CUTTING TOOL ENGINEERING plus

# Custom Connection

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*Compression router trimming edge of composite panel*

## Custom Metal Cutting Tools Tackle Complex Aerospace Applications

As machined parts become more complex, require tighter tolerances and have higher value, the metal cutting tools and processes to make them must become more sophisticated.

Aerospace components are a good example. Requirements for reliability, efficiency and performance drive aerospace part manufacturers to make them stronger, lighter and more precise, while employing advanced workpiece materials. In addition, aerospace parts are typically produced in small volumes, often from proprietary designs. Accordingly, the processes and the tools to make the parts are, in many cases, customized to their applications. According to various estimates, 75 percent or more of the metal cutting tools used in certain aerospace manufacturing operations are specials.

**The variety of carbon fiber-reinforced plastic materials and manufacturing methods used in the aerospace industry require custom-designed tool geometries, such as these compression routers from Amamco with separate sets of left- and right-hand flutes that overlap to push and then cleanly cut the material's layers.**

What exactly determines if a tool is a special is a matter for discussion. A custom tool can be an endmill with minimally altered geometries or a one-of-a-kind, massive milling cutter that starts as a blank CAD screen. Andrew Gilpin, business development manager for toolmaker Amamco Tool, Duncan, S.C., said his basic definition of a custom tool is "anything other than a traditional standard endmill or jobber length drill. You take a regular 4-flute endmill, put a 15.5mm radius on the corner, and that becomes a custom." However, that simple definition can change.

An example would be the compression routers Amamco produces for trimming the edges of the carbon fiber-reinforced plastics applied in aerospace parts. The tools have separate sets of left- and right-hand flutes that overlap to push and then cut the composite layers cleanly.

When developing compression routers for aerospace manufacturers, Gilpin said, "The tools are definitely custom designs all the way through the R&D and the tweaking phase of the part manufacturing process. But when the aircraft goes into production, and the manufacturer starts buying the tools in mass quantities, then it's no longer a custom tool to us; it's a 'standard custom tool,' if you will."

Even when produced in large quantities, custom tools lack the economy of scale characteristic of standard tools. John Aiello, a business development specialist and aerospace industry veteran with experience in both cutting tool manufacturing and distribution, said a part maker's willingness to pay a premium and take advantage of specials depends largely on the shop culture.

"Standard tooling is cheaper, but there is value in the more expensive custom tools; they offer more capability," he said. "If a shop uses the custom tools properly, their productivity can go way up and their profits can go way up too." With many operations reluctant to make large capital purchases, a custom tool may enable a shop to increase productivity without purchasing new equipment.

## Convenient vs. Custom

Convenience or complacency may also affect a shop's decision to employ specials. Peter Diamantis, Amamco plant manager, said some shops try to make do with tools that are not customized, or optimized, for a particular operation. "They will have headaches with them, but the tools are readily available and they don't have to wait 4 to 5 weeks to get them."

This special aerospace grooving tool from Greenleaf illustrates a development process that supplements detailed data regarding the specific application with information from Greenleaf 's database of previous special designs.

(Courtesy of Greenleaf)

He pointed out that large aerospace manufacturers regularly use custom drills because they generally provide longer tool life and better hole quality, and the cost of reworking out-of-spec holes can easily exceed the custom tools' cost. Those manufacturers plan months ahead in most cases.

However, according to Diamantis, other shops serving the aerospace industry are not as proactive with inventory. A shop may deplete its supply of a certain diameter custom drill and then rush to find a standard drill in that diameter. "They will put it out there and let the machine operator fight it because it's convenient."

Planning ahead can produce multiple benefits. Diamantis cited a shop that was machining a stainless steel missile component, which included drilling, reaming, counterboring and chamfering a hole with four different tools. Amamco designed and made a multifunction tool to handle all four steps in one pass. "Cycle time went from 5 minutes down to about 1½ minutes, and they don't have to keep four different tools in inventory," Diamantis said. The trade-off is that the shop now has to order the tools 4 weeks in advance.

While specials do require longer lead times, they help shops avoid production problems, according to Don Hughes, applications and project development engineer for toolmaker Greenleaf Corp., Saegertown, Pa. "We have witnessed instances where, due to time constraints, customers have had to dramatically alter a standard tool on their own to begin prototype production," he said.