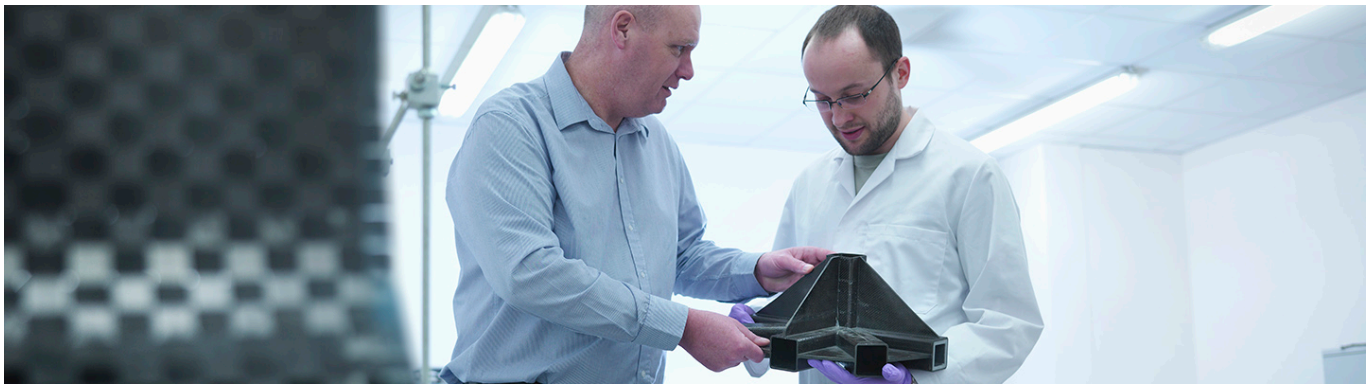

Return on Investments

Composites Machining and the Search for Better Cutting Tools

Kip Hanson | Mar 01, 2017

What You Need to Know

Interest in composite materials continues to grow.
It's important to select the right tools when machining composites.
When cutting composites, make sure to avoid problems with fraying and fiber pullout.

A look at some of some of the latest innovative methods of machining this material.

Lately, interest has increased in lightweight yet robust materials to build with in the automotive, aerospace, defense and other industries. Aircraft wing components, implantable orthopedic devices and parts for radio-controlled cars are just a few of the items produced from tough, abrasive composites.

The dilemma is in machining composites, particularly when breaking is the goal but cutting is the difficulty. Separation, or "delamination," of the layers is a common problem during machining, as is splintering and chipping of the machined edge, uncut fibers and "fuzzing" around holes. Also, machinists who use the wrong cutting tools will quickly have to purchase replacements, which is why most composites are machined using polycrystalline diamond (PCD) or diamond-coated carbide.

One provider of such tools is Utah-based Precorp Inc., a specialist in engineered cutting tool solutions. "Selecting the optimal solution for machining composites is a matter of achieving the best edge quality and cost per part possible, often in the face of very demanding materials," says Jason Dodds, general manager at Precorp's South Carolina facility. "[Carbon fiber-reinforced plastic] CFRP-titanium, for example, is an extremely challenging composite used by some of our aerospace customers. Here, a veined PCD tool offers a distinct advantage, whereas some composites cut just fine with a lower-cost, [chemical vapor deposition] CVD-coated carbide. The choice of cutting tool is entirely dependent on the material being machined, the part geometry and the expected production quantities."

What's All the Fuss?

Aaron Howcroft, Precorp application engineering manager, agrees, saying it's also necessary to consider the method by which the hole or part feature will be machined. "You're much more likely to go with a *PCD* tool on a *CNC* machine because the process is more predictable and the amount of material being removed is generally much higher. With manual or semiautomated drilling operations, on the other hand, a lower-cost carbide tool is likely a better option."

Scott Daggett, national aerospace specialist for OSG USA Inc., a leading manufacturer of taps, drills and indexable cutting tools in Irving, Texas, says he's seeing greater interest in composite machining, especially with the reinforced thermoplastics used in everyday products like golf clubs, prosthetics and automobile components. Daggett, whose company provides products to the automotive, aerospace, medical and energy industries, among others, recommends CVD diamond-coated cutters as the tool of choice for many of these applications, provided there's a strong bond between the substrate and coating.

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> Aaron Howcroft

"Some in the industry might have a bad taste in their mouth about CVD diamond coatings," he says. "If so, they should take another look. OSG has leveraged proprietary substrates and coating technologies to develop a solution that excels in these applications. We control the entire process and couple it with a tool geometry specifically designed for composite cutting. The result is a tool that offers excellent flexibility while alleviating problems with fraying and fiber pullout, and allows for more aggressive cutting than competing solutions."

An Uphill Battle

"The biggest challenges of composite machining are heat, abrasion and surface integrity," explains Don Graham, manager of educational and technical services at Seco Tools Inc. in Troy, Michigan. He notes that coolants cannot be used during machining operations because delamination and material swelling may occur. This makes dust inhalation a health concern—a good vacuum system is critical to operator safety. Making matters worse is that the fibers holding the material together are very hard and often have random orientation, so it is difficult to shear the material effectively.

For composite milling operations, Graham advises machinists use a dual-flute cutting tool, one with opposing left- and right-hand spirals that "squeeze the layers like a guillotine."

Composite machinists should also pay close attention to their tool paths—rather than plowing in with a full-width cut, try using a trochoidal tool path with light radial engagement. "Mastercam calls it Dynamic Milling, Esprit calls it ProfitMilling—there are a zillion names for it, but put simply, it's a technique by which you control the arc of contact between the end mill and the material you're machining," says Graham. "Just as with pocketing and slotting operations in metal, it will help reduce heat while allowing for higher feed rates, increased RPM and substantially increased tool life."

Key Takeaways

- Find out how to avoid delamination during composites machining.
- See what happens when you use a PCD tool on CFRP-titanium.
- Get tips to reduce heat, produce higher feed rates and extend your tool life.

Have you noticed an increased curiosity in composites machining?

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