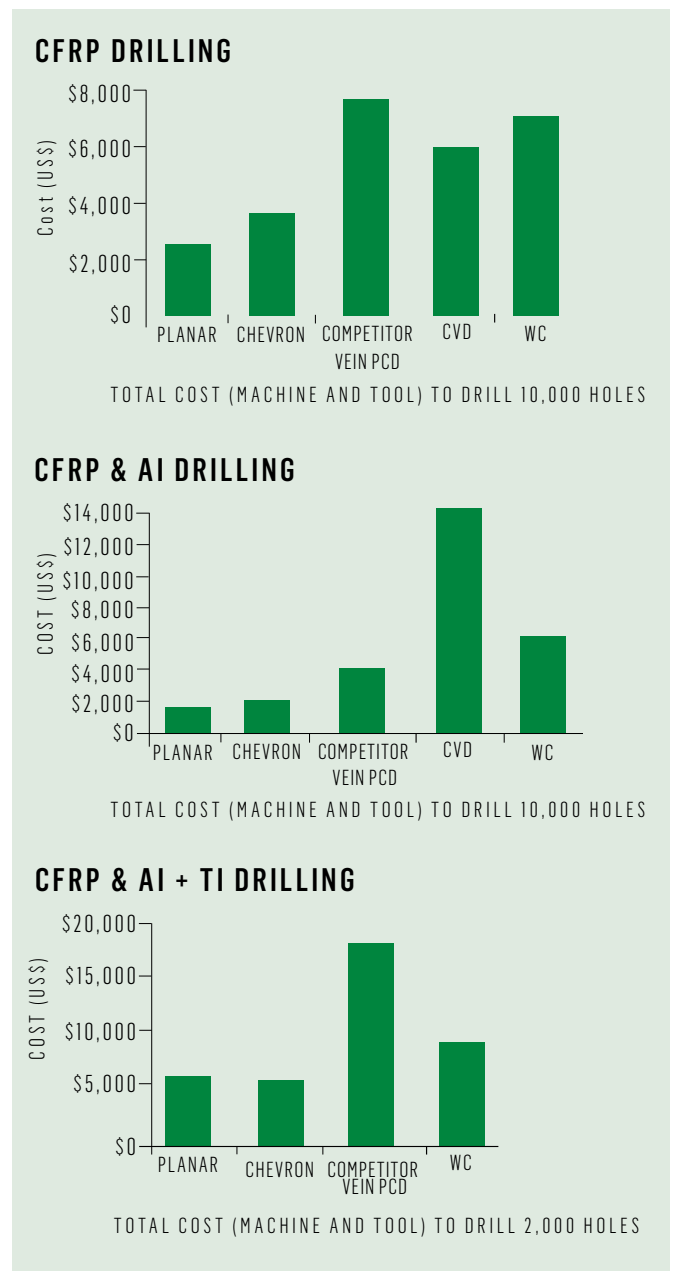
MILLING

Aero-Dianamics Helix tools significantly reduce total time required to mill 10,000 metres compared to uncoated tungsten carbide and competitor flute PCD.



DRILLING

Aero-Dianamics Planar and Chevron tools significantly reduce the total cost required to drill 10,000 holes compared to competitor veined PCD, CVD and tungsten carbide tools.



ELEMENT SIX

Element Six, part of the De Beers Group of Companies, designs, develops and produces synthetic diamond and other supermaterials, and operates worldwide with primary manufacturing facilities in China, Germany, Ireland, South Africa, the UK and US.

Element Six supermaterial solutions are used in applications such as cutting, grinding, drilling, shearing and polishing, while the extreme properties of synthetic diamond beyond hardness are opening up new applications in a wide array of industries such as optics, power transmission, water treatment, semiconductors and sensors.

If you would like to know more about Element Six please visit our website www.e6.com or contact us at the address below.

GLOBAL

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