A Five-axis **Triumph**

Thin-walled aerospace components are more efficiently machined in a new cell.

Triumph Structures–Wichita strives to constantly meet the needs of its aerospace customers by being a progressive and innovative company, continually acquiring new technologies, and maintaining an entrepreneurial environment for continuous change and rapid response.

Founded in 1975 as Excel Manufacturing Inc., the shop's core competency was CNC turning and grinding. During the late 1980s, it ventured into CNC milling, and gained a reputation as an organization centered around the incorporation of emerging technology such as robotic systems for loading and unloading machined product.

By the 1990s, the contract-manufacturing shop further evolved by investing in a then little-known technology called "high-speed machining." Customers within

Photo courtesy Dept. of Defense

Components for the V-22 Osprey are machined at Triumph Structures–Wichita.

the aerospace industry soon considered Triumph Structures–Wichita one of the most innovative and progressive "high-speed machining" shops in the area. It again invested in additional technology, purchasing the world's first Flexible Manufacturing System, and was selected as the Boeing Supplier of the Year for Purchased Outside Production in 2003.

The shop currently specializes in complex precision machining, assemblies, and kitting for major aviation and

Machining operation on a Vortex 815.

aerospace industries worldwide. And to this day, Triumph Structures–Wichita continues its philosophy of being innovative with technology-based investments to maintain its standing as a global leader in aerospace contract manufacturing. Five-axis, high-speed machining is the shop's most recent technological investment, adding to its already established core capabilities of FMS production, waterjet cutting, three and four-axis machining, engineering services, and quality assurance.

At the heart of the facility's five-axis machining operations are seven high-speed, five-axis machines from Mazak Corp. (Florence, KY). Two of the machines are column-feed Vortex 815s, while the remaining five are double-column Vortex 1400s.

Incorporating these machines, with their different designs and table sizes, provides the shop with more options when deciding on how to best process aerospace parts.

The five-axis machines have expanded Triumph Structures–Wichita's part size and shape machining envelope. What was once a 50 × 50 mm average part size capability, is now 1.2 × 4.2 m with the Mazaks' expansive *Y* axes. This has allowed the shop to further diversify the range of jobs it accepts and to take on more work involving bigger parts.

Mazak's Vortex five-axis machines allow Triumph Structures–Wichita to machine large workpieces with complex contours. Special tilting spindles on the machines provide high accuracy as well as heavy-duty machining thanks to backlash-free roller gear cams. Their rotary *A* and *B* axes can position over a range of ±40°, and each axis can be indexed in 0.0001° increments.

Unlike on its three and four-axis machining centers, Triumph Structures—Wichita can cut complex aerospace components using the side faces of ball end mills positioned with the *A* axis and *B*-axis spindle rotation on the Vortex machines. This allows the shop to reduce machining time and increase part accuracy.

Most of the facility's aircraft components have thin walls and cross sections. The shop successfully cuts walls and floors as thin as 0.5 mm, and provides products made from single pieces rather than the conventional riveted metal assemblies. Some of the components made here are used on the Huey UH1 aircraft and the V-22 Osprey tilt-rotor aircraft. They have also produced complex kits and assemblies for C-17 window frames, C-17 Intercostals, F-15 horizontal stabilizer leading edges, F-15 third ramp door engine inlets, and UH-60 Blackhawk FLIR nose mounts.

Aluminum makes up about 80% of what is machined on the five-axis machines, along with some hardened metal parts. Part volumes vary from 6 to 20 per job/order, with a lot of jobs often repeating. On the Mazaks, parts are completed in single setups, which increases accuracy and reduces cycle times.

The five-axis machines are arranged in a cell and run 24/7—two 12-hr shifts Monday through Thursday, and two 12-hour shifts on the remaining days of the week. During the weekend shifts, the machines operate basically untended. A core group of machinists with a leader are in charge of the cell and operate only the shop's five-axis machines.

"In this day and age, there are button pushers, operators—and machinists. Fortunately, machines such as the Mazaks are quite easy to learn and are quickly up and running. This is a benefit for our operators who may not yet be able to set up our expensive complex parts, but can almost immediately run production on the machines," says Mike Schierling, production manager at Triumph Structures–Wichita. "These machines are simple, straightforward, and easy to run, besides being efficient."

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Schierling comments that the learning curve for the five-axis machines was quite short. The simplicity of the machine controls contributed to this, and the initial training provided by Mazak technical personnel was all they needed. Plus the shop already had several machinists experienced in five-axis machines. He adds that the only real challenge to incorporating five-axis machining appeared in the shop's programming department, but even that learning curve was a short one.

In its engineering and programming departments, Triumph Structures–Wichita uses several engineering and NC-programming support systems. These include CATIA V5 CAD/CAM software, Mastercam X, Siemens NX6, and—specifically for its five-axis operations—Vericut V7 verification and five-axis simulation with Auto-Diff.

Quality leads the part-production process at Triumph Structures–Wichita, especially in the case of first-article parts. Once the required part quality is achieved for a specific job, the shop then studies the process and determines ways to reduce cycle times through feed-and-speed adjustments, and within the programming process. Triumph Structures–Wichita is certified to AS9100 Rev B, D1-9000A Approved, and in conformance with ISO9001:2000.

"We have the same group of experienced machinists run our first-article parts, because these guys are quick to spot potential problems before they turn serious. And these guys will re-evaluate jobs and improve upon how we run them on the Mazaks," says Schierling.✈