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MMT MoldMaking TECHNOLOGY®

Brand Vice President
Dale Jackman . . . . . djackman@gardnerweb.com

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

Senior Managing Editor
Grace Nehls . . . . . gnehls@gardnerweb.com

Fiona Lawler
Associate Editor . . . . . flawler@moldmakingtechnology.com

Content Marketer
Cara Decknadel . . . . . cdecknadel@gardnerweb.com

Copy Editor
Jann Bond . . . . . jbond@gardnerweb.com

Contributing Writer
Peggy Malnati . . . . . pmalnati@garpub.com

Art Director
Sheri Kuchta Briggs . . . . . sbriggs@gardnerweb.com

Advertising Production Coordinator
Patty Caldwell . . . . . pcaldwell@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

Subscription Inquiries:
For questions or issues related to your subscription, please call 513-527-8800 or email subscribe@moldmakingtechnology.com

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Features

ON THE COVER

Cover image courtesy of Dynamic Tool Corp. The company's reputation for high performance in the packaging, cosmetics, personal care and medical device markets goes back nearly five decades. The past six years have seen the company grow quickly – with significant increases in the number of Dynamic's employees, equipment and facility space. While expanded capabilities and resources play a large part in Dynamic's success, it is the company culture that drives its growth. With a sharp focus on developing a collaborative and shared educational work environment, the company has created an effective system of training and progressing its apprentices, ensuring Dynamic lives up to its name and evolves to meet customer needs. See related article on **page 10**.

Source (left to right) | iD Additives, Microrelleus (Barcelona, Spain) and Boride Engineered Abrasives.

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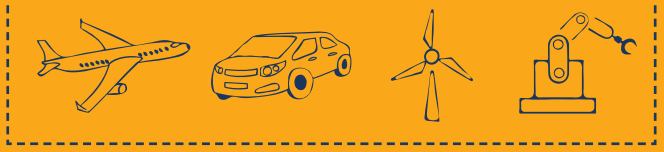

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And the 2024 Winner Is...

Dynamic Tool Corp.

Congratulations!

Since 2003, the moldmaking industry has acknowledged exceptional performance and innovation in mold manufacturing through *MMT*'s Leadtime Leader Award, sponsored by Progressive Components. This award represents the culmination of the entire mold manufacturing process, emphasizing more than just achieving the shortest delivery times. It signifies a commitment to working smarter, using resources effectively and pursuing excellence.

This year's recipient, Dynamic Tool Corp., based in Menomonee Falls, Wisconsin, embodies the essence of a Leadtime Leader. Their dedication to growth and core values of excellence, integrity, safety and customer focus, along with their innovative approach to quality, precision and efficiency, sets them on a continual path to success.

Here are some of this winner's standouts:

- Repeat business from top custom molders and OEM brand owners reflects Dynamic Tool's commitment to on-time deliveries, customer service, engineering expertise and a dedicated workforce.
- Dynamic Tool specializes in high-performance parts with features like living hinges, threads, multiple materials, aesthetic requirements, inserted components and advanced mold capabilities.
- Differentiation in the injection mold builder market comes from Dynamic Tool's significant investment in engineering resources.
- Craftsmanship plays a crucial role in designing and building critical components in injection molds.
- Team culture emphasizes collaboration, education through mentorship and self-motivation among employees.
- In-house design and integration of two automated machining cells and the use of a laser sintering and high-speed milling system showcase Dynamic Tool's technological capabilities.
- Dynamic Tool's focus extends beyond engineered steel to providing a complete experience, including service throughout the injection mold build, preventative maintenance and repair.
- The sales team, consisting of engineers first and sales professionals second, is crucial to delivering the Dynamic Tool experience.

Congrats again! In addition to reading about this Leadtime Leader on p. 10, we recognized the Dynamic Tool Corp. team at NPE 2024 during a live awards ceremony, which can be viewed online at **www.moldmakingtechnology.com**. MMT

Christina M. Fuges
Editorial Director

Follow MMT on: Follow@MMT_ChristinaF

MMT TIPS

5 TRICKS OF THE TRADE

Great Tips from This Issue

1. Ask What Your ERP Can Do for You
Base your ERP decision on answers to two questions: Is the ERP easy for my team to use? And how many problems does it solve off the shelf?
PG. 8

2. Simulation Success
Through in-house simulations, the Dynamic team evaluates alternative thermal and material designs to determine the best combination of performance, cost and longevity in a matter of days.
PG. 10

3. Chemical Cleaning
A preventative maintenance cleaning system uses a special chemical that can be reused. Some shops have flushed with this same chemical for up to five years thanks to a built-in filtration feature.
PG. 26

4. Laser Fast
Ultra-fast femtosecond laser texturing enables identical results in plastic and steel workpieces. This allows mold builders to texture a plastic lens directly, eliminating the need for texturing before molding and simplifying the testing process.
PG. 30

5. Polish it Up
Lower grades are meant for finer polishes. For instance, a diamond compound with a grade of one or smaller is best used to create the final, best finish. Higher grades are for stock removal or earlier stages of polishing.
PG. 48

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How to Balance Roles, Integrate New Talent and Embrace Industry 4.0

By Christina Fuges

What follows is a Q&A with Isaac Trevino, an MMT *EAB member and Best Tool and Engineering (BTE) business development manager.*

Q: You juggle multiple roles — engineering, business development and even shopfloor tasks. How does your background as a mechanical engineer support your diverse responsibilities?

A: It's helped me learn enough to be dangerous. The study of mechanical engineering is very broad. I've supported everything from the design and release of programs to filling in on the mill to final assembly at BTE.

The business development side came partly from my past ventures and work experience but also from my senior project in college. We were effectively tasked with creating a startup within a niche field and that experience has aided tremendously in gaining trust with entrepreneurs and companies in the early design phases.

Isaac Trevino, *MMT* EAB member and business development manager for Best Tool and Engineering (BTE). Source | Best Tool and Engineering

Q: You stress the importance of attracting and training new talent. What specific challenges do you see in integrating the younger generation into the moldmaking industry, and what solutions do you propose?

A: I see a few challenges: Creating an environment that can support onboarding, personnel and resources, opportunities for growth and some spring cleaning.

I'm sure many companies like us, for the longest time, relied on a talent pool that was plug-and-play. Consequently, the skilled labor shortage has forced our hand — for all the right reasons — into overhauling how we train and retain. We must do better at prioritizing organization and cleanliness, even on rush jobs, by making our workspaces inviting to those who wouldn't expect anything less from any other industry.

My biggest piece of advice is if you don't have the resources to train, find out how to outsource it and then focus on everything else. We're currently working with Ryan Pohl at Praeco Skills to develop a remote training program for new hires.

Q: What are your key takeaways from implementing an ERP system and exploring Industry 4.0 technologies? What advice would you give to other small/medium moldmaking businesses considering similar steps?

A: Key takeaways are:

- Know what you need. ERPs will not solve your problems if you don't know what they are and how much they're affecting you.
- Take the time to research beyond what's marketed toward manufacturers. I found *many* smaller, affordable players outside of manufacturing who can open the door to Industry 4.0.
- Don't let the ERP companies pressure you. They will tell you how many happy customers they have and that they're the best, but they may not be the best for you and your situation.
- Base your decision on your answers to two questions: Is the ERP easy for my team to use? And how many problems does it solve off the shelf? Seventy percent of ERPs fail in implementation. You want a product that is easy to adopt based on what you're already doing. MMT

FOR MORE INFORMATION

Best Tool and Engineering
586-792-4119, Ext: 5 / isaac.trevino@bteplastics.com
bteplastics.com
Isaac Trevino, Business Development Manager

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By Christina Fuges

MMT LEADTIME LEADER 2024 AWARD

DYNAMIC TOOL CORPORATION

Dynamic Tool Corporation –

Creating the Team to Move Moldmaking Into the Future

For 40+ years, Dynamic Tool Corp. has offered precision tooling, emphasizing education, mentoring and innovation. The company is committed to excellence, integrity, safety and customer service, as well as inspiring growth and quality in manufacturing.

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

In the past six years, the Dynamic Team has grown from 60 to 85 full-time employees, a 40% increase. As the company continues this progressive course, they are proactive in maintaining and improving their collaborative culture. After completing ISO certification last fall, Dynamic is implementing the 5S workplace organizational method to promote efficiency and productivity increases. Source (All Images) | Dynamic Tool Corp.

"Our vision is to become the first choice for our customers by creating a lasting, positive impression on the industry," says Steve Eberle, president of Wisconsin-based Dynamic Tool Corp. "We accomplish this with our focus on innovation and continuous improvement, which is a mindset of not accepting just what we do today but instead looking at what we can do in the future."

Customers come to Dynamic because the team engages them upfront before the tool hits the floor. "We want to be their first call and we don't care what they call us about. We are here to help and provide solutions for their needs whatever they may be," says Ken Eberle, vice president of business development.

The repeat business the company receives from world-class custom molders and OEM brand owners is perhaps the most demonstrable evidence of Dynamic Tool's on-time deliveries, exceptional customer service, engineering-based capabilities and dedicated workforce. This has earned the team the title of 2024 Leadtime Leader Award Winner.

The Evolution of an Enterprise

Dynamic Tool Corp. began operations as Dynamic Tool & Design in 1976 in an industrial region near the Milwaukee airport. Shortly after its inception, the company relocated to the southwest region of the city. The shop swiftly gained a reputation for quality and timely delivery, resulting in years of success serving various markets, including cosmetics, electronics, industrial, plumbing and packaging.

Around 1988, the company acquired and moved to an existing facility in Menomonee Falls, a northwest suburb of Milwaukee. Since then, this facility has undergone several expansions and refurbishments to accommodate the growth in capacity, personnel and services. Today, it houses the mold building team, consisting of designers, programmers, toolmakers and machinists, as well as materials inventory and equipment.

"It must be said that Dynamic Tool Corp. would not be here today without Roy Luther's investment and commitment. It has been a multistage process," says Dan Gouge, vice president of sales. "In 2017, it was all about getting stability back into the company to then assess where we could take Dynamic from there. From 2017 to 2020, we focused on rebuilding customer confidence and then transitioning out 60% of the machines. Then in 2021, we went from focusing on being a tooling provider to a solutions provider. Everything that goes into a mold and everything that goes into cell development is what we are all about."

2024 Leadtime Leader Award: Winner

COMPANY:

Dynamic Tool Corp.

W133 N5180 Campbell Drive
Menomonee Falls, WI 53051
262-783-6340
molds@dyntool.com / dyntool.com

Leadership Team

Steve Eberle, *President* Dan Gouge, *Vice President of Sales* Ken Eberle, *Vice President of Business*

Workforce

- 85 team members
  - Toolmakers
  - Designers/programmers
  - Mechanical/electrical/process engineer
  - Apprentices
  - Program management

Facilities

- 50,000+ square feet – Mold Manufacturing
- 110,000+ square feet – Development Center
- Turnkey cell development
- Launching 2024
- 24-hour lights-out manufacturing

Capabilities, Products & Services

- Engineering and design for manufacturing (DFM)
- Mold building with inline quality inspection
- Scientific sampling and process qualification
- Turnkey manufacturing systems
- Multishot/multiple material technologies
- Production molds from one to 256+ cavities

Mold Types

- Single shot
- High cavitation
- Multishot/multiple material
- Core back/toggle
- Robotic transfer
- Indexing/rotary stripper plate
- Rotary turntable
- Horizontal rotary stack (90- or 180-degree)
- Rotary spindle system
- Auto unscrewing
- In-mold close
- Collapsible core
- Insert
- IMD/IML
- Stack molds
- Thin wall
- High complexity
- Tight tolerance

End Markets

- Healthcare
- Medical Device
- Packaging
- Personal Care
- Electronics

Manufacturing Technology

Engineering Resources

- Creo 9 (formerly Pro-E) (3D CAD)
- AutoCAD (2D CAD)
- DraftSight (2D CAD)
- Dynamic Tool proprietary 2D software
- Mastercam 2023 (CNC programming)
- ESPRIT CAM (CNC programming and simulation)
- DelCam PowerMill (CNC programming)
- FeatureCAM (CNC programming)
- SURFCAM (CNC programming)
- Sigmasoft Virtual Molding (comprehensive process simulation)
- Creo Simulation Live (molding process simulation)

Additive Manufacturing

- Sodick 3D Metal Printer OPM 250L

Machining Equipment

- Makino graphite cutting centers (5)
- Yougar CNC hole-poppers (2)
- Hurco VMXi machines (6)
- CNC lathes, grinders, jig grinders
- Yasda five-axis
- Yasda VMC (2)
- Roku VMC, graphite (2)
- Mazak CNC lathe (3)
- Hardinge bench lathe
- Webb lathe
- OKK VMC (3)
- Makino VMC (5)
- Makino five-axis
- Kuraki horizontal boring mill
- Hurco VMC (8)
- Kitamura double-column VMC (2)
- Sharp vertical knee mill (4)

EDM

- Mitsubishi wire EDM (6)
- Yougar CNC hole popper (2)
- Elenix EDM drill
- Makino sinker EDM (5)
- Sodick EDM
- EDM Sales

Drills

- Clausing drill press (2)
- Ikeda radial drill (2)

Grinding Equipment

- Okamoto grinder (19)
- Moore jig grinder (5)
- Mitsui grinder (4)

Inspection Equipment

- Hexagon CMM (6)
- Keyence digital microscope
- Microvu vision system
- Mitutoyo microscope
- Zoller Venturion tool presetter

Mold Material

- Uddeholm

Mold Components

- Progressive Components
- PCS Company
- Meusburger
- Hasco

Hot Runners

- Mold-Masters
- Husky
- Mastip
- Incoe

Mold Maintenance & Repair Resources

- Tykma Electrox, Zetalase laser engraver
- Ultrasonic cleaning system
- Material handling systems
- Manifold cleaning system

Injection Molding Equipment

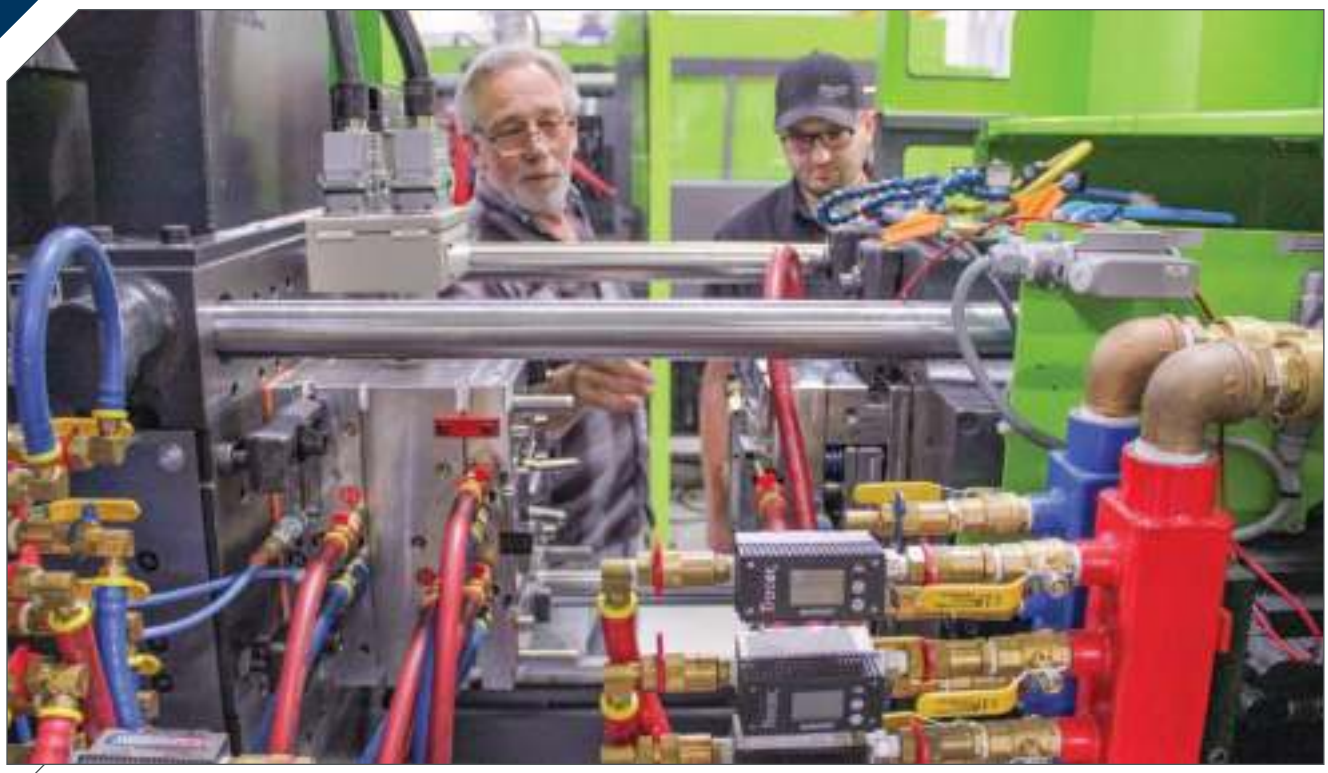
- Krauss Maffei and Engel injection molding machines (8)
- 22T – 900T dedicated to development
- All multishot capabilities

Visit our Leadtime Leader Zone for more coverage of past and present winners and honorable mentions since 2003.

A long track record of success in the delivery of high-performance production molds has enabled Dynamic to become a go-to source for their customers' new product development teams. Along with extensive experience in caps, closures and dispensers, the company's proficiency in tight-tolerance, high-cavitation applications brings opportunities in medical device, personal care and electronic components.

Together, the company's two facilities encompass approximately 170,000 square feet in the Menomonee Falls Industrial Park. The original mold manufacturing facility covers 51,000 square feet, while the newly acquired Development Center, purchased in 2022 and currently under refurbishment for scientific sampling and manufacturing cell fabrication, spans over 120,000 square feet. The total workforce comprises 85 employees, with 75 directly involved in injection mold fabrication and the remaining 10 handling accounting/finance, general purchasing, facility maintenance and administration. The toolmaking facility currently houses a fleet of injection molding machines used for sampling and qualification, which are in the process of being relocated to the new Dynamic Tool Development Center.

"We are receiving more opportunities where presses are delivered to us for integrating the tooling and developing the process. So, we need dedicated space to offer turnkey solutions," Ken says. "The Development Center facility is less than a mile down the road and when completed will house process development, mold sampling, a metrology lab and a customer care area with private offices and conference rooms."



Going well beyond traditional mold functional sampling and short runs, Dynamic's processing team embraces scientific molding principles as a proven method to yield the most repeatable production processes.

Dynamic Tool now offers a range of services, including additive manufacturing, CAD/CAM, grinding, milling, sinker and wire EDM, tool maintenance and repair, mold finishing and injection molding for consumer products, packaging, medical and electronics/computer industries. Given the diverse scope of tool builds — ranging from single-cavity prototypes to four-cavity bridge tooling to multiple high-cavitation molds (16, 24, 32, 48, 64, 96, 128, etc.) — lead times vary accordingly. The shortest lead time, as per customer request for a single-cavity bridge mold, is six weeks, while longer lead times, as an example, for a 128-cavity mold (featuring auto-unscrewing and in-mold closing technologies), is 20-24 weeks.

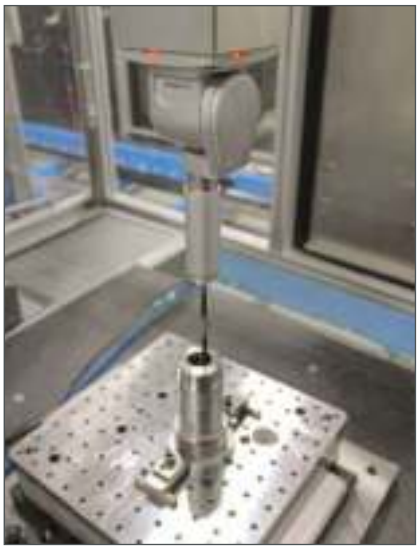
Dynamic's exceptionally deep staff of engineering and development experience fosters an ongoing environment of collaboration and sharing. The shop's target is a tooling system with the highest level of productivity and repeatability. The team's diverse knowledge of design applications, materials and machining processes support their customers' target — hitting the launch window.

Most of Dynamic Tool's core customers, specifically those involved in high-volume projects, require tooling systems for all phases of production molding. This includes prototype tools for time-critical evaluation, pilot molds for essential testing and performance verification, bridge molds for interim production quality and volume needs, and optimal steel mapping for high-cavitation molds. Notably, Dynamic Tool achieved industry recognition for delivering a 512-cavity stack mold in 2022, showcasing high-cavitation tooling packages with industry-leading uptime and productivity.

In 2023, injection molds for Dynamic Tool's customers encompassed single shot and multishot, living hinge/in-mold-closing, auto-unscrewing, insert, collapsible core, thin wall and stack systems, all with varying degrees of tight-tolerance dimensions. The complete cavitation range of delivered molds for 2023 spanned from one cavity to 256 cavities.

The Family of Business — From the Farm and Into the Future

Steve, Ken and Dan make up the current ownership team. The Eberle brothers are two of five kids who grew up on the family farm, which they both credit with teaching them the value of



Dynamic's shop floor features three automation cells, each with distinct machining processes and CMM validation. In each cell — hard-cutter, sinker EDM and graphite machining — machines and metrology are integrated with a rail-mounted robot for efficient workpiece storage and management. Each system was designed and built in-house by Dynamic engineers and toolmakers.

customer service when they were tasked with selling their crops. "That's where we learned to talk with people," Ken says. "Plus, our father also had a massive woodshed where we'd make things. We've been around making things our entire lives."

Steve and Ken apprenticed at Dynamic 30 years ago and became journeyman toolmakers. They left in 1997 to pursue other moldmaking opportunities, returning in 2017 and purchasing the business in 2020. "We both have a passion for problem-solving, providing solutions and leading growth," Steve says. Fast-forward to today, and their daughter and son, respectively, are working at the company.

"When I think about Dynamic and family, what comes to mind is much more than blood. It's our team on the floor. They are our brothers and sisters, too. They're family." Steve says. "Every decision we make is to provide a gateway for Dynamic to live on and make progress. Every step we take is meant to move moldmaking and Dynamic long past our tenure here and into the future. That mission takes great people and great technology which equals great customer service."

Business Dynamics and Differentiators

So much happens before a project hits the floor and that's what makes Dynamic special. "Our investment in engineering resources — both personnel and technologies — is a key differentiator in the injection moldmaking market," says Dan. "Engineering is a huge part of what we do here. We provide a solution from the beginning to the end whether that is cost savings, changing your automation or improving cycle times. It's all part of our upfront engineering."

Engineering and Design

"We are a real tool shop with journeyman toolmaker leaders. We are here to make tools, but there is so much to it," says Bill Mentzer, development. "You must be able to design a robust tool, you have to select the right material, you need to know when to use coatings and thermal management. That's the real engineering stuff and we have that in spades."

Most of the team spent a lot of time on the concrete, then parked their toolboxes and got involved in engineering. "We are very passionate about plastic. It's a big deal. Someone throws a part in front of us, and we are engaged in examining the gating, actions, knit lines and so on right away," Ken says.

> "We create and sell engineered steel, but it is our service before, during and after the injection mold build that defines the Dynamic Tool experience for our customers and leads to repeat business and referrals."

Dynamic Tool applies design for manufacturing (DFM) best practices to support the initial and evolving development process. Their DFM process is well-defined and rigorous, identifying immediate critical specifications to allow mold design to commence while optimization details are developed. "Finding ways to get a tenth of a second out of that tool is the type of solution we want to bring to each customer. That's the value we bring to them," Dan says.

"We have a clever approach to DFM because we don't start off by saying you need to answer *all* the questions. Instead, we say you need to answer these core questions," Bill says. "Then, we have checkpoints gathering new information as needed, ensuring everyone knows what they signed up for."

Through in-house simulations, ranging from basic fill to comprehensive assessments, the team evaluates alternative thermal and material designs to determine the best

combination of performance, cost and longevity in a matter of days. This facilitates timely cost/benefit analysis.

"Our interpretation of the data that simulation offers is what differentiates Dynamic Tool from other mold shops, and that's because of our experienced people," Steve says. "We can always do better, so we've created an environment of critical thinking to come up with the best solution. We analyze and interrogate a part's geometry and listen to understand the scope of the customer's full manufacturing program to find out where we can add value and where we can provide a greater solution than just an injection mold."

Dynamic Tool's in-house platform is Sigmasoft Virtual Molding, but they also use Moldex3D and Autodesk Moldflow analysis based on part size, geometry and material characteristics.

Diverse Internal Manufacturing Capabilities

Dynamic Tool possesses internal machining process capability for most fabrications, enabling the in-house construction of nearly all mold components. This internal capability allows Dynamic Tool to manage lead time and avoid outsourcing bottlenecks.

"We only invest in reliable, high-precision machine technology and we engage qualified, suitably experienced and equipped outsource partners for specialized machining services if required. This option enables us to maintain emergency and quick-response capacities for key customers," Dan says.

Encompassing Mold Qualification Services

The in-house sampling team provides a range of services — from a basic shoot-and-fill mold functional sample to identify any mechanical issues to a full scientific molding protocol. They embrace scientific molding principles as a proven method to yield the most repeatable processes for most applications, exploring key attributes such as mold balance, velocity curve, short shot study, design of experiments (DOE), pack and hold, window study and initial production runs available to suit customer launch plans. Engineers design to the exact specifications of the intended production press, ensuring all phases of production are reviewed for productivity: installation, safety, mounting and preventive maintenance (PM).

"When it comes to tool validation, our ability to adapt to our customer's workbook is what differentiates us," Dave Hourihan, plastics operations manager, says. "It's not a canned solution at Dynamic. It's a collaborative solution."

The team is excited to move into the new Development Center, a dedicated space to provide a higher level of focus on development, which includes a state-of-the-art water system, 1-2 additional presses and a new metrology center to go through a higher level of validation on Dynamic's end to provide less need to ship molds back and forth for steel-safing and adjustments.

The Center also presents the opportunity to support the customers' higher runs and other needs (multiple tool samples, color samples, material trials) to help develop the products they come to Dynamic to build. It'll be the same personal treatment during validation but now in a dedicated facility.

Dynamic's core customers include the industry's leading custom molders and contract manufacturers. To support their goals of high-productivity molds and downtime reduction, Dynamic has created an extensive mold refurbishment, repair and preventive maintenance (PM) department. Because of the company's extensive build experience of complicated/multiple-action molds (auto-unscrew, in-mold closing, multishot), the Dynamic PM Shop is well equipped and capable of working on tooling systems they have built and those of other shops as well.

Culture, Communication and Collaboration

The Dynamic Tool team is a cross-section of the industry that includes people from the production molding side of the business, toolmakers on the floor, engineers and designers and even experts in metrology, who possess a winning combination of attitude and aptitude.

While additive manufacturing can offer significant time-saving advantages for some mold component applications, traditional hard-cutting and sinker EDM are the processes that deliver long-term performance and repeatable accuracy.

"Our team is loaded up with a lot of experience because customers don't come to us for the standard poker chip or the washer tool. They come to us for super-high cavitation or help with the beginning of a project with pilot tooling," Ken says. "It's more than a quick quote; customers are looking for solutions. They know we are going to answer the door with someone who knows and understands what they are asking for to provide the right solution."

Customers rely on this team to design and build the molds that produce the parts and products they target to increase their market share. These are inevitably high-performance parts — with living hinges, threads, multiple materials, high aesthetic requirements and inserted components — and molds with conformal cooling channels, in-mold closing, in-mold rotation and auto-unscrewing. While the machining processes and related equipment required to make these molds and mold components are expensive and expansive, it is the Dynamic Tool human element that enables them to succeed.

The brothers believe that if you surround yourself with like-minded people, engagement improves and good things happen. "When it comes to our people, our culture is one of having each other's backs — building people up and not tearing them down, which takes honest and open communication. I have been blessed with a great team of people who have passion for providing world-class tooling and molding solutions and we are committed to growing the next generation to continue this passion," Steve says.

Account managers, design engineers and toolmakers meet regularly to ensure the execution of a well-managed and timely project. Additional internal resources for mold simulation, DFM and material processing are brought in as required by the scope of the project.

However, leadership does have an expectation of team members. "They must have a best-performance mindset, and there is no shortcut to fulfilling that focus," Dan says. "Everyone must perform to the best of their abilities day in and day out. People who care about efficiency, doing their job well and putting the time in when necessary are key attributes we look for in a Dynamic employee."

Employees everywhere place a premium value on salary/wage, but given that pay is close to equal at similarly sized shops, it is the extras involved that invariably generate loyalty from the employees. Those extras include recognition and rewards for individual performance, challenging projects, involvement in the creation of lifesaving/life-improving products, working with global brands, being a valuable part of a winning team, shared celebrations of company successes, and employee on-premise and off-premise social events.

Career Advancement

"Most importantly, we focus on providing each team member a career opportunity in a collaborative, mutually supportive, safe and healthy environment," says office manager Tracy Rhyner. "Our culture is based on collaboration and education. Each Dynamic Tool employee is self-motivated to bring their best performance and their best support for the team to meet and exceed customer expectations."

Shops ran differently when Steve and Ken were younger. "We both wanted to be part of discussions and projects, but that wasn't the culture back then," Ken says. "So, we've made a concerted effort to open the door and invite the young ones

in to listen and learn. That invitation is a big deal to help them connect what they hear from us to what they experience on the shop floor."

And that line of thinking doesn't stop with Steve and Ken. "The Eberle family values integrity, hard work and excellence. With Steve and Ken holding those values at the top, they trickle down to the company and attract people to want to work here. The culture is one that fosters a place to grow, find your own way and figure out where you fit best," says Lauren Eberle, quality management representative.

The same goes for Ken's son, Bryan Eberle, Dynamic Tool's account manager. "I became so intrigued by what Steve was building at Dynamic that I wanted to be a part of it, so I applied and got hired as a leadman toolmaker," Bryan says. "Now I am a mentor to the next generation while building tools. They give opportunities to run with. It's up to you to take it to the next level and show them what you're made of."

Apprenticeship and Mentorship

Dynamic Tool's goals are to share successes to teach and motivate others and to share problems to solve them quickly and effectively and add to the team's collective tribal knowledge. They have six employees under the age of 25 — approximately 9.1% of their workforce. During 2023, the company employed a total of eight participants in the State of Wisconsin's Tool and Die Apprenticeship program. "Currently we have six apprentices: five on the shop floor and one designer," Tracy says.

They also have more than 60 journeyman moldmakers on the team in varying roles — some are hands-on, but others are the president, vice presidents, account managers, operations manager and plant manager.

"Since we've become ISO certified, we aim for a 96% retention rate and have kept it there over the past six years. We've gone from 60 to 85 people. That's a 40-45% increase," Tracy says. A critical factor in attracting and keeping these talented performers is an encompassing, collaborative and supporting culture. "I attribute all these new employees to Steve. People trust him and he is an incredible toolmaker. People want to work for him. We genuinely care about our people and that starts with Steve."

Dynamic Tool has created a dedicated resource of 20 toolmakers, design engineers and machinists who actively mentor and monitor the progression of each apprentice. These toolmaker instructors meet regularly with each other and the apprentices for the timely exchange of feedback, continuous improvement plans and advice for career success. This ensures that not only modern best practices for safe and effective workmanship are passed on to the next generation, but tribal knowledge and how-to methods are also taught.

"This environment is highly valued by our team — from rookie to veteran," plant manager Scott Matenaer explains. "My goal is to download everything I know to the next generation by having them experience it. Live it. Learn it. Retain it. Before the end of their apprenticeship, they can build a mold from start to finish. I always say: 'Be a toolmaker first. Once you're a toolmaker you can do anything else. Toolmaking is where it starts.'"

Every one of Dynamic's six apprentices has their dedicated mentor and the support of the entire team. The shop encourages the students to learn through observation and hands-on involvement, and is always quick to follow up and check in on progress.

Dedicated Outreach

While Dynamic Tool has attracted an impressive number of experienced veterans from the regional area, it has focused its future growth on communicating with and selecting premium young candidates while they attend high school and technical college. This provides the opportunity for mentoring and collaboration, ensuring both a fit for the shop and the best environment for career development for the apprentice or intern.

"We make sure the students are a fit for us. It's a contract. We ensure they want to work here. We look for attitude, work ethic and trainability in our apprentices," Scott says.

Dynamic Tool has dedicated resources to supporting and interacting with its educational community. Team members regularly meet with lead instructors to review new developments in machining processes and industry best practices and engage directly with students in their classrooms and on their shop floor. They interview candidates while allowing them to get an understanding of the Dynamic Tool culture and method of using manufacturing technologies.

"For example, our sales coordinator, Cassidy Egan, is a guest instructor at Arrowhead Union High School in Hartland, Wisconsin," Steve says. "She recently taught shop class students a best practices approach to creating their resumes. Arrowhead's Anthony Christian, manufacturing and engineering instructor, meets with Dynamic Tool's shop leaders to glean current process improvements and machining advancements."

Other schools with which Dynamic Tool regularly works and hosts student/teacher/parent tours include Waukesha County Technical College, Moraine Park Technical College and Kewaskum High School. They are also regular participants in career fairs at the University of Wisconsin Platteville and Stout campuses.

"We have made it a point to concentrate on recruiting, identifying and developing young talent. We also host a general open house event every year, where we invite students, parents, teachers, job seekers, middle schools, high schools, technical colleges and universities to tour our facilities and speak with our team members about the careers available in mold, tool and die. We always have our eyes on the future as we maintain and grow our commitment to our intern and apprentice programs," Steve says.

Ongoing training is critical to company growth and innovative thinking. Dynamic's key supply partners play an important role in teaching best practices in machine setup, use and safety.

Innovation & Technology

While Dynamic Tool fully embraced and uses the latest advancements in traditional and additive manufacturing, a tour of the shop at any time highlights the crucial role of the craftsperson's eye, mind and hand in designing and building critical components for an injection mold.

Dan states, "The machinery in our shop, built by leading brands and considered premium in terms of performance, tolerance and repeatability, is carefully planned, programmed and set up through the efforts and experience of the craftsperson." All machined steel undergoes validation using appropriate metrology tools, including calipers, drop indicators, vision systems, digital microscopes or coordinate measuring machines (CMM, touch or laser). However, at every step, it must also pass the inspecting hand and eye of the moldmaker.

The diversity of machining processes and the quality of equipment on the Dynamic Tool shop floor are mandated by the technical requirements of its customers. "We need advanced gear to successfully meet the tight-tolerance specifications of our customers' mold builds," Ken explains. "An average Dynamic mold is hardly that. The part designs we work with require sophisticated engineering and tool building, with one or more of auto-unscrewing, multiple slides, lifters, in-mold closing, multishot, thin-wall and insert features — with production cavitation ranging from 16 to 256 cavities."

Whether it's 3D metal printing, five-axis milling, high-speed machining, lathes with live tooling, robotically integrated CMM inspection or automated cutting and EDM operations, you'll find it on the floor creating injection molds. Due to their history of investment, leading machining center brands provide frequent training and updating support, keeping Dynamic Tool informed of new developments, enhancements and best practices.

For instance, two current **automated machining cells** — hard-cutter and EDM sinker — were designed, built and integrated by the in-house team. "That's a big deal as they are continuously improving it. There are a lot of proposals on the table for more automation! There is a lot of pride of ownership there," Ken says.

These cells include multiple machines with a custom rail-mounted robot for material handling and an inline CMM for component validation. The next stage involves automating the graphite machine centers and wire EDM operations.

Dynamic's Sodick OPM 250L 3D Metal Printer's key use is for the creation of conformal cooling channel inserts. By using the specific geometries of part design to create the shape and placement of cooling channels, Dynamic customers achieve more precise control of injection mold thermal dynamics. The machine is also used for the manufacture of injection mold components — facilitating the creation of prototype and developmental tooling systems.

"Automation allows us to take on more volume with the same amount of people. The skillset has changed as our specialists must be more technical," Lucas Lemberger, lead sinker EDM specialist, explains. "They not only program the EDM, they program the robot and the CMM — it's the whole cell. Our team built a new system and cell from scratch based on processes we had in place. We went from multiple robots feeding older machines to more throughput potential and improved quality because everything goes through the cell."

The cell consists of five Makino EDM sinkers, one Hexagon CMM and even an integrated cleaning station to keep everything inside the cell. It also includes 30 12 × 12 Dynafix Pallets and four electrode carousels for a total of 800 electrode positions, with the ability to expand further if needed in the future, with the current setup. Only three people run the equipment, program, set up and tear down.

"The majority of my job can be done through offline programming and remote viewing and accessing of the equipment. Eventually, this area will be a bottleneck, so we are constantly looking for ways to automate to increase our throughput potential," Lucas says.

Dynamic Tool has also developed **proprietary techniques** to improve long-term mold performance, interchangeability of spares/core and cavity stacks/mold components, efficient PM and robust tooling actions (in-mold closing, auto-unscrewing, rack systems).

"A lot of mold builders have closed over the past 5-10 years and customers still have tooling assets that have a lot of life left in them," Dan says. "We are here to refurbish and maintain them. This is a growing opportunity for us. Whether we build the tools or not, our customers know our team has their backs when it comes to maintaining their molds."

In addition, Dynamic Tool has extensive experience and success in implementing **conformal cooling design** into production tooling systems, having built hundreds of cores using this technology in critical areas for enhancing thermal control. Traditional mold manufacturing processes (milling/grinding/EDM) are augmented by 3D printing technologies that facilitate the creation of conformal cooling channels for more precise control of injection mold thermal dynamics.

The Sodick OPM250L, combining laser sintering technology with high-speed milling, is used to print and finish a product in one automated operation when appropriate. "This machine has offered us another bullet in our chamber. It allows us to further problem solve and even take a project to the next level," Ken says. "For example, it's allowing us to experiment at the pilot level to develop conformal cooling inserts… more of the work we do upfront."

Ken emphasizes the benefits of using the specific geometries of part design to create the shape and placement of cooling channels including increased production via shorter cycle times, lower piece part cost, improved part dimensional stability, less warpage/shrinkage, improved surface finish, lower scrap rate and a minimal thermal gradient throughout the part while cooling for a more uniform temperature profile.

The system uses maraging steel (36 Rockwell before aging/53 Rockwell after aging) and offers the additional option for printing stainless. The print area is 9 × 9 × 9 inches, but the 2D footprint of a single part must be less than 9 × 9 inches. It avoids sharp corners in water channels and the surface finish depends on laser settings. This approach allows cooling channels in areas that are not possible to achieve using traditional methods, reduces the need for O-rings, simplifies

mold designs, expands part design innovation opportunities and provides prototyping capabilities for 3D printed injection mold components.

Finally, Dynamic Tool's system for **quality assurance integrates metrology into its automated machining processes**. With integrated in-machining cell quality reporting, any fabrication issue is detected upon workpiece completion, ensuring it is identified, corrected and not duplicated in subsequent components. This eliminates schedule-effecting rework loops.

The inline accuracy and data drive any risk of rework loops out of more than the mold build alone. This same steel data also adds value during the process validation stage, enabling part measurement results to be correlated for precise targeting and, ultimately, a larger process window. The result is inline quality validation for all related machining operations, documented and archived for any future reference needs.

Steve concludes, "This in-process metrology provides our customers with the assurance that mold components are built to specification and form the groundwork for any steel adjustments that may be required after sampling."

Design manager Dave Miller and president Steve Eberle discussing the results of a recent systems audit with quality management representative Lauren Eberle. Implementing ISO best practices has led to greater communications within and between company departments.

Maintenance & Service

Dynamic Tool has built a strong reputation for delivering efficient and effective mold DFM services, drawing on decades of success and perspective in crafting high-performance tooling. However, the company's dedication to customer service extends beyond the mold build phase, encompassing molding and maintenance as well.

While account managers play a crucial role in project planning, coordination and communication, and the mold qualification team provides process development and validation services, Dynamic Tool also frequently offers production mold integration/qualification/launch support services at a customer's molding site. This aids in bringing new injection tooling systems online and includes mold PM, refurbishment and repair services.

Equipped with the necessary tools, knowledge and process plans, Dynamic Tool supports customer initiatives to retain and restore molds. This involves a proficient team of toolmakers, designers, process engineers and project managers. They diligently evaluate, document and execute the job in a dedicated PM area, equipped with essential equipment and technological resources.

The PM arsenal comprises ultrasonic cleaning, material handling and the capability to accommodate large molds, high cavitation and multiple inserts. Additionally, there is a 3D metal printer, eight sampling presses ranging from 22 to 900 tons, a metrology lab, reverse engineering capabilities, manifold cleaning/baking with quick turnaround, a variety of thermocouple sizes and stocked wiring supplies, close relationships with leading coating service suppliers and expertise in medical tooling (including areas of lubrication and medical/food-grade lubricants).

"We create and sell engineered steel, but it is our service before, during and after the injection mold build that defines the Dynamic Tool experience for our customers and leads to repeat business and referrals," Dan says.

Sustained Growth

You can have all the technology, processes and people in place, but you also need a plan to land new business and promote your company. This is where the Dynamic Tool sales team comes into play, comprising individuals who are engineers first and salespeople second.

"Each member brings years of technical experience to the customer's table, including mold design, moldmaking, materials, processing and production molding. Their first initiative is to solve a customer's problem by identifying challenges, options and impending decisions. They also employ and embrace sales best practices such as customer market research, targeted communications and timely follow-up," Ken says.

The Dynamic Tool marketing objective is relatively simple: to position Dynamic Tool as a recognized and trusted thought leader in the plastic injection molding industry. The team achieves this by promoting the company's growth and technical success using traditional means (website, LinkedIn, select trade events) and by becoming active participants in technical events where they share best practices.

The Dynamic Team is focused on productivity, progress, and safety. Everyone in the company is responsible for keeping all areas of the company clean, organized and safe. That way every day truly is 75 and sunny.

"We also communicate with our customers via brief email updates on any progress that is beneficial to their business, such as new machining purchases, facility upgrades and expansion, ISO certification and published content," Ken says.

For example, in August 2023, Dynamic Tool earned ISO 9001:2015 certification. Under the leadership of Lauren Eberle, Dynamic's quality management representative, the team developed the appropriate tracking system and procedures to document and monitor on-time deliveries. Before ISO certification, they monitored and reviewed projected/contracted lead time for each project against actual logged shop hours.

Today, Lauren manages ISO, continuous improvement and sustainability for the company. Customers were demanding ISO certification and with no one on staff schooled in the process, Lauren took it on with her father's encouragement and the support of the entire organization.

"ISO gave us the framework to successfully implement innovation and improvements that maintain quality through our products and services, which at the end of the day helps our customers," Lauren says. "ISO brought systems and processes into focus. It helped us improve efficiency and our internal communications. Innovation is inherent in our culture and within our engineering and development mindset. It's who we are. And ISO helps us with the framework to effectively and successfully implement improvements and innovate with our business processes. ISO created and forced necessary change and standardization that only improved the business."

5S is Dynamic's new initiative. They launched the MIB (Make It Better) team and are now accepting applications to be on the team — just another tool to help Dynamic continue to clean up, organize and become more efficient.

The company is also focused on developing stronger relationships with its service and technology supply partners (Sigmasoft, Krauss Maffei, Engel, Kitamura, Yasda, Sodick, Makino and Hurco) through cross-collaboration and mutual promotion. They have also started collaborating with customers' engineering and design teams by presenting at their facilities for educational events.

"Our first lunch-and-learn events included sessions on best design practices for optimized auto-unscrewing molds and the various methods and applications of multishot molding (common core, core and cavity change). We will continue to share educational content with our customers' engineering teams that target the geometries and designs of their specific product lines and promote industry best practices for overall improvement," Steve says. "The path forward is exciting. We are really trying to set it up to carry on our legacy for the next generation who will lead Dynamic into the future."

"What's going on now with Dynamic makes me smile. It's all coming together. It's working. We are building this machine that continues to grow! It's exciting. And I feel we are just getting started," Ken says. MMT

VIDEO: Meet Our 2024 Leadtime Leader Dynamic Tool Corp.
Dynamic Tool Corp. team members meet with *MoldMaking Technology* editorial director Christina Fuges to discuss their innovative engineering, design and development solutions for optimizing the production of plastic components and products. They also discuss the team that makes it all happen, both now and in the future.

By Perc Pineda, Ph.D.

Shift in U.S. Mold Imports: Emerging Countries Gain Ground in Market Share

The dynamic nature of the U.S. mold industry's global trade landscape offers challenges and opportunities for growth.

Keeping on top of industry trends and data will help mold builders prepare to capitalize on growth opportunities. Source | Stock, Copilot

To sum up recent activity, U.S. Molds Export Values experienced a steady rise from 2015 to 2017, peaking at $624.2 million, before plateauing and experiencing a minor decline in subsequent years. Conversely, imports demonstrated a more pronounced upward trajectory until 2018, followed by relative stability. This trend contributed to a widening trade deficit, which grew at a compound annual growth rate (CAGR) of 4.1% over the past decade. Domestic mold production exhibited volatility, aligning with economic cycles, while facing threats from increasing imports.

Emerging countries like Thailand, South Korea and India have gained market share in the U.S., presenting challenges and opportunities for mold builders in the U.S. Economic policies addressing issues such as energy security and workforce development are crucial for enhancing U.S. manufacturing competitiveness. Also, optimizing trade with free trade partners, including leveraging existing agreements, offers potential avenues for U.S. moldmakers to explore and capitalize on.

Now, let's break these trends down.

U.S. Net Importer of Molds for Plastics

Recent data indicates a fluctuating trend in exports and imports over the past few years. However, the U.S. has remained a net importer of molds for plastics. Export values increased from $581.8 million in 2015 to $624.2 million in 2017, marking a steady rise. However, there was a slight dip to $622.0 million in 2018, representing a marginal 0.3% decrease. Since then, exports have remained relatively stagnant, with a decrease of 0.9% observed in 2023.

In contrast, imports displayed a steady upward trajectory from $1.6 billion in 2013 to $2.3 billion in 2018. However, after reaching this peak, imports declined slightly to $1.8 billion in 2020. Subsequently, imports have maintained a relatively stable pattern, hovering above the $2.0 billion mark. Like exports, imports experienced a minor decrease of 0.1% last year compared to the previous year.

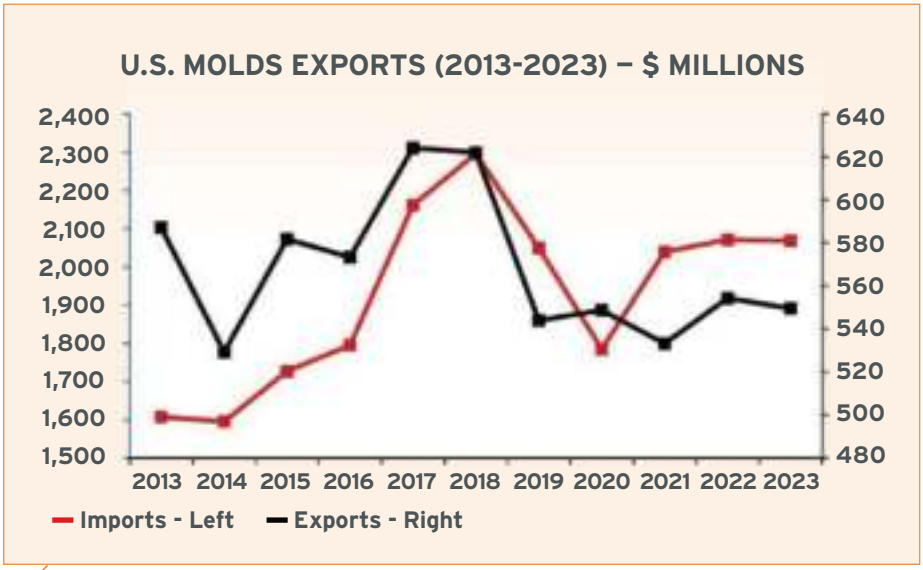
The trade deficit, resulting from the surplus of imports over exports, has consistently widened over the past decade, with a CAGR of 4.1%. Last year, the deficit amounted to $1.5 billion. In terms of quantity, the deficit witnessed a 10.2% CAGR over the same period.

Volatile Domestic Mold Production: Growth on Pace With Economic Expansion

Industrial mold production offers insights into the dynamics of molds for plastics manufacturing in the U.S. According to Plastics Industry Association (PLASTICS) estimates, there

has been notable variability in long-term growth rates, exemplified by a 20.4% decrease in 2009 during the Great Recession, followed by an expansion of up to 16.7% postrecession.

Similar growth patterns were observed after the technology bubble in 2001 and the great recession in 2009. Despite a minor dip of 0.3% during the COVID-19 recession, the historical average growth rate of industrial mold production stands at 2.5%, aligning closely with the long-run growth of the U.S. economy measured by gross domestic product (GDP).



Recent data shows that while there has been a fluctuating trend in exports and imports over the past few years, the U.S. continues to be a net importer of molds for plastics. This graph compares U.S. mold exports and imports in dollars from 2013 to 2023. Source (All Graphs) | PLASTICS analysis of U.S. ITC data

Imports Threaten Domestic Producers' Market Share

Apart from domestic production fluctuations, competition from imports has added another dimension to the domestic market. As noted previously, since 2013, U.S. imports of molds have grown at a CAGR of 10.2% in units. In 2023, there was a significant decrease of 28.0% in mold imports, while total U.S. imports surged to 68% in 2014. The year 2018 witnessed a 21% decrease, followed by a remarkable 46% increase in the subsequent year. The impact of the COVID-19 pandemic led to a 10% reduction in mold imports in 2020 due to disruptions in international trade.

From a macro perspective, the trend of mold imports into the U.S. reveals a shift toward countries increasing their share in the U.S. market.

From a macro perspective, the trend of mold imports into the U.S. reveals a shift toward countries increasing their share in the U.S. market. In 2013, Mexico's share of U.S. mold imports stood at 7.3%, soaring to 30.2% by 2023. Similarly, Canada's share nearly doubled from 2.2% in 2013 to 4.7% in 2023. This increase can be attributed to the free trade agreement between Mexico, Canada and the U.S., which facilitated their access to the U.S. molds market, resulting in respective import growth rates of 27.0% and 18.9% from these countries between 2013 and 2023.

In contrast, China, the second largest source of U.S. mold imports, witnessed a decrease in market share from 42.6% in 2013 to 20.9% in 2023, with tepid growth of 2.7% CAGR. The 25.0% tariffs on Chinese-made injection molds are still in place. Total unit imports of molds from China have seen a decline of 30.9% and 59.4% in 2022 and 2023, respectively.

Emerging Countries Gain Market Share

Emerging countries like Thailand, South Korea and India have gained market share over time, with impressive CAGR figures of 45.7%, 23.3% and 15.9%, respectively, in U.S. mold imports. France also saw its share in U.S. mold imports more than triple, reaching 4.0% in 2023 from 1.2% in 2013, with a CAGR of 23.9%.

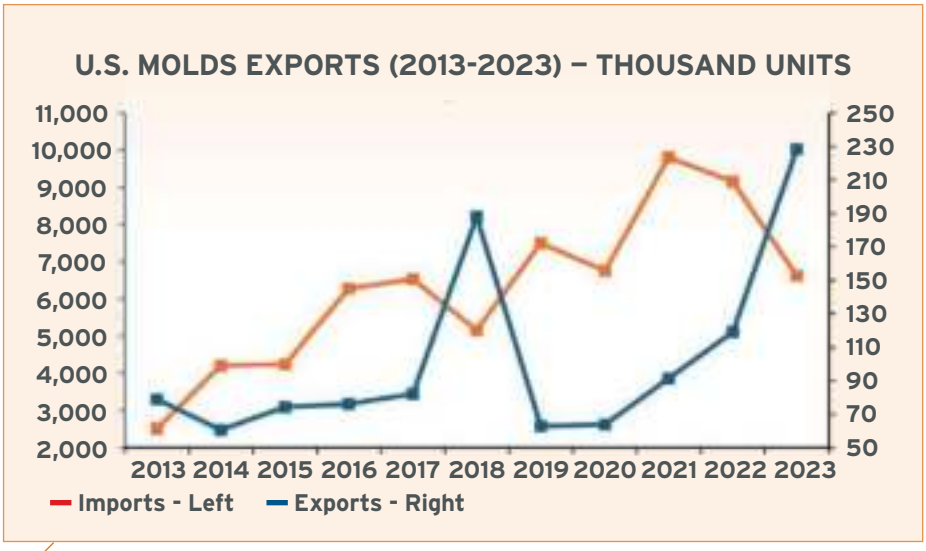
Looking ahead, it is likely that the U.S. will continue to experience an increase in domestic mold production as other countries gain access to the U.S. market. This could be explained by the advantages of labor and policy that other countries have over the U.S.

Economic Policies Boost U.S. Manufacturing

The recent weakening of the U.S. dollar has adversely impacted the competitiveness of U.S. exports, including molds for plastics, while simultaneously enhancing the affordability of foreign-made goods. Beyond currency exchange rate practices of major U.S. trading partners, there exists a spectrum of economic policies that could bolster the competitiveness of U.S. moldmakers both domestically and internationally — energy security comes top to mind.

A thriving manufacturing sector is contingent upon affordable energy costs. While some countries with flourishing manufacturing sectors are net importers of energy, the rate of change in energy costs is paramount. Stable energy prices facilitate better planning and budgeting for manufacturing firms. Recent data from the U.S. Bureau of Labor Statistics indicates a significant surge in the manufacturing sector's energy costs, with increases of 24.9% in 2021 and 30.5% in 2022, compared to much lower increases in previous years.

The U.S. Census Bureau's latest estimates show that energy costs in industrial mold manufacturing increased 10.7% in 2021, following a 6.4% increase in 2020. Ensuring an ample energy supply in the U.S. — which will stabilize energy prices — will support stable energy prices and sustain the manufacturing sector.



A comparison of U.S. mold exports and imports from 2013 to 2023, measured in thousands of units, reveals a notable increase in exports. However, this growth is overshadowed by the significantly larger volume of imports.

Aside from energy, another critical issue deserving of a forward-thinking economic policy is attracting the workforce into manufacturing. The U.S. economy faces a disadvantage in manufacturing due to a shortage of skilled workers in this sector. According to a 2018 report by the Brookings Institute, the U.S. ranks 16th among 18 countries in terms of the percentage of the population employed in manufacturing[1]

For example, Poland leads with 20.2% of its population employed in manufacturing, while the U.S. lags at 10.5%. Comparatively, China, Germany and Mexico have higher percentages of their populations employed in manufacturing. Exploring tax incentives for manufacturing workers could help augment labor participation and productivity in manufacturing. One such policy that many economists have considered is making overtime pay tax-free.

Expanding the manufacturing workforce could lead to increased manufacturing value-added for the economy. Although these comparisons are based on dated information, countries that have increased their share in the U.S. molds for plastics markets typically have high manufacturing value-added as a percentage of GDP. In 2022, Thailand and South Korea had percentages of 27.0% and 26.6%, respectively, while India had 13.3%. Notably, China and Mexico boasted percentages of 27.7% and 21.5%, respectively, compared to the U.S.' 10.0%. Other countries exhibit higher productivity in manufacturing compared to the U.S.

Relieving U.S. manufacturing from regulatory costs would enhance productivity. One of the key economist arguments against regulatory burden is its tendency to misallocate resources. Businesses may divert financial and human capital away from productive activities toward compliance efforts. According to the National Association of Manufacturers (NAM), federal regulations cost small manufacturers $50,000 per employee per year. Significantly, in 2022, based on NAM's study, the cost of federal regulations to the U.S. economy exceeded $3.0 trillion, with average compliance costs for a U.S. firm reaching $277,000.

Optimizing trade with free trade partners. Lastly, the U.S. has free trade agreements with 20 countries.[2] The U.S. exports to these nations totaled $449.9 million last year, remaining virtually unchanged from the previous year with a slight decrease of 0.6%. However, over the past five years, the value of U.S. mold exports has experienced a decline with a CAGR of 2.8%.

While unit exports surged by 94.6% in 2023, unit exports over the last five years have declined by 1.2%. Our free trade partnerships with these 20 countries, particularly outside of Mexico and Canada, present opportunities for U.S. moldmakers that certainly warrant attention. MMT

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[2] Australia, Bahrain, Canada, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Korea, Mexico, Morocco, Nicaragua, Oman, Panama, Peru, Singapore.

FOR MORE INFORMATION

Plastics Industry Association
@PercPineda / PPineda@plasticsindustry.org / plasticsindustry.org
Perc Pineda, Ph.D., Chief Economist

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By Bryan Whitaker

How to Clean and Maintain Molds With Intricate Conformal Cooling Channels

A water-based, eco-friendly plastic mold cleaning system helps Rankine-Hinman Manufacturing restore flow rates and avoid big-ticket failures on complex and costly molds.

The custom cart at Rankine designed for transporting molds and connecting to Eco-Pro for cleaning. Source (All Images) | iD Additives

Mold cleaning is one of the most essential steps in making plastic products. When those products include sensitive medical devices created via molds featuring intricate conformal cooling channels, those molds require a cleaning system that is just as precise.

That's why Rankine-Hinman Manufacturing, based in St. Augustine, Florida, which services the unconventional molds of a leading plastics healthcare molder among other customers, relies on the Eco-Pro XL system of mold cleaning carts and cleaners from LaGrange, Illinois' iD Additives. Initially used to restore the function of clogged molds, the Eco-Pro system is now used for preventive maintenance (PM).

Addressing Zero Flow-Through

Rankine-Hinman owner and president Bryan Hinman explains that clogged cooling lines can cause parts to stick in the mold. To make matters more challenging, the molds used to produce a tiny, thin, curved part also feature uniquely shaped cooling channels that surround the part in hard-to-reach areas to ensure heat is removed evenly.

Rankine's healthcare customer puts flowmeters on all of its mold cooling channels and found several with zero flow-through. The customer researched solutions and purchased two iD Additives Eco-Pro carts in 2018 and the results were immediate. Using flow rates of up to four to five gallons a minute, the benefits became obvious quickly. "One mold took 16 hours to break free, but Eco-Pro did the job," Hinman says.

The customer demonstrated the Eco-Pro on six molds before turning the system over to Rankine, which has supported various production needs for this customer for more than 25 years. Hinman adds that the customer sends molds to Rankine when a mold's flow rate falls below a certain threshold. "They tell us it is a significant improvement each time Eco-Pro is used."

3GT molds (three-plate, gated, threaded) were the customer's main pain point prior to introducing Eco-Pro into the maintenance regimen. The customer initially attempted to clean the mold channels using ultrasonic baths and other methods but was unsuccessful due to a hairpin turn that made it impossible to insert a brush — or even a drill — manually. Eco-Pro saved the customer money by preventing corrosion in these molds, which are prone to leaking through a hot runner plate or a crack in the face plate. This prevention averted a $70,000 failure.

Moving From Repair to Prevention

Hinman explains that the use of the Eco-Pro system has recently evolved. "Setting up and running it right out of the box was easy," he explains. "We just needed to ensure we had the correct fittings for the molds. We would attempt to flush and open up some channels. Before and after this process, we'd take measurements to verify the mold's function." Rankine-Hinman has seen what the Eco-Pro system can do to clean molds. With this technology, the customer is even performing more PMs to prevent restrictions in the lines.

Flowmeter readings: Gallons per minute (GPM; flow rates) are displayed on the left, showing a 114% increase in flow. The bottom number is the user-set target GPM, adjustable to any desired value. Upon reaching the target, the light on the right turns green.

Over time, Eco-Pro's ease of use has greatly streamlined cleaning times for this customer. "They've reduced the amount of attention they give to cleaning to the point where they can hook it up and trust that the chemical will do its job. It may require monitoring, but they no longer have to constantly monitor it," Hinman explains.

RANKINE-HINMAN MANUFACTURING

PROBLEM: Clogged conformal cooling channels, corrosion and long cleaning times for hard-to-clean molds.

SOLUTION: iD Additives Eco-Pro XL system of mold cleaning carts and cleaners.

RESULTS: Unrestricted cooling channels, streamlined cleaning times, reduced maintenance costs and eliminated corrosion.

The iD Eco-Pro 360 System is a preventative maintenance (PM) cleaning system featuring a pump and filter combination unit. It effectively removes, protects and helps prevent rust in various components including cooling passages, heat exchangers, waterlines, TCUs/Thermolators, chill rolls, chill rails, feed sections, tools and more.

The company will revisit it after it's been running for 45 minutes to an hour, then run water through and check to see if there's any difference. If they don't see a significant improvement or the numbers they want, they hook it back up and let it run a little longer.

The customer also periodically checks the filters to monitor the contents of the discharged water. During the flushing process, they open a line and inspect the water to identify any changes. This enables them to distinguish between what has been broken up in the channels and what is coming out of the molds.

"While they trust that the chemical is effective, they also rely on visual inspections to ensure that the discharge and water are being cleaned properly," Hinman says. "They tell us they even put their hands on the hoses and feel everything running through the channels to ensure that everything is running smoothly."

Cleaning System and Service

The Eco-Pro system consists of an air-operated cart that uses the Eco-Pro 360 chemical and can accommodate injection molds, blow molds, feed sections, Thermolators (TCUs), chill rolls and more.

The system is equipped with an air diaphragm pump, ensuring that every shop has accessible air and providing safety by allowing the system to pause during pressure builds, thereby avoiding downstream line ruptures. The key advantage of this chemical is its ability to be reused; some current users have been able to flush with the same chemical for up to five years, thanks to the built-in filtration feature of the cart.

Eco-Pro can also clean customers' heat exchangers, enabling them to be reused instead of thrown away. Because the Eco-Pro flushing chemical is water-based, environmentally friendly, non-aerosol and nonflammable, it even removes and prevents rust by providing a protective nanocoating. It works on all metal surfaces without etching.

Notably, training operators on how to use the machine doesn't take long. While there is some training involved, it's for a relatively simple machine and doesn't require extensive time.

When consumables like filters and chemicals are required, Hinman and his customers can count on prompt customer service from iD Additives. "They pull up our information, and the product is usually on the truck the next day — sometimes on the same day, depending on how early they get the call."

> "We've flushed two or three molds a week now. We have a truck going back and forth to that customer and I know they can count on us and the chemical to service all of their molds."

Rankine-Hinman performed a complete hose replacement about a year ago due to the amount of chemical they ran through it, and a package of hoses of the correct lengths arrived quickly. "We essentially got a new machine after replacing all the hoses," Hinman says.

Ultimately, Eco-Pro has been a most welcome addition to the mold cleaning partnership between Rankine and its top-tier healthcare customer. "We've flushed two or three molds a week now," Hinman adds. "We have a truck going back and forth to that customer and I know they can count on us and the chemical to service all of their molds." Hinman believes that Rankine-Hinman will be expanding this operation soon, and anticipates an additional system to keep up with demand. MMT

FOR MORE INFORMATION

iD Additives
708-588-0081
BWhitaker@idadditives.com
idadditives.com
Bryan Whitaker, Technical Manager

Rankine-Hinman / rankine-mfg.com

By Rick Klein

Ultra-Fast Lasers Make Their Mark on New Automotive Lighting Molds

Edge-lighting lens patterns present moldmaking challenges that ultra-fast femtosecond laser texturing technology can overcome.

Ultra-fast femtosecond laser texturing technology opens the door to new approaches for electric vehicle (EV) lighting lens molds production.
Source (All Images) | Microrelleus (Barcelona, Spain)

The electric vehicle (EV) industry is pushing the design and look of automotive lighting to the edge, so to speak. Instead of conventional headlights and taillights that use multiple bulbs behind specific-size lenses, EV designers are incorporating a new system known as edge-lighting to provide better-controlled lighting and enhanced vehicle visibility along with other design options in terms of aesthetics and functionality. However, the special lens patterns necessary for edge-lighting pose some unique moldmaking challenges that are only overcome with new, ultra-fast femtosecond laser texturing technology.

Solving Edge-Lighting Challenges Super Fast

Edge-lighting systems use internal LEDs around the edges to illuminate the entire lens cover, operating much like a fiber optic. What makes this possible is a special pattern of tiny channels or micro facets textured into the plastic lenses that refract the light. Unlike current vehicle lighting lenses, it is impossible to impart this new pattern onto a mold using conventional milling, chemical etching or even current nanosecond laser texturing processes.

Ultra-fast femtosecond laser texturing technology, on the other hand, creates new approaches to producing EV lighting lens molds as well as those for other applications. In a typical molding cycle, a shop begins by building a prototype of the metal mold. Then, they would apply the desired texture to it, mold the part and test it in an actual lighting assembly to ensure the lens performs as intended. If it doesn't, they have to retexture the mold, produce another lens and test it again, all of which increase time and cost within the product development cycle.

Ultra-fast femtosecond laser texturing generates nearly identical results — sharp facet feature edges without radii — in both plastic and steel workpiece materials. This enables mold builders to mold a test lens without any texturing on it, load the lens into an ultra-fast femtosecond laser texturing machine, apply the texture directly to the plastic lens itself and then test it. If the texture meets specifications, the shop can apply that texture onto the mold for production. This capability eliminates the need to produce a mold for testing and significantly shortens the product development cycle.

In early 2023, an ultra-fast femtosecond laser technology was launched as an option for a new laser texturing product line and some existing laser machine models. While moldmakers have been effectively texturing molds using nanosecond laser technology for quite some time, that type of laser is unable to generate pattern details in actual plastic parts that are as sharp and intricate as with an ultra-fast femtosecond laser.

Ultra-fast femtosecond laser texturing enables mold builders to texture plastic and steel workpieces with sharp facet feature edges, eliminating the need for pre-textured test lenses.

Understanding How it Works

What makes a laser ultra-fast is its pulse width. Essentially, laser texturing is machining with light, and when doing so, the process/application depends on how fast the laser's beam turns on and off — its pulse width.

In sheet metal cutting, for example, the laser stays on constantly to cut. As it does, it creates heat, so for surface texturing, intermediate pulse speeds allow for material removal but without inducing excessive heat into the workpiece. With ultra-fast femtosecond lasers, the pulse on-and-off timing/speed is extremely fast and measured to a number that's 15 decimal places of a second. Such speed also reduces the amount of heat transferred into the workpiece.

Nanosecond lasers typically used for mold texturing generate a heat-affected area and a melted raised portion or burr/deformation that's about 20 microns in height. With conventional femtosecond lasers, there is no heat-affected area, and the burr measures only 0.2 micron. The less deformation there is, the more "crisp" the feature details and the smaller details can be generated.

Making the Switch

For over a year, an automotive supplier beta-tested the ultra-fast femtosecond laser technology in its actual operations. As a result of this technology, the company totally changed its business profile in terms of lighting production.

Prior to lasers, many automotive OEMs and their suppliers produced auto-lighting lens mold textures using milling, EDM or existing laser technology. However, as features/facets continue to shrink in size, those processes become less viable options, mainly because of the time and cost involved. This need for smaller, more precise details or extremely sharp facets, like those required for EV lighting molds, is the driver behind new technology such as ultra-fast femtosecond lasers.

Obviously, there is a cost involved with ultra-fast lasers. Nevertheless, a shop can have an ultra-fast laser texturing system and nanosecond laser as well — having both laser

High Tech Becomes Shy Tech

New EV vehicle edge-lighting systems are part of a growing product design trend known as "shy tech." One major automotive OEM refers to it as a hidden world of interaction and functionality at the user's fingertips.

The goal is to reduce the number of buttons, switches and displays in the vehicle through the use of smart materials and surfaces – many of which involve laser texturing – that allow for interaction with the vehicle's systems through touch. The result is a more modern, clean-looking vehicle cabin environment that's free of clutter.

Product design will focus on people and aesthetics instead of technology. As such, more manufacturers will adopt a less-is-more philosophy.

Using ultra-fast femtosecond lasers, automotive mold builders can generate textures not only for standard interior component molds but also for new, intricate lighting systems.

platforms and capabilities on one machine significantly increases a mold builder's ability to expand its range of applications, making the initial investment well worth it.

For automotive work, these mold and die shops can generate textures not only for standard interior component molds but also for new, intricate lighting systems. These dual-platform machines would enable shops to switch back and forth between laser types and even do so within the same part program if needed.

Beyond EV edge-lighting applications, ultra-fast femtosecond lasers offer mold shops the ability to generate other sophisticated and unique end-product textures or finishes onto molds that were previously impossible or cost-prohibitive.

These include brushed finishes, such as those often found on parts made from stainless steel or nickel, and gloss finishes, used to reduce the appearance of smudges or fingerprints.

These are finishes that would otherwise be achieved through such processes as painting or powder coating. Eliminating or minimizing these secondary processes further reduces product development time and production costs while helping to differentiate end products.

Ultra-fast femtosecond laser texturing technology, on the other hand, creates new approaches to producing EV lighting lens molds.

Other potential applications include any part that requires functional textures, such as those used on medical implants. These surfaces are often key to osseointegration, where the bone fuses with the implant for greater stability.

The faster molds are made, the shorter the product development lead times and the quicker and more cost-effectively companies can get new products to market. Time and money savings mean companies will be more likely to develop even more new and unique products that will, in turn, require additional molds. Since turnaround time and costs are less, more companies will be willing to develop more products.

As this happens, technology suppliers continue to advance laser texturing technology, developing machines with more capabilities through advanced controls, software and laser sources. As a result, these laser texturing machines are faster and able to cost-effectively generate textures, including those that are impossible with other existing conventional processes. MMT

FOR MORE INFORMATION

GF Machining Solutions
800-282-1336 / 847-913-5300
info.gfms.us@georgfischer.com / gfms.com/us
Rich Klein, Technical Sales Manager – Laser, Advanced Manufacturing

(Data courtesy of Reichle Technologiezentrum, Teck, Germany, and Microrelleus, Spain)

By Peggy Malnati

3D Printed Manufacturing Aids Improved Molding Efficiency

Moldmakers and molders turn to 3D printing for end-of-arm tools, fixtures for increased safety and functionality, lower cost and faster turnaround times.

Just as additive manufacturing (AM) is increasingly producing mold components and even molds for plastic and composite parts, another growing use of both metal and plastic/composite additive technologies is to print end-of-arm tooling (EOAT)/end effectors to help molders load materials into tools and remove formed parts from them faster and more efficiently, as well as fixturing parts as they cool or undergo secondary operations. In fact, this growth area has spawned specialist suppliers that design and print EOAT and fixtures and automation companies that largely use AM to produce portions of the equipment they build to automate molding cells. Many different AM technologies are used, and the purposes to which the printed parts are put cover a broad spectrum. Following are some companies doing interesting work in this area.

The design freedom of polymer/composite additive manufacturing (AM) makes it easy to design different front-facing/insert holding (middle left and right) and rear-facing/handle versions (bottom) of the claw manual end-of-arm tooling (EOAT) that Zero Tolerance LLC has produced for its own and customer molding operations. (Middle left shows an unloaded EOAT waiting for inserts and middle right shows inserts preloaded.) Not only did 3D printing a manual EOAT greatly reduce cost versus using a robot, but it increased operator safety and shortened the effective molding cycle time versus loading inserts by hand into the hot mold cavity (top showing operator using the claw to rapidly load inserts). Source | Zero Tolerance LLC

Case Study 1: Zero Tolerance

Zero Tolerance LLC is a toolmaker specializing in the production of high-complexity, tight-tolerance, small-to-medium size injection molds for the medical device, automotive and defense industries. The company also custom injection molds parts ranging from olefins to high-temperature polyamides (PA) for customers in the oil/gas, prototyping and consumer goods markets.

Taking advantage of grants available from the state of Michigan during the pandemic, Zero Tolerance's team acquired an X-7 industrial-grade continuous carbon fiber composite printer from Markforged Inc. and since then has added two additional Markforged models: an Onyx One discontinuous carbon fiber printer and a Mark Two continuous carbon fiber printer. Initially, Zero Tolerance used its printers to produce prototypes and proof of concepts for customers in continuous and discontinuous carbon fiber-reinforced polyamide (PA) and neat polylactic acid (PLA). The team also participated in a distributed manufacturing program called Project Diamond, where participants in multiple locations simultaneously printed the same parts, including protective medical equipment during the pandemic, and later, tourniquets for the war in Ukraine.

> "Although we try to use off-the-shelf automation components whenever possible, having the ability to design a fixture in-house and either print it ourselves or have it printed nearby is a big advantage to us."

Custom injection molder Westec Plastics Corp. operates 23 injection presses (some of which are shown at top) and uses additively manufactured EOAT and fixtures produced on its own in-house printer or those of local service bureaus. Shown on the bottom is an EOAT that pulls molded parts for the consumer segment from a four-cavity injection tool and clips off the runners. Source | Westec Plastics Corp.

A newer use Zero Tolerance has found for its printers is to produce manual (human-, not robot-operated) EOAT. The work started with a molding job the company was running for a customer that involved hand-loading eight 76-millimeter-long brass inserts into a 275°F/135°C tool prior to overmolding. Given the tool temperature (and burn risk for the operator), plus the amount of time it took to hand load each insert between molding cycles (which could extend effective cycle time significantly), co-founder/co-owner Steve Michon says Zero Tolerance initially priced out a robot. However, this wasn't a high-volume molding job that could cost-justify that investment, so he and his team went to work and designed, printed and tested a carbon fiber-reinforced polyphthalamide device they call the "claw."

As the current molding cycle begins, the technician monitoring the press manually slides eight inserts onto fingers on the EOAT. Once the cycle ends, the mold opens and the last set of parts are demolded, the operator positions the hand-held claw against the cavity side of the tool and, using two guide pins that act as locators to ensure proper positioning, pulls a handle,

This inspection assembly fixture — a hybrid of metal and polymer additive technologies — features 3D printed maraging steel (top bronze components with bolts produced via direct metal laser sintering/solidification, or DMLS) and PA12 (lower gray component produced via MultiJet Fusion (MJF) or selective laser sintering (SLS)). Use of both additive technologies helps Linear AMS reduce mass, cost and print time while producing a usable assembly aid much faster than conventionally machined metal would allow.
Source | Linear AMS, a Shapeways Co.

which strips the inserts off the fingers and slides them into position inside the mold. The operator then removes the claw and closes the press, and the next cycle commences as the operator loads another eight inserts into the EOAT.

"For an application like this, proper alignment was critical, so it took us a few iterations — with small design changes in critical areas of the claw — to make sure everything lined up properly," Michon explains. The claw does its job beautifully, increasing operator safety, reducing CAPEX by more than 90% versus a robot and boosting molding throughput by 50%. To date, this EOAT has been used for more than 125,000 molding cycles (producing over 1 million overmolded parts) and only shows minor wear. Since the claw is designed and printed in 15 different pieces, if components wear or break, or a different size finger or a different number of inserts are needed, it's easy to print and replace select components."

"Interestingly, one of our mold customers saw the claw in action in the molding area of our shop and wanted us to design something similar for their molding operations," Michon adds. "We've also printed EOAT to hold parts during pad printing as well as fixtures to hold precision molded parts during CMM [coordinate measurement machine] inspections."

Yet another way Zero Tolerance uses its printers is to produce "dummy" inserts to load into the claw when restarting the press. "Instead of wasting precision-lathed or Swiss-turned brass inserts when we restart our press to run another order of parts, we load printed dummy inserts into the claw and then into the mold, which doesn't know the difference," he adds. "This way, we're throwing out inexpensive material, not costly inserts, until we get our molding process stabilized to run for the day."

Why does Zero Tolerance keep using polymer/composite AM for these types of applications when they have a well-equipped tool shop and can easily machine metal parts? "First, you essentially add capacity in one area of your shop without having to interrupt work in another area just to create a part for an experiment or a proof of concept, and you can produce that part much quicker at a lower cost than machining metals," Michon continues. "Design time is shorter, so you can iterate much faster to prove an idea. With the high-strength carbon fiber-reinforced parts we produce on our Markforged printers, we can achieve our objectives in a much lighter design. That way, even if we were to use a robot to operate the tool instead of a human hand, we could use a smaller robot and it would experience less wear thanks to the EOAT's lower weight. The key is not to be closed-minded and don't assume something won't work until you try it out. Additive manufacturing is just another tool in your moldmaking toolbox. It's not going to do everything, but on the other hand, it's not going to take away anything from what you're already doing."

Case Study 2: Westec Plastics

Westec Plastics Corp. is a 54-year-old custom molder that operates 23 injection presses ranging in size from 28 to 610 U.S. tons/25 to 553 metric tons. Specializing in molding high-temperature engineering thermoplastics for the medical device market in ISO Class 6, 7 and 8 cleanrooms, Westec also serves customers in the consumer and government segments.

The company builds some of the molds it uses and outsources the rest to local toolmakers. As such, it has been

specifying metal AM technology for the last few years for mold inserts with conformal cooling features that toolmakers and local service bureaus produced. Westec recently took possession of the first production metal AM printer from Mantle Inc., so it will now be able to design and print conformally cooled mold inserts in-house.

Additionally, the company has used polymer AM technology for the past seven years — the last four in-house with an Ender 5 Plus fused filament fabrication (FFF) printer from Shenzhen Creality 3D Technology Co. Ltd. Initially, polymer AM was used to prototype parts. Later, use was expanded to produce part fixtures.

Interestingly, it's not moldmaking customers who request Linear's AM molding aids but rather molders themselves.

"We work with a lot of medical customers and they frequently modify designs, so it's really nice to be able to print sample parts and have something physical to hold, as everything looks doable when it's on the [computer] screen," explains Cory Vohs, Westec director of molding. "As we gained experience, we slowly used our printer to try other things, including printing PLA fixtures to hold molded parts for pad printing. Additively manufacturing these parts is certainly faster and less costly than keeping our CNCs running." Vohs adds that simple and smaller fixtures are printed in-house, but external resources produce larger and more complex ones. The company also uses EOAT in conjunction with cobots to help molding technicians quickly and safely demold parts.

"Although we do try to use off-the-shelf automation components whenever possible, having the ability to design a fixture in-house and either print it ourselves or have it printed nearby is a big advantage to us," adds Travis Meeks, Westec vice president of tooling. "This way, we don't have to interrupt our tool shop, and we can get the component much faster and at a lower cost than if we had to wait weeks to have an outside tool shop produce it conventionally. Plus, a polymer additive fixture isn't going to damage our molded parts."

Case Study 3: Linear AMS

Linear AMS, now part of Shapeways Holdings Inc., is a 20-year-old moldmaker turned supplier of metal additive mold components, a custom metal additive components supplier and a custom injection molder serving customers in the automotive, ground transportation, consumer/appliance, industrial, medical, oil/gas, packaging and space/defense markets. Initially, Linear's metal AM focus was on designing and printing conformally cooled/heated mold components like slides, lifters and inserts for its injection molds, and later, those of molding and mold building customers. It added polymer AM capabilities for part prototyping. Subsequently, Linear began printing gages, fixtures and assembly aids for its manufacturing operations, including injection molding, and later for customer needs.

Taking advantage of additive manufacturing's ability to produce lattice structures, which not only reduce mass, material usage and cost and speed printing time, but also increase structural integrity, Linear AMS applies the technique to 3D print inspection fixtures like those shown above. The gray lattice material is PA12 produced on an MJF or SLS printer; the red handles/clamps and bolts are off-the-shelf purchased components; and the silver base plate is conventionally machined aluminum. Source | Linear AMS, a Shapeways Co.

On the metal AM side, the Livonia site has two direct metal laser sintering/solidification (DMLS) printers from EOS GmbH — one that solely prints maraging steel and one that solely prints Inconel (718) — plus an electron beam melting printer from GE Additive that solely prints titanium, and two metal binder jet printers from Desktop Metal Inc. on which are printed 17-4PH and 316-L stainless steel alloys. On the polymer AM side, there are three MultiJet Fusion (MJF) printers from HP Inc. and six selective laser sintering (SLS) printers from EOS. Typical polymer AM materials used include PA11, PA12, polypropylene, thermoplastic elastomer and thermoplastic polyurethane. Other services offered by the company include material jetting, binder jetting, stereolithography and wax casting, as well as conventional subtractive manufacturing.

"Most of our EOAT and fixtures combine both metal and polymer AM components for structural integrity, to address wear items, and to seat assembly fixtures," explains David Myers, Linear AMS senior business development executive. "In fact, we're currently finishing off an inspection assembly fixture that uses a combination of PA12 and maraging steel, as these items can get abused. This enables us to provide a turnkey solution for our customer."

Typical tools the team is printing include press-based robotics for part removal or insertion of hardware into a tool prior to molding, as well as hybrid gages and fixtures. "There are times when you've tried everything you can from a processing and tooling standpoint and you still have warpage," Myers continues. "In cases like that, we use our AM technology and knowledge of thermoplastic materials, injection molding and Kentucky windage to design cooling fixtures that counteract warpage and deliver dimensionally accurate parts." He adds that initially, it was design flexibility and speed of production that encouraged the team to try producing manufacturing aids additively. "The first time we tried this, not everything worked perfectly out of the gate, but the beauty of digitization is how fast you can fine-tune a design and how quickly you can build a digital catalog that can be used to tweak future designs," Myers says. "In fact, we'll often design a print build to include two different design revisions at the same time since we have the real estate in the build chambers to add more parts and this makes finalizing the design quicker and easier. There are so many advantages to getting to market faster."

Interestingly, it's not moldmaking customers who request Linear's AM molding aids but rather molders themselves. "Typically, moldmakers aren't as concerned with downstream processes, but it's the molders who reap the benefits," Myers notes. "Often, because they purchased a mold with conformal cooling, now they can cycle parts much faster, which means that the downstream process isn't keeping up with the upstream portion, so suddenly molders are asking how they can do this task or that faster. We work with them to define the scope of the process, then design manufacturing aids to address that functionality."

> "Additive manufacturing is just another tool in your moldmaking toolbox. It's not going to do everything, but on the other hand, it's not going to take away anything from what you're already doing."

What benefits do AM technologies bring? "There are the obvious things like design flexibility, speed, no scrap and lower cost," Myers adds. "However, there's also the ability to print lattice structures that not only are lighter and faster to print but also improve structural integrity. Also, what we've seen, especially on the metals side, is that AM manufacturing aids will go head-to-head with conventionally produced parts in terms of life expectancy and damage tolerance. You get all that and don't have to wait six weeks to have a component produced conventionally — that's a win-win." MMT

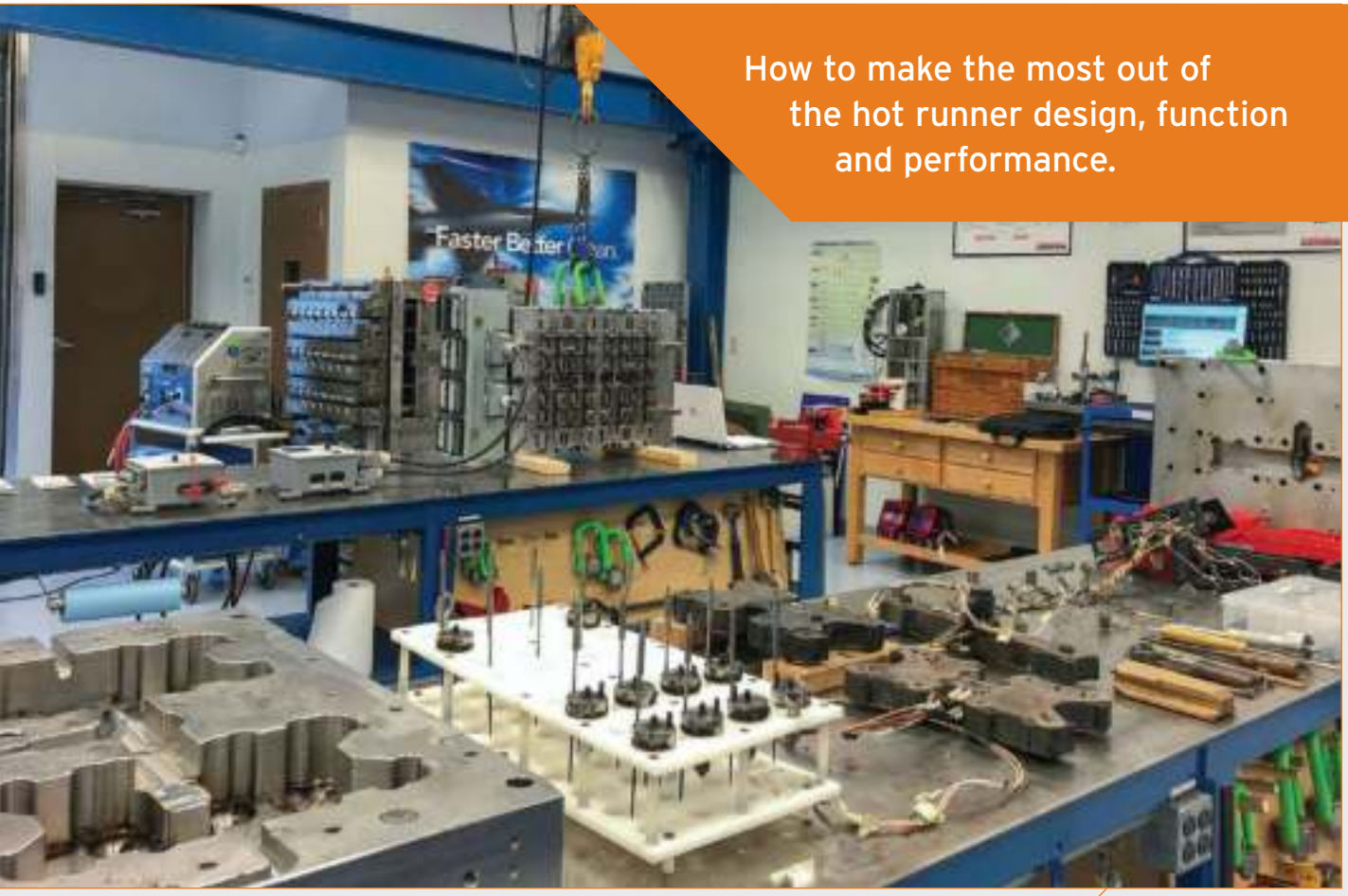
FOR MORE INFORMATION

EOS North America / 877-388-7916 / na.eos.info
Desktop Metal / 78-224-1244 / desktopmetal.com
GE Additive / 844-202-3865 / ge.com/additive
Linear AMS / 734-422-6060 / linearams.com
Mantle / 415-655-3555 / mantle3d.com
Markforged / 866-496-1805 / markforged.com
Westec Plastics / 925-454-3400 / westecplastics.com
Zero Tolerance / 586-630-3032 / zerotolerancecnc.com

By Christina Fuges

What You Need to Know About Hot Runner Systems and How to Optimize Their Performance

How to make the most out of the hot runner design, function and performance.



Hot runner systems involve hot halves/manifolds, nozzles, gates and temperature controllers whose design and maintenance are critical for optimal cycle time, final part quality, long mold life and minimal maintenance. A hot runner maintenance program should involve purchasing, processing and preventive maintenance training.
Source (All Images) | *MMT*

Hands-on learning is without a doubt an effective addition to classroom curricula when it comes to learning about almost anything. To be sure, it is advantageous to those who want to know more about how to care for and optimize the growing number of hot runner systems being used in injection molds everywhere.

Anyone working with these systems understands how complex and critical they are to the successful performance of a mold. There are many factors to consider when it comes to hot runner system maintenance, not the least of which is how to use an ohmmeter — an important tool for measuring electrical resistance in hot runner systems — but here are a few essential considerations from a hot runner maintenance workshop led by MoldTrax in 2019 that still stand today.

Injection molding is not simple, and the hot runner system makes it even more complex.

During the workshop, Steve Johnson, MoldTrax's president at the time, spelled it out. He told attendees that MoldTrax surveyed 12 companies over three years and discovered that the number one mold issue that they deal with, by far, is flash on parts. "The second biggest defect is the hot runner manifold, and breaking it down further, everyone has an encapsulation horror story, but that was not as much of a problem as we expected," he said. Nevertheless, issues with hot runner manifolds ranks number two!

Johnson also told attendees that raising the "maintenance bar" when caring for hot runner molds means developing a higher skill level through:

- Better documentation.
- More knowledge of hot runner function (seal areas, leak points, valve gate operation and so on, to recognize where the critical areas are and to be better troubleshooters, not just tooling replacers.
- It's a crime scene! Read the clues, detect the issues.
- Electrical knowledge — understanding insulation and element resistance testing and monitoring, continuity — replace, splice and more.
- Developing the methodology and bench techniques needed to accurately and safely disassemble, clean, inspect and reassemble a manifold system.
- Acquiring the skills and tools to work more closely (precise measuring, smaller tolerances, coordination, patience, focus).
- Having a keener sense of feel for resistance (the head to hand connection). "You must figure out where the resistance is coming from versus taking the old rawhide hammer and letting her fly," Johnson said. He recommends a more professional approach, including using the right tool for the job and refraining from quick, cheap fixes.

Johnson also touched on the lack of skilled technicians, saying that 2.5 million jobs need to be filled today. "Companies are losing business opportunities because they don't go anywhere near hot runner repair or maintenance or they are sending the work out." He added that "joystickers" (young adults who are into playing video games) are lacking in mechanical knowledge and they need guidance and training, but they do have a higher comfort level with digital tools, which can be an advantage.

Once a manifold hits the bench, a toolroom technician should take ohms readings of all thermocouples (T/Cs) and heaters.

Lean on those who know because you can't understand everything.

Seek knowledgeable minds in hot runner and molding technologies that understand the latest hot runner system technologies, how to make more informed manifold choices, what to know when reviewing hot runner applications and more.

The following are a few tips and takeaways from presentations by DME, Husky, Mold-Masters, Synventive and Yudo. These are intended to be "food for thought" when addressing hot runner designs and challenges:

- You can have a beautifully constructed manifold and great material, but if your nozzle wells and your tips do not interact the same way, you are going to have relative shear differences. Your cavities are not going to fill properly.

Tips for Using an Ohmmeter

- Get a self-regulating ohmeter.
- Don't buy a cheap one.
- Use it on every hot runner mold that lands on your bench. Practice makes perfect.
- Make sure it is equipped with overload protection, and a large, easy-to-read screen in daylight or a dark display.
- Ensure it has a rugged case that can take a drop.
- Make sure it has long, easily stored leads and offers audible alerts.
- Use the controller (incrementally or via a smart controller) to set a recipe for a soft start.
- Use a soft start (intervals) when heating everything up as the manifold heats up differently from other components.
- Perform an organized disassembly, so the right heater goes back in the right cavity.

Courtesy of Fast Heat by Spark Industries

- Flash is primarily caused by heat, pressure or tool damage. If a flash condition exists with little to no hold pressure applied, inspect the mold for damage.
- Sink can be caused by heat, underpacking or overpacking a part. It is often attributed to a part design issue as well.
- Burns (indicated by streaks or color swirl) and trapped gas are generally related to poor venting conditions or to shear heat that is created by filling cavities too quickly.
- Cascade filling can lead to sudden flow-front accelerations and stagnations, causing defects, including halos, witness lines, blemishes and others.
- Hot runner cable upkeep is paramount to proper setup. Cables should be inspected every change for crimps and plug wear/breakage. Repair or replace damaged plugs and wiring to prevent their use in setup events. This will help to avoid downtime.
- Marrying the hot runner controller to the molding press is highly recommended because two identical units can perform differently. So, for the sake of process repeatability, it is best to use the same controller every time.
- Precise temperature control means no more than a 1°F variation.
- Cleanliness is the biggest reason why hot runner technology is moving to servo/electrification, but it also enables more precision, better efficiencies and more reliable operation.
- Networking (connectivity, as in Industry 4.0) is something that our industry is way behind on, but it is coming.
- Few people calibrate their temperature controllers, but they should.
- Using a temperature controller as a diagnostic tool can save time and make root cause troubleshooting much easier.

Collect, analyze and use data to make decisions that will improve mold and part quality and performance.

While this is good advice for overall mold maintenance and repair, it was also emphasized by various speakers during the hot runner conference. Rich Oles of Alba Enterprises said, "Assume nothing, check everything. Assess the issue and validate everything — everything that you are going to use as a basis, it is your responsibility to go down to the baseline and get everything documented. Develop a logical thought process on the 'why' with a foundation based on what could be causing it in order to determine a goal for fixing what's wrong. A shotgun approach to fixing any issues is not the right approach if you want to sustain the effects of the solution and keep that mold running optimally."

"Documentation of a mold's production and maintenance history is so important," Johnson added. "Every bench should have a docking station for a computer to make the documentation process more convenient and quicker. If you want tradesmen to use data, you better make it easy for them."

Ohmeters test T/Cs and heaters for proper ohms and insulation resistance.

Tips for Testing Thermocouples:

- Put your multimeter in the ohms range.
- Thermocouples (T/Cs) are the feedback loop for the temperature of a manifold.
- Read the temperature by measuring the difference in expansion between two dissimilar metals.
- Only the tip of the T/C matters when measuring.
- Note that the resistance value increases with T/C wire length.
- Zero ohms is the ideal value but typically it will read about 2-10 ohms with 40 inches of lead wire.
- Standard T/Cs come with red (+) and blue (-) wire colors.
- North American T/Cs come with white (+) and red (-) wire colors.
- A magnet will be attracted to the positive lead of the T/C.
- When testing connectivity between the positive and negative leads, keep in mind that the audible alarm will not work, as the T/C will be grounded.
- Map and document the mold wiring of the T/C, then use the data to predict when heaters may fail and when to perform some action on the bench before running the mold in the machine.

Courtesy of Fast Heat by Spark Industries

Johnson has contributed many informative features for *MMT* over the years, and many of these address the importance of documentation and proactive mold maintenance best practices. To read more about how and why he believes it is so critical (one reason is because it can save companies a lot of money), you can find his columns (older and newer — all relevant) primarily under Across the Bench and under Maintenance Matters.

An understanding of velocity and the viscosity curve is vital to improving the mold design, molding process and final part.

In addition to Oles, processing guru John Bozzelli and Bill Hartwick of Filter Specialties Inc. also spoke, providing relevant insights into scientific molding as it pertains to hot runner systems and their design, walking attendees through the "pellet to part" process and noting important aspects that influence the success or failure of part production.

Specifically, Oles, Bozzelli and Harwick addressed the fundamentals

of troubleshooting melt delivery systems, whether a hot runner or cold runner. Oles began by saying that any time he presents at an event like this, attendees are curious and want to know what the best temperature settings for optimum melt delivery are. "I tell them that every case is unique. Each application has a different volume, a different part geometry, a different press and screw configuration, different valve size and manifold configuration and so on. All of these things contribute to the end result," he said. "If you try to pull one part or aspect out of the equation and make it standard, you will fail."

Specialized equipment used in conjunction with mold maintenance training courses created and hosted by Steve Johnson, owner and founder of MoldTrax, was acquired by the American Injection Molding (AIM) Institute in July 2023, which is a member of the Beaumont Family of Companies (including Beaumont Technologies).

T/Cs are the feedback loop for the temperature of a manifold.

Oles went on to explain that plastic is a non-Newtonian fluid, meaning that its viscosity changes during the injection molding process. What is viscosity? It is the plastic's resistance to flow. High viscosity means the plastic flows like honey, very slowly, while low-viscosity plastic flows freely, almost like water. Additionally, shear is the change in viscosity that happens when one layer of polymer slides against another layer of polymer. Shear rate is determined by the volume of plastic that is flowing through a fixed vessel (the melt delivery system). The higher the shear rate, the lower the plastic material's viscosity becomes. Heat, and how it is applied, directly affects viscosity and the overall melt condition of the plastic.

"You have to understand how plastic behaves," Bozzelli said, referring to a graph showing a typical velocity curve. "This curve starts out very, very stiff, and as you get it to flow, the faster you go, the more the molecules line up and the easier it flows. This is counterintuitive, but plastic is kinder and gentler, filling the mold reasonably fast." This is especially important when one is dealing with a multi-cavity mold, he said, because viscosity from one cavity to another can be very different, as can the pack and hold stage in each cavity. "Make sure you do a proper investigation for every mold, and if at all possible, conduct a head-to-head same mold comparison with someone who truly knows scientific molding and knows how to process."

"How many times have you been at a machine and said, 'This is my problem,' and stopped looking for any other possible causes?" Oles added. "Consider what John just said and avoid evaluating on bogus data."

If you have a well-established and validated process, you can assess new technology based on that process. However, without understanding what you are evaluating or collecting data and measurements over time, including ohm ratings, you may encounter difficulties in production. MMT

FOR MORE INFORMATION

American Injection Molding (AIM) Institute
866-344-9694 / gkeith@aim.institute
dhoffman@aim.institute / aim.institute / aim.institute/courses/mold-maintenance-courses/
Glenn Keith, Instructor, Mold Maintenance
David A. Hoffman, Director and Instructor

Moldmaking Activity Has Contracted in a Desirable Direction

April – 48.3

The Gardner Business Index (GBI) Moldmaking ended April at a reading of 48.3, up 0.7 points from March, indicating that moldmaking activity contracted at a slower rate. This was driven primarily by slowed contraction of key components, new orders and production.

These components were not the only ones experiencing slowed contraction, however. Backlog has maintained this activity for three months in a row now, and continues to do so at an increasing rate, which is not surprising given the nature of the metric (backlog generally lags new orders and production).

Employment and exports hummed along at steadily contracting rates while supplier deliveries lengthened just a little faster again in April.

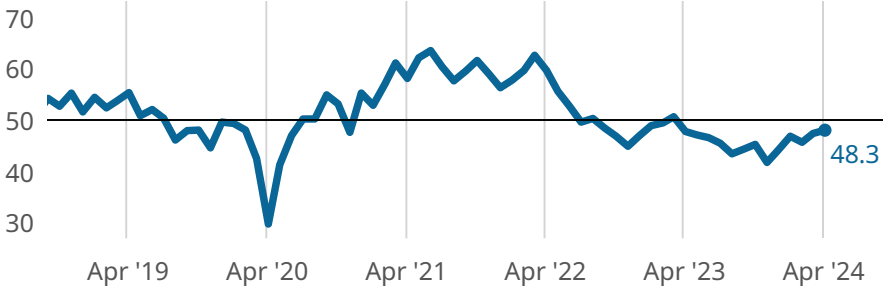
A bit concerning is that in April, expectations for future business (not part of the GBI calculation), while still positive, and at a reading higher than it has been in almost two years, accelerated a little slower for the second month in a row.

Nevertheless, April remained a month with mostly positive signs in moldmaking activity, such that (once again) the overall index crossing into expansion should not be out of the realm of possibility in the near future. MMT

ABOUT THE AUTHOR

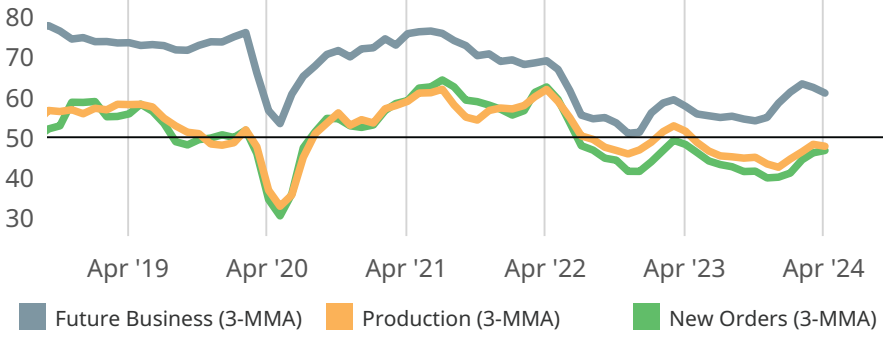
Jan Schafer, MBA, is the director of market research for Gardner Intelligence, a division of Gardner Business Media (Cincinnati, Ohio, U.S.). She has been an essential part of Gardner Intelligence for over five years, and has led research and analysis in various industries for over 30 years. Jan is available at jschafer@gardnerweb.com

Gardner Business Index (GBI): Moldmaking



The moldmaking index continues to inch toward a reading of 50, up 0.7 points in April. Source (All Images) | Gardner Intelligence

Future Business, Production and New Orders (Three-Month Moving Average)



April's slowed contraction in new orders and production drove slowed contraction for the total index.

**The further away a reading is from 50 the greater the magnitude of change in business activity.*

#ICYMI

Content you may have missed. Read full stories with the QR codes provided. (This content is collected based on analytics and represents a variety of content and topics such as videos, products, features, etc.)

Mentorship Matters: A Fresh Perspective from a Young Female Newcomer to a Mature Male-Dominated Industry

Jane Huot, a 23-year-old mold designer and project manager, celebrated her one-year anniversary with Accede Mold & Tool by going on her first business trip to a conference geared for women in plastics and shadowing sales on customer visits.

30 Under 30 Honoree, Journeyman and Apprentice Moldmakers Tag Team to Talk Continuous Learning and Doing

Editorial director Christina Fuges brings on Superior Tooling's journeyman moldmaker Ben Johnson and apprentice moldmaker Isaac Wier as guests for this video interview to share their common paths into moldmaking, current challenges, continuous learning opportunities and future ambitions.

On-Machine Inspection Eliminates Machine Interruption

Jingdiao's online measurement and intelligent modification technology measures parts on the machine, eliminating interruption of the continuous production process.

How Moldmakers Impact New Product Development

Dynamic Tool Corp. discusses the mold builder's role in defining injection molds to support new product development with *MMT*'s Christina Fuges.

Benefits of Simulation to the Mold Builder, Molder

Mike Skaja, a technical sales representative at Sigmasoft Virtual Molding,

discusses the value of simulation in the moldmaking process.

5 in 5 with StackTeck

Leading mold builders reveals five best practices for improving efficiencies in culture, technology, process, measuring success and staying competitive... in five minutes.

WEBINAR: Rapid Variant Analysis: A Better Way of Working With Simulation

In plastic injection molding, it's a good idea to test different design ideas on the computer before making the parts and molds. This trial-and-error way of doing simulation is quickly becoming obsolete. There is a better way.

Outlook for Automation in 2024

I want to share an article I found that discusses the reasons manufacturers should adopt automation in 2024 as a strategic response to global uncertainties, reshoring requirements, labor shortages and the pursuit of increased productivity.

FAQs

SURFACE TREATMENT

Commonly asked questions about the various technologies, processes and strategies used in moldmaking along with their answers and additional sources of information.

Source | St. Paul Engraving

Q: What are the steps to follow when using laser texturing off of 3D CAD data?

A:

1. Start with a mold or part design as an .stp or .iges file and select the surfaces to be textured. A colored CAD model or print indicating the surfaces speeds up the process.
2. Create and flatten a mesh from the surfaces to apply the texture. Using high-resolution grayscale images, apply the pattern to the mesh to achieve seamless patterns with minimal deformation on complex geometries. Textures can be industry standard, created from CAD data or custom designed.
3. Next, create renderings of the finished part to enable designers to apply final adjustments before laser texturing the mold.

The Impact of Laser Technology Advancements on Moldmaking

Q: How does peening achieve automated mold polishing?

A: Peening is the process of working a metal's surface to improve its material properties, using mechanical means, such as hammering, blasting with shots (shot peening) or blasting of light beams (laser peening).

Today, this process can use automation to hammer and control each point of impact. An electronically controlled hammer head produces machine-hammer peening, and a CNC machine or a robot controls the head positioning, executing CAM software that is programmed specifically for peening applications.

Source | Accurapuls Canada Inc.

Machine Hammer Peening Automates Mold Polishing

Source | Custom Etch Inc.

Q: How do digital mold textures fit into Industry 4.0?

A: Digital textures play a vital role in Industry 4.0 by delivering product digitization that illuminates more about the manufacturing process and business. This digitally scanned data eliminates manual documentation and human error of vital product information. For example, tracking product transportation.

Five-Axis Laser Machining Makes Digital Mold Textures Possible

Q: How do you fix a scuff in a micro texture?

A: Most textures can be reglossed at least once and still maintain 95% of the original profiles, as long as the technician is trained in the process. Overly aggressive sandblasting can and does damage textures.

Understanding Texture Repair

Source | Mold-Tech

Q: What is dry ice cleaning?

A: Dry ice cleaning is a dry process and is nonconductive, enabling it to be used to clean equipment while it is still hot, eliminating timely cool-down and reheating periods. Dry ice cleaning is also non-abrasive and will not damage or dull molds.

Mold Cleaning Beyond Conventional Methods

Source | Cold Jet LLC

For more information, visit each FAQ's original article with the QR code provided.

ADVERTISERS' INDEX

TIP

SURFACE TREATMENT

Understanding Diamond Compounds

By James Gaultier

Diamond compounds, whether oil- or water-soluble, offer an ideal solution for polishing a diverse range of hard and soft materials in moldmaking. These compounds, sometimes referred to as "diamond pastes" in professional circles, play a crucial role in achieving precise and superior finishes across various applications.

The meticulous combination of natural and/or synthetic diamond particles with a water- or oil-soluble base creates a highly effective polishing medium. This blend ensures optimal cutting capabilities and superior finishing results. To maintain consistent quality and facilitate easy application, diamond compounds are conveniently packaged in syringes.

Professionals in mold and die polishing frequently turn to diamond compounds for final or mirror-finishing applications. These compounds prove versatile and suitable for a broad spectrum of materials that require quick stock removal, pre-polish lapping, pre-polishing and final polishing. Tailored to meet the demands of different metals, diamond compounds are available in various precision levels.

Four Compound Types

1. *Versatile diamond compounds* are available in a wide variety of concentrations and grades to meet the needs of most applications. They are specially engineered for precision finishing for all types of mold and die applications. Consistent particle distribution and a wide thermal processing range enable them to be used under the most demanding conditions. This compound type consists of a precise blend of synthetic diamond particles, resulting in an aggressive yet cost-effective product.

2. *Premium diamond compounds* are an option for all applications with fast cut rates and optimized surface finishing. A precise natural diamond blend in a medium-heavy concentration gives it a toughness, durability and cutting capability to generate the best possible finishing results.

3. *Economical diamond compounds* are an option for general-use mold and die applications. A blend of synthetic diamond particles and a large thermal processing range enable them to be used under extremely demanding conditions.

4. *Fast cutting and superior finishing diamond compounds* are a precise blend of natural and synthetic diamond particles that are sharp, blocky and equal in size, resulting in excellent finishes quickly. They are available in grades ranging from the finest finish to stock removal to tool mark removal and everything in between.

Diamond polishing compound options are available for hard or soft metals requiring different levels of precision. Source | Boride Engineered Abrasives

Diamond compounds are graded to cater to specific polishing needs. Lower grades, such as one or smaller, excel in creating a final, fine finish. In contrast, higher grades, like 25 or above, are designed for stock removal or earlier polishing stages. The choice between these grades depends on the precision requirements of the task at hand.

The base of the diamond compound, whether oil or water, also plays a crucial role in its performance. Oil-based compounds offer improved adherence to the surface and enable increased heat during polishing without causing damage. Water-based compounds, on the other hand, facilitate easier cleaning post-polishing and are preferred for molds set to be coated. In most cases, polishers opt for oil-based diamond compounds due to their advantageous properties.

The color of diamond compounds corresponds to their grades, aiding users in quick identification. Darker colors like black, brown and purple are indicative of compounds suited for stock removal, while lighter colors like white, light gray and yellow are associated with smaller grades for final polishing. Multiple grades and colors are available for each diamond compound, providing flexibility based on the specific application.

Diamond compounds, with their varied grades, colors and base options, provide a comprehensive solution for professionals in need of precise and superior polishing across diverse materials and applications. MMT

FOR MORE INFORMATION

Boride Engineered Abrasives
231-929-2121 / lmurphy@borideabrasives.com
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