

Solid performance

The fastest developing machining technology area for composites is solid carbide drills. **Steed Webzell** assesses the latest breakthroughs

Those thinking that composites in engineering are restricted to the aerospace and motorsport sectors would be very wide of the mark. Many varied industries are taking up these innovative materials, some at very rapid rates indeed. Wind energy and marine are two that spring to mind, but there are several others, such as: architecture – the new Stedelijk Museum in Amsterdam is the largest composite building in the world; housing – Innovative Composites International Inc has signed a \$68 million deal to build earthquake- and hurricane-resistant composite housing in countries such as Haiti; leisure – Fanatic Windsurfing has just released its FreeWave TeXtreme composite board; and consumer electronics – Carbon Eleven has created a new carbon fibre case for the iPad2.

What do they all have in common? Well, they all need holes. With this in mind, the geometrical shape of CoroDrill 854 from Sandvik Coromant (0121 504



LMT has a special division to produce hybrid tools such as this, see next page

5400), for instance, is designed to improve hole entrance and hole exit quality on high fibre content materials. CD854, with its 'spurred' geometry, is preferred where splintering or fraying is the problem, while users will find greater benefit with CoroDrill 856, if delamination is proving to be the difficulty in resin-rich materials – thanks largely to double-angled geometry that allows soft entry and exit of the workpiece.

In the aerospace sector, typical hole requirements through composites include surface finish Ra of <4.8 micron, delamination of less than 1 mm over the diameter, and no splintering.

Extensive cutting trials demonstrate the productivity and tool life of the new CoroDrill products. For instance, using CD854 to produce ½" (12.7 mm) holes in CFRP epoxy resin stacked with aluminium (12 + 12 mm) generated the following results. At a cutting speed of 118 m/min and 0.05 mm/rev feed rate, 650 holes were produced through the 24 mm thick stack – the equivalent of 15.6

Machine tool moves

Recent industry developments have seen established suppliers of machine tools for composites production move stables. For instance, portal machining centre manufacturer Zimmermann of Germany, which specialises in building 5-axis and 6-axis machines for producing large composite components, has appointed Geo Kingsbury Machine Tools (023 9258 0371) as its sole sales, commissioning and service agent in Britain and Ireland.

"The new appointment launches us into the rapidly expanding composites sector," states Geo Kingsbury's managing director, Richard Kingsbury. "It therefore allows us to increase our presence in the aerospace industry through an expanded portfolio of production options for primes and their subcontract supply chains."

The latest Zimmermann 5-axis machining centres are equipped with an extra B-axis on the spindle head. Six-axis machining is said to speed cutting cycles, improve accuracy and avoid singularity errors in rotary axis movements.

In another development, US-headquartered machine tool maker MAG has acquired 100% of France's Forest Liné Industries Group, an expert in manufacturing equipment for composites processing. The company claims to be the technology leader in composite wing and wing box applications and operates sites in France, Germany, China and Canada, employing about 300 staff.

MAG (0121 313 5300) has been operating a Composites Centre for advanced composites applications in Göppingen, Germany since 2009, and has also been developing new fibre-cutting technologies for applications in the automotive industry.

COMPOSITES MACHINING

m of drilling. All holes achieved a surface finish within <1.6 Ra (aluminium) and <3.2Ra (CFRP), while maintaining IT8 tolerance standards.

In another trial, Sandvik Coromant says CD856 outperformed a competitor drill, in terms of both penetration rate and hole quality. Drilling ¼" (6.35 mm) holes in CFRP bismaleimide (high temperature) resin, the target was to beat the penetration rate of 300 mm/min set by the competitor, while maintaining H11 hole tolerance. By increasing the cutting speed to 150 m/min (from 100 m/min) and slowing the feed rate slightly to 0.05 mm/rev (from 0.06 mm/rev), CD856 not only achieved a penetration rate of 373 mm/min, it also provided a 25% improvement in entry and exit quality.

Another new drill type available from Sandvik Coromant for CFRPs and stacked materials is based on vein technology. Developed in conjunction with Precorp, this integrates the PCD edge in the carbide drill body. It's an advanced method, based on a patented process, and makes the best use of the hard, wear-resistant PCD edge in a tougher carbide shank. The PCD edge is made part of the drill at a sufficient distance from the cutting tip to allow the application of a high strength brazed joint. Tool geometry is ground, leaving the edge shielded to a variable extent by the

carbide part of the drill.

Engineers at Dormer Tools (0114 293 3800) – now operating as part of Sandvik Coromant, not just the Sandvik Group as before, in fact – are also working hard on new solutions for composite drilling. One recent example occurred when Dormer was asked to advise on a drilling application involving a wing skin assembly. Here, the customer needed to drill a stack material comprising 10 mm thick aluminium and 4 mm thick carbon fibre.

DRILL IN ONE

"Ordinarily, the customer would have to cut a smaller diameter hole first, gradually opening it out to the final size," says Ricky Payling, Dormer's European key account manager for aerospace and composites. "This not only takes time but also requires several different tools. However, with Dormer's R790 carbide composite drill, we were able to machine through-holes with no delamination or splintering on the carbon fibre and no exit burr on the aluminium."

Trial and error engineering cloaked in secrecy, is the way Onsrud, part of the LMT Group, describes providing a solution to the machining of composite materials. LMT UK (01676 523440) says aerospace and specialist users of composites are pushing out real challenges to the tooling industry.

Here, the development by Onsrud of the Parabolic Flute Form Drill is said to overcome the problems associated with delamination, flaking, splintering and whiskering, and give improved chip flow and abrasion resistance, due to a multi-layer, nano-crystalline diamond coating. While just 0.006 mm thick, the coating creates a very low coefficient of friction (between 0.15 and 0.2). Cutting trials have demonstrated an ideal speed of 75 m/min at feed rates of 0.075 mm/rev to obtain the best surface finish.

For composites stacked with metal alloys, LMT claims that PCD is by far the best cutting tool material, as it offers the hardness of diamond, while maintaining the toughness of carbide to give longer, more consistent tool life. It also enables tools to be run at higher speeds. As a consequence, LMT's Kieninger division has set up a specialist tool operation for manufacturing bespoke hybrid tools, using combinations of PCD and carbide able to produce associated features of a component within the same cutting cycle.

Among the recent developments is the inclusion of a carbide tool to drill a hole with a separate PCD insert to produce a counterbore with further features machined on the component using cartridge-based carbide inserts.

Choosing the right drill is obviously vital, but having some form of automated assistance with programming and simulation can add genuine zeal to composite hole-making operations. With this in mind, CGTech (01273 773538) can now offer its new Vericut 'Drilling and Fastening' software, which allows users to program drilling and fastening operations in a virtual machine tool environment. It provides simulation to check for a variety of error conditions and comes with interfaces to most popular CAD/CAM systems.

Whatever the application, and whatever the composite, astute cutting tool and machining technology selection can form the basis of high quality, efficient and cost-effective solutions to challenging production tasks. □

Vericut Drilling and Fastening software is a new solution from CGTech

