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# Cutting Cavities and Costs

Recent offerings help moldmakers boost productivity.

Few would dispute that, as a whole, job shops have seen better days. And, because no other class of shop has been hit harder than moldmakers, keeping costs low and productivity high is a religion among these companies. Technical innovation is counted on to increase productivity without expanding head count.

For example, Eric Stevens, director of sales for Colonial Machine Co., Kent, Ohio, said his company is experimenting with cryogenic tool treatment to increase cutter life.

Others, like Olav Bradley, president of PM Mold Co. Inc., Schaumburg, Ill., are adding rapid prototyping and part fabrication to their capabilities to garner new business.

So, when a good day in moldmaking means just keeping your head above water, an innovation that can keep productivity high without adding personnel is prized. To that end, let's take a look at a few recent offerings that can help a moldmaker boost its productivity.

## Endmills and Runner Cutters

Carbide is a reliable tooling material for many moldmaking applications. However, high-speed machining has placed an added burden on tool performance. Thus, tools are increasingly designed for taking light depths of cut at high speeds in hard materials.

Amherst, N.Y.-based Niagara Cutter's Elite line of endmills was created with just such applications in mind. A titanium-aluminum-nitride coating allows the machining of tool

steels as hard as 62 HRC. The tools' core content is 85 percent, meaning only 15 percent of the tools' cross-sectional volume is used for flutes. This characteristic makes it very rigid and suitable for machining hard materials, such as tool steels.

The endmills come in two configurations: ballnose and square-end. The ballnose has two flutes; the square-end has six. For the ballnose configuration, diameters are from 1/2" to 1", and in the square-end, from 1/8" to 1/2".

Two lines of diamond-coated endmills from RoundTool Laboratories, Huntington Beach, Calif., the GR and the DM series, are for cutting graphite and machining dies and molds, respectively.

Application-specific GR endmills are designed to rough and finish almost any size production run. According to the company, there are more than 3,000 possible combinations of substrates,

geometries and coatings from which customers can choose.

The center-cutting tools come in 2- and 4-flute configurations with ball-nose, square-end or radial tips. Metric diameters are from 0.25mm to 12.0mm, in 0.1mm increments through 3.5mm. Inch diameters are from 0.010" to 0.500", in 0.001" increments through 0.062". Tool tolerances are  $\pm 0.0005$ ".

The DM series is for cutting heat-treated materials at high speeds. The geometry allows the endmills to handle materials up to 65 HRC. Like the GR series, the DM tools have cutting surfaces imparted via the company's Smooth-Grind process. The VA2 coating facilitates the tools' use for dry machining.

Machining cavities on a sinker-type electrical discharge machine can be a time-consuming process. Millstar LLC, Bloomfield, Conn., offers a line of carbide-shank endmills that it says eliminates EDMing such cavities. In a test conducted jointly by a Tier 1 automotive-parts manufacturer and Millstar, a forging die for steering trunnions was milled with the intent of replacing EDMing.

The 4"-dia. workpiece was made of M-4 HSS, with a hardness of 64 to 68 HRC. Finishing and semifinishing were accomplished in a hardened state, and tolerances were held to  $\pm 0.001$ ". To beat out the EDM, the total cycle time had to be less than 2.5 hours.

First, the part was roughed with a 1/2"-dia., indexable-insert ballnose endmill. The part was then hardened and, following that, semifinished



Mikron's XSM 400 ultrahigh-speed machining center. While the company's BMC's axis acceleration is 1.7G, the XSM can reach 2.5G.

with a 0.236"-dia., solid-carbide, 2-flute ballnose endmill, which removed between 0.025" to 0.035" of stock. The machining parameters were a 10,000-rpm spindle speed, a 120-ipm feed with a 0.020" step-over and a semicircle zigzag (climb and conventional) milling pass, up and down the width of the cavity and perpendicular to the channel axis.

To finish the cavity, by removing the remaining 0.004" to 0.005" of stock, a Millstar standard Moldstar 0.080"-dia., 2-flute ballnose endmill with a tapered, extended nose was employed. This was done with a step-over of 0.001", at a 13,500-rpm spindle speed and a 140-ipm feed. Tool wear, according to Millstar, was held to 0.0006", and total cycle time was 1 hour and 45 minutes—45 minutes less than the original target.

Runners are sometimes considered an afterthought in mold design, but dedicated runner cutters can save tool life by doing work otherwise performed by ballnose endmills.

Two new runner cutters are available from Micro 100 Inc., Los Angeles. The MRT line has a 10° taper with a 20° included angle, while the MRF has a 15° taper and a 30° included angle. Tool tolerances are from -0.0001" to -0.0003", and ballnose radii are from 1/32" to 5/32" at +0.003" to -0.000".

In addition, these tools are made with Micro's Super Carbide process, which reportedly gives the tools the highest transverse-rupture strength in the industry.

## Machine Talk

Short lead times are but one of many issues confronting moldmakers. Once, moldmakers had 8 weeks to finish a job. Today, 30-day lead times are common. As such, the machine that cuts the molds must be versatile and fast.

A large work envelope accommodates a larger variety of parts. Irving, Texas-based Mori Seiki U.S.A. Inc.'s latest iteration of its NV5000 series, the NV5000/B, boasts an X-axis travel that has been lengthened by 8.7". It also has an expanded table, measuring 52"×23.6", compared to the NV5000/A's 43.3"×23.6".

Expanding the work envelope, however, cuts zero ice when it comes to in-

creasing productivity and compressing lead time. That's where faster machine acceleration and shortened tool-changing time come into play.

Spindle acceleration time has been cut 44 percent, from 1.74 to 0.97 seconds, compared to previous models; deceleration time has been reduced 58 percent, from 2.16 to 0.91 seconds.

Travel accelerations have also increased. The NV5000/B's X-axis now accelerates at 13.68 ft./sec.<sup>2</sup>, a 1.4× increase over the previous model; Y-axis acceleration was increased 1.7× to 12.46 ft./sec.<sup>2</sup>; and Z-axis acceleration was boosted 2.7× to 23.91 ft./sec.<sup>2</sup>.

In addition to cutting molds from tool steel, machine tools must also cut intricate graphite electrodes for sinker EDMs, and cutting graphite electrodes is no mean feat. Compared with other workpiece materials, graphite is relatively expensive. Since there's little room for error when machining it, a machine tool that can achieve high speeds and hold tight tolerances is ideal. Mikron Bostomatic Corp., Milford, Mass., offers the BMC 12 TNC bridge-type, high-speed vertical machining center for this work.

Rigidity and stability is ensured "from the ground up," according to the company, by the unit's 3-ton concrete/polymer base. A liquid-cooled spindle with hybrid ceramic ball bearings achieves speeds up to 30,000 rpm. The permanently sealed, grease/lubrication system reportedly prevents oil drips from the spindle head, and the standard oil-mist lubrication system reduces lubrication consumption, eliminating handling and disposal of coolant emulsions. The sealed cabinet and integrated extraction system equipped with a suction frame removes dust from the tool/workpiece interface to make this U.S.-made VMC particularly suited to cutting graphite.

When extreme accuracy is needed,



RoundTool Laboratories' GR series endmills are available in over 3,000 variations.

look no further than the Lightning 435 vertical machining center from Roku-Roku Sangyo Ltd., Tokyo. Imported into the U.S. by Mitsubishi, the machine's 36,000-rpm spindle easily places it in the "high-speed" category. However, it's the static accuracy of the tool that grabs attention. Positioning accuracy is ±0.000080" per full stroke, repeatability is within ±0.000020" and spindle runout is held to 0.00002".

One of the latest offerings from Davidson, N.C.-based Agie Ltd. is the Vertex WEDM. It features the Agieduo dual-wire spooling system that allows two different size wires to be changed without operator intervention.

In addition, wire diameters from 0.2mm to 0.02mm can be accommodated, allowing the machine to cut mold components previously not suited to wire EDMing.

If part size matters, then another recent entrant on the WEDM front from Mitsubishi EDM, Wood Dale, Ill., might interest you. The FA30 can accommodate submerged workpieces more than 20" high.

The machine's Anti-Electrolysis power supply can vaporize up to 30 sq. in. of metal per hour. Time is further saved with what the company claims to be the world's fastest automatic threading system, which has a 10- to 15-second insert time, submerged.

## Accessorize Your Molds

When it comes to polishing ribs and slots of a mold, access is the name of the game. Polishing tools need to be thin but



Erowa Technology Inc.'s tooling consists of a chuck, a fixed and adjustable toolholder and assorted clamps.

rigid enough to remove burrs and scales.

Boride Engineered Abrasives, Traverse City, Mich., recently introduced the Ribstone tool for polishing die/mold ribs and slots. The Ribstone is made from tapered composite materials, a bronze protective layer and a diamond abrasive.

Combined, these materials form an abrasion-resistant tool that Boride says allows for efficient material and scale removal from machined molds.

The company recommends the tool be used as a short-stroke profiler, with a stroke length between 0.012" and 0.039". The tool can be applied in a wet or dry environment.

In addition, the Ribstone can be shaped with a conventional grinding wheel, but when dressing the tool, the company recommends using a diamond stone facing upward.

Turning to another critical accessory, Dielectric Systems Inc., Tyler, Texas, recently introduced a unique dielectric fluid. DSI's Premier EDM fluid has a 120° C flash point and a 98-percent

biodegradation rate within 28 days. Yet, it's the skin-protector additive that makes the fluid unique.

Striking a balance between an EDM fluid that delivers results while not harming the operator's skin is never easy, considering these qualities tend to work against one another. What makes a good EDM fluid tends to irritate the skin, whereas "hand lotion" makes for a terrible EDM fluid. DSI's Skingard reportedly offers skin protection without being a drag on conductivity.

Developed in consultation with dermatologists who had experience treating patients with EDM fluid-related irritations, the additive is a blend of lanolins and lanolin alcohols that minimizes dryness and irritation.

A second accessory for WED-Ming is a set of basic tooling from

Erowa Technology Inc., Arlington Heights, Ill. The tooling consists of a chuck, a fixed and adjustable toolholder and assorted clamps. While the chuck and holder are derived from the company's Pallet Set W system, they are not, however, directly compatible with other systems. In addition, clamping components from the Pallet Set W can be fitted on the basic WEDM toolholders.

### The Vision Thing

There's no shortage of pessimists decrying the tribulations of manufacturing, particularly moldmaking. True, margins are thinner and globalization presents daily challenges. However, one school of thought argues that investment during slow-growth periods pays the largest dividends when good times return. The trick is having the vision to know where to put that investment and when to do it.

None of the products discussed in this article promise profitability. What they offer are possible avenues for that investment. The vision is up to you.

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