

Composite



Solutions for composite applications



Composite wing

Surface machining

High demands on machining surfaces found on carbon fibre components demand innovative solutions. The CoroMill® family includes products such as CoroMill 590 and CoroMill 390, with high precision indexable PCD inserts. Diamond-coated carbide inserts can be a productive solution for surface machining on materials with a high fibre content.



CoroMill® 590 with PCD inserts



CoroMill® 390 with diamond-coated carbide inserts

With a focus on composites

Solutions for carbon fibre and stacked materials

Carbon fibre and other composite materials are developing fast, new material properties are evolving and the usage is expanding. Various benefits such as lighter and stronger components as well as reduced problems with corrosion make them very suitable in many applications.

But with the success of these as constructional materials comes new demands on machining capability, where variations in machinability add to the challenge.

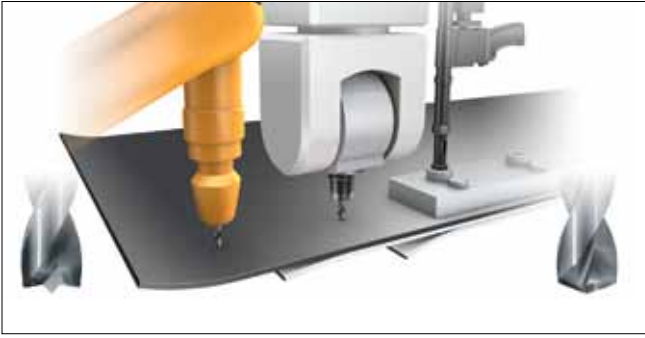
Materials and features

Establishing individual processes for applications is the cornerstone of successful composite machining. Tool, geometry and grade selection followed by cutting data and new innovative solutions will lift the manufacturing to a new level.

Solutions, usually application-specific can include one of the CoroDrill® geometries. The PCD drills with vein-technology (sintered PCD) cutting edges include geometries to minimize delamination tendencies at hole entries and exits.

Application solutions include:

- Standard and engineered products
- Carbide or PCD drill solutions
- Innovative drill geometries for improved hole quality
- Milling cutters for improved surface quality and machine utilization



Hole making

Producing holes in various carbon fibre materials demands unique geometries to achieve hole tolerance and quality, as delamination and splintering are common problems. Combining carbon fibre (CFRP) with a stacked material such as titanium adds another dimension as the two materials vary in machining methods.

- CoroDrill® family includes geometries for high fibre (splintering) and high resin (delamination) CFRP materials
- Solutions include geometries for the combination of CFRP, aluminium and titanium-stacked materials
- PCD and carbide drill designs for CNC, PKM and positive feed machines



Edging and trimming

Whether it is the trimming of larger components or edging the circumference of CFRP (carbon reinforced plastic), CoroMill® milling cutters are the solution. CoroMill 329 slotting cutters using carbide or PCD inserts for trimming or CoroMill Plura PCD and diamond coated cutters for edging are all designed to reduce splintering and improve edge quality.

Positive angles and sharp cutting edges are essential for the reduction of heat and the production of high quality surfaces for the aerospace industry.



Coated carbide or PCD tipped tools?

Each material and machine tool demands optimized solutions.

Carbide tools with diamond coating:

Suitable for various composite materials as well as aluminium stacks with a high demand on flexibility.

PCD:

A tool solution with predictable tool life, consistent surface dimensions and quality. Suitable for most material combinations and various machine types.

Structural components

For airframes, composites are especially developed to add stiffness, strength and durability to structures. Composites have excellent strength to weight ratio and can be formed into complicated shapes. In comparison to aluminium, carbon fibre composites (CFRP) typically have more than fourteen times the tensile strength; nineteen times lower thermal expansion; five times greater stiffness and yet weigh only half as much. But they are also much more challenging to machine.



CoroMill® 590, a high precision solution for surface machining with demands on dimensions and surface finish. Serrated seat indexable inserts make it a flexible but still accurate solution, in comparison to brazed milling cutters.

Surface machining with high security

Application of the high precision CoroMill 590 resulted in a productive surface machining solution, to extend production runs and security.

CoroMill® 590 with PCD inserts			Surface milling
Cutting speed	V_c	m/min	300
Depth of cut	a_p	mm	2.5
Feed rate	f_n	mm/rev	0.17



Edging of composites

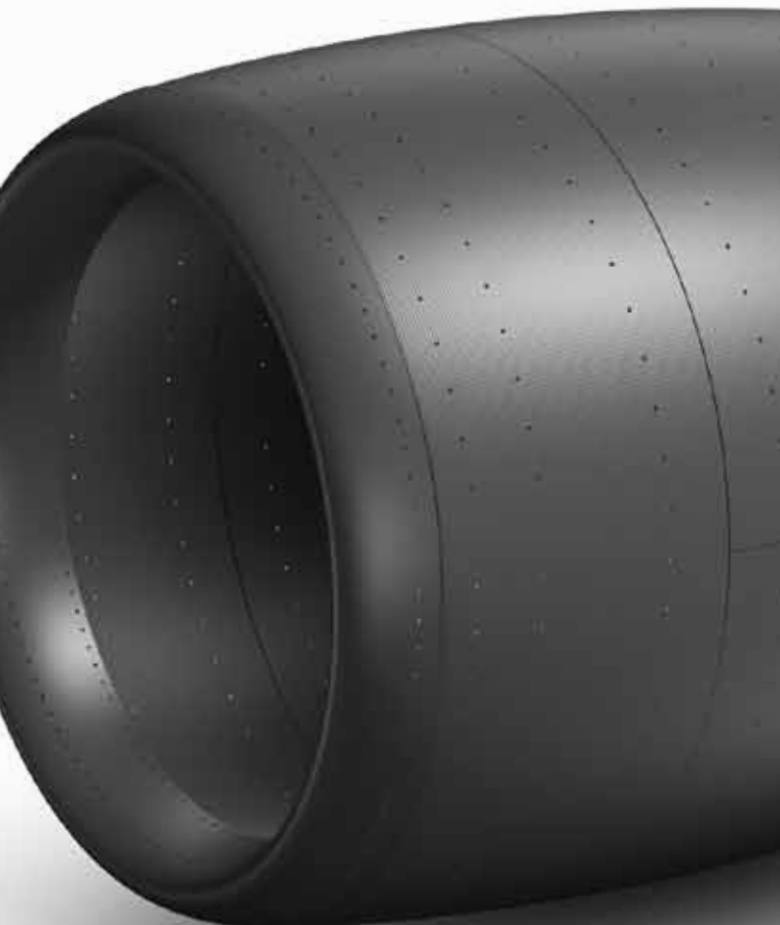
The finish achieved in one operation can reduce or eliminate secondary operations, and increased tool life can reduce machine downtime.

Rough machining or finishing of composite materials can be improved with CoroMill® cutters. PCD end mills and diamond-coated carbide cutters can be engineered to suit most applications, reducing splintering of fibres and increasing metal removal rates.



Hole making in demanding materials

CoroDrill® geometries include the 854 geometry. Its shape is designed to improve hole entrance and exit quality on carbon fibre materials with high fibre content. Producing holes in high resin materials, with increasing demands on delamination and splintering can be optimized by drill geometry design. Small point angles and high rake angles help to improve hole quality as well as reduce axial forces, which is critical on thin-walled surfaces.



Producing holes in CFRP/AL stacked materials

Producing high quality 1/4" (6.35mm) holes in CFRP and AL stacked materials, was made possible with the CoroDrill® 854 with diamond coating. Improvements include the reduction of splintering, as well as the elimination of burr and enhancement of surface finish.

CoroDrill® 854 carbide drill			Holemaking
Cutting speed	V_c	m/min	45
Drill depth	a_p	mm	70
Feed rate	f_n	mm/rev	0.03
Penetration rate	V_f	mm/min	51

Carbon fibre materials

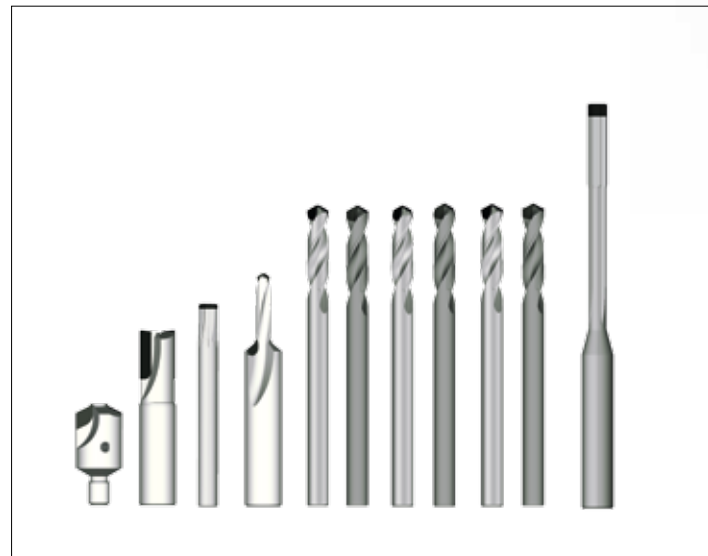
In the composite material, fibres, whiskers, particles or woven material are dispersed in a matrix where they add stiffness and strength. Structural composites are made up of laminates or sandwich layers and can include stacks of titanium and aluminium. Therefore cutting speed recommendations can vary from 100 m/min (320 sfm) for carbon fibre to 20 m/min (65 sfm) in titanium in order to produce high quality holes and surfaces.

Application demands

Structural components such as composite wing - including spars, stringers and skins - are made out of variations of carbon fibre and matrix materials, which result in the need for individual tooling solutions.

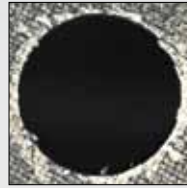
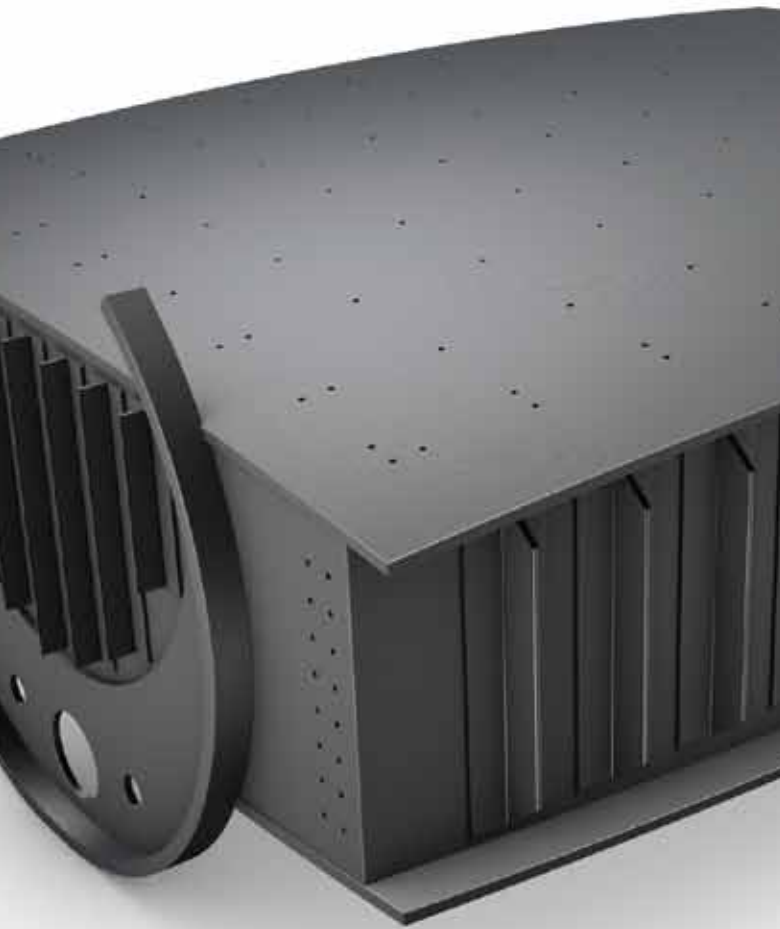
Other demanding structures, such as the central wing box, made out of several types of composite material, commonly stacked with aluminium and titanium, increase the need for an optimized process.

The combination of stacked materials challenges the manufacturing process, tool security and surface quality even more. Issues such as chip evacuation, effective production and hole quality, are made more difficult due to the large difference in material properties.



Tooling solutions

A varied selection of tool geometries, designs, as well as one or two-hit process solutions can drastically improve the production process. Product solutions from Sandvik Coromant include carbide and brazed or vein type diamond drills, counter-sunk tools as well as reamers for demanding surface finish and hole tolerance.



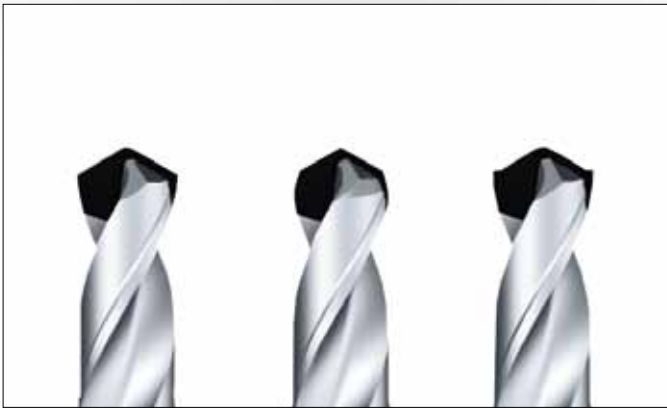
Delamination with previous drill type.



The CoroDrill® solution improved hole quality without delamination and splintering.

Hole quality

High resin and high fibre content materials can demand optimized tool geometry designs in order to produce high quality holes in a productive setup. The CoroDrill® geometries reduce the risk of fraying, delamination and splintering, to produce high quality holes.



CoroDrill® geometry range

A design for various carbon fibre materials ensures excellent hole quality and surface finish. Variants include geometries with optimized rake and point angles depending on material and machine type, such as CNC or pneumatic positive feed (power feed machines).

Hole making in carbon fibre and titanium-stacked material

Carbon fibre stacked with titanium is one of the most demanding material combinations. The CoroDrill PCD vein drill, designed with a unique geometry, was able to raise productivity in this challenging hole making application.

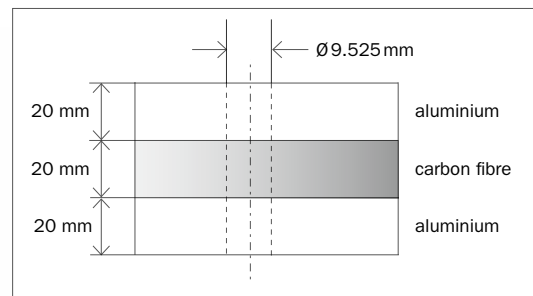
A sandwich of carbon fibre, with a thickness of 15mm, layered with a 10mm sheet of titanium was machined with good security and precision.



CoroDrill® Vein PCD drill			Hole making
Cutting speed	V_c	m/min	12
Drill depth	a_p	mm	25
Feed rate	f_n	mm/rev	0.05

Demanding application in stacked materials

Material:	Aluminium, carbon fibre, aluminium stack
Application:	– Hole making
Hole diameter:	– 9.525 mm (3/8")
Drill type:	– CoroDrill® 854 composite drill with diamond coating
Machine type and condition:	– Positive-feed machines (pneumatic) – Micro lubrication
Cutting data:	– RPM: 2000 – Feed: 0.03 mm/rev
Hole tolerance demands:	– H9
Surface roughness:	– Demand: 3.2 Ra – Result: 1.6 Ra



Demands on a secure machining process with accurate dimensions, surface finish and limited burr formation were achieved with CoroDrill® 854. Long and stable tool life with excellent chip formation supported the production of high quality holes.

For more information please visit www.aero-knowledge.com or www.coromant.sandvik.com

Head office:
AB Sandvik Coromant
SE-811 81 Sandviken, Sweden
www.coromant.sandvik.com
E-mail: info.coromant@sandvik.com

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