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MoldMaking TECHNOLOGY

MAY 2019

Machining Arsenal Raises the Bar of Complex Moldmaking PG 14.

Get Your Hands Dirty to Clean Up Your Maintenance Act PG 20.

Considerations for AM Powder for Tooling PG 56.

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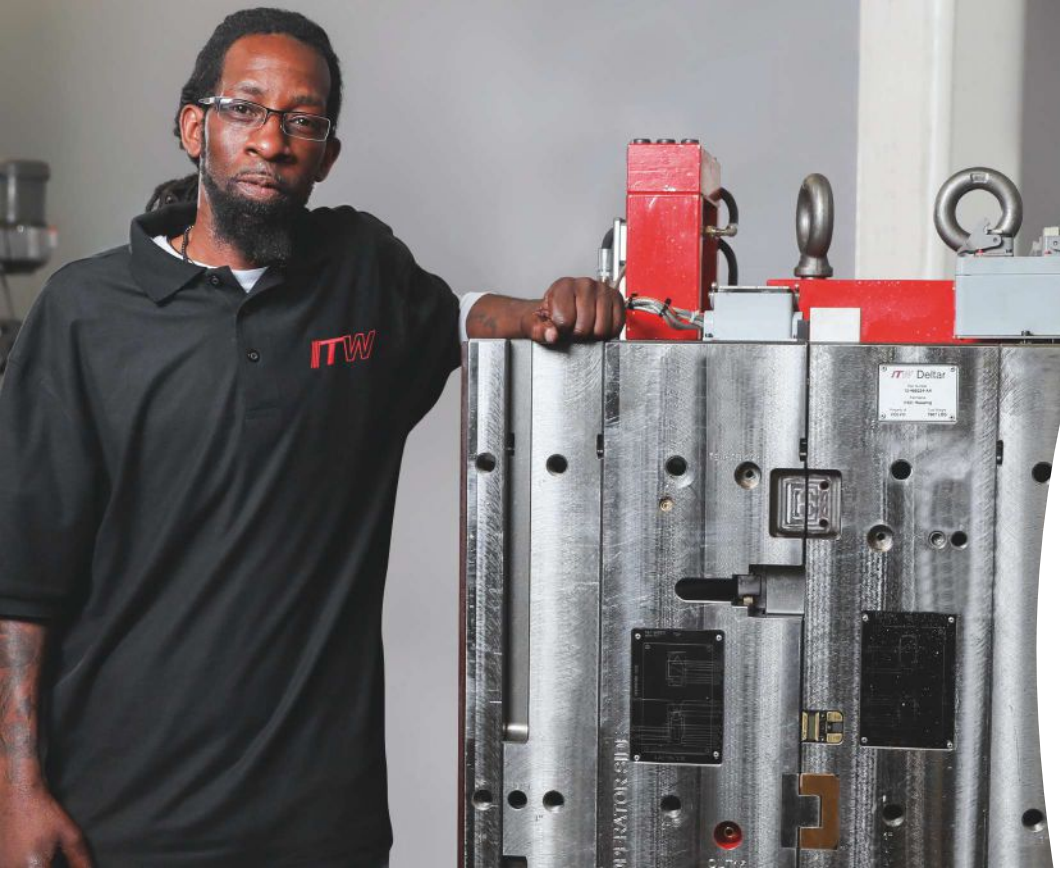

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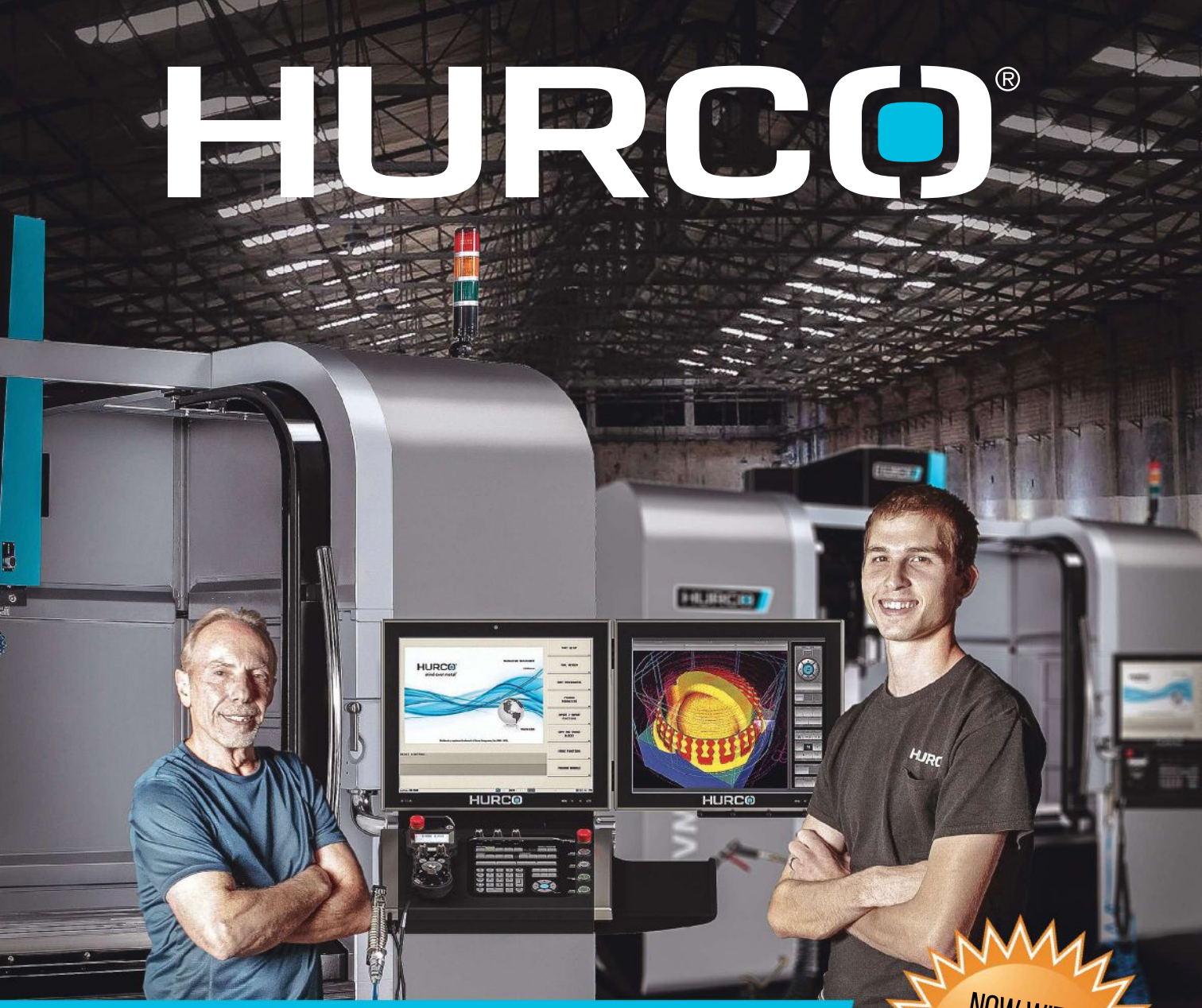

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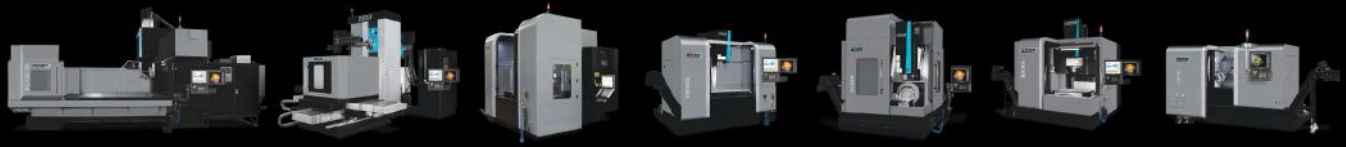

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Publisher
Ryan Delahanty . . . . . rdelahanty@gardnerweb.com

Editorial Director
Christina M. Fuges . . . . . cfuges@gardnerweb.com

Senior Editor
Cynthia Kustush . . . . . ckustush@gardnerweb.com

Assistant Editor
Heather Wintle . . . . . hwintle@gardnerweb.com

European Correspondent
Barbara Schulz . . . . . bschulz@gardnerweb.com

Art Director
Carla M. Turner . . . . . cturner@gardnerweb.com

Advertising Production Manager
Chris Larkins . . . . . clarkins@gardnerweb.com

GARDNER Business Media, Inc.

6915 Valley Avenue
Cincinnati OH 45244-3029
P 513-527-8800
Fax 513-527-8801
gardnerweb.com
moldmakingtechnology.com

Richard G. Kline | Chairman
Richard G. Kline, Jr. | President
Melissa Kline Skavlem | Chief Marketing Officer
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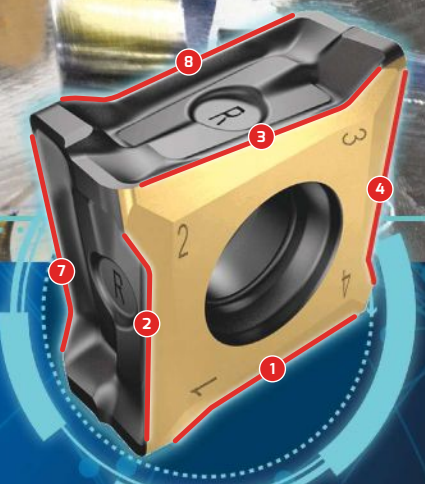

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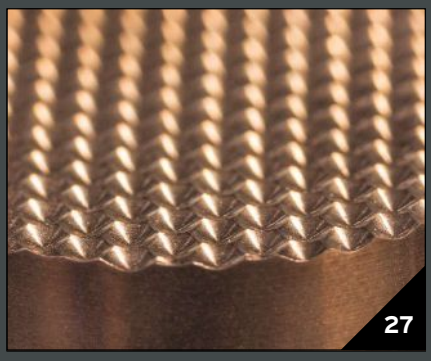
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Features

Departments

ON THE COVER

Cover photo courtesy of Creative Technology. This month's cover shows the arsenal of machining technology at Custom Mold and Design (CMD) in Forest Lake, Minnesota. Challenged with the super-close tolerances needed for quality silicone rubber molds, CMD found Yasda machines to uniquely fit the need. Since CMD's first Yasda in 2007, the shop has built up an arsenal of nine machines with varied features including five-axis simultaneous contouring, robotic part changers, and video tool probing. See related feature on **page 14**.

Images courtesy of (left to right) Mold Trax, GF Machining Solutions and voestalpine.

VIDEO ACCESS

5 TRICKS OF THE TRADE

Great Tips from This Issue

1. One Step at a Time
PM preparation, disassembly, trouble-shoot, correction action, clean, assembly, final check, and stage/rack make up systemized repair.
PG. 20.

2. Ultrafast
Femtosecond lasers have pulse durations of one quadrillionth of a second, putting them in the category of ultrashort pulses.
PG. 27.

3. Go with the Flow
Conformal cooling can work as intended if properly designed, requiring a thorough simulation using CFD analysis to understand fluid flow characteristics.
PG. 30.

4. Preference Point
Laser welding is not the answer for everything, but when you have smaller areas, small corners and deep ribs to weld, it is a preferred solution.
PG. 38.

5. Size It Up
Particle size distribution for powder-based fusion technology requires 15 to 45 microns compared to direct energy deposition, which can be 50 to 150 microns.
PG. 56.

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Be In The Know

I centered Amerimold 2019's free show floor Tech Talk program around "What You Should Know". Here is a snapshot of the sessions:

What You Should Know about Additive Manufacturing for Conformal Cooling: This panel discussion presents different additive manufacturing and 3D printing technologies available today, advantages and disadvantages, and specific ways to implement them without issue. *ALBA, ROI Industries, Crest Mold, Contura, HTS International, Linear AMS, Proper Group*

What You Should Know about Getting Venting Right: This presentation reviews ways to get venting right, including guidelines for designing and machining vents to optimize venting capacity and more. *Estée Lauder, Tri-Par Mold, CAE Services*

What You Should Know about the Last 20 Years of Innovation: Learn how moldmaking trends and technologies evolved over two decades, what standout innovations panelists have witnessed during that time and how they've adapted their businesses to stay relevant. *Progressive Components, Bales Metal Surface Solutions, Mold Trax Heidenhain*

What You Should Know about the Skilled Workforce Crisis: Panelists share best practices for building a next-generation manufacturing workforce, developing the right strategy and program for effective apprenticeships/skills training and engaging with industry and community to find, train and retain a diverse next-generation workforce. *Human Asset Management*

What You Should Know about Improving Your Third-Party Mold Maintenance Culture: Panelists discuss improving the care and performance of third-party molds with an action plan, as well as barriers to systemize and change mold maintenance and repair culture across multiple facilities. *Mold Trax, Husqvarna*

What You Should Know about a Mold Builder's Role in IMD Work: This presentation reviews various challenges a tool shop must consider before and during IMD, as well as best general practices for IMD mold design. *SussexIM, StackTeck*

What You Should Know about Excellence in Mold Manufacturing: *MoldMaking Technology*'s 2018 and 2019 LLA winners share best practices in customer satisfaction, workforce development, industry involvement, continual improvement, business growth and technology deployment. *2019 Winner TBA, 2018 Winner Maximum Mold Group*

What You Should Know about Public Policy: This panel reviews trade and tariff updates and their impact on mold manufacturing. *Alliance for American Manufacturing, MSI Mold Builders, Janler Corp.*

See you in Rosemont on June 12 & 13! Register Today! MMT

Christina Fuges

Christina M. Fuges
Editorial Director

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THIS MONTH ON moldmakingtechnology.com

VIDEO: How Water Flow Monitoring Optimizes Mold Production

MoldMaking Technology Editorial Director Christina Fuges and Progressive Components' Rebecca Hamstra discuss the importance of monitoring water flow in injection molds.
short.moldmakingtechnology.com/waterflow

PODCAST: So You Think You Know the American Mold Builders Association

MoldMaking Technology and The Manufacturing Alliance Podcast get the latest news on initiatives and upcoming events from the American Mold Builders Association.
short.moldmakingtechnology.com/ambapod

BLOG: Rethink How You Track Unattended Machining

Mold builders can get much more meaningful job costing calculations by incorporating total machine runtime and total labor hours.
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EVENT: Amerimold 2019

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This annual tradeshow, which takes place June 12 and 13 in Rosemont, Illinois, addresses the business development, best practices and networking interests of the plastic injection mold manufacturing industry. Register Today!
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3D Printing Offers a Link to Manufacturing Careers

By Kylee Carbone

As one of the team members responsible for finding new talent at Westminster Tool, I'm excited to see how students are learning more about 3D printing technology's role in manufacturing.

I have attended many career events where students say they want to pursue a job in which they can work with technology, but they don't correlate that manufacturing thrives on the utilization of advanced technologies.

Westminster Tool is considering using 3D printing to be able to quickly create prototype parts for our customers and evaluate our ability to measure the complex geometries of those parts. With that intent in mind, our talent development team has been tasked with finding an intern who will evaluate the different types of 3D printers, determine which technology best aligns with our needs and create a presentation supporting why they chose that technology. Interns have great resources they can utilize through their universities, which helps us to access the information we need in a timely manner without having to dedicate an employee to the task. We assign a support person to each intern to provide guidance and act as a sounding board.

Image courtesy of Westminster Tool.

Westminster Tool employs a unique apprentice recruitment and training program, where interns research system options and benefits to determine the right 3D printing investment.

The final decision on purchasing a 3D printer will be made by leadership, but the intern's research is a critical factor. We often employ college interns for these types of projects because their education promotes a research mindset. It is also a low-risk opportunity for us to evaluate how an intern would do as a permanent part of our team. If the outcome shows that we should invest in the technology, then we will follow our standard training process. Someone (more than likely it would be the intern) will be tasked with using the technology, and when they have become proficient in its use, they will create a training program within Westminster Academy. Our philosophy is to hire for character and train for skill, so it's important that we have the training developed to support the next employee who will be working with the technology. MMT

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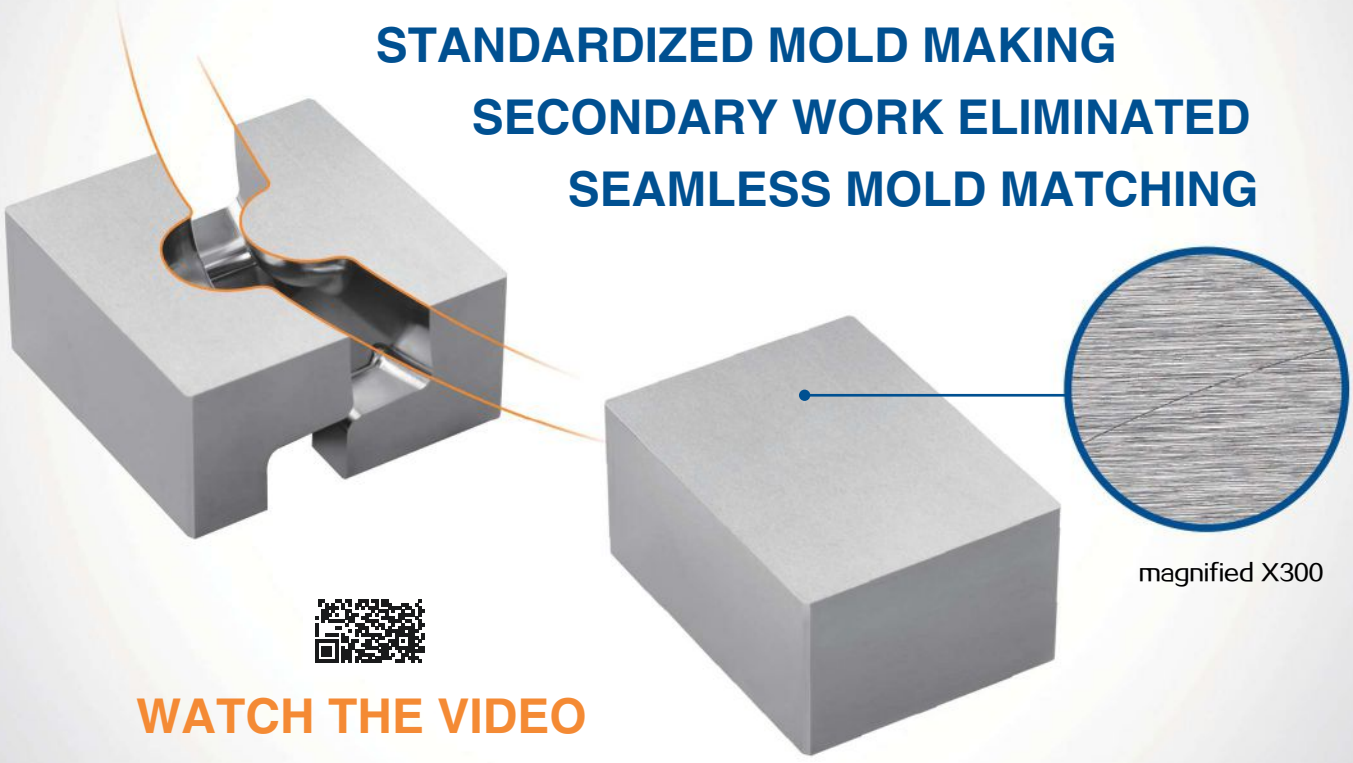

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A Conversation with ...

Omega Tool Inc.

Images courtesy of Omega Tool Inc.

Omega Tool Inc. is a third-generation, family-owned company specializing in the design and build of single and multi-cavity molds up to 700 tons. The company prides itself on its robust tool designs and state-of-the-art manufacturing capabilities. This recently built 16-cavity closure mold features a hydraulic "shedder" ejection system on it.

What competitive advantages does Omega Tool bring to the table when working with customers?

Jed Weber, vice president: We excel at creating robust tool designs. From these tool designs we build precision molds that have been known to run in excess of 20 million shots with very little maintenance. Our design team has nearly 60 years of combined experience designing plastic injection molds. We have learned what works best over the years for specific applications. For example, we pay close attention to cooling to help customers' molds run faster and more efficiently, and more specifically, we ensure the precision fitting and guiding of moving components. Most of the molds we manufacture utilize high-end mold materials, including unique, new "hybrid" tool steels, as well as mold coatings that are engineered for specific applications. Approximately 80 percent of our molds get coatings, and it appears there are new ones being developed every week. All these things contribute to molds that can last for years if properly cared for.

What equipment or technologies enable your company to maintain this level of quality and robustness in the molds you build?

Weber: For one, programming software technology is crucial for creating flawless tool paths on the high-end machine tools throughout our facility. Some key pieces of equipment include a Hermle C42 five-axis CNC with pallet changer, a Mikron 600U five-axis CNC with pallet changer and a Fidia K199 five-axis CNC. We have been utilizing five-axis machining centers for more than a decade, but with the recent advancements in the technology of these machines, such as speed, superior accuracy, reliable performance and superior surface finishes, we have been able to push the limits of what they are capable of. An example of this is a cavity block we recently cut with numerous intricate details including threads. This was a duplicate job for us. The first time we manufactured it a few years back, we machined the cavity, made electrodes, burned the details in the sinker EDM and polished it. This time we machined 100 percent of the details in our Hermle, and the finish was so superior, it didn't require any hand polishing. It reduced our machining time by more than half versus what it took to manufacture the cavity block the first time. This capability has helped tremendously with efficiency as well as quality and has been instrumental in keeping us ahead of the competition.

We currently use Autodesk PowerMill and PowerShape, Mastercam and Esprit CAM software. We are continuously seeking out new tooling and software to help us improve. For example, using high-end cutting tools and shrink-fit toolholders to

Omega Tool Inc.
N93 W14430 Whittaker Way
Menomonee Falls, Wisconsin
262-255-0205
www.omega-tool.com

- Third-generation, family-owned and operated company founded in 1954 by John Weber Sr. and currently led by John Weber, president, and his son Jed Weber, vice president.
- Specializes in designing and building single and multiple cavity molds ranging in size from small master unit die molds up to 700-ton multi-cavity production molds.
- Currently employs 45 team members, 3 being state indentured apprentices.
- Industries served include consumer goods, caps and closures, automotive, appliance, medical and electronics.

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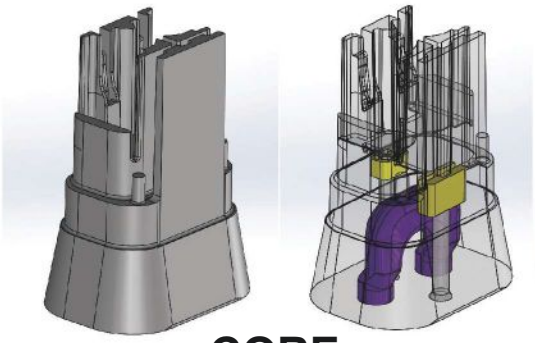

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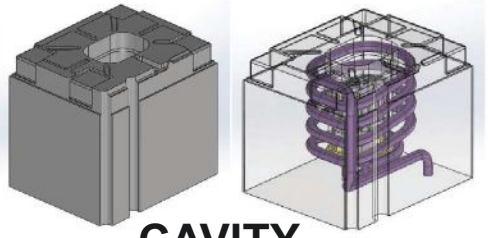

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Omega Tool has been utilizing five-axis machining centers for more than a decade and invests a significant amount of time to research and try out the latest machine tools on the market before buying. Machines are judged by three criteria: Accuracy, surface finish and speed, in that order. One of the company's latest purchases, a Hermle C42 five-axis CNC machining center, is shown here, cutting some beryllium copper cores for a mold build.

minimize runout. Recently, we have also been utilizing hydraulic slim-line holders for applications where vibration may be a problem. But even more than that, I feel that "thinking outside of the box" has been instrumental in Omega Tool's current success. Something we say quite often around the shop is that our mold components should look and function like they came out of a catalog as a standardized component. Nothing leaves scratched. Every component has machined chamfers. We do very little hand work, if any, on our tooling. You'll rarely see hand grinders or pencil grinders in our shop. If you need those, it just means you didn't machine or design something correctly.

Looking more closely at Omega Tool's focus on quality and accuracy, how does the company go about evaluating and purchasing its high-performance equipment?

Weber: With customer lead times being dramatically shortened, Omega Tool has sought out the most sophisticated machine tools available. From automated five-axis milling machines to robotic EDM burning, we continue to push the envelope of what true precision, unattended machining is.

For example, the process of purchasing our first trunnion five-axis machine took a little more than a year. When a company our size spends in excess of one million dollars on a single machine, it can be very nerve racking. We wanted to make sure we were making the right choice for what we had envisioned. We visited six of the world's leading machine tool manufacturers. We spent countless hours, days and weeks on this project and even developed a test cut that would really push the machines to their limits. We made the programs and each manufacturer had to run our program with our tooling. We then critiqued each machine's performance based on three categories. Accuracy was the most important. Surface finish was second, and time was third. Some of these machines were holding a tolerance of a few tenths of an inch over a six-hour cut where the machine was moving simultaneously in all five axes.

What does true precision, unattended machining look like at Omega Tool?

Randy Meissner, plant manager: Years ago, we started out just trying to keep a standard three-axis machine running for an hour after we left the building. Now we can run our five-axis machines through an entire weekend using automation to change pallets and run multiple jobs.

We invest heavily in automation. As mentioned earlier, both our Hermle and Mikron five-axis CNC machines have pallet changers. Our latest sinker EDM cell consists of a Mitsubishi EA12V and EA28V. We have the capability to change electrodes and workpiece pallets. They are all equipped with touch probes and laser tool setters as well as kinematics verification programs to keep everything precise.

Omega Tool has an advanced inspection department. How has this helped you to deliver the precision molds you build?

Weber: Omega Tool's quality relies heavily on detailed inspection. We have a temperature-controlled inspection department where all our mold components and electrodes are verified and documented for accuracy. This is done with a Brown and Sharpe coordinate measuring machine and is a vital step in ensuring consistent accuracy. MMT

By Christina M. Fuges

VIDEO Access the related video under the Videos tab at *MMT* online.

Machining Arsenal Raises the Bar of Complex Moldmaking

Unique business model—with an eye on complex projects and an arsenal of machine technology to meet the required accuracy levels—raises the bar in mold and machined component manufacturing.

"Most mold builders intend to design out the complexity of a customer's part. Here at Custom Mold & Design, we are looking for work for which we can leave in the complexity and bring outsourced operations in house. We believe that the more layers customers add, the more valuable we are to the customer. Our true value is being used early on in the design process," Lester Jones, Vice President of Custom Mold & Design of Forest Lake, Minnesota, says. This philosophy has served the company well over the past 54 years.

Custom Mold & Design considers itself an engineering company. "We help people develop products, not just new molds," Owner Ray Newkirk says. "We find creative ways to solve complex problems." And that means its 320 people across three facilities do a lot of work for which one-thousandths of an inch makes a difference. Jones calls this "cringe work" and not because of the tight tolerances it demands, as much as it is a product portfolio that consists of life-saving things people hope they never need: ultra-precision work that changes lives, such as implants, surgical tools, programmers for pacemakers and different regulators, hospital bed components, and chemotherapy process reservoirs (for high-temperature chemo drugs). Custom Mold & Design works in highly regulated industries with products that seem different, but in reality, the requirements are very similar. Forty percent of Custom's customer base is medical, 25 percent is defense and the rest is spread across the aerospace, electronics and consumer products industries. Plus, this sought-after complexity drives reshoring, a positive side effect in our globally competitive marketplace.

One key component of this business philosophy is machine technology, and you don't have to be on the shop floor long to notice they are tooled up just right to support this strategy.

Images courtesy of Creative Technology.

Yasda's five-axis trunnion design keeps the cutting location near the center of rotation for optimal accuracy, allowing easy access to detail areas for this short, 0.2 mm (0.008 inch) diameter ball mill.

This 15-inch long core with its complex geometry is easy work for the Matsuura MX-850 which has big capacity and rigidity for heavy cutting with precision.

Beyond Accuracy and Speed

Within the past six months alone (back in October 2018), Custom Mold & Design purchased seven semi-truck loads of equipment from an Ohio auction, on top of the equipment it already has in place. This arsenal of machine technology equips this mold builder to take on tough-to-tackle molds and production parts, as well as overmolding, metal injection molding (MIM), silicone and multi-shot work. Strategically purchased machine tools and presses help produce the accuracy levels demanded by the markets Custom serves. Current machining equipment includes CNC machining centers, CNC turning centers, graphite machines, sinker and wire EDMs, grinders and additive manufacturing machines from a variety of machine tool builders.

This machine technology permits Custom to take on work others won't, like a family of titanium mesh/PEEK spinal implants that are laser sintered, wire EDM'd, overmolded, laser marked and five-axis milled. The Custom team molds PEEK (polyetheretherketone) to the porous titanium material, so it is bonded to the inside layer, which leaves the outside layer for the bone to grow into. This product is all about tight tolerances (two-tenths), as it must fuse to the lower back. Custom procures additively manufactured titanium plates that have a porous plate with a solid layer, then a layer of porous material, which the shop wire EDMs to fit the mold cavities.

Custom's sister company Teamvantage (located four miles down the road) then injection molds the components, returning them to Custom Mold & Design, which then machines the titanium mesh spinal implant parts in one of two five-axis Yasda micromachining centers. Each part is loaded onto automated pallets that run unattended. "We hit the button, and the cell runs all weekend. We come into work on Monday, and 60 pallets with four parts per pallet have compound angled holes machined in perfect locations," Jones says. Finally, a metal insert plate is installed, the part is laser engraved, cleaned, packaged and ready for sterilization. Patient kits for the doctors comprise multiple different sizes. "A project like this requires the technology to do every process for each part," Jones says.

Custom Mold & Design does not shy away from these complicated projects. They buy the technology they need to do the job. For example, a tight-toleranced, two-cavity LSR tool Custom designed and built for a firemen's face mask, which has slides pulled in multiple directions. Custom bought a Yasda Vi40 five-axis machining center specifically for this job. "Most LSR tools are sampled and end up with flash, so you need to work on shutoffs to get the flash tightened up, but we can build tools so tightly fit together that we can't fill them. They are so tight that you can't get the air out of them. You have to go in and selectively vent it," Jones says.

These are just two examples of how Custom Mold & Design has raised the bar in mold manufacturing with its machining technology. It all started when the shop attempted hard milling back in 2004 but failed because of the machine choice. The operators were having such a hard time with the equipment that they would rather EDM. The Yasda YBM 640V was the answer. Its accuracy and surface finish capabilities were at the level their customer's work required. Custom Mold & Design evaluated many machines, and although they might be as accurate and as fast, the surface finish with other machine tools cannot compete with that of a Yasda.

The company now has a total of nine Yasdas, three of which are five-axis machines (Methods Machine Tools, Inc. represents Yasda across North America). "The lines of code flying through the five-axis machining centers is crazy, and the capability to hold the tolerances we do while swinging a big block of steel on the table is nuts!" Jones says. "And just down the aisle, we are cutting hardened tool steel with

Yasda micromachining centers equipped with robotic part changers perform precision five-axis machining unattended in continuous operations through the weekend.

a 0.004-inch diameter end mill. That's just bigger than a human hair. When I worked on the shop floor many years ago, I couldn't have imagined such things, and now the guys do it every day. It boggles my mind!"

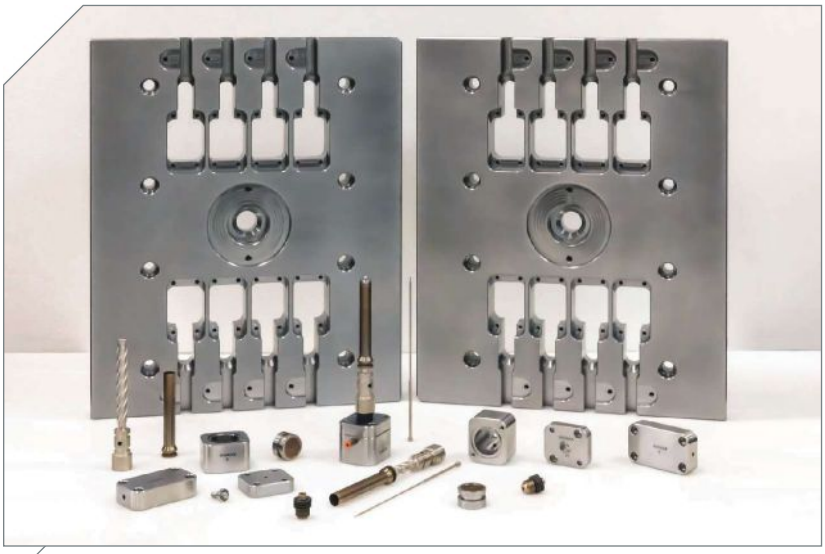
At the time of my visit, Custom Mold & Design had a mold sitting on the shop floor that runs at 375-425°F with slides pulling at angles with many complex shutoffs. With silicone, if there is a half-thousandth gap, it will flash. "This mold demands a precision fit for every component. They have to be perfect to eliminate flash, and by using the right software, cutters, machine tool and skilled personnel, we can produce the accuracy and the surface finish required. If we eliminate polishing, we increase accuracy. Our five-axis Yasda does the trick every time," Jones says.

However, when it comes to accuracy, the real challenge according to Newkirk is bringing all of its work, which is being completed across multiple facility locations, together to fit. The molds are run all over the world, so customers demand interchangeable parts that must be built to the numbers. Again, Yasda has been the answer to this demand. Even two lightly used Yasdas Newkirk purchased, with all the tooling for parts and mold manufacturing from a bankrupt company, perform at the required speed, accuracy and surface finish levels.

Strength in Numbers

As Jones mentioned earlier, it takes more than one kind of machine to take on the types of complex projects that Custom

These examples show some of the variety of parts machined complete in one operation from barstock on three Nakamura-Tome multitasking machines that combine turning and milling operations in one machine.



This array of mold parts, all produced in house, starts with a creative design and a wide range of materials.

Mold & Design does. So, they also make unique use of other machine technology across the three companies. For example, Custom Mold & Design uses its five CNC Swiss *screw machines* to take on all kinds of work, especially work other shops don't want to do because of the low volume and major setup required. "We don't use our screw machines like a screw machine shop; we use our screw machines as a tool shop," Newkirk says. "We use the technology to make tools and tool-related prototypes. We are not trying to be a screw machine shop."

Its new Matsuura MX-850 *five-axis machine* sees a lot of action also, especially for unique and complex machined parts. The company purchased this machine to expand capacity for the machined component portion of the business. Custom uses two Nakamura-Tome Super NTMX *multitasking machines* and an NTJ-100 turret type multitasking machine to manufacture mold components, such as drop components for LSR cold decks, mold inserts and cool gate inserts along with precision machined parts. These items drop out of the machine complete.

We want work for which we can use our engineering and problem-solving capabilities.

Custom continues to add *hard milling machines* (Yasda and Matsuura) and other equipment today as the business and work dictates. Custom Mold & Design is looking at a building expansion this spring to accommodate these equipment additions. Now, with all of this machine technology comes *automation*, and for Custom Mold & Design, automation is not an afterthought. The shop has eight wire and seven sinker EDMs, some with Erowa robots and two Yasdas and a graphite mill that all have robotic capabilities.

Custom is also going beyond its subtractive roots with a recent partnership and investment in a Matsuura Lumex Avance-25 *hybrid metal laser sintering/milling machine* for building conformal-cooled inserts and other metal parts. "The best value for us is having the option to use laser and milling together," Jones says. The machine builds 10 layers at a time and then machines. The new

Swiss turning can quickly and accurately make long, thin parts like this core pin, and make most parts in a single operation without custom fixturing.

improvement of this fifth machine version is a suction system programmed to go around and suck up the unsintered powder in the milling area, after which it comes back and machines, providing much longer cutter life.

Teamvantage, the largest of the three companies, runs the molds and assembles the parts Custom and Paradigme Engineering build. Then there are technology transfer projects for which Teamvantage engineers a system (tool and process) for its customers. For example, a precision mold for Becton Dickinson with a hot runner system complicated by very tight valve gate spacing. Teamvantage developed an automated cell to leak test 100 percent of the parts, assemble them, record data and validate the process. "It's in its own little clean room," Newkirk says.

Teamvantage houses 26 Sodick Plustech molding machines (60 machines in total). Newkirk believes these are the Yasdas of molding machines because, while other press designs demonstrate variation in part weights, the Sodick Plustech V-Line *two-stage injection system molding machine* has no check ring and provides extremely accurate shot sizes due to its use of two separate systems to process resin. It uses a screw to melt the resin, and then a plunger is used to very accurately fill the cavity.

Micro molding is another area of expertise at Teamvantage. For example, they work with micro needle arrays that are molded plastic needles used to deliver drugs through the skin, requiring the needles to be very small and sharp so as not to hurt the patient. Teamvantage has developed needle strength and sharpness. Plus, they do a lot of thin-wall parts with high-temperature resins that involve using high pressures to get material into the cavity fast. Teamvantage also conducts mold trials for other mold shops and is constantly adding equipment and capabilities to stay ahead of the competition.

"Making billions of things is boring. We want work for which we can use our engineering and problem-solving capabilities. We are constantly practicing and honing our skill level, so we want customers who need us to do the hard, challenging stuff," Jones says. MMT

FOR MORE INFORMATION

Custom Mold & Design
651-757-4000 / custommold.net
Paradigme Engineering
763-261-2000 / paradigme.net
Teamvantage
651-464-3900 / teamvantage.com
Yasda / 847-439-0201 / yasda.com
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By Christina M. Fuges

Images courtesy of MoldTrax.

Get Your Hands Dirty to Clean Up Your Maintenance Act

Intensive workshop teaches the process of mold maintenance to help put an end to the firefighting culture of many toolrooms.

I met Captain Jack recently and took a pry bar to him. Okay, let me explain. Captain Jack, or more commonly known as the "beast," is the most challenging mold (with 48 cavities and a valve-gate manifold system) presented to trainees at the MoldTrax mold maintenance training facility, which I was invited to participate in, along with Senior Editor, Cyndi Kustush.

Now, I didn't actually meet Captain Jack, but I did break down Husky Joe and got a good look at T-Rex and Dirty Bird, too. Each of these molds, designed with different complexity levels matched to the appropriate attendee skill level, is used to demonstrate the importance of choreographing mold bench work because proper mold maintenance is not freelance work; it is a process. This process demands effective communication among mold designers, processing engineers and repair technicians, as well as data. Now, let me share with you what I experienced during this training.

The Setup

As you open the door to the MoldTrax training facility in Ashland, Ohio, you are standing in an intentionally designed toolroom, set up with equipment and a workflow mostly for medical-size molds that are 6,000-8,000 pounds or less, and ready for hands-on training. The environment includes maintenance benches optimized for mold assembly/disassembly, mold light bars, grinders, hoists, broken-down unscrewing and three-plate molds with status tags, damaged hot runner systems, workstations furnished with top-of-the-line Gerstner toolboxes and computers running MoldTrax data management software. Lastly, flat-screen TVs are scattered across the shop floor to provide an up-close-and-personal look at various mold maintenance and troubleshooting best practices.

As you move through the toolroom making your way to the classroom for some instructional theory and strategy, walls are lined with photographs dating back to 2009, highlighting more than 1,700 industry peers who have completed training in this facility. An impressive wall of happy faces because they are now better armed to tackle the tooling challenges of each day. They now understand that if their shop is performing a

MoldMaking Technology Editorial Director Christina Fuges and Senior Editor Cyndi Kustush each take a pry bar to this injection mold for a lesson in proper disassembly for maintenance during an intensive three-day workshop.

lot of troubleshooting, they did not properly build their preventative maintenance (PM) processes.

Training here is not new, but there was something special about this particular training session: the mix of content. This time, Steve Johnson, president, and Glenn Keith, global assessment and training manager at MoldTrax, set out to connect design, processing and maintenance because they believe and have discovered that cross-training across these disciplines can dramatically improve the troubleshooting skills of a mold designer, processing engineer and toolroom technician. And, the interest of trainees reflected this balance of design, processing and maintenance.

Specific objectives included mold cleaning, proper guidance for PM, PM scheduling, strategies for heading off problems, collecting data, prolonging gate inserts and broadening knowledge of tooling issues to improve mold designs. To make this "connected" training happen, Johnson partnered with Andy Routsis of Routsis Training, who added mold design and processing to the standard maintenance mix.

The Maintenance Process

"Mold repair is the second most expensive budgetary item in a plastics molding facility," Routsis says. That statement should make everyone stop and pay attention. The only way to change that figure is to change the culture, and we all know that culture change is tough.

"We wish we could just have somebody purchase maintenance widgets that they could just stick in the mold to make things better. But it doesn't work that way. It's one little piece at a time," Johnson says. "Begin with the process, start systemizing things and then people will begin to see it working and experience the payback, so then you can implement a little more and then a little more."

Specific maintenance systems and process are necessary to end the firefighting culture of many toolrooms today. "We have a process that allows shops to efficiently produce quality parts on time. Without a process, you are freelancing how you do something, and then it is never done the same way," Keith says.

Johnson strongly believes in justification through dollars. He advises that before a toolroom tries to make any changes in the maintenance environment, they figure out how to turn everything they do plus all the issues into money. "That will get everyone's attention because that's the equalizer," Johnson says.

Let's face it, every other aspect of plastics manufacturing has a process that employees must follow, from scientific modeling to design guide checklists to simulations, but maintenance is an afterthought most of the time. "Maintenance is thrown in the back of the warehouse with a bench, some rags and a five-pound hammer working on a half-million-dollar piece of equipment. This is not the way it is supposed to be," Johnson says.

This attitude makes this mold-maintenance training program a culture shock to many attendees who range from mold repair technicians to processing engineers. "For so long, there's been no accountability. It's a free for all because they've been free to do whatever they want to do when they want to do it, and here we demand following the system *every* time," Johnson says.

An intentionally-designed toolroom equipped for hands-on training provides the perfect learning environment because unless technicians get their hands on a tool and fail, they won't retain as much information. The toolroom includes maintenance benches optimized for mold assembly/disassembly, mold light bars, grinders, hoists, broken-down unscrewing and three-plate molds with status tags, damaged hot runner systems. Workstations are furnished with top-of-the-line Gerstner toolboxes, computers running MoldTrax data management software and flatscreen TVs providing an up-close-and-personal look at various mold maintenance and troubleshooting best practices.

Steve Johnson, president, and Glenn Keith, global assessment and training manager for MoldTrax, teach an intimate room of "students" their process of mold maintenance, which allows shops to efficiently produce quality parts on time. Programming also includes a look at how connecting design, processing, and maintenance disciplines can dramatically improve the troubleshooting skills of a mold designer, processing engineer and toolroom technician.

The Cost

What system, you ask? Well, there's a lot to it, but it's also a lot of common sense. For example, everybody has a horror story, like putting cavity blocks in upside-down, forgetting bolts or leaving things out. Then someone places the mold in the press, puts the bolts in and closes the press, causing 500 tons of pressure to crush $50,000 worth of tooling because they didn't have the patience to slow down to see what the problem is. Yikes! The first thing to do is slow down or, as Johnson says, "Put down the hammer!"

Little mistakes can cost hundreds of thousands of dollars because people are in a hurry due to the manufacturing urgency that everyone feels. However, a toolroom needs to be accurate, safe and fast. It's all about a tech's focus level and his or her ability to work very carefully and measure before starting.

"Before you can grind and work in tenths you need to measure in tenths, which takes a lot of feel and the right equipment. Sometimes we have a loose connection between the hand and head. Critical areas need to be measured as you're putting molds back together while you're assembling the tool, especially when working on hot manifold systems," Johnson says.

For example, for a technician to truly have command of a tool in his hand, whether it's a hammer, pry bar, screwdriver, saw or even a precision micrometer, he must read the resistance because when you are trying to measure something within two-tenths (a hair split 10 times) you have to have a delicate feel. "You cannot be heavy-handed. Your job is to understand the resistance and how much you should feel, and when it becomes too much, you have to put the tool down and find out where the resistance is coming from. The answer is not always more leverage," Johnson says.

When I asked Johnson and Keith for their recommendations on what a toolroom should do first to get a maintenance process underway, they both said to clean up the shop and get organized, then work on standardizing the language to collect better data for improved documentation.

Maintenance is a process, so as a toolroom equates everything to a dollar, they must also do that within a process of documentation. However, historically that's been very difficult to do because shops use data collection through maintenance stories that use ambiguous, non-standard terminology. "You're never going to get any better if you can't measure to justify what you do. You must standardize first," Keith says. Here is where MoldTrax maintenance tracking software comes into play. Key software features include track performance metrics along with maintenance and tooling costs for a variety of molds and dies, drop-down menus built on a shop's standard terminology for accurate reports, consistent instructions and images and a custom troubleshooting guide to create a specific knowledge base for every mold.

The Workshop Takeaways

The method to this maintenance madness can be taught in a classroom setting all day long, but Johnson and Keith believe that until techs get their hands on a tool and struggle, they won't retain as much information. So, MoldTrax workshops involve both lecture and hands-on practice. "We want to get toolroom teams trained up, so you don't need to call for help," Keith says.

If you walk away with nothing else, both Johnson and Keith want toolroom technicians to understand the eight stages of systemized repair: PM preparation, disassembly, troubleshoot, correction action, clean, assembly, final check and stage/rack. Each of these stages can be broken down into ten vital steps. For example, Final check:

- Verify all available cavities are open and those unavailable are blocked
- Verify current cavity identification numbers are correct
- Air/water check all cooling circuits
- Electric test manifolds, heaters, probes and thermocouples
- Check knockout rods and components for uniformity, length and condition
- Complete repair sheet form and return to the mold maintenance office
- Enter repair sheet data into the maintenance system
- Tag and place salvageable tooling into appropriate rework bin
- Track mold location and status
- Stage mold in the appropriate location

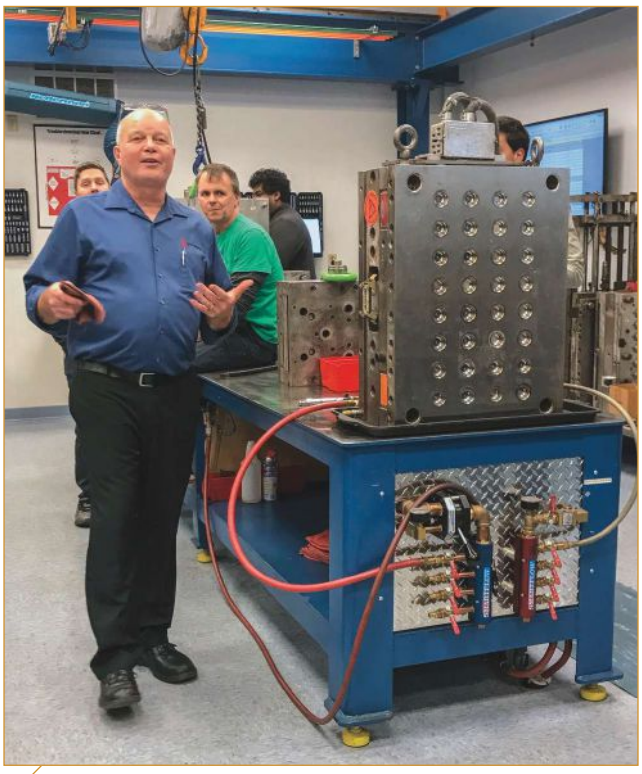
Each stage has its own setup steps to follow. To pique your interest in the other types of insights and instruction you experience through proper mold maintenance training, here are some of the workshop highlights.

Mold Design

- Plastic parts are getting more complex (more detail, functionality and specialized plastic materials), simplify part design and use standardized mold components when possible to reduce costs and lead time.
- Gate location and gate type is the most important consideration for any injection mold.
- Use software to simulate the result of gate location and note what happens when you change gate type and location.
- More gates always result in more weld lines.
- If at all possible, use only one gate.

Processing

- Look at plastic through the eyes of a process engineer. Simplify the process and establish process outputs that correlate to an acceptable part.
- Ensure the best mold quote by presenting the moldmaker with a model of the part that you wish to produce. Identify critical features and dimensions so that the mold can be constructed to accommodate.



MoldTrax Global Assessment and Training Manager Glenn Keith demonstrates an easy and effective method for doing a pressure check for water leaks. For this workshop, he also teams up with MoldTrax President Steve Johnson and Andy Routsis of Routsis Training to cover mold cleaning, proper guidance for PM, PM scheduling, strategies for heading off problems, collecting data, prolonging gate inserts and broadening knowledge of tooling issues to improve mold designs.

- Scientific molding is simply short shot molding—shifting from velocity to pressure when the mold is filled 90-95 percent.
- Match the outputs of the process to yield the same part every time. Perfect process outputs equal a repeatable part.
- Use a setup sheet and capture process outputs. Revise your existing setup sheet to include process outputs. This will ensure part consistency.

Venting

- You can never over vent an injection mold.
- Vent everywhere—sprue and runners, inserts, cores, ejector pins and blades, slides and lifters.
- Be certain that you are venting to atmosphere and relieve pass the seal-off area. Utilize the correct vent depth to avoid flash.
- Always check clamp tonnage. Determine when the part flashes by dropping tonnage. Once the part starts to flash, add 10 percent to accommodate process variation.
- With poor venting, the vents will begin to build up residue. In extreme cases when the entrapped gas cannot get out, you'll experience dieseling (explosion).

Tonnage

- Determine minimum tonnage and add 10 percent for variation. This will maximize venting effectiveness.
- Measure tie bar stretch with family molds to see if it is even and to determine if tonnage is affecting the press/machine (not just the mold).
- Use dial indicator and measure the stretch of all four tie bars.
- Understand mold size and tonnage, or you will damage the toggle mechanism. The footprint of the mold is important. Too little and you will damage the platens. Too big and you may damage the toggle.

Maintenance

- Every mold has a weakness. Create a PM plan around that weakness.
- No more duct tape maintenance books or files of work orders. Today, proper mold maintenance requires software.
- Share knowledge to maintain repair/maintenance consistency
- Avoid under or over maintenance. PM mode is replacing things at a certain number when that number comes up. That's good as long as that number is right.
- Following the eight stages of PM: preparation, disassembly, troubleshoot, corrective action, clean, assembly, final check and stage/rack.
- Follow the system. Cleaning is number five for a reason: you are wiping away all the clues, which will make it difficult to troubleshoot.
- Clean cooling channels.
- Chart mold wear to help create a PM plan.
- Doing a mold positional analysis to remedy runner imbalance (lineal vs. rheological balance)

- Always look for wear defects.
- Identify the controlling features of each mold.
- Determine where your maintenance dollars are going.
- Collect data points at the press to identify root causes.
- Use data to convince someone in the corner office that you want to improve efficiency.
- Don't use brass or aluminum hammers during assembly because they chip.
- Listen to your hot runner. Look for cable issues, loose pins/damaged cables, gate insert problems, and incorrect flow.
- Check tip "l" heights (distance from the front of the manifold plate to the top of the tip) because short tips cause a temperature increase.
- Check hot tip systems as tips erode.
- Follow the proper start up and shut down procedure (waiting for the hot runner to soak out; 30 minutes or so).

The Impact

Matt Lance is the Assistant Manager of Plastics Maintenance in Tool and Die for Toyota Motor Manufacturing in Georgetown, Kentucky. He recently moved to the tool and die side of the business, so this workshop was perfect timing to broaden his experience and knowledge of mold design, setups and various mold components. Lance is now armed to tackle documentation tracking, which he knows is key to helping the toolroom get out of firefighting mode.

"My team calls itself a MASH unit, which is the opposite of what it should be," Lance says. "After my first few months in this new role observing the team and now attending this workshop, I know that we don't do a whole lot with documentation, so I need to find what we *are* doing and then implement some simple tracking methods to truly understand what's going on and where we need to focus."

Abraham Martinez has been with Albea Cosmetics in Brownsville, Texas, for 30 years and has been mold shop superintendent for the past three years. He brought the company's manager responsible for process and managing personnel and the mold shop supervisor as well. "We want to learn to interact more effectively with the process guys in the shop to provide a cross-training experience when it comes to proper mold maintenance. I want to take what we are doing to the next level," Martinez says.

For example, they do pressure checks for water leaks, but lack the equipment that Keith demonstrated in the shop, which provides an actual number to record.

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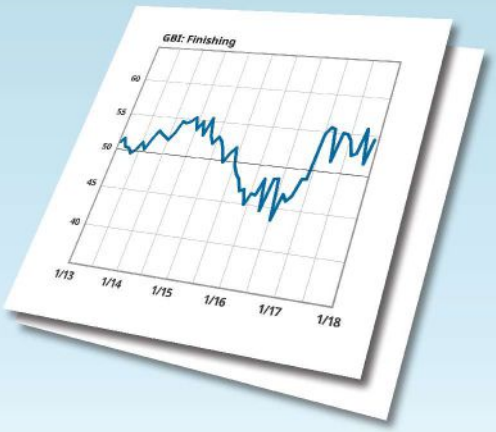

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Kevin Rapant is a process engineer with MGS Manufacturing in Germantown, Wisconsin, and came to learn more about mold maintenance and to tie that together with processing. "Many times, tribal knowledge can limit learning, so programs like this provide alternate ways of doing things. For example, we can clean molds faster using dry ice, so we don't have to pull molds as much, or to think before just jumping in and flashing tools. Stepping back and taking a second to think about things," Rapant says.

Mexico-based Cubasa sent its Director of Engineering, Adalid Perez, and the first thing that he is going to do is "sign the P.O. for MoldTrax and sign more of my shop guys up for the ToolingDocs Certification Levels one and two." He's also interested in ultrasonic cleaning because they have a lot of beryllium copper applications, and cooling lines are critical for their thin-wall fast-cycle molds.

Everyone Cyndi and I spoke with agreed that connecting face to face with peers, suppliers and instructors with material and tools in-hand in an intimate, intensive workshop setting provides a more effective way to learn about technology, and more importantly, share your problems and find solutions.

Whether you want to work on molds, manage molds or design molds, you need to understand how these systems work and what is necessary to take them apart to clean them up. Proper mold maintenance is not difficult, but it is an exercise in patience, professionalism, accountability and discipline to do the right thing without someone looking over your shoulder. "That is what separates the pounders and apprentices from the journeymen. It is *that* person who can do all that without constant supervision," Johnson says. MMT

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MoldTrax Hot Runner Conference is August 20-22, 2019.

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Albea Cosmetics / albeacosmetics.com
Cubasa / cubasa.net
MGS Mfg / mgsmfg.com
MoldTrax / 419-281-0790 / Steve@moldtrax.com / moldtrax.com
Routsis Training / 978-957-0700 / andyr@traininteractive.com/ traininteractive.com
Toyota / toyota.com

By Jon Carlson

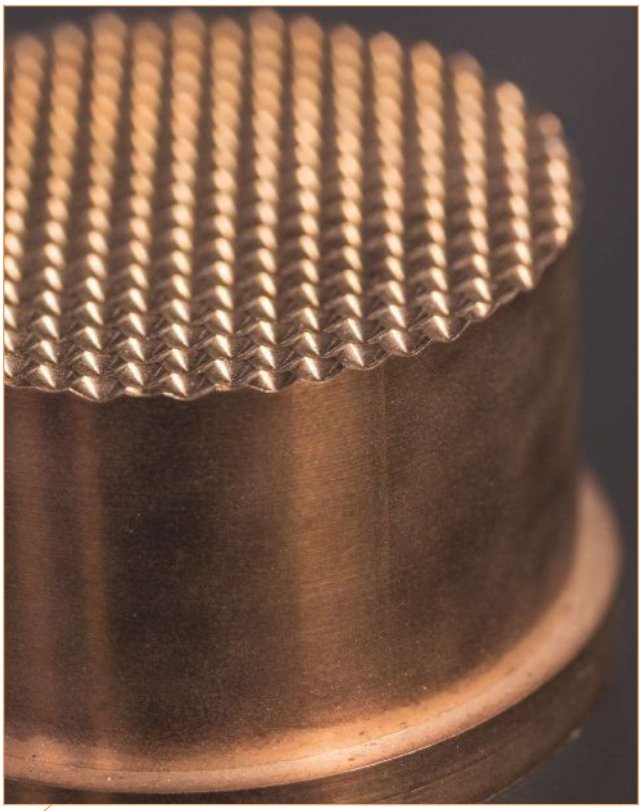
VIDEO Access the related video under the Videos tab at *MMT* online.

Femtosecond Lasers Power Up Mold Texturing and Micromachining

Newer femtosecond laser machine option solves common working distance challenge for micromachining and mold texturing.

As some shops have already discovered, femtosecond laser technology represents a new frontier in moldmaking. The aim of this new laser is not to replace traditional machining methods; instead, it complements them in a way that ultimately leads to increased productivity for mold shops and manufacturers alike.

Femtosecond lasers are, as the name implies, lasers with pulse durations in the femtosecond range (one quadrillionth of a second), a pulse length that puts these lasers in the category of ultrashort pulses. One prominent advantage of this extremely short pulse length is the reduction of heat absorption, a quality that made femtosecond lasers useful for medical applications, particularly ophthalmological procedures such as LASIK.



Images courtesy of GF Machining Solutions.

Lasers have become an indispensable tool for moldmakers who have used the technology to achieve textures and precision beyond the capabilities of traditional milling or EDM machines.

Naturally, the avoidance of heat transference and a high degree of precision make femtosecond lasers excellent tools for mold production. The ultra-short pulse duration of the laser prevents materials from reentering a fusion state resulting in true ablation while engraving is ongoing. The ablation process vaporizes the material, eliminates burr formation and provides an exceptional level of finish. While nanosecond lasers produce sufficient heat to harden the surface of materials and damage coatings, femtosecond lasers avoid these issues, making them ideal tools for heat-sensitive parts.

Laser-Focused on Working Distance

Unlike die-sinking EDM or conventional micromachining, laser micromachining has relatively few requirements. The first is simple *line-of-sight*, a far less restrictive requirement than one finds with other machining operations. As a non-contact tool, lasers can reach places otherwise impossible even with the smallest of diameter spindles and can create small mold features at working distances often unobtainable with ram EDM.

The second laser requirement involves *working distance*. Because lasers use amplified light as the cutting tool, they rely on lenses and their corresponding focal distances to the workpiece. Many of the ultrashort pulse laser options for micromachining on the market have a working distance of only a few millimeters owing to a working spot size just 1-3 microns in diameter. This allows for amazing detail when hole drilling, cutting or creating micro-structures on flat or tubular surfaces but constrains the laser movement to third or fourth axes, ultimately limiting their capabilities.

Today, the market offers a femtosecond laser machine with a working distance configurable from 73-300 mm,

Femtosecond lasers can create micron-level features that demand tolerance ranges too difficult or even impossible with traditional techniques.

which makes for close work for traditional machining but incredibly generous for laser texturing and other moldmaking applications.

At these distances, laser pulse spot sizes range from 18-70 microns at full power, depending on the lens option, but refined parameters can yield spot sizes in the single-digit microns. These lasers also excel in terms of angles of attack, with full five-axis movement and high-quality cuts remaining possible at up to 70-degree angles.

Manipulating Laser Parameters

Laser ablation, whether used for engraving, texturing or machining part features in molds, requires a different approach to traditional material removal operations. Unlike the speeds and feeds one considers in milling and turning, the primary parameters used in laser operations involve the laser's power output, its frequency and the speed of the galvo mirrors that control the laser's movement across the workpiece.

Generally speaking, power is the most straightforward of these factors. If you set the laser's power to 20 percent, in most cases, you get an output of 20 percent. Modifying the laser's frequency, the oscillation of the laser's energy controlling wavelength has a more complex relationship with depth of cut and detail.

To understand frequency, imagine ocean waves. Large waves have loads of power (energy) but occur less often, whereas you could see dozens of small, less powerful waves in the same period. So, low frequencies can remove material fast and aggressively, and higher frequencies will often create higher quality cuts with a slower material removal rate.

Similarly, there is a correlation with the speed of the galvo mirrors movement across the material surface, affecting both removal rate and surface quality. By managing these key factors, operators can vary the depths-of-cut per slice and impact the quality of the ablated surface significantly.

Smithfield, Rhode Island-based Providence Texture is one shop that mastered the manipulation of laser parameters and has already begun taking femtosecond laser technology used to the next level with its machine for micromachining part features. The shop produces a vast range of textures, including those with extremely low Ra-value surface finishes, and generates numerous laser-only textures and patterns.

Many of these part features are deceptively simple, such as a V-shaped groove to add additional pressure to a gasket seal

This femtosecond laser has a working distance ranging from 100-300 mm, which is close work for traditional machining but incredibly generous for laser texturing and other moldmaking applications.

that may be as little as 0.005 inches deep, or one to two-millimeter thread features on a plastic syringe barrel mold. Both femtosecond and nanosecond lasers can create these features faster and more economically than typical die-sinking operations. Furthermore, femtosecond lasers can create micron-level features that demand tolerance ranges too difficult or even impossible with traditional techniques.

Providence Texture has also found that a strategic key to achieving the highest levels of part precision and laser machine production is automation. With its palletized automation system and custom fixturing designed around the laser's capabilities, the shop keeps its repeatability within ±3 microns. Automation also makes it possible for this shop to handle a high-mix, low-volume manufacturing environment while maintaining the capacity for high-volume production when necessary.

The combination of laser technology and a robot automation solution are critical for the shop. "With our custom fixtures, we can program a reference offset and know that we're within two to three microns of accuracy when that fixture goes back in front of the laser. That kind of precision is key when you're working at the micron level. We maintain the ambient shop temperature within four degrees to ensure the greatest possible accuracy," President and CEO Matt Melonio says.

Throughout only a few decades, lasers have become an indispensable tool for moldmakers who have used this technology to achieve textures and precision beyond the capabilities of traditional milling or EDM machines. Today, laser micromachining and texturing have taken another big step forward thanks to femtosecond lasers, but laser technology pioneers will continue forging ahead in search of methods for pushing the limits of the technology. MMT

CONTRIBUTOR

Jon Carlson is Product Manager, Advanced Manufacturing for GF Machining Solutions.

FOR MORE INFORMATION

Providence Texture / 401-642-9490 / matt.melonio@providencetexture.com / providencetexture.com
GF Machining Solutions LLC / 847-955-7145 / jon.carlson@georgfischer.com / gfms.com/us

By Jay Vang

Get the Full Story on Conformal Cooling

Moldmakers must look beyond heat sink simulation and use 3D CFD analysis to achieve the right conformal cooling design.

Today, there are still conformal cooling skeptics, and because of incomplete analysis, they should be. Simulation is a great validation tool, but that's all it is. It is a powerful tool, but results are still based on user input. Of course, there are optimization tools and modules within the software, but the saying "garbage in, garbage out" applies. Two analysts running a plastic injection simulation can give totally different results if inputs are different. For conformal cooling, specifically, wrong assumptions and dismissing important factors such as the ability to achieve the necessary flow rate to ensure turbulent flow can result in a bad investment.

Simulation vs Analysis

Conformal cooling can help minimize cycle time and achieve dimensional tolerances. However, it will only work as well as the simulation if the designer can maintain the necessary flow rate through the conformal cooling circuit. A designer running a *heat sink simulation* (cooling channel defined only as a heat sink source) on complex designs will not tell the full story of what may occur in the mold. In **Figure 1**, results are from a computational fluid dynamics (CFD) analysis showing Reynolds number at a flow rate of approximately 2.0 gpm.

Some regions show a Reynolds number above 4200, indicating turbulent flow, while others show a Reynolds number below 4200, indicating that the flow in certain regions may not be turbulent necessarily. This variation will vary cooling efficiency throughout the circuit. Velocity has a direct correlation to the Reynolds number, so if a designer identifies the low/no flow regions he or she can optimize the cooling channel design. Simulation can also display velocity results that indicate low/no flow regions that are doing less work and potentially stagnant areas. Keep in mind that fluids take the path of least resistance, so instead of taking random paths and flowing around all the holes, the coolant will flow straight from the inlet side to the outlet side.

Designers can use such data to optimize design to minimize low/no flow regions (shown in dark blue between the

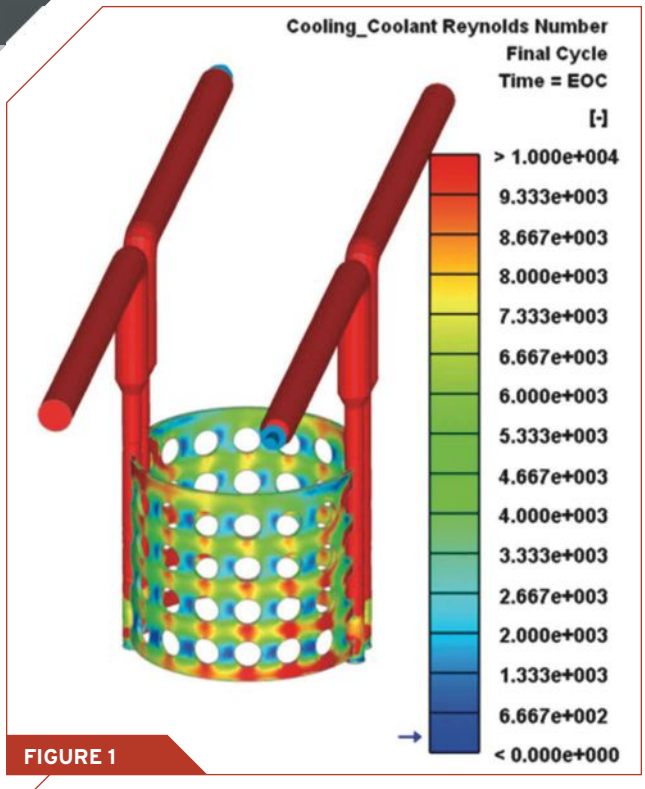


FIGURE 1

Results from a computational fluid dynamics (CFD) analysis showing Reynolds number at a flow rate of approximately 2.0 gpm.

Images courtesy of Moldex3D.

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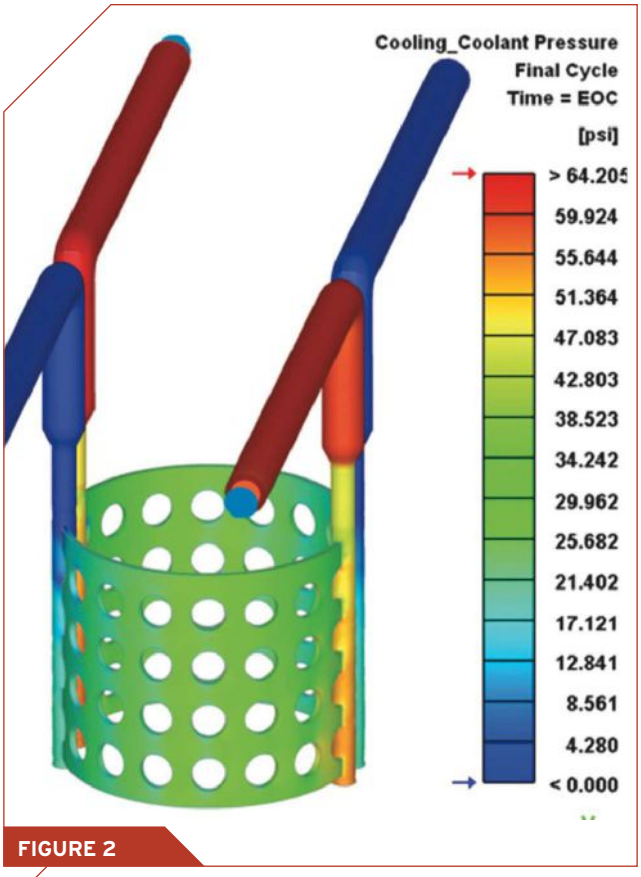

FIGURE 2

Coolant pressure results from the same model at the same flow rate of 2.0 gpm.

holes). For example, designers can try offseting the holes to divert water through regions with a low Reynolds number, which indicates low/no flow regions. Despite offsetting the holes, a path of least resistance may remain. However, offsetting the holes can still help to minimize the no/low flow regions, maximizing turbulent flow throughout with an achievable flow rate.

The question now is "How much will the results of a heat sink analysis differ from these?" Not much from a cooling calculation standpoint and depending on flow rate input. However, heat sink analysis along with CFD analysis can determine effectiveness and amount of change.

Heat sink analysis alone also does not work well for conformal cooling channel analysis because conformal cooling typically consists of small-diameter circuits with long flow lengths that conform to the geometry of the parts (**see Figures 2 and 3**). The small diameter or thickness of the design and longer flow length circuits require higher pressures to effectively push sufficient flow rate through the circuit.

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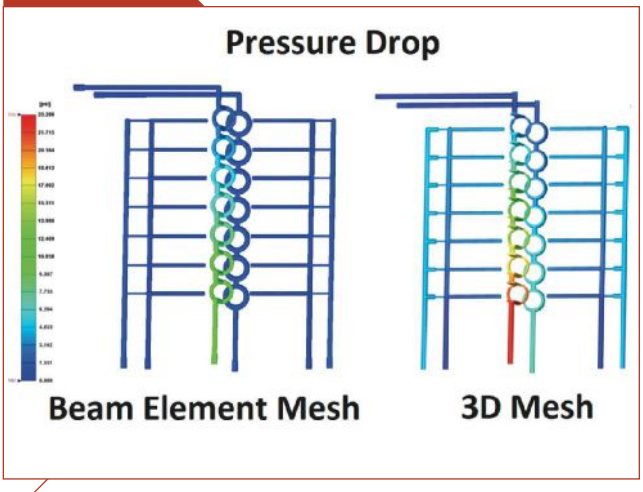

A comparison of pressure drop results between beam element and 3D mesh simulation methods. Pressure drop results indicate the head pressure required to push the indicated flow rate through the cooling circuits.

FIGURE 4

MGS Mfg. Group used this testing equipment to validate pressure indications: (1) a DMLS-conformal-cooled insert, (2) a 3D-printed set of bubblers, (3-4) clear tubing with different length and diameters, pressure gauges and flow gauges connected to a water transfer pump and a water tank.

Pressure Requirements

If Reynolds number and velocity are dependent on flow rate, identifying the pressure required to achieve a certain flow rate is essential to determine if achieving the required flow rate is realistic. **Figure 2** shows coolant pressure results from the same model at the same flow rate of 2.0 gpm.

A designer must understand pressure requirements and minimum flow rate to achieve turbulent flow where they intend to have good heat transfer, because fluids take the path of least resistance. **Figure 1** indicates that water flows in areas where the Reynolds number is between 4,000 and 10,000+ and that turbulent flow (Re # > 4200) is likely present in most regions. However, high pressure is required to flow 2.0 gpm through the circuits to achieve these values.

Thermolators on the market today can generate up to approximately 100 PSI, but 65 PSI might not be achievable because fluids prefer the path of least resistance or areas with less resistant circuits such as manifold plates and core and cavity plates. If the flow rate falls below 2.0 gpm, the Reynolds number will decrease, potentially yielding laminar flow through the circuit, which is not efficient. Also, a designer simply increasing the flow rate to the manifold will not result in a linear distribution of fluid through all circuits.

Simulated results and actual results may differ if conformal cooling circuits are not hooked up to their own thermolator or if they don't use flow restrictors to divert water to specific lines. If the designer cannot achieve the necessary flow rate to maintain turbulent flow through a conformal cooling cir-

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FIGURE 5

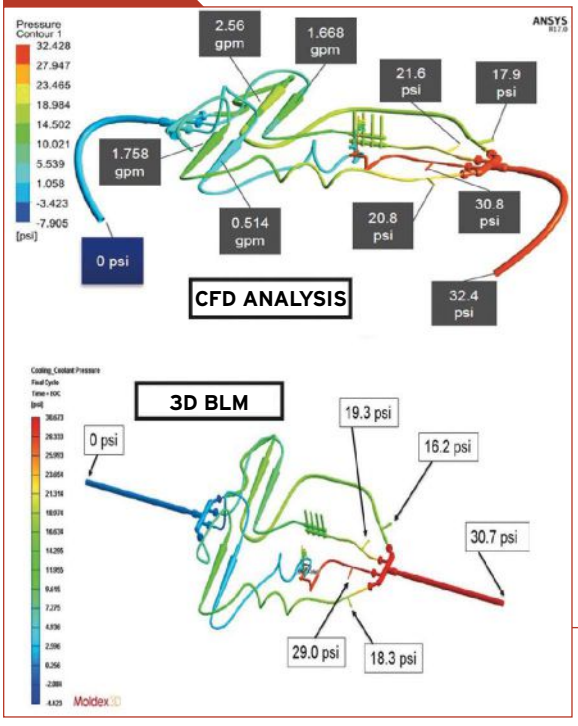

FIGURE 6

CFD ANALYSIS

	Recorded Results	ANSYS Results	Δ Pressure
Inlet	32	32.4	0.4
Circuit 01	14	17.9	3.9
Circuit 02	18.5	21.6	3.1
Circuit 03	26	30.8	4.8
Circuit 04	18.5	20.8	2.3
Exit	0	0	0

3D BLM

	Recorded Results	Moldex Results	Δ Pressure
Inlet	32	30.7	1.3
Circuit 01	14	16.2	2.2
Circuit 02	18.5	19.3	0.8
Circuit 03	26	29	3
Circuit 04	18.5	18.3	0.2
Exit	0	0	0

Comparison of the recorded values to the simulated pressures.

Results from a CFD analysis and 3D BLM to mesh the model. Using the latter, the designer modeled the inlet and outlet hoses straight instead of curved, as the software requires inlets and outlets of fluid source to be perpendicular to the mold face.

cuit, they can drill conventional circuits and achieve equivalent or better results.

Meshing Matters

A designer can achieve more accurate and reliable analysis of conformal cooling designs with accurate CFD analysis. However, not all CFDs are the same. The two main meshing methods for cooling channels in injection simulation software are beam elements and 3D elements.

Beam elements can determine the Reynolds number, temperature rise/fall throughout the mold, and flow distribution but are not nearly as accurate as *3D mesh elements* when predicting pressure drop. Beam elements also have a hard time capturing true complex geometries and require modeling as relative volume. However, beam elements do yield faster simulation times compared to 3D mesh.

Figure 3 compares pressure drop results between beam element and 3D mesh simulation methods. Pressure drop results indicate the head pressure

required to push the indicated flow rate through the cooling circuits. Although the pressure requirement ratio from one circuit to another is similar, the beam element indicates 25 to 50 percent less pressure required for the complex circuits and the potential to exacerbate the pressure with a complex conformal cooling design. Pressure drop results alone can lead to false thermolator requirements, which will yield insufficient flow through circuits that are more restrictive. For example, conformal cooling circuits that create an ineffective conformal cooling design.

Proving It Out

To determine if 3D mesh elements capture more precise pressure drop prediction than beam elements, Kevin Klotz from MGS Mfg. Group conducted a test to validate pressure predictions (**see Figure 4**).

Klotz used one DMLS-conformal-cooled insert, a 3D-printed set of bubblers, clear tubing with different length and diameters, pressure gauges, and flow gauges connected to a water transfer pump and a water tank. The apparatus was modeled in CREO and recorded to compare with simulation. The same model was sent to Dr. Jeet Sengupta of Hoerbiger Corporation of America to run a CFD analysis via ANSYS CFX and to Moldex3D to simulate using their 3D boundary layer meshing (BLM).

Both software tools use the recorded flow rate values through each circuit and the combined flow rate value of 6.5 gpm as the input from the pump to record pressures at the inlet, exit, and pressure gauge locations. **Figure 5** shows results from CFD analysis and 3D BLM to mesh the model. Using the latter the designer modeled the inlet and outlet hoses straight instead of curved, as the software requires inlets and outlets of fluid source to be perpendicular to the mold face.

Pressure results from both software tools are very close to the recorded values from the physical apparatus. **Figure 6** compares the recorded values to the simulated pressures. For example, the largest difference from CFD analysis to recorded values is about 5.0 PSI and 2.5 PSI using BLM mesh. Both results are well within acceptable accuracy for the intended purpose, considering the tolerance in pressure gauge reading and flow rate measurements from an inline flow gauge.

Lessons Learned

Conformal cooling can work as intended if properly designed, which requires a thorough simulation using CFD analysis to understand the characteristics of the fluid flow. For example, if a 3D-printed insert branches into two or more channels, determining the favored branch can make a large impact on conformal cooling design effectiveness.

If a designer only runs a heat sink analysis, he or she will not capture the difference or predict the pressure required to achieve a flow rate for turbulent flow for complex cooling designs like conformal cooling. However, a designer can precisely capture fluid flow characteristics using 3D mesh elements. 3D mesh elements capture fluid flow characteristics, such as momentum change, for accurate pressure predictions. MMT

CONTRIBUTOR

Jay Vang is a customer success engineer for Moldex3D Northern America.

FOR MORE INFORMATION

Moldex3D / 248-987-7987 /
jayvang@moldex3D.com / moldex3d.com
MGS Mfg Group / 262-255-5790 / mgsmfg.com

VIDEO Access the related video under the Videos tab at *MMT* online.

Laser Welder Delivers Big on Time and Cost Savings for Small Repairs

By Cynthia Kustush

United Tool and Mold Inc. (UTM; Liberty, South Carolina) is a 24/7 operation specializing in engineering changes and repair services for the injection- and blow-molding industries. With the motto "Keeping the Plastics Industry Running," having the right equipment to deliver refurbished, production-ready molds to its customers quickly and efficiently is key to building customer loyalty and maintaining a thriving business.

Various processes are used in mold repair and refurbishment, including welding. UTM President Scott Phipps has no lack of skilled TIG welders among his 80 U.S.-based employees to handle big repairs on the large molds (up to 125,000 pounds). "We have to use TIG (tungsten inert gas) welding when we are putting on large amounts of steel, so we must maintain the TIG welding skills, as well as embrace the new laser technologies with the best equipment for applying small precision welds," he explains. To wit, Phipps says he's been amazed at the efficiencies gained and the speed of the learning curve when it comes to making smaller repairs using the ALFlak 300 Laser Welder his company purchased from Alpha Laser—US (Meadville, Pennsylvania) just over a year ago.

Image courtesy of United Tool and Mold Inc.

Large, complex molds that need repair in small or tight places are no contest for United Tool and Mold Inc. since purchasing the ALFlak 300 Laser Welder from Alpha Laser—US, shown here. Operator Hunter Gibby says the Nd:YAG system's foot-switch controls, flexible lens positioning, rigidity and other "creature comforts" made it the most ergonomic laser welder they found for making small repairs on molds ranging in size from 20,000 to 50,000 pounds.

UNITED TOOL AND MOLD INC.

PROBLEM: Inefficient and cumbersome welding processes compounded by required, labor-intensive preparation resulting in longer lead times on mold repair jobs.

SOLUTION: Purchase of an ALFlak 300 Laser Welder from Alpha Laser US.

RESULTS: More ergonomically designed, easier to use and control welding system requiring notably less upfront preparation.

Superior Ergonomics

"We are probably one of the earliest adopters of laser welding in the mold industry. We started using the technology in 2005 because we do a lot of work for Germany-based BMW, which required that we laser weld their molds to reduce the risk of having heat-affected zones, and that is how we were introduced to it," Phipps says. At the time, UTM purchased a different brand, going on the suggestion of the mold shop and the BMW people that UTM was working with.

Fast-forward to 2018, when it was determined that UTM needed to invest in a new laser welder to keep up with the workload in the Easley plant (UTM recently purchased a new facility and has consolidated two locations under one roof in Liberty, South Carolina). Phipps enlisted the help of an apprentice, Hunter Gibby, who showed an interest in laser welding technology, to research some options. Three different machines were initially considered and ultimately UTM purchased the Alpha Laser ALFlak 300, an Nd:YAG laser welding system.

"Probably the most amazing feature, and the primary reason we went with this machine, is the ergonomics of it," Phipps

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says. "It is the way the arm and lens can be positioned to get into small, tight spaces without the need for the operator to fuss with adjusting the workpiece, which saves a lot of time. Plus, the lens can be moved in and out on an angle without having to reposition the arm, making it much easier to reach those tight areas, like deep ribs."

"That feature is probably my favorite," Gibby adds. "I don't have to fight with the workpiece to get that visibility and see what needs to be welded. The lens on the ALFlak 300 is very flexible, meaning I can angle it from zero to 40 degrees and shoot the laser exactly where the weld should be applied. I can also twist the entire head of the arm 90 degrees, as well as rotate the laser beam 180 degrees."

> The most amazing feature, and the primary reason we went with this machine, is the ergonomics of it.

Both Phipps and Gibby attribute the ability to laser weld with such precision to the ALFlak 300's rigidity. "It's a very solid design, with the number of arm joints kept to a minimum so it does not vibrate when in use," Phipps says. "Even on large, awkward fascia molds, you can position yourself comfortably in the chair while the arm reaches in to weld because the ALFlak 300's movements and functions are easily controlled using a joy stick and foot switches." He adds that the laser welding system's joy stick, foot pedals and other "creature comforts" set this machine apart from most others and are worth the investment.

Gibby, who has since become UTM's laser expert, running the ALFlak 300 eight to 10 hours a day to laser weld smaller repairs like chipped edges and corners, cracks, intricate threads and deep ribs on molds ranging between 20,000 to 50,000 pounds, couldn't agree more. "The foot pedal is a huge advantage to this machine once you get used to it. With the pedal, I can control everything: Volts, milliseconds, hertz and spot size (weld size). The pedal consists of six different buttons or switches. For example, if I slide my foot left, my spot size will go down 0.10 mm. If I slide my foot to the right switch, it will go up 0.10 mm. It is so simple. All functions of the ALFlak can also be controlled using the button pad that is located on the unit's arm, but once you get the hang of the foot switches and which switch controls what functions, you can be welding something and change it on the fly using your foot instead of having to stand up and make any adjustments. It becomes second nature after a while," he says.

Faster to the Finish

Phipps points out that laser welding is not the answer for everything, but when you have smaller areas, small corners and deep ribs to weld, it is the preferred solution at UTM because it is quick and precise. "If you are building up a corner or other small area, you can apply a very small bead and then hand work or quickly machine it off without worrying about heat issues," he says. "UTM has many good welders on staff but using traditional welding applications like TIG on small jobs can go hit or miss on heat-affected zones."

For example, a customer recently required UTM to weld out its company logo and some words around it and re-establish the logo and wording in another location on the mold core.

Phipps says the act of TIG welding itself is about four times faster than laser welding; however, there is a lot of time-consuming, upfront preparation involved, even for a small job like this. He explains what must occur: "To weld out that logo on a piece of P20 that has a high, number-two polished surface, first that block must be cleaned and then preheated to bring it up to temperature. Depending on the material and size of the block, that could be anywhere from 300 to 800°F. That can take at least two to three hours using a heat plate," Phipps says. "If any corners are cut on preheating the workpiece, the weld will show up badly in the end because of the color match, so setup time is key. Then the welder must make sure that when he applies the weld, he doesn't put too much heat into the welded area and risk compromising the color match." Finally, blankets are used to cool the workpiece down slowly. Besides the time to get the TIG weld right, Phipps adds that it may be necessary to redo the weld two or three times to get everything matched up properly. "Realistically, you are looking at a minimum four- to five-hour process to TIG weld a project like that correctly."

Phipps explains that, when performing small repairs, the odds of getting a good match on color and grain structure without creating a heat-affected zone are better with laser welding. "With either process, you have to do everything right or it can go wrong," he says. "On small jobs, if you do everything right, you have about a 60 percent chance of success with TIG welding. With the ALFlak 300 laser welder, the chance of success is 80 percent or better, if you get the correct rod on the correct steel. That's a big deal. It adds an element of security."

Using the ALFlak 300, Gibby completed the job in an hour. He says preparation for jobs like this one entail using UTM's chemical analyzer to determine the type of steel being welded in order to color-match the wire. Next, he chooses the correct size wire for the weld. "I have learned from the color-matching side of the process that less heat is better, so in this case I used the smallest wire possible (typically 0.010 inch)." Setting up the workpiece so that he can clearly see where to weld through the microscope is the final, and most important, step. "If I can see the weld and angle the laser directly onto the spot, I will be successful nine times out of ten, and thankfully, the ALFlak 300 offers the flexibility to get almost any spot welded. There's really nothing else to it," he says.

"He's welding it cool; you can touch it," Phipps says. "He's not creating a heat affected zone. The laser welder eliminates

that and the risk of transforming the steel. That workpiece can immediately go back and be benched or machined, whereas the TIG welded workpiece requires time to cool down."

Material Concerns

UTM works primarily on the repair and maintenance of larger molds, most of which are made of materials with not more than a 50 Rockwell hardness rating. But lately, the company is seeing a few cap and closure molds, which typically require harder steels where the heat effect from TIG welding can quickly make the steel brittle and prone to chipping. This is where having the ALFlak 300 has been an advantage. "Once you get up into the D2s and A2s and the S7s and even the stainless materials, they're hardened, and their tempering is a low number," Phipps says. "When you TIG weld these materials, you're affecting their properties and creating a brittle, white layer that breaks off very easily. But the laser welder's temperature is so low that you are not putting any heat into the material. Instead, you're just attaching the weld to it with a 0.050-0.001-inch wire without creating that white layer that can chip off. The laser weld doesn't break off."

New mold cooling strategies have also made the ALFlak 300 an invaluable asset at UTM, according to Phipps. "Our customers are using a lot of MoldMAX and aluminum these days to cool molds better, and this presents its own welding challenges," he says. "These materials are designed to pull energy out of molds fast, and when they need repair, TIG welders must put a lot of energy (heat) back into the molds to be able to melt the rod—but the material is trying to pull that heat away. The laser welder doesn't need the heat."

Gibby concurs, saying that he frequently uses the laser welder on molds made from MoldMAX and with good results. "I hear from the TIG welders how, when they weld MoldMAX or AMPCO, they have to put so much heat into it that sometimes they can't control the size of the weld," he says. "I can control the ALFlak laser welder so that it makes the bead so small that heat is not an issue, and it can be hand worked off very easily."

Phipps sums it up by saying, "It's on the little jobs that the ALFlak 300 has generated big-time savings for us." MMT

FOR MORE INFORMATION

Alpha Laser – US / 814-336-9000 / blair@phoenixlaser.com / alphalaser-us.com

United Tool and Mold Inc. / 864-859-8300 / scott@utminc.com / utminc.com

Spotting Press Features Ensure Perfect Parallelism

By Cynthia Kustush

Cavalier Tool & Manufacturing Ltd. of Windsor, Ontario, Canada builds more than 200 mid-to-large-size molds annually, the majority of which are complex in their design. Because of this, Cavalier believes using a spotting press to fit molds is a critical step in its moldmaking process, and the most efficient and cost-effective way to deliver precision, production-ready tools to its customers.

"If we built molds for something like a pizza tray or a pie plate that is very small, very flat and very easy to make, my dependency upon spotting would be very low," Brian Bendig, president, says. "I could almost always build that kind of mold and never have to spot it. But Cavalier builds large, complex molds with deep cavities, angles and shutoffs, and we would have a heck of a time building them without spotting them."

Two years ago, Bendig and his team decided it was time to upgrade the company's spotting press capabilities by purchasing a new Millutensil MIL-306 500-ton spotting press. The company's old spotting press also has a 500-ton capacity, but Bendig says it was cumbersome to use, not as precise and required many more steps in the process to use. "This Millutensil is the sniper rifle of spotting presses," Tim Galbraith, sales manager, asserts. Bendig agrees.

Increased Efficiency and Accuracy

Both Bendig and Galbraith credit the accuracy and efficiency of today's CNC machining centers for making mold assembly and fitting processes easier. "I remember the days when we used to put a tool into the spotting press and spend a week spotting a mold down because we were not as accurate with our machining as we are today," Galbraith says. He describes how moldmakers would use masking tape to tape their wrists, ankles and around their necks to keep the grinding dust from getting inside their clothing, there was that much spotting and grinding to be done. "But now, we are at the point where we are just tickling the mold, and it takes only three, or maybe two, hours to spot it."

Bendig adds that while Cavalier's Millutensil, which features a table size of 138 by 94 inches, has a 500-ton capacity, today there is rarely a need to use such high clamping pressures to spot molds. "We sometimes only spot with 50 tons of clamp pressure—or even just the weight of the mold itself—because we can cut so accurately, and we don't want to force the mold together like in the past. We just want to identify what's high and grind that high spot off and fit it again, as needed. It's a much quicker method of getting to the finish line, and it's more accurate."

Helping Cavalier reach that finish line faster and more accurately is the fact that the Millutensil features encoders

Image courtesy of Cavalier Tool and Manufacturing.

At Cavalier Tool and Manufacturing, the spotting press is as essential a tool as any machining center or other equipment. Here, a spotting press operator uses the Siemens touch-pad control to set up a 37,000-pound, reverse injected, hydraulic ejection single-cavity mold in the company's Millutensil MIL-306 500-ton spotting press. Ergonomically designed, note that the press is floor-mounted for easy access from all sides, plus the upper platen can flip 100 degrees (standard), 150 degrees and 180 degrees.

CAVALIER TOOL AND MANUFACTURING LTD.

PROBLEM: Antiquated spotting equipment made the task cumbersome and very inefficient.

SOLUTION: A Millutensil MIL-306 500-ton limited edition spotting press.

RESULTS: Advanced spotting press features make the process of fitting molds more efficient, cost-effective, precise and ergonomic.

on each of its four tie bars that actively gauge the flatness and parallelism of the mold halves throughout the spotting process. "In a perfect world, when you're spotting, you need perfect, exact parallelism between the upper and the lower halves of the mold. The more exact you are, the more likely you are to spot properly. The Millutensil's encoders, in the event you were to cock the plate, would identify the problem, automatically default to a soft 'hold' mode and sound an alarm to alert the operator before any damage can occur," Bendig says. In addition, flow regulators and balance units at the top of the press ensure that it lowers exactly parallel, and there are large copper bushings that help prevent the crown from tipping or turning. "That's how we are able to make it go up and down very accurately."

The Millutensil's design simplifies mold setup as well, Bendig adds. "In a real small press, you have four guides and one cylinder in the middle that pushes down, but imagine you have a mold that is very long, like your kitchen table. Where do you put the cylinders to be accurate? Do you put them on the center of the table? Do you split the difference with one on the outside and one on the edge? With the Millutensil, setting up a mold is straightforward. There's no guessing or risk-taking because this is a four-post, down-acting press, meaning it's got four cylinders that cover greater than 60 percent of the usable platen, and they are spaced out evenly on the platen so that you have equal clamping forces going down."

Beatrice Just, vice president at Millutensil SRL (Milan, Italy), points out that spotting operations are intuitively controlled using the system's Siemens Touch-Panel tablet and diagnostics program, which provides the operator with a specific pictogram of every movement the press makes during the spotting process. If something should malfunction, the relevant point is displayed on the specific page within the diagnostics program for easy access to a solution. "This allows for down time minimization, quick troubleshooting and reduction of service costs, especially after the warranty period," she says.

Bendig adds, "The benefit of the control is more accuracy and pressure. You can very accurately set the pressure, where an old press operated using a valve control that you would rotate to generate either more or less hydraulic pressure on the clamp force."

Cavalier tracks a variety of metrics to help keep operations on schedule. One of those metrics involves its goal to get every mold to T-zero (functional tool trial) and have no flash. The Millutensil is key to meeting that objective. "If we go to T-zero and we see flash, we want to know what went wrong," Galbraith says. "We don't need to run a trial cycle in a plastics press to look for flash because we have the Millutensil spotting press that ensures our molds are fitted perfectly."

Safer and More Ergonomic Operation

Ergonomically, the Millutensil has made an impact on how spotting is done at Cavalier. "Our old spotting press was as big as a dinosaur, and it was surface mounted, so we had to go up several steps to climb onto the platen and literally get into the press to set molds up. Sometimes it felt like we were spotting parts for Noah's Ark," Galbraith says. Additionally, the press was not parallel, which, combined with clamping forces, often led to crushed vents that needed to be redressed. "It was difficult spotting properly using an old and tired press."

Cavalier's Millutensil is installed at floor level so operators can simply walk up to it and work on it. "If they need tools from their toolboxes, there is no need to go up and down stairs to get them. It is ergonomically more efficient just

from that standpoint," Galbraith says. "The other benefit is you can drive a lift truck up and place the mold into the center of the platen, then roll it into the press to be spotted, which is really convenient," Bendig adds.

Just says that Millutensil presses are designed with the spotting crew in mind. On the MIL-306, the upper platen features the capability of flipping 100 degrees (standard), 150 degrees and 180 degrees, helping to avoid stressful maneuvers during the spotting process by making the molds easily accessible. In addition, the lower platen slides in and out of the press, giving workers better ergonomic access to both halves of the mold in the same work space.

With ergonomics comes safety, and Just says the patented SITEMA safety device is unique to Millutensil's presses. Differing from the multi-hole or toothed bar system commonly found on other spotting presses, this anti-fall safety device is externally installed on the right and left side of the upper floor of the press and mechanically wedged in a locked position, preventing the press's upper platen from falling if power is ever lost.

Bendig says that, unfortunately, spotting presses are one of the last things shops look at because it is a large capital investment for a non-sexy operation. "It goes up and down. It's not five-axis, and it doesn't have a robot," he says. "It's got some disco lights, but that's one of the cool things we have here."

Sharing the Press Benefits

The Millutensil may be the sniper rifle of spotting presses, but Galbraith and Bendig agree that to make the most of its capabilities, it is important to have sniper-quality spotters on the Cavalier team to achieve that perfect fit every time. The company has two employees who do nothing but mold spotting. In addition, it also has a company that works within its facility and provides spotting services for Cavalier and other mold builders in the area. "We insource work from no less than ten of our competitors every month because we are achieving much better results with the Millutensil than an old press can achieve," Bendig says. "Our highly-skilled spotters have good artistic talent and experience to know how to grind off just enough. What takes other shops 100 hours to do, we can do it in 50 or 70 hours in our Millutensil, so there's not only a time advantage, there's a cost advantage."

Galbraith points out that shops often have more than one spotting press because of the time it takes to spot one mold in an older press. The modern, advanced Millutensil, which is in operation 24/7, handles all the molds from Cavalier and those from other shops in the region. "When customers come in and they see our spotting press, they make mental checkmarks, so we do use it as a sales tool," he says.

"At Cavalier, we recognized the long-range benefits of having a good, modern and robust piece of spotting equipment and what it brings to the table as far as getting T-zero parts flash-free, getting crisper parting lines, not crushing vents, no rolling edges and so on," Bendig says. "At the end of the day, the molds run faster, and there's also less tool runout." He adds that it is a real art to be able to do spotting efficiently and effectively. "The Millutensil spotting press helps take the art of spotting to a higher level of perfection." MMT

FOR MORE INFORMATION

Cavalier Tool and Manufacturing Ltd. / 519-944-2144 / timg@cavaliertool.com / cavaliertool.com
Millutensil SRL / +39 02 74296801 / info@millutensil.com / millutensil.com

Is Your Technology **at Risk?**

By Michael J. Devereux II, CPA, CMP
Timothy Grace, CIA, CISA, CRISC

State-sponsored hackers, ransomware agents, corporate spies and corporate espionage campaigns are attacking today's manufacturing technology environments. In most cases, the bad actors never announce themselves. They gain unauthorized access to systems through well-hidden malware, quietly sitting on network devices, watching and recording traffic, data and information to steal or provide them a competitive advantage. In some cases, systems are being used to stage attacks on other organizations or store data for future use. How can a mold shop protect itself from becoming a victim?

With the ever-evolving and diverse range of technology within today's mold shops, threats to your information are already in place or can be introduced at any time. Executives and company leaders must consider the implications of technology reliance on the organization.

With the ever-evolving and diverse range of technology within today's mold shops, threats to your information are already in place or can be introduced at any time. Executives and company leaders must consider the implications of technology reliance on the organization. They must ensure their organization and customer data is protected and stays confidential, with the integrity intact, while also remaining accessible within the organization.

Three key issues molds should evaluate during a technology risk assessment:

- Ability to control cybersecurity.
- Ability to upgrade or replace systems. As shops look to stay relevant, they will need to assess their current systems to ensure they are providing an optimized solution. Shops need to upgrade old and outdated systems to newer versions and technology.
- Ability to align operations with technology. Today's business technology needs are quickly outpacing a mold shop's information technology functions. Executives need to ensure their organization meets the demands of their technology user base to ensure sustained levels of productivity.

Mold shops must not only assess their needs but their technology risk. Without assessing the risk associated with that technology, they may be unaware of potential financial and reputation damage. Privacy issues and cybersecurity breaches often become highly publicized incidents, which can affect your shop's perceived integrity. Therefore, it is vital that the appropriate controls are in place to protect the confidentiality and accessibility of private information.

Risk Management Essentials

The risk management cycle is continuous and iterative. It begins with a shop identifying the risk universe by reviewing its broadest risk areas. Once they identify the root causes, they can develop action plans to mitigate these issues.

The basic steps of the risk management process include:

1. Identify the opportunities for risk within the shop.
2. Prioritize and filter the universe to quantify the impact, probability and risk tolerance.
3. Evaluate the prioritized risk items within the universe to determine remediation or mitigation strategies. During this evaluation:
   - Develop a corrective action plan to eliminate or mitigate the risk.
   - Determine steps to reduce risk to an acceptable level.
   - Determine whether to transfer the risk to another lower-priority process.
   - Determine whether management has a plan to accept the risk.
4. Monitor each identified risk item in the universe for events or prompts that indicate a change in the risk environment or control infrastructure.
5. Revalidate risk for changes or additions in the risk universe.

Technology Risk Assessment Timing

A shop can perform a technology risk assessment at any time, but there are certain indicators for the most appropriate time. Here are some suggestions:

- Annually to support the development of a multi-year, risk-based technology audit plan.
- When new technology risks or challenges are introduced into the business or technology environment.
- When organizational changes occur.

- Along with strategic actions such as mergers, acquisitions, outsourcing or off-shoring.
- During operational initiatives including organizational restructuring, changes in technology use and new applications of technology.
- When market condition changes such as growth, globalization, downsizing or stagnation.
- When the use of technology is reactive and is not keeping pace with business demands.
- When new or updated mandates are introduced (Sarbanes-Oxley, privacy, cybersecurity or internal controls regulations or industry standards).

A shop can also use a risk assessment for technology optimization, process improvement, resource focus, valuation services and due diligence reviews.

Without a technology risk assessment and the corresponding remediation or mitigation actions, a shop may be vulnerable to an increasing range of threats that may result in legal liability, financial impact, regulatory non-compliance (state, federal, international), reputation damage, diminished resiliency, reduced reliability or lack of integrity.

The vulnerabilities uncovered by a technology risk assessment if not mitigated could also result in a decrease in your tool shop's valuation, impacting stock value, equity, borrowing power, liquidity or a potential merger or acquisition. Vulnerabilities could also disrupt strategic alliances, joint ventures or result in a loss of client revenues.

Technology risk assessments are key components of risk management, and they are essential to identifying the danger zones in your business and effectively control these risks. Regularly scheduled technology risk assessments should be used to update risk management plans and programs and to monitor the progress of the organization's overall technology risk management program.

If your business has not performed a technology risk assessment, or if an existing assessment is more than a year old, now is a good time to contact your advisor. MMT

CONTRIBUTOR

Timothy M. Grace, CIA, CISA, CISM, CRISC, is the director of technology risk advisory services for Mueller Prost. Michael J. Devereux II, CPA, CMP, is a partner and director of manufacturing, distribution and plastics industry services.

FOR MORE INFORMATION

Mueller Prost / 314-862-2070 / muellerprost.com
mdevereux@muellerprost.com / tgrace@muellerprost.com

Moldmaking Index Moves Higher

March 2019 – 53.9

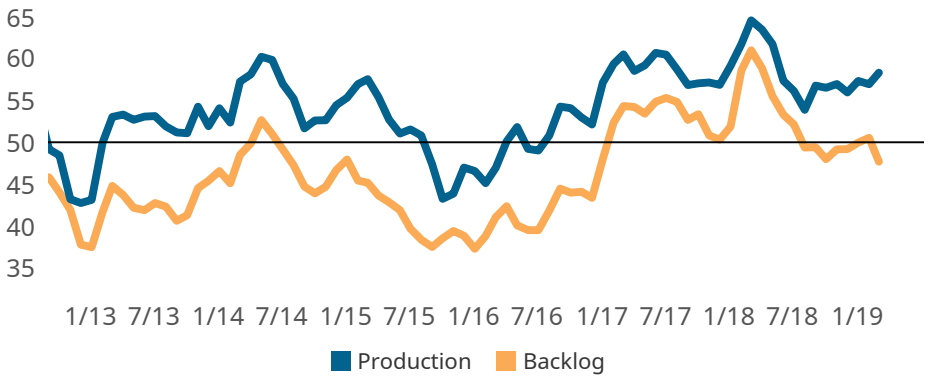
The Gardner Business Index (GBI): Moldmaking climbed to 53.9 through March's end. During the last nine months, the Index oscillated within a narrow range of readings, averaging 53.6. Compared to March 2019, the Index is down 9.9 percent; however, one year ago the Index was just coming off February 2018's all-time high. Gardner Intelligence's review of the month's underlying data reveals production, supplier deliveries, new orders and employment lifted the Index higher, while exports and backlogs pulled it lower. Only backlogs registered a contractionary reading for the month.

The March data signaled strong activity in production, new orders and employment. The last time these all expanded at similar rates was May 2018, just three months after the Index reached its peak in the current business cycle. The greater expansion in production compared to new orders and unchanging export orders sent March's backlog reading to its lowest level since 2016's fourth quarter. Since July 2018, production activity generally outpaced new orders, causing a significant contraction in backlogs at times. MMT

ABOUT THE AUTHOR

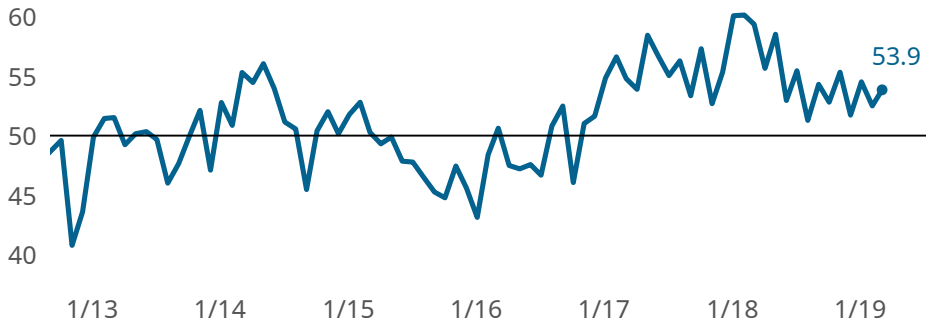
Michael Guckes is the chief economist for Gardner Intelligence, a division of Gardner Business Media (Cincinnati, Ohio, United States). He has performed economic analysis, modeling and forecasting work for nearly 20 years among a range of industries. He is available at mguckes@gardnerweb.com

Gardner Business Index (GBI): Moldmaking



An enduring expansion in supplier deliveries, new orders, employment and production have kept the Moldmaking Index expanding for a record-breaking 29 months. Leading indicators including new orders and employment suggest further expansion ahead.

New Orders and Exports



Greater production activity relative to new orders is resulting in reduced backlogs among manufacturers. Backlogs in March contracted at a rate not seen since 2016.

amerimold

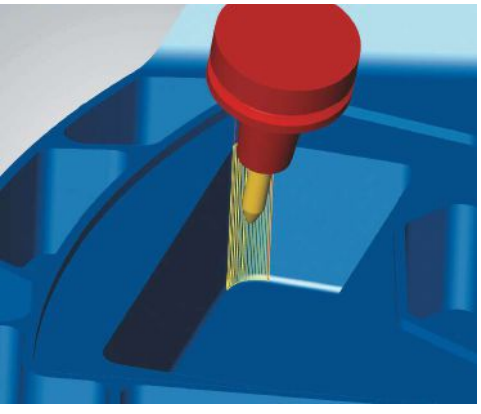
The Event for Mold Manufacturing 2019

Rosemont, IL | June 12-13, 2019

Here is a sampling of what will be on display at this year's show. Look for more products in our June issue.

Software Offers Range of Features and Enhancements

Open Mind Technologies will showcase the advanced capabilities of hyperMILL CAM software at Amerimold. The latest software release has a range of features and enhancements for five-axis machining, including an expanded finishing module in the hyperMILL MAXX Machining Performance Package. This package enables the use of conical barrel cutters (a.k.a. arc segment or circle segment end mills) to reduce cycle times and is ideal for planar, ruled and curved surfaces. It offers three powerful modules for finishing, roughing and drilling. A five-axis Prismatic fillet finishing function enables the geometry and automatic inclination of barrel cutters to be applied similar to high feed cutters, using a plunging and pulling movement at high feed rates. Maximum performance is attainable using conical barrel cutters. Ball or bull nose end mills can also be utilized with this milling strategy.



The company also offers hyperCAD-S in the 2019.1 suite, specially optimized for CAM requirements, which includes polyline management, enabling CAD functions, such as lengthening or shortening to be applied by the polylines element type. Polylines can also be machined similar to other elements, with trim, join, orient or select.

OPEN MIND Technologies USA / 888-516-1232 / Booth 702

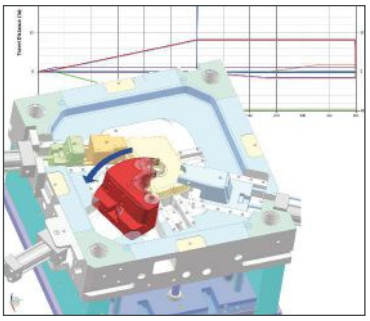
Welder System Produces Precision Mold and Die Repairs

Gesswein & Company's PUK U5 welder offers precision mold and die repairs. Utilizing micro TIG technology, the welder produces small, consistent spot welds to penetrate mold surfaces, and it does not require pre-welding heat treatment. Users can repair parting lines, mold seams and three-point corners and edges, as well as fill in pits and deep scratches. Using different electrodes can weld into slots, corners and ribs. Slides, ejectors and core pins can also be repaired. It can be used on common tool steels, stainless steels, aluminum and copper. All heat is concentrated at the weld spot, eliminating distortion and metal stress caused by overheating, enabling the mold to withstand pressures during the molding process. The system comes complete with microscope, LED light, electrode handpiece, set of 0.6 mm and 0.8 mm electrodes, electrode sharpener, ground cables, argon gas regulator, tack resistance welder and foot pedal, and a one-year manufacturer's warranty.

Gesswein / 203-366-5400 / Booth MS7 / See in Toolroom Live

Application Verifies Individual Mechanism Designs

Cavalier Tool & Manufacturing offers equipment and facility improvements, as well as network infrastructure and new software. The company's purchase of NX Dynamik Design, a state-of-the-art application for virtually simulating motion and interactions, enables them to verify the design of individual mechanisms throughout the entire mold build. The interface verifies the complex mechanisms for potential damage caused by collisions, simulating all actions simultaneously. The company also simulates the plastic injection process to review how plastics warp, then builds windage into the mold before cutting for dimensional accuracy.



Cavalier Tool & Manufacturing Ltd. / 519-944-2144 / Booth 815

Drilling and Machining Centers Match Capabilities to Production Needs

Unisig will highlight its recently expanded line of deep hole drilling and machining centers at Amerimold. Technical experts will be on hand to discuss the all-encompassing USC-M range of solutions that enable users to match system capabilities to specific part and production needs. The range includes universal spindle-style machines, dedicated spindle types and high-dynamic machining centers. For both gundrilling and machining, the universal spindle machines offer versatility and fast changeovers between the two processes for efficient complex mold components production. Equipped with both milling and drilling spindles, the dedicated spindle type machines provide gundrilling, BTA drilling and machining. This selection of five- to seven-axis machines enables users to acquire the exact machine capabilities for their production requirements and improve overall part machining performance. For robust mold component processing, the high-dynamic machining centers provide geared-headstock milling, dynamic machine motion performance and both BTA and deep hole drilling all on the same platform. These machines feature seven axes, tool changer capacities of 90 to 120 tools and automatic pallets changers that handle up to 25-ton loads.

UNISIG Deep Hole Drilling Systems / 262-252-3802 / Booth 1108

System Cooling Platform Validates Pressure, Temperature and Flow

Progressive Components's system cooling platform offers validation of pressure, temperature and flow in a mold's cooling circuits. This platform monitors each circuit within a mold via embedded, individual sensors which measure based on the vortex flow principle and alerts the user of deviations that reduce cycle times and affect product consistency or increase scrap. It supports temperatures up to 250°F. Available in 4-, 8-, and 12-zone units, each can be connected to as many as 8 manifolds for a total of 96 zones. It includes a Reynolds number feature to detect turbulent, transitional or laminar flow by zone and determine any flow variations or restrictions, as well as a temperature delta feature to monitor water temperature delta (±4°F) from the in/out port of each circuit and identify issues and reduce troubleshooting time. Other features include trackability over time, baselines, trending reports and history logs, as well as maintenance alerts for molding machine production control.

Progressive Components / 847-487-1000 / Booth 1205

Mold Shop Delivers High-Quality Plastic Injection Molds and Tooling

Prodigy Mold & Tool, Inc. offers the manufacture of high-quality plastic injection molds and tooling for the medical, electronics and consumer goods industries. The company specializes in demanding applications, like precision plastic gears, medical specialties and unscrewing molds, and they combine traditional craftsmanship with state-of-the-art technology in designing and producing the high quality injection tooling and molded products. The company builds molds for 400-ton presses and smaller, and offers insert molding and overmolding. High-cavitation molds for caps and closures, automotive enclosures and covers are examples of typical applications. The company designs and builds for functional superiority, delivering tools combining precision accuracy, reliable operation, cycle-time efficiency and reasonable costs.

Prodigy Mold & Tool, Inc. / 812-753-3029 / Booth 501

New Facility Saves Customers Product Transit Time

Vista Metals Corp. completes another significant expansion at its Georgia facility. Investments including large sawing equipment, additional tooling for casting mold plate slabs along with large increases in overall capacity were completed to improve lead times to the company's diverse customer base. With the company's Duramold-2 and Duramold-5 product lines under constant lead time pressure from distributors and customers, the ability to produce, process and ship from its Georgia facility saves customers days of transit time when compared to shipping from its California facility. The company's continued dedication to domestic production, combined with its AS 9100 quality system certification, strengthens its position as an independent producer of specialty aluminum products.

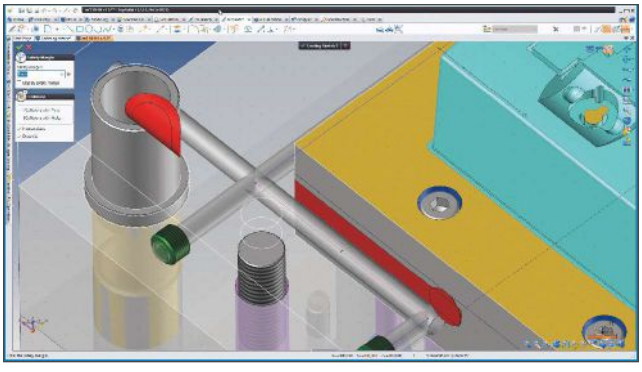
Vista Metals Corp. / 909-829-6109 / Booth 1006

AMERIMOLD

Hydraulic Block Cylinders Improve Interchangeability and Maintenance

Cumsa USA releases a line of technically reliable and high-quality designed hydraulic block cylinders. The block cylinders use magnetic sensors with steel cylinders and an extended rod with a hole for a dowel pin or screw to prevent wrench trapping. The included centering and locking bushing for models A and B provide simple installation, and they are rod finished with oxide to avoid rust and set up with Viton O-rings. Models C and D are cartridge cylinders designed for molds that create a modular system to improve interchangeability and maintenance. They utilize a pre-installed sensor housing to incorporate an end-of-stroke detector and threaded oil ports which enable 360-degree tube orientation. Cartridge cylinders have standard strokes up to 180 mm, although longer customized strokes may be available upon request. For high temperature molds, cooled cylinders are available, too. All cylinder models include mounting screws.

CUMSA USA LLC / 248-850-8385 / Booth 919



Software Package Programs Boost Mold Design Efficiency

Top Solid/Missler Software Inc. offers several software package programs. TopSolid'Split enables more precise control of automatic parting surfaces creation. Certain irrelevant surfaces can be excluded to save time when designing parting lines, boosting efficiency. TopSolid'Mold enables process modification of components and increases productivity by reducing time to make changes because of the multiple modification of parameters, such as modifying hole clearances of several screws processes in a single action. It can place injection gates, and management of the types of gates, calculation of the injection section and specific wizard shorten the injection circuit design cycle and cut design times. It provides dynamic collision detection, so users can view parts in collision during the circuit design phase, minimizing the error risk. TopSolid'Electrode automatically removes electrode-eroded surfaces to send a simplified part to TopSolid'Cam for machining. This function speeds up the production of cavity blocks in an integrated environment when using TopSolid'Mold, TopSolid'Electrode and TopSolid'Cam.

Top Solid / Missler Software Inc. / 630-889-8055 / Booth 1221

Modular Connection Increases Milling Performance

Ingersoll Cutting Tools' stock standard M20 Top-On modular connection increases strength and milling performance in the Top-On system. The connection will increase the application range of the current system sizes M6, M8, M10, M12 and M16. It provides increased rigidity for long- and short-reach milling applications. Other features include milling flexibility and special purpose cutters holders available upon request. It also offers stock standard CAT40K, CAT50, HSK63 and straight shank holders.

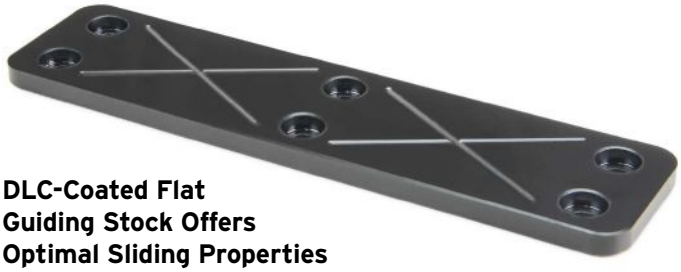
Ingersoll Cutting Tools / 815-387-6968 / Booth 408

End Mills Series Suited for Tight Tolerances and High-Speed Machining

RobbJack will showcase product lines at Amerimold, highlighting its DM/MDM die/mold series end mills. Made with a revolutionary coating technology, the carbide end mill reduces wear and lasts longer than comparable tools in hard metal applications, according to the company. The carbide end mill offers tighter tolerances, lasts longer in difficult areas like parting lines and produces finishes that reduce or eliminate polishing needs.

The company will also display its FMHV series end mills, designed for high horsepower and high velocity machining in aluminum mold making. These series tools feature a patented mirror edge geometry, which enables users to take deeper Z-depths of cut, reducing vibration. They are suited for high-speed machining of deep pockets and thin walls.

RobbJack/Crystallume / 916-645-6045 / Booth 501

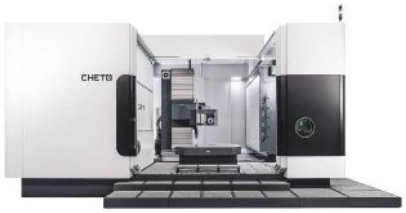


DLC-Coated Flat Guiding Stock Offers Optimal Sliding Properties

The E 3174 flat guiding stock from **Meusburger** offers optimal sliding properties and minimal wear because of the diamond-like carbon (DLC) coated surface, which provides longer service life and reduced maintenance. To avoid sharp edges, a 15-degree chamfer is provided around the entire plate. The flat guiding stock and many other products from the company's product range will be displayed at Amerimold.

Meusburger US, Inc. / 704-526-0330 / Booth 1226

Milling Machines Provide All in One Drilling Optimization



Cheto Corporation SA offers CNC deep hole drilling with milling machines. These machines provide all in one optimization for deep hole drilling, standard drilling and milling. They feature ATC gun-drill with up to five tools and are available with as many as 7 axes.

Cheto Corporation SA / 35-125-624-7970 / Booth 1436

Hot Runner Controller Offers Intuitive Touch Interface

Hasco America, Inc. extends its hot runner product line with control units in the H1280/ series. With an intuitive touch interface, the controller's operating functions enter data at different navigation levels. The Quick Start assistant guides users through key settings and enables even untrained personnel to safely commission the controller. The integrated help function provides comprehensive help, and its navigation retains an overview for users. The 7-inch individually adjustable zone display can be set at ideal viewing angles no matter where the controller is located. It locates malfunctions to protect the controller, hot runner system and mold and contains illustrated fixing instructions. Outside cooling elements for ideal heat elimination and sensor inputs for voltage protection ensure longer electronic component service life. It detects short-circuits to prevent fuses blowing. Individual zone fuses are accessible from the outside and replaceable without opening the controller housing. The controller operates in star and delta networks and offers multiple languages. The integrated Ethernet, RS485, CAN and USB communication interfaces permit universal data exchange. Equipped with OPC UA, the controller is ideally suited to modern Industry 4.0 applications. Three housing sizes with 6 to 36 zones are available as table-top units.

HASCO / 877-427-2662 / Booth 906

Mold Shop Provides Precision Injection, Thermoset and Compression Tooling

B A Die Mold, Inc. builds Class A unscrewing molds for threaded parts, specializing in molds that run in 650-ton presses or smaller. The company provides a patented Programmable Electric Rotating Core (PERC) system, which is fully programmable and accurate. Users can program an unlimited number of profiles and repeatability is absolute, making it useful for electric molding machines and clean rooms. The company builds and programs the control cabinet, so it is ready to run at users' facilities. One cabinet can also be used with multiple molds, and the system requires little to no maintenance.

The company also assists customers with any repair, maintenance or engineering changes that may be required, whether they built the tooling or not, and they offer sampling, troubleshooting and "tuning up" underperforming molds.

B A Die Mold Inc. / 630-978-4747 / Booth 1324

Sinker EDMs Increase Productivity and Reduce Electrode Wear

Makino releases an upgraded version of the high accuracy EDAF2 and EDAF3 Sinker EDMs with developments to increase productivity while reducing electrode wear. The machine features a new heat generator that increases machining power by 25 percent to a peak power of 100 Amps. The digital generator reduces energy consumption while enabling low-wear electrode technologies to achieve a lower wear ratio, reducing electrode manufacturing expense through using a single electrode to rough and finish a cavity.

The upgraded series feature the HS-Rib high-speed Z-axis that reaches jump speeds of 20 mpm with a 1.5 G acceleration. The design utilizes a core-cooled ball screw and closed-loop chiller unit to jump at high speeds while maintaining a 1-micron level depth control. The machine includes a digital and programmable auxiliary flushing system, which enables precise and consistent fluid flow control for punch machining applications. The combined technologies and performance of the machine's new generator and Z-axis reduce cycle time of common die/mold rib details with lower electrode wear.

Makino / 513-573-7200 / Booth 1113

Software Update Ensures High-Quality Finishes

CGS North America releases an updated version of CAM-TOOL, V15.1, a CAD/CAM system corresponding to five-axis machining centers for molds and dies. In this version, a five-axis conversion algorithm significantly decreases the occurrence of inefficient interference avoidance or warning exit by interference by automatically calculating un-interfered fixed tilt angles on simultaneous five-axis automatic conversion function. Simultaneous five-axis auto is to ensure high-quality finished surfaces through heightening machining accuracy by minimizing sudden interference avoidance actions and the number of axes that move at the same time. Users can create high precision and high efficiency five-axis machining data optimized with this algorithm by choosing an angle value that indicates interference avoidance.

CGS North America / 519-737-6009 / Booth 1434

Family Mold Ensures Flawless Finishes

HRSflow presents its Flexflow technology family mold for one-shot production of three high-quality parts for a door module. The family mold ensures flawless surfaces even if parts differ considerably from one another in dimension and volume. It manages control of the servo-electric drives for the valve gate systems used. The position and speed of each individual valve pin can be regulated to optimize pressures, flow rates and volumes of the melt in all three cavities.

HRSflow / 616-228-6900 / Booth 605

AMERIMOLD

Dry Ice Cleaning Provides Non-Abrasive Cleaning

Cold Jet, LLC will provide dry ice cleaning demonstrations at Amerimold. The demonstrations will display i3 MicroClean, which provides a non-abrasive cleaning method that helps clean molds in-place at operating temperatures. Featuring patented shaved dry ice technology, it cleans intricate cavities, extends equipment life and enables increased cycles between preventative maintenance while reducing scrap. The company develops environmentally responsible cleaning solutions to reduce maintenance costs, enhance product quality and improve productivity.

Cold Jet / 513-831-3211 / Booth MS4 / See in ToolRoom Live

Shrink Fit Machine Provides Integrated Cooling and Intuitive Software

Haimer USA will demonstrate its shrink fit machine, Power Clamp Sprint i4.0, at Amerimold. The machine provides superior ergonomics and integrated cooling for all cutting tools types. Its holding fixture can shrink fit ER collets for Swiss-turn and live tooling. It features intuitive software targeted to simplify usability, intelligent cooling system with temperature control and a 7-inch durable touchscreen. Users can customize the machine with a laser scanner to read and set shrinking parameters automatically.

Haimer USA / 630-833-1500 / Booth 1015

Hot Runner Solutions Provide Leak Protection, Precision Control and Wear Reduction

Mastip announces cost-effective hot runner solutions ideal for commodity and engineering grade polymers. The company releases the Nexus valve gate with Cylix actuation. Pre-assembled, the valve gate can be installed out of the box, includes customized trunking to match mold layouts and offers quick removal from the mold. It incorporates a nozzle range with a threaded connection that attaches to the manifold, providing a secure, leak-proof operation. With advanced heating technology, the nozzle delivers thermal performance for a wide molding window. The company's Cylix Cylinder features pneumatic valve actuation in a thermally stabilized system mounted to the manifold. With adjustable valve pin height and high temperature seals, it is the optimal solution for precise control of molding requirements. The company offers open valve tips designed to house clip-on cap insulators, in G1 and G5 tip grades. The guided open valve G5 tip with open nut delivers precise valve pin alignment for cylindrical gates, reducing wear and tear on the valve pin and gate. Both the GI and G5 grades feature a tip end groove to accommodate clip-on cap insulators.

Mastip Inc. / 262-644-9400 / Booth 1315

Cutting Sprue Bushing Enables Feeding Plastic Components Near Mold's Center

DMS adds Almo's cutting sprue bushing to its range of edge gate cutting components. The cutting sprue bushing enables feeding plastic components near the mold's center, virtually eliminating cold runners into a runnerless cold feed and trimming the gate as the mold opens, removing the need for secondary operation. It also provides a large edge gate area to reduce injection pressure and improve the packing and quality of the final plastic product. The company stocks the Almo range for rapid delivery and will highlight this product at Amerimold.

DMS / 800-265-4885 / Booth 1132

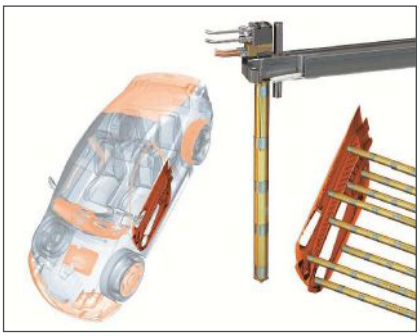
Radial Discs Ideal for High-luster Polishing

Boride Engineered Abrasives adds Dedeco Sunburst Radial Discs to its line of mold and die polishing supplies. This product is ideal for finishing, smoothing and high-luster polishing on nearly any material. The specially treated ceramic abrasive grain embedded throughout thin flexible bristles enables faster and longer work than rubber wheels, brushes, buffs and conventional sanders. This product, as well as the company's full line, will be displayed at Amerimold.

Boride Engineered Abrasives / 231-929-2121 / Booth 1220

Nozzle and Heater System Produce Optimum Processing Conditions

Incoe Corp. presents at Amerimold the Direct-Flo 12 nozzle with MultiPower MP24 heater, with reduced outer dimensions and simplified mold cut out. With a homogeneous temperature profile, it produces optimum processing conditions. The MultiPower MP24 heater with two separate heating zones and a length as high as 600 mm has only a single cable outlet at the nozzle head, saving heating zones and lowering costs. Exchangeable thermocouples for both heating zones sit in matching grooves. An additional groove for each heating zone can incorporate a spare thermocouple. The heater creates a compact valve gate solution that can be used in tight spaces with deep gating points, such as the back injection of natural fiber mats for lightweight components manufactured in the automotive industry.



Incoe Corp. / 248-616-0220 / Booth 922

3D Printers Create High-Performance Parts

Shopware Inc. adds to its Mastercam product line with printers built for the shop floor. MarkForged 3D printers free designers and engineers from long lead times and high costs of traditional manufacturing and machining. Customers can 3D print high-performance parts on-premise in under 24 hours, such as carbon fiber for parts that are as strong as, but lighter than, aluminum.

The company provides shop floor applications, such as soft jaws, end of arm tooling, inspection fixtures and welding fixturing that can fit customers' needs and budgets. They also offer a metal printing line that can be less expensive than alternative metal additive manufacturing technologies or traditional fabrication technologies like machining or casting.

Shopware, Inc. / 847-428-4350 / Booth 628

AMERIMOLD

Machining Center's Operational Design Suited for Precision

Heidenhain Corporation will display the TNC 640 high performance mill-turn control with a workshop-oriented operational design and functions for users at Amerimold. It is suited for milling-turning, HSC and five-axis machining on machines with up to 18 axes. It utilizes a touch screen that supplements field-proven cycles and functions, enabling users to operate the control screen like smartphones or tablets. Features include dynamic precision options, which improve mold surface quality and precision specifically on 3D, and dynamic efficiency features, which enables the machining center to automatically optimize speeds and feeds cutting speeds in variable workpiece thicknesses.

Heidenhain Corporation / 847-490-1191 / Booth 611

Hybrid Milling Machine Fuses Metal Laser Sintering and High Speed

Matsuura Machinery USA, Inc. displays the Lumex Avance-25 metal laser sintering hybrid milling machine, which relies on one-machine, one-process manufacturing of complex molds and parts by fusing metal laser sintering technology with high speed milling technology. The hybrid technology creates a "finished" part with machined surface finish and accuracy, without additional variation from multiple machine setups and part handling. It achieves accuracy in part fabrication since metal powders are melted and sintered via laser, while surfaces are precisely milled at high speeds. It incorporates 3D cooling channels into molds, increasing cooling efficiency and enabling high-cycle injection molding, reducing costs and improving efficiency. The company will host a demonstration of the machine with Custom Mold & Design at Amerimold.

Matsuura Machinery USA / 651-289-9650 / Booth 623

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TIP

MOLD MATERIAL

A Look at AM Powder for Tooling

Image courtesy of Voestalpine.

The most common application for AM powder for tooling is conformal-cooled inserts to reduce cycle times.

By Sami Arsan, P. Eng, PMP, CAM-F

Materials development in additive manufacturing (AM) is a growth area and one that mold builders should keep their eyes on as they consider offering alternate mold manufacturing solutions for their customers. The start of any good product is the raw material, and that includes AM powder for tooling.

The key to AM is determining the most appropriate path of production for the part. Once you design the part and determine the method of manufacturing, material selection is the next step. The three elements of a quality additively produced part are powder, parameters and the system. Let's focus on the powder. The five material aspects to consider for AM powder for tooling are:

- Chemical composition
- Particle size distribution
- Particle shape
- Particle flowability
- Particle density

Changing any of these five powder aspects will impact the quality of the part you are building with AM, and each one varies across the available AM technologies. For example, particle size distribution for powder-based fusion technology requires 15 to 45 microns compared to direct energy deposition (DED) which can be 50 to 150 microns. As a result, some mold material suppliers have invested in a lot of R&D to study AM powder material and to ensure their materials meet industry standards and customer requirements.

> The five material aspects to consider for AM powder for tooling are chemical composition, particle size distribution, shape, flowability and density.

One such AM powder is tailored for tooling and was developed with the appropriate corrosion and wear resistance properties as well as polishability. This material is both a traditional tool steel and AM powder with the same properties. Its microstructure, hardness (36-50 HRC, achieved by an aging treatment in the temperature range 790-1110°F) and mechanical properties are similar. Its main application is conformal-cooled inserts to reduce cycle times due to the high demand, short-run series and ever-increasing need for shorter lead times. Current development also includes a powder for high-pressure die casting.

If a mold shop is ready to select an AM powder on its own or if the shop is working with an AM partner, inspection reports can verify powder characteristics. For example, for particle size distribution, use a laser to examine a sample of the powder; for particle shape, use a microscope to determine how spherical the powder is as well as the aspect ratio, and for flowability, measure the number of seconds it takes to flow 50 grams of the powder. These are all industry standards used to identify the quality of a powder. A mold builder should also be aware of the need to control for humidity and oxygen content during any handling processes to ensure powder quality.

> The key is to get data before you build.

Simulations can also prove the effectiveness of AM powder for tooling, such as finite element analysis (FEA) for structure and computational fluid dynamics (CFD) for flow and plastic component. A shop itself, or with its AM partner, can take the AM tooling powder data sheet (chemical composition and mechanical properties) and enter the information into simulation software to simulate the performance of the injection process. The key is to get data before you build. MMT

CONTRIBUTOR

Sami Arsan, P. Eng, PMP, CAM-F, is Vice President, Advanced and Additive Manufacturing Technologies in North America for the Voestalpine Additive Manufacturing Centers.

FOR MORE INFORMATION

Voestalpine High Performance Metals
800-665-8335 / sami.arsan@voestalpine.com
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