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AUMA manufacturing engineer Brian Weaver (left) and CNC technician Bob Carr (right) discuss operation of a multifunction cutter on an aluminum casting with Greenleaf sales and service engineer Dick Chobot.

Multiple Improvements

Manufacturer reaps productivity benefits by upgrading machining processes.

Continual efforts to boost metalcutting productivity and efficiency are enabling the U.S. division of a global manufacturer of actuators to reduce costs and enhance competitiveness.

The process improvements instituted at AUMA Actuators Inc./USA, Canonsburg, Pa., have involved multiple elements of its metalcutting operations, including workhandling, cut-

ting tool material, toolholding and tool geometry. The changes are not only keeping manufacturing operations at AUMA, they are bringing work to the shop that previously had been performed overseas.

Valve Jobs

AUMA is a subsidiary of AUMA Reister GmbH & Co. KG, a global supplier of electric valve actuators and

gearboxes headquartered in Müllheim, Germany. AUMA actuators can actuate virtually any type of valve, damper or similar device. The actuators—available in multiturn, quarter-turn, linear and lever styles—are used by a wide variety of industries.

AUMA furnishes the actuators with motor controls and accessories operated by microprocessors that interface with plant-control systems. Depending on

the size and specific application, typical multiturn actuators work at speeds from 5 to 216 rpm and have output torque ratings of 7 to 23,600 ft.-lbs.

The U.S. division manufactures components and assembles actuator packages for customers worldwide. The shop currently machines three actuator-housing components from cast iron and two from aluminum. Each casting weighs 5 to 35 lbs., and machining involves cutting various chamfers, faces, grooves and flanges.

The shop's products generally are made to order, which presents challenges in terms of balancing manufacturing output and inventory. AUMA manufacturing engineer Brian Weaver said many of the orders for assembled parts are for one or two pieces. He schedules runs of parts for stock, but keeps inventory at a minimum.

A typical production run of cast iron parts is 400 to 500 pieces. Completing a run of parts previously averaged 4 to 6 weeks. Since AUMA instituted its productivity-improvement program, the average has dropped to about 2 weeks.

Setup Efficiency

The shorter run times are partly due to AUMA reducing its setup times, a result of adopting a new workhandling strategy.

The shop machines cast iron parts on a Makino A77 horizontal machining center featuring a twin-pallet workhandling system. Twenty-five to 30 bolts attach tombstone fixtures to subplates, which, in turn, are each affixed to a pallet by eight bolts.

To change fixtures and set up a new part, the company used to unbolt the fixture and leave the subplate bolted to the pallet. Bolting the new fixture onto the subplate required tedious alignment and tightening of the 25 to 30 bolts.

At the suggestion of workholding supplier Unique Machine Tool, McKees Rocks, Pa., AUMA acquired a subplate for every tombstone. The shop now keeps the subplates and fixtures bolted together as a unit when changing part setups. Removing a subplate from the pallet and aligning the replacement subplate is relatively simple.

AUMA's setup time per part has plummeted from 8 to 10 hours to, consistently, 2 to 3 hours.

In-Cut Time Halved

In addition to slashing setup times, AUMA has reduced its machining time by more than half, Weaver said. This was achieved by replacing carbide-insert milling cutters with Greenleaf Corp. mills fitted with HSN-100 silicon-nitride ceramic inserts designed for high-productivity machining of cast iron.

"It was actually one of the first things we tried," Weaver said of the SiN inserts.

Dick Chobot, sales and service engineer at Greenleaf, Saegertown, Pa., noted that high metal-removal rates result from keeping the chip load low and running at high cutting speeds. "You run your cutter at 2,000 to 2,500 sfm and you don't have to have a real heavy chip load," he said.

Most of the machine-time savings was a result of careful planning. Greenleaf assisted AUMA in developing special tools to machine multiple diameters and faces in a single pass. The tools consist of special steel bodies fitted with standard or modified cartridges that accept off-the-shelf inserts. Prior to the new tooling, individual tools were used to bore, chamfer, face

and groove the housings.

To generate certain features, it often was necessary to circular-interpolate the tools (move them in two axes simultaneously). Now, Weaver said, "instead of having to interpolate a mill, we are actually able to [plunge] into a pocket and mill in only one axis. Instead of machining one face at a time, we are actually going in and hitting four, five or six faces at once. When you do something like that, you drop machining time dramatically."

Chobot added: "When interpolating a flange opening, you may have to go all the way around a 4" diameter, [even though] the flange is only 1/2" deep. Can you imagine how fast you could get down there by plunging? Boom! You're done. Not only that, but you've chamfered, counterbored and spotfaced all in the same motion."

For two of the cast iron housings AUMA produces, 10 multifunction tools replaced the 30 separate tools used previously. The change has reduced machining time 40 to 50 percent.

The multifunction tools also have eliminated some finishing operations. Features created by an interpolated tool often failed to meet required tolerances, necessitating a pass by a finishing tool. The stout, rigid, custom tools follow straight, relatively short toolpaths, which has enhanced part accuracy.



By changing the tombstone fixture and subplate as a unit when tooling up for new parts, AUMA significantly reduced setup times.



A Greenleaf multifunction cutter poised to machine multiple features on a cast iron housing.

Weaver said AUMA has purchased at least a dozen of the special tools; the design and production of each typically takes about 8 weeks. Each tool is one of a kind. Making spares would be expensive and, Weaver pointed out, the need for redundant tooling is minimal. It would take a major crash to damage a tool body, and if cartridges wear or are damaged, they are easily replaced.

Landing New Work

When AUMA began its process-improvement campaign, the shop machined two different sizes of cast iron housings for multiturn actuators. The success of its efficiency efforts prompted the parent company to authorize machining of a third housing at the Pennsylvania facility. That part previously had been processed overseas.

As noted earlier, the U.S. division also machines two castings made of aluminum. The upfront preparation for that work was more complex than taking on the third cast iron housing. It involved starting from scratch and required choosing and acquiring a new machining center to perform the work. The operation went from concept to production in a short time, though.

Weaver said, "The basic design was done by our parent company, but we got the drawings, met with the suppliers, purchased the machine (a Haas VF-2), had the tooling made, received and approved samples, and were in production within 6 months."

An additional challenge was dealing with the differences between machining aluminum and cast iron. Cast iron



Multifunction cutter and the cast iron housing it was designed to produce.

generally is machined within a certain speed range, Weaver said, but "on aluminum, you fly. The faster you can run it, the better off you are."

Chobot said the aluminum castings typically are machined with high-positive, coated-carbide inserts.

As with the cast iron housing,



A grooving insert fitted in a multifunction cutter replaced a 2.5mm-dia. endmill that required two passes to interpolate a

AUMA switched to advanced tooling to machine the aluminum parts. Weaver said a Greenleaf insert (Hush Cut) with a new geometry lowered tool-load pressures from 80 percent to 30 to 35 percent when run at aggressive speeds and feeds—in excess of 3,000 sfm and 60 ipm—significantly raising the mrr.

Multifunction tools were also enlisted. When AUMA was first machin-

ing sample aluminum parts, a 2.5mm-dia. endmill interpolated a 2.8mm-wide groove in two passes around a flange face. Interpolating was time-consuming, and, according to AUMA CNC technician Bob Carr, the endmill often would break after two parts.

A multifunction tool was designed to cut the groove with a grooving insert while simultaneously facing the flange. It "removes a lot of steps and probably took only 20 minutes to program," Carr said.

Attitude Adjustment

Reflecting on AUMA's process-improvement efforts so far, Weaver said "when I first came here, we machined 40 to 45 percent of our housings for multiturn actuators. Now, we're around 90 percent."

The increase in productivity and efficiency has put the shop in line with what is being done overseas, making it feasible to machine more parts in this country.

Chobot said that achieving productivity improvements like those AUMA did involves overcoming the we-always-do-it-this-way attitude. New ideas, he said, require "someone who is receptive to them and who will take the time to make the changes." △

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