Automating Aerospace Processes

Aerospace Metrology Tools for the Working Day

AeroDef Show Preview
Big CNC Machine Gives Shop An Aerospace Lift

When a contract manufacturer sees an opportunity in the competitive aerospace market, it sets priorities aimed at providing the right combination of processes required to meet the industry's exacting demands. Precision machining and finishing, parts inspection, and, of course, certifications from OEMs and industry alliances are at the top of the list. Increasingly, aerospace suppliers like Volvo Aero Connecticut (Newington, CT) are benefiting from five-axis machining, advanced CNC controls, motors and drives, robotic deburring, and on-machine inspection for a competitive advantage.

For five-axis, five-sided machining, the Zimmermann FZ42 gantry portal milling machine brings high material removal rates to large precision aerospace workpieces like fan housings at Volvo Aero Connecticut.

Investments made in the latest machining technology have enabled Volvo Aero Connecticut to make significant inroads in supplying aerospace OEMs with precision-machined components. Parts include fan cases for aircraft engines and gas turbines, fan and compressor structures, compressor rotors, low-pressure turbine cases (LPT), and military parts. According to Martin Thordén, engineering manager, the company machines workpieces as large as the 3.5-m diam fan casing for the GE90 engine for the Boeing 777, as well as fan casings for the GE9x and Rolls Royce Trent 1000 engines for the Boeing 787 Dreamliner, among others.

In the six years since Volvo Aero (Trollhättan, Sweden) acquired Aero-Craft (as the basis for its growth in the fan-casing segment), Volvo Aero Connecticut's employment has grown from 35 to more than 110 in step with the growth of its aerospace business. The acquisition immediately opened up the availability to expand Volvo Aero's fan-casing business with aerospace OEMs like Pratt & Whitney, GE, and Rolls Royce, through larger machining capabilities. To strengthen this fan case growth plan, the company also entered into an alliance to machine forgings from Carlton Forge Works, a California-based supplier of nonferrous rolled rings for fan cases used in aircraft engines and gas turbines.

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"Our business is built on three legs," Thordén explains, "machining fan cases; semifinish machining of forgings, removing scale and leaving 0.040" (1 mm) for finish machining; and machining smaller to medium-sized fan cases. In order to build the best manufacturing shop for large fan cases, we added a Zimmerman FZ42 five-axis, five-side portal milling center to our machining lineup that includes four and five-axis milling machines, VTLs, and a robotic deburring machine."

The five-axis Zimmermann FZ42 milling center is equipped with a Siemens Sinumerik 840D CNC control and Siemens motors and drives to support precision machining spindles that can be readily changed: a high-speed spindle for machining aluminum, and a high-torque spindle for machin-
ing titanium and other difficult-to-machine materials like Inconel and Waspaloy.

"The Sinumerik 840D CNC controls all machine motions, as well as a series of subsequent measurement and test operations, plus the temperature-control system, which is an integral part of the machine's design," Thordén explains. "In this way, it's able to accurately perform all the complex machining tasks required, and also perform the probing required to transform the machine into a CMM for inspection of finished parts." The FZ42 features a 4.5 x 5 x 1.5-m working area and a feed rate of 60 m/min. The milling head is equipped with the Zimmermann multiple spindle technology (MuST) changing system. "After machining, the machine tool can be used as a CMM because of the accuracy of the 840D CNC and the 90° angle heads supplied as a part of the MuST spindle technology. Heads are stored in side stations that are used for

Side stations on the FZ42 hold six specialty 90° heads used for inspection, measurement, and comparison of actual to predetermined CAD/CAM values on parts.

inspection, measurement, and comparison of actual to predetermined CAD/CAM values on parts," Thordén says. Programming is done with Mastercam, NX, and simulation by Vericut.

The temperature control system of the FZ42 is built into the machine's structure through the use of a special
fiber-reinforced compound in the side columns. Accuracy of the machine is facilitated by built-in cooling ducts in the portal and Z-axis slide, independent cooling circuits for the A axis, C axis, and spindle, and ground surfaces on the guide ways for the Z axis. The machine has a 120-position tool carriage that holds HSK63 and HSK100 tools for machining the largest parts.

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"All roughing and subsequent finish passes on any material can be achieved in one setup, saving as much as 10% in preparation time and overall production costs, and there is no need for additional machines and material-handling time between machines," Thordén says.

Volvo Aero Connecticut's approach to fixtureing and the more recent addition of robotic deburring to its processing capabilities relies heavily on the parent company's research and application engineering. "Because our agreements involve long-term commitments, we put a lot of effort into designing fixtures, which can be quite heavy. Parts can be as thin as 0.060" (1.5-mm) thick. In the case of the FZ42, we chose a stationary fixture rather than a rotary table for a number of reasons. Tool movements are small, and it's better to have the tool move around the workpiece rather than move the mass of the fixture and workpiece on a rotary table to accurately machine these features. Working with the X-Y axes and the C axis in the head instead of the table made so much more sense for these moves, and the Sinumerik 840D gives us the precision control of tool movement that we required," says Thordén.

In developing robotic deburring with the ABB IRB6600 robot equipped with an ABB control, Volvo Aero considered the quality of the workpiece, as well as the benefit of eliminating a manual process that had negative health-related issues for its operators. "We are deburring about 90% of all features on the fan cases we have introduced to the cell. What we especially like is that with the robot we get a consistent edge break, and the operators can run it overnight or while deburring other parts that we have. It requires limited operator intervention," says Thordén.

Martin Thordén, engineering manager, with the deburring robot, which features an IRB6600 with ABB control for deburring about 90% of all features on the fan cases.

"As demand for more fuel-efficient engines for the latest aircraft grows, parts are being machined thinner and thinner from lighter materials, requiring stable machining processes without vibration in tools and cutters, which is another reason for the
careful attention to fixtures. Workpieces must be accurate, because they are parts of assemblies,” says Thordén. Volvo Aero Connecticut also semifinish-machines forging parts for low-pressure turbines and sends them out for finish machining.

In addition to certifications with its principal OEMs, Volvo Aero Connecticut has AS9100 and ISO 14000 certifications. ME

For more information on Siemens, go to www.usa.siemens.com/cnc, or phone 847-640-1595; on Volvo Aero Connecticut, go to www.volvoaero.com, or phone 860-667-8502; on Zimmermann, go to www.zimmermann-inc.com, or phone 248-305-9707.