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Leveraging CAD/CAM Advances PG 12.

Cutting Tool Data When You Need It PG 22.

Supplier-based Training Fuels Mold Industry Needs PG 30.

Welding Pre-hardened 40 Rockwell Material PG 72.

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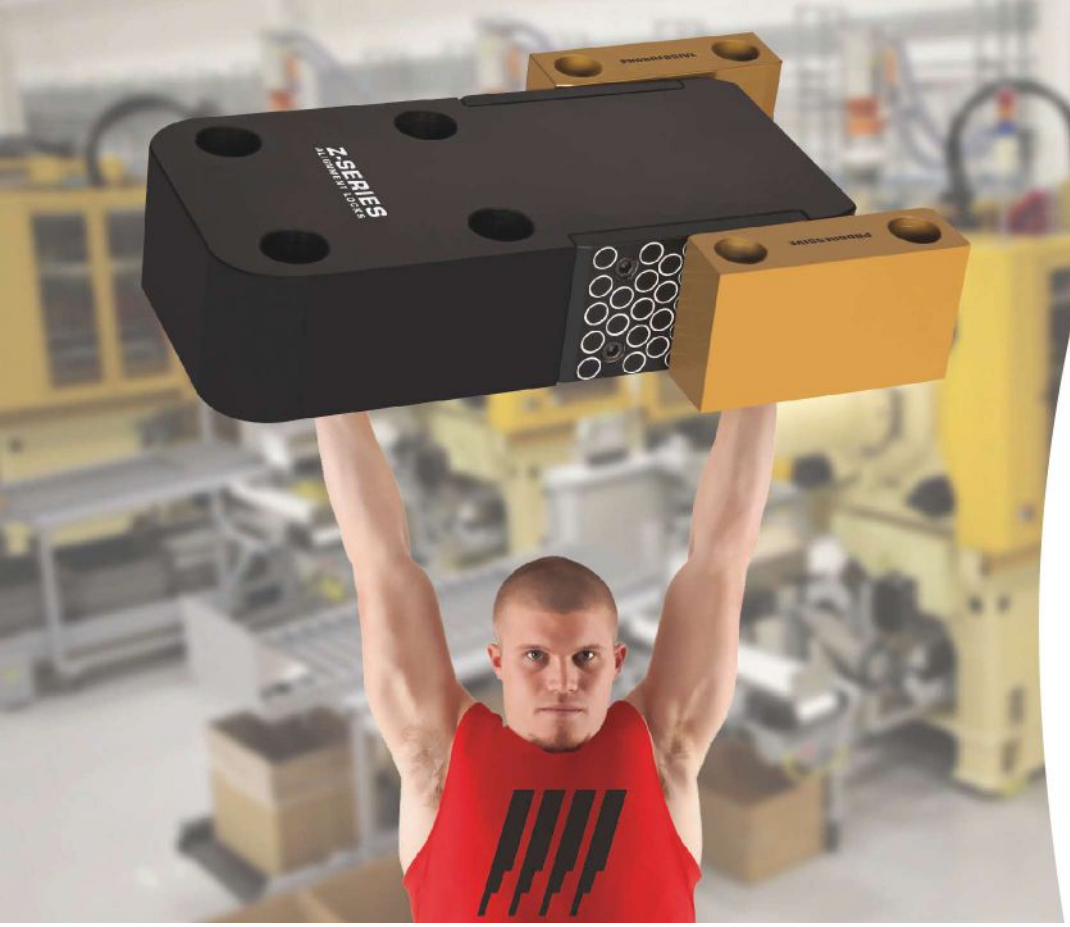

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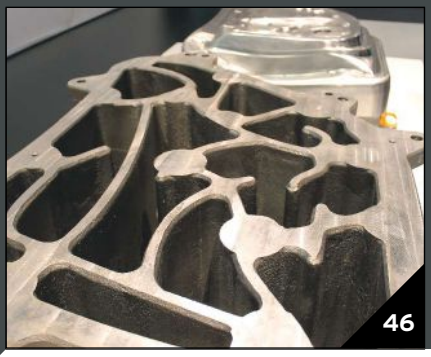
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30 **Education/Training**

This article is part of a series highlighting ways organizations are shaping the next generation of manufacturing professionals.

Supplier-Based Training Programs Fuel Mold Industry Needs
Moldmaking industry supplier companies are establishing workforce development programs to help increase the flow of new talent for themselves and for the industry at large.

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ON THE COVER

Image courtesy of CNC Software/Mastercam. This month's cover shows a partially programmed mold core. It's machined from 420 stainless steel and will eventually become a housing for a medical filtering system. The darker tool motion in the image illustrates a variety of strategies, including Mastercam's Dynamic Motion and remaining stock cleanup. The lighter tool motion with the tool is the beginning of a multi-axis finish pass that uses one of the newer-shaped cutting tools that are coming onto the market and delivers a very large radius cutting surface for faster machining and a cleaner finish. Moldmakers who use contemporary toolpath strategies that maintain a consistent chip thickness report a substantial positive impact on lead times and operating costs, and this cutting strategy is a relatively easy approach that a mold shop can take to become more competitive. See related story on **page 12**.

Images (left to right) courtesy of CGTech, Extreme Wire EDM Service Inc. and Audi Toolmaking.

VIDEO ACCESS

5 TRICKS OF THE TRADE
Great Tips from This Issue

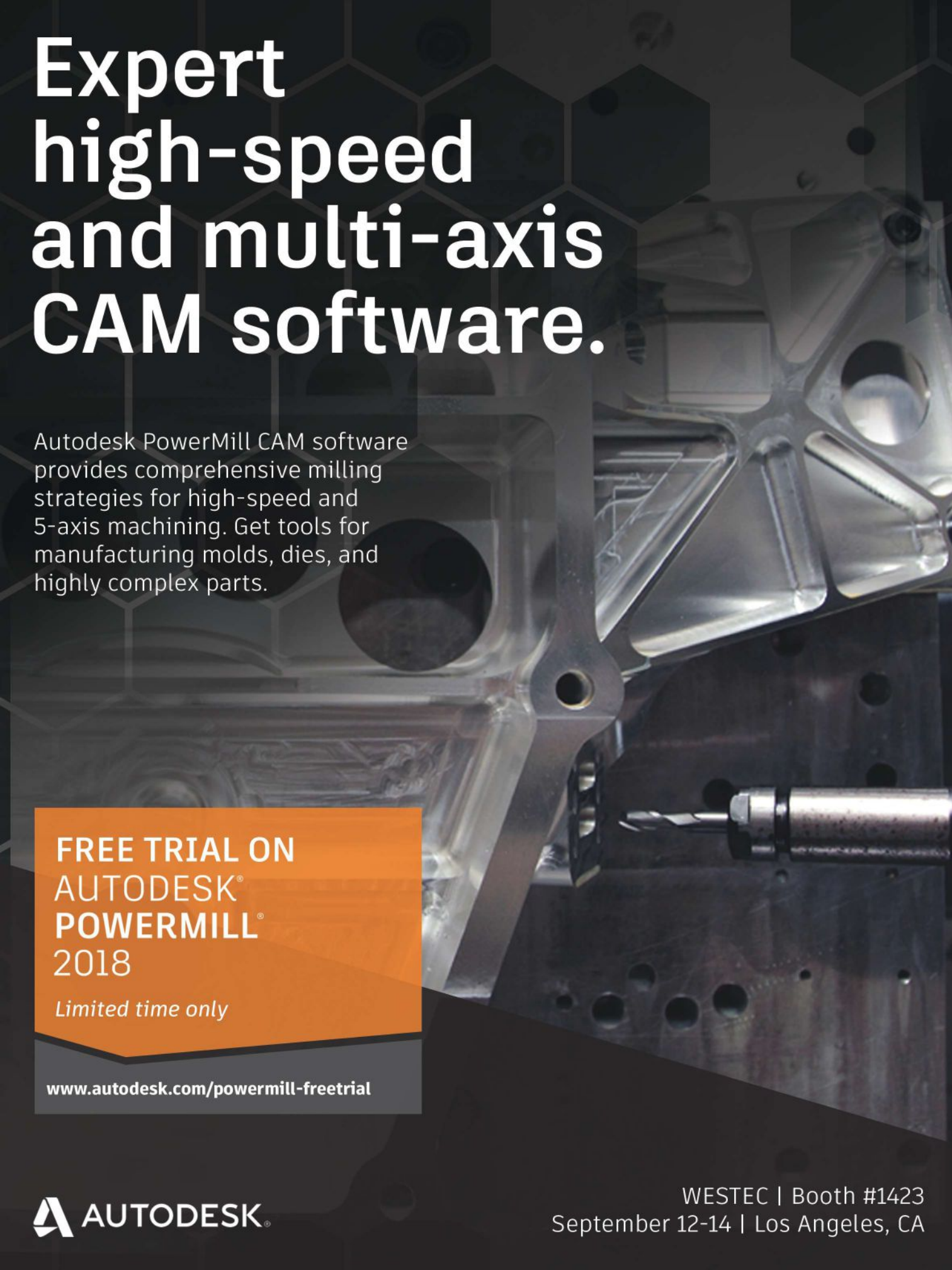
1. Safety First
It is important to recognize the fact that a safe robot does not mean a safe *system*. You need to consider the *overall* expense of cobot implementation.
PG. 18.

2. At The Center
A centralized database can replace the cost of all homegrown systems or silos that require maintenance, so total cost of ownership is reduced.
PG. 22.

3. Be Aware
Molds and processes are not the only "gotchas" when leaving a foreign location. Companies must also consider employment contracts and must obtain the proper permits from the Chinese government to shut down a factory.
PG. 26.

4. Getting Hands On
An emphasis on project-based learning is key when training because collaboration and creativity are a big part of how injection molded parts are designed.
PG. 30.

5. Clean It Up
When you are ready to begin your weld on pre-hardened 40 Rockwell material, ensure that the mold is free of oil, rust, scale residue or any other potential contaminants.
PG. 72.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Apprentice Success

Last year I met Nick Carroll, who at the time was a technical sales apprentice at Edro Specialty Steels in Conshohocken, Pennsylvania. Nick and I discussed his background and perspective on the apprenticeship program, which was new. What stood out to me was how Edro encouraged him to participate in crafting the program as he advanced through it.

This past June, I bumped into Nick at Amerimold. I learned that he is employed full-time now at Edro working in outside sales and managing the northeast accounts. Because this month's feature is on supplier-based training programs (page 30), which includes a snapshot of Edro's current efforts, I thought it was appropriate to share with you where Nick is today.

"Coming out of college, I knew it would be tough learning a new industry and starting a career. This program gave me the ability to learn the moldmaking industry from every angle over the course of a year and a half before working alone on outside sales. When I finally took over a budgeted territory for sales, I felt very prepared," Nick says.

While the program has been restructured a bit and uses some new training materials, the philosophy remains the same. They maintain an open program that introduces apprentices to every part of the business as they work with all team members and develop projects they would like to work on that could help the company. This gives each apprentice a chance to structure his or her own program with the help of management.

Throughout his time in the program, Nick submitted weekly reports detailing what he was learning and which parts of the program needed improving. Mike Guscott, who continues to manage the program, actively listened to his suggestions. "I believe the best aspect of our program is that management is always listening to the ideas and thoughts of our apprentices. This makes everyone feel part of the team right from the start," he said.

Today, Nick attends career fairs at local universities to hire new apprentices. He conducts initial interviews and takes apprentices on sales trips. Although his apprenticeship is over, he still receives regular training when he travels with other members of the sales team and visits mills, sister companies and attends trade shows.

When I asked him about future plans, Nick noted it was a difficult question to answer. "I am still learning what I enjoy doing the most. The nice thing about this program and working with Edro is that I am free to explore opportunities within the company. So, for now, I will continue to enjoy my work in sales and see what the future holds," he said.

If you have a successful apprenticeship program or apprentice, reach out to me at cfuges@gardnerweb.com so we can continue to share what is new and what works in training and workforce development. MMT

Christina Fuges

Christina M. Fuges
Editorial Director

Follow MMT on: Follow @MMT_ChristinaF

THIS MONTH ON moldmakingtechnology.com

VIDEO: Improving Machining Accuracy

This video demonstrates how position measurement in the feed drives plays a central role in stabilizing the thermal behavior of machine tools.
short.moldmakingtechnology.com/accuracy

BLOG: Invest in Die/Mold Automation

Investing in new technology and automation makes it possible for this mold shop owner to innovatively meet customer demands for shorter lead times, more complex designs and tighter tolerances.
short.moldmakingtechnology.com/investauto

ZONE: Leadtime Leader Awards: Honoring Excellence in Mold Manufacturing

Read about past Leadtime Leader winners, get a virtual look inside winning shops, check out the benefits and rewards, learn about the criteria, comb through some FAQs, review the questionnaire and nominate your shop today!
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EVENTS: Additive Manufacturing Conference 2017

AMC returns to the site of its largest event—Knoxville, Tennessee. From October 10-12, 2017, AMC will benefit from the innovation and participation of returning guest Oak Ridge National Laboratory.
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2017 Editorial Advisory Board

Francine Petrucci
President
B A Die Mold
Aurora, Illinois

Francine Petrucci is president and co-owner of B A Die Mold Inc. in Aurora, Illinois. B A Die Mold is a full-service, Tier 1 and Tier 2 supplier of small- to medium-sized, highly complex molds for customers in the medical device, water filtration, automotive and home appliance industries. The company specializes in the manufacturing of unscrewing molds for threaded parts. B A Die Mold possesses a patent for its Programmable Electric Rotating Core (PERC) System, which exemplifies the company's expertise in this area. Francine is a second-generation leader of her company. Her dad, Alan Petrucci, is the company's founder. She'll tell you that from a very early age, she knew she loved this industry and would one day pursue a career in it.

After high school, Francine enrolled in the engineering program at Northern Illinois University. She graduated with honors as one of very few female engineers from the School of Engineering. She then joined the team at B A Die Mold, working in the shop's CNC and quality assurance departments before moving on to administrative duties and office management. Today, as part owner and company president, Francine oversees general corporate management, building and equipment management/maintenance, corporate marketing and customer relations.

Francine is as committed to the moldmaking industry as she is to B A Die Mold. She has volunteered in several capacities with the American Mold Builders Association's Chicago Chapter, which included four years as president, a role from which she recently stepped down. During her tenure, she led the creation of the chapter's Education Committee, which educates students, parents and teachers about viable careers in mold manufacturing. She continues to be very active with the Chicago AMBA and now sits on the advisory board for West Aurora High School's new Advanced Manufacturing program.

Francine says she is proud to be an *MMT* EAB member. As a woman who owns a mold manufacturing company, she is happy to have a new avenue for promoting careers in moldmaking to other women who have that "maker mindset." "I'm also excited by the opportunity to meet and share ideas about best practices/lean, workforce development and automation with my fellow mold manufacturing professionals (and enthusiasts) from around the United States and Canada," she says. In her spare time, Francine enjoys reading, shooting, volunteering and spending time with Rufus, her German Shorthaired Pointer. Visit the "Women Impacting Moldmaking" page at *MMT* online to read more about Francine Petrucci and other women influencing positive change in the industry. MMT

EDITORIAL ADVISORY BOARD (EAB)

The EAB enhances the standing of the publication and strengthens its professional integrity through the active involvement of its members.

The Board represents all aspects of the mold manufacturing industry with a balance of moldmakers, molders, original equipment manufacturers and academia, and various moldmaking segments and job functions. A member is selected based on his or her experience and knowledge of the moldmaking industry to serve a three-year term.

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Primary topics:
- Conformal Cooling
- Thermal Management
- Mold Efficiency
- Conformal Cooling Maintenance

David is a Senior Product Manager with DME.

David holds a MBA in International Business and marketing from Wayne State University and a Bachelor of Science Electrical Engineering degree from the University of Michigan. With 20 years management and leadership experience, David has achievements in product management, high-tech programs, sales, and engineering in the automotive, automation, and industrial markets. David has honed his skills during his career working for industry leader Honeywell, and ABB corporations.

DATE & TIME:

Tuesday, Oct. 3, 2017, 2 pm EDT (1 hour duration)

Register at: http://short.moldmakingtechnology.com/Milacron10

A Conversation with ...

Big 3 Precision Products Inc.

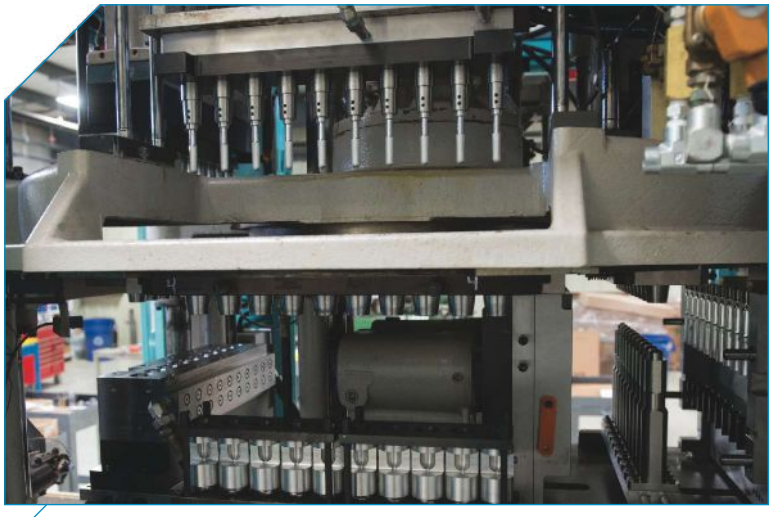

Image courtesy of Big 3 Precision Products Inc.

Big 3 Precision Products designed and built this 10-cavity injection stretch blow mold, which is installed in the customer's Nissei 70 DPH molding machine. Big 3 built this tool specifically for its customer's Nissei. Big 3 qualified it on its own and matched the Nissei 70 DPH in the Big 3 ISBM validation lab in Centralia, Illinois before shipment. This process is part of how Big 3 serves as a turn-key solutions provider in the blow mold tooling industry.

Over the last 15 years, Big 3 has made several moves to expand, including being acquired by TVV Capital, acquiring other companies and forming strategic partnerships. How has this affected the way Big 3 operates and serves its customers?

Todd Riley, COO: In 2001, founder and CEO Alan Schedit and a team of successful industry veterans formed the injection stretch blow mold (ISBM) group. In 2003, we acquired a well-established Injection Blow Mold (IBM) tool group and its facility in Millville, New Jersey, from the Alcan Plastics Group. In 2006, we acquired the world class design team known as R. J. Abramo Associates Inc., located in Holliston, Massachusetts. In 2012, the Nashville, Tennessee-based private equity firm TVV Capital acquired us. Earlier this year, we partnered with Fuseneo Inc., a structural design firm comprising industrial designers, graphic designers and engineers. We feel that partnership gave us a competitive advantage by ensuring that the product design is creative, innovative and manufacturable.

We put these partnerships together to be the best "turn-key-solutions provider" in the industry. We are willing to take responsibility for the projects that we undertake by offering end-to-end service capabilities, which is uncommon in IBM and ISBM. Instead of one company designing the bottle, another designing the tool, another building the mold and maybe yet another sampling it, we eliminate the "silo" approach. There is no throwing a project over the wall, because we can do it all ourselves.

Many mold manufacturers struggle to overcome cost objections. How does Big 3 get customers past those objections and on to approving projects?

Riley: We have worked diligently to explain what we do, how we do it and what they can expect in terms of quality when they do business with us. We tell customers not to focus on the initial price. Instead, we tell them to look closely at the value over the life of the project. Typically, any well-trained purchasing agent will want to discuss the tooling price on a quote. It is our responsibility to explain that the tooling that we have quoted is of quality and will last for the life of the project. We use the best quality steel and materials that money can buy. We provide evaluations and quotes within 48 hours, and we perform project kick-off meetings and design reviews before engineering is released to ensure that we meet customer expectations. We have a

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- Founded in 1970 as a small machine shop in rural Illinois and is now headquartered in Centralia, Illinois.
- Has a total of four design, manufacturing and product validation facilities in the United States with more than 250 employees companywide.
- Has a title (Big 3 Precision Products) that refers to the company's main blow-mold manufacturing business plus its two divisions, Metal Stamping and Rack/Material Handling (for the automotive industry).
- Builds injection blow molds (IBM), one- and two-step injection stretch blow molds (ISBM) and extrusion blow molds and offers product development and preform design capabilities as well as sampling and in-field mold startups for customers in the household/personal products, nutrition/drinkable, and pharmaceutical/medical industries.

product development and validation lab, and we can provide quality analysis reports verifying that our tools are built to specified tolerances.

One of the largest blow molders in the world audited us recently. They told us that of all their tooling providers, we ranked the highest in quality, support, service, value and on-time delivery—not just in tooling types that we provide, but out of everyone. It was a great honor.

Millions of dollars have been invested in equipment for mold qualifications. Explain what Big 3 currently uses and why such an emphasis is placed on this aspect.

Riley: Big 3 Precision has invested several million dollars over the past 10 years in the latest, state-of-the-art IBM and ISBM molding machines to eliminate any doubt and to deliver what we promised. For example, for the one-step ISBM process, we use three Nissei machines, including a ASB-70DPH, ASB-250HT and ASB-50MB. We also provide a Sidel SBO-1 Reheat Stretch Blow Molding lab machine for the two-step reheat and blow ISBM process. Our Nissei 70 DPH is housed in our Centralia, Illinois plant, and it is identical to one a customer owns. We design and build this customer's molds and then validate them on our Nissei so that when we deliver those molds, we know exactly how it will perform in their Nissei.

To qualify injection blow molds, Big 3 has three Jomar machines (a 40-ton, 115-ton and 135-ton), three Uniloy machines (a 54-3-ton co-injection machine, an 88-ton and a 199-3-ton machine) and a custom-built, Big 3 BMP 145-ton molding machine for qualifying molds. We recently designed and built a mold specifically so that it could run in a customer's Uniloy 135-ton machine. We have the same machine in our Millville, New Jersey, facility so we can qualify the tool before it's delivered.

While we don't have a molding machine to match every customer's own molding machine, the purpose of our continued investment in this equipment is to establish Big 3 as the best "turnkey solutions provider" to our customers. Not only do we use this equipment to develop units and concepts, but we qualify production tools as well. Our customers take comfort knowing that when their tools arrive at their plants, they will install properly, and they will process as expected. It is also reassuring to the customer that we have already established and met the QA data. MMT

By Ben Mund

VIDEO Access video at end of article.

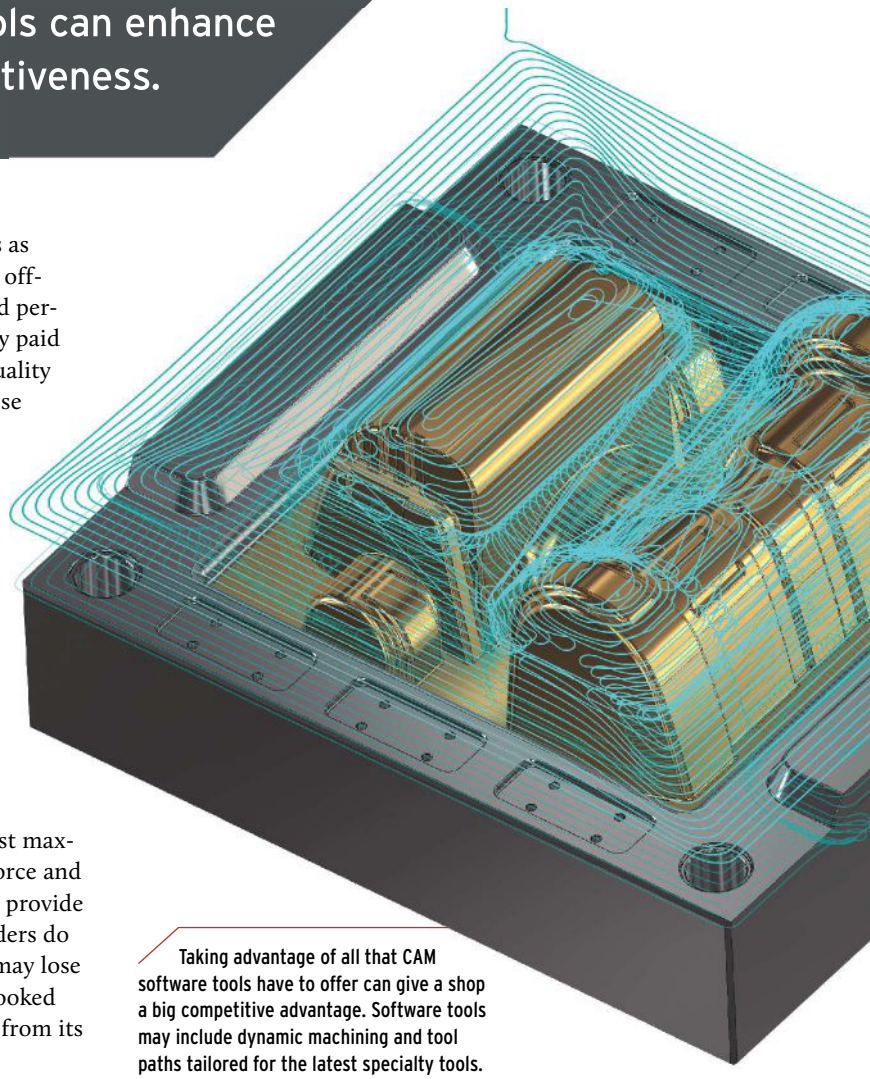
Leveraging CAD/CAM Advances

Often-overlooked software tools can enhance moldmaking business competitiveness.

Mold builders have experienced difficult times as inexpensive labor enticed customers to look offshore in search of bargain pricing. This trend persisted even though many of these shoppers frequently paid hidden costs in terms of communications barriers, quality and leadtime challenges. In recent years, many of these issues have been resolved for manufacturers and U.S. mold builders who have established their own presence in distant locations.

As time has passed, many of these distant suppliers have seen their own labor costs rise and the demand for higher quality increase. This has started to level the playing field to the point where North American mold builders and their customers are willing, once again, to factor the value of shorter leadtimes, reduced shipping costs and closer communications between designers and moldmaking engineers into their purchasing decisions.

To stay in the game, mold builders everywhere must maximize the performance of their critical, skilled workforce and CNC equipment resources. Good CAD/CAM systems provide a surprising number of tools that can help mold builders do both. They provide so many, in fact, that busy users may lose sight of them. Check out this list of commonly overlooked features to ensure that your shop is getting the most from its CAD/CAM software.



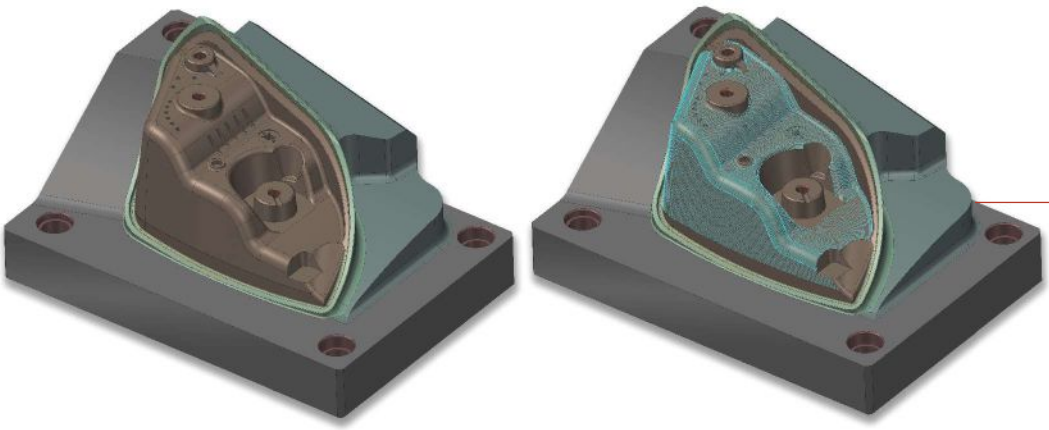
Taking advantage of all that CAM software tools have to offer can give a shop a big competitive advantage. Software tools may include dynamic machining and tool paths tailored for the latest specialty tools.

Constant Chip Load Machining

Conventional roughing approaches back off on material removal rates to compensate for an anticipated worst-case condition, such as burying a cutting tool in a corner. Feeds and speeds are reduced to accommodate this possible event with a little extra added just to be safe. With today's advanced cutting tools and toolpaths, this approach is unnecessary and harmful as it saps productivity.

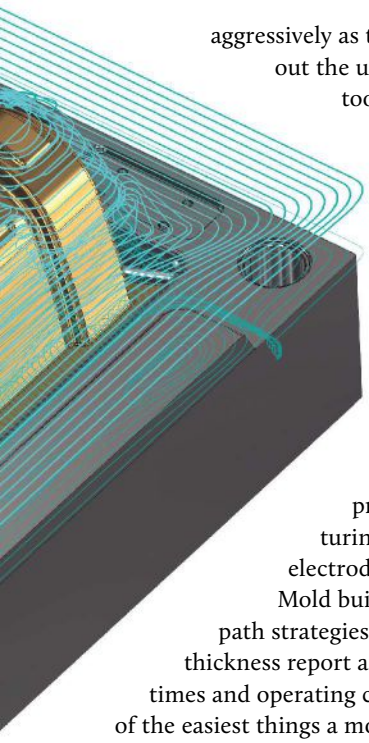
The better alternative is to employ toolpaths that rely on material-aware algorithms to maintain a constant, ideal chip load as defined by the cutting tool manufacturer throughout the entire roughing operation. This is achieved by the toolpath automatically adjusting its trajectory and motion based on feed per tooth specifications and the remaining material ahead of the tool.

As a result, tool burial is avoided no matter how complex the geometry. Material can potentially be removed as



The ability to quickly and temporarily fill holes and remove features can help ensure smooth, high-precision finishes.

Images courtesy of CNC Software, Inc.



aggressively as the CNC machine will allow without the user worrying about exceeding the tool's cutting capabilities, which can result in tool breakage or part or machine damage. Mold builders who have adopted this approach report a range of advantages that include material removal rate improvements of 25 to 70 percent or more, reduced tool wear, improved productivity and a reduction in overall cycle time. This machining strategy can also safely accelerate both the programming and CNC manufacturing efficiency for the machining of electrodes.

Mold builders who use contemporary toolpath strategies that maintain a consistent chip thickness report a substantial positive impact on lead-times and operating costs. This cutting strategy is one of the easiest things a mold shop can do to become more competitive.

Great simulation will give you the confidence to use newer and more innovative machining strategies.

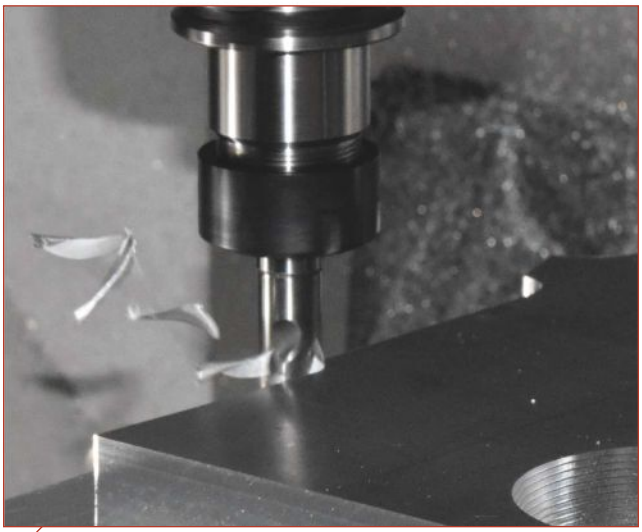
Better Finishing Strategies

Machine tool builders, cutting tool vendors and CAD/CAM software developers are continually challenging each other with new solutions that require each to constantly improve their own products. For example, some of the super-hard materials that are sometimes used in mold-making spurred cutting tool makers to develop advanced tool coatings, materials and geometries that would provide ultra-efficient cutting. This led to the expansion of constant chip load cutting strategies, so that these tools can be used effectively.

Now, a similar evolution is happening in the realm of finishing. New finishing toolpaths are in development to effectively drive new "shaped" cutting tools with cutting radii many times greater than conventional ball end mills. The toolpath's mission is to orient the tool to the part, allowing it to finish much larger areas per pass, while producing a better finish with fewer and shallower cusps. This emerging technology is not applicable to every mold surface. However, mold builders have realized up to 80 percent improvement in surface finish cycles on projects where they have used these new cutting tools.

Faster Production

In some shops, the starting point for generating a part pro-



Dynamic toolpaths deliver a consistent chip size and the most efficient use of tools, time and machines.

Using toolpath smoothing, hybrid finishing techniques and the latest tools can help mold builders achieve the best possible finishes.

gram comes after the CAD file is imported from a dedicated CAD system into the CAM environment. In this case, it is important to ensure that the CAM software can cleanly import CAD files, regardless of the source. Oftentimes, additional CAD work is required to prepare the CAD file for efficient CNC programming.

Rather than continuously reverting to the model to make iterative changes required for best CAM practices, it can be far less time-consuming to use resident CAD for CAM capabilities within the CAM software itself. This ensures that the production process moves continuously forward. For example, sophisticated repair algorithms make it possible to fix sketchy surfaces, particularly where the initial data came from a scanned physical model. Features like push/pull or direct modeling enable changes such as changing fillet sizes, moving or editing features or temporarily filling in holes so they can be machined properly, even if the model does not have an associated history tree.

> The better alternative is to employ toolpaths that rely on material-aware algorithms to maintain a constant, ideal chip load as defined by the cutting tool manufacturer throughout the entire roughing operation.

Another attractive alternative for getting mold components on the CNC machine faster is to move the mold design process forward into an integrated CAD/CAM environment with moldmaking-specific functionalities. Examples include parting line separation, cavity splitting, templates for mold plates and electrode creation.

Mold builders can be more competitive when they implement a combination of digital tools that make the process of moving from design to CNC manufacturing as seamless as possible so that the model does not become a roadblock on the path to customer satisfaction.

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Incremental Advancements

Some improvements that are introduced with each CAD/CAM software release are incremental. New features and tools from these releases are not always easily noticeable. However, improved functionality from these features can offer big advantages to shops that have limited time to identify and implement them.

A great example of this is simulation, which has become increasingly accurate and inclusive. Today's CAM simulation incorporates machine-specific kinematics so that the image on the screen is a much more accurate reflection of the toolholder, workholding solution and all machine axes (and not just how a tool will behave). Great simulation empowers a mold builder to use newer and more innovative machining strategies.

Toolpath smoothing is another example of ongoing incremental improvements that can result in improved workpiece production. The algorithms governing some of the latest 3D multi-surface finishing toolpaths can now smooth out angular changes where different cutting strategies intersect. This results in a better, smoother finish and reduces the extent of bench work required at the end of the mold manufacturing process.

Other features of CAM software that moldmakers should investigate are the management tools incorporated within the software. Examples include an operations manager that allows programmers to easily save and then access effective machining strategies for similar parts. These types of tools allow experienced users to store hard-won proprietary knowledge that can be used on their own, and these types of tools enable coworkers to build competitiveness on the foundation of previous successes.

CAD/CAM software developers spend thousands of hours maintaining and updating their product offerings. Chances are there will be some things in the next release of your CAD/CAM software that can make your shop more competitive. MMT

VIDEO:
Light Stepovers and Deeper Stepdowns
short.moldmakingtechnology.com/step

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By Keith Vozel

VIDEO Access video at end of article.

The True Cost of Cobots

Defining expectations and determining the ROI of collaborative robots help guide sound investment choices.

Collaborative robots, also called "cobots," are the newest trend in robotics. A cobot is a special type of industrial robot designed to work with, or closely to, humans. Various technologies can be implemented to reduce the speed of a cobot's motion when a worker enters its work area, or to sense when the cobot encounters a human and stops or moves away. While cobots have been around for many years, it seems that almost every company and industry has taken some initiative in looking to use the technology. In moldmaking, that could be material handling or machine tending.

But why? The claim is that cobots cost less, provide more safety for workers and can quickly deliver a remarkable return on investment (ROI). Is this true, or is there more than meets the eye?

Companies should approach the question of whether to use cobots in the same way they approach other business decisions. Cobots can provide tremendous value, but their implementation necessitates proper application. For example, companies need to consider whether the cobots would have jobs that bring the cobots near humans, jobs with smaller payloads or jobs without high-speed cycle time requirements. Do not get caught up in the hype. Evaluate the bottom line, and consider both direct and indirect costs and benefits.

Cobots can be "fenceless robots," but only after a business performs a risk assessment.

When determining the ROI, be sure to identify the objectives of the project first. The objectives could be both qualitative and quantitative, but even the qualitative ones should have value associated with them. For example, are you looking to reduce costs, improve productivity or increase product quality? These can all be assigned a metric. Offset the benefits with the true cost of implementation, which includes the initial purchase, reduced throughput, labor impact and cobot lifespan. Remember that businesses make good investments when they have a strong understanding and definition of expectations and costs.

The following include some of the key features of collaborative technology that reveal the most important considerations a business should have for evaluating that technology's ROI. The purpose of this article is not to show you how to calculate the ROI, or even give you a basic spreadsheet model. This article outlines the factors that will help you evaluate ROI.

Lowered costs. Everyone expects collaborative robots to cost less than what they are currently using. The reason is they are typically smaller, simpler to install, may not require extensive integration with other technology in the facility and can be implemented without a large investment in safety infrastructure. But is that accurate? For the most part, yes. However, even these key selling points have their caveats.

Self-integration is a key part of collaborative robots. Still, not everyone has the knowledge and expertise to implement them. Sure, unpacking a unit and getting it running in an hour or so sounds great, but many do not realize how much knowledge it takes to understand the impact a cobot will have on the rest of the organization. It is therefore vital to pay attention to the cost of integration within exist-

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Images courtesy of Yaskawa America, Motoman Robotics Division.

Safety features provide a safer environment by protecting workers in the event that they come into contact with the robot.

ing infrastructures and to any process changes. For example, introducing a cobot may require installing additional communication lines and programming to allow that cobot to communicate with other technology in the facility.

It is also important to recognize the fact that a safe robot does not mean a safe *system*. You need to consider the *overall* expense of cobot implementation. Although cobots are thought of as 'fenceless robots,' it is more accurate to say that they can be fenceless. The specific application or product being manufactured may require unique end-of-arm tooling, fencing or other safety equipment that is not typically associated with a cobot. You need to determine if you will save a significant amount of money using the sensors or force-limiting technology that comes with cobots, as opposed to fencing or curtains.

A proper risk assessment will help with that decision. This involves evaluating the entire process and all equipment to identify and determine the risk level. Keep in mind that a proper risk assessment *now* can help identify safety concerns and provide significant savings *later*.

Less intrusion. Floor space is a scarce commodity in any business. Cobots, because of their small, compact size, tend to require less space. They also tend to have smaller payload capability, and workers can move them easily without a fork lift. This translates directly into cost savings when they can coexist in confined spaces where it would be impossible to implement a traditional, industrial robot. That is a big plus in the ROI calculation.

Greater flexibility. It is difficult to put a dollar value on

flexibility. If the cobot can be redeployed or moved to perform other tasks, then a company can save on acquiring a second or third unit. But, consider the time and effort required to redeploy the cobot to a different location for a different application. Redeploying the cobot may affect downtime enough that it warrants the purchase of an additional unit.

Beneficial trade-offs. When implementing any type of new technology, there may be trade-offs that affect ROI either directly or indirectly. For example, safety features such as power and force-limiting sensors provide a safer environment by protecting workers in the event that they come into contact with the robot. That is why the collaboration feature exists, but it means that they operate more slowly than traditional robots. Slower cycle times may affect throughput or overall productivity.

Less expensive equipment may also mean less robust equipment. Is the cobot built to last? You certainly do not want your ROI influenced by the need to replace the robot in three to five years. Your ROI may be affected if the unit is not designed with a platform to last or built to withstand the rigors of your specific environment. Units that are not designed with a lasting platform or that are not built to withstand the rigors of a specific environment may impact ROI.

Many users claim that cobots are easy to use, and often they mean that cobots are easy to set up and to start using quickly. This may be true, but this ease of use usually means less functionality. For example, the user interface may be great for the novice. But, as the expertise of a user grows, he or she will want greater capability for more complex needs. Therefore, it is important to acknowledge that expanding the use of a cobot may require hiring someone with more experience or even advanced technical programing skills.

These benefits and costs of collaborative technology highlight all that is required to make sound investment decisions. Hopefully, this information can help you determine the value that collaborative technology may provide to your company. MMT

VIDEO:
Cobot in Action
short.moldmakingtechnology.com/robots

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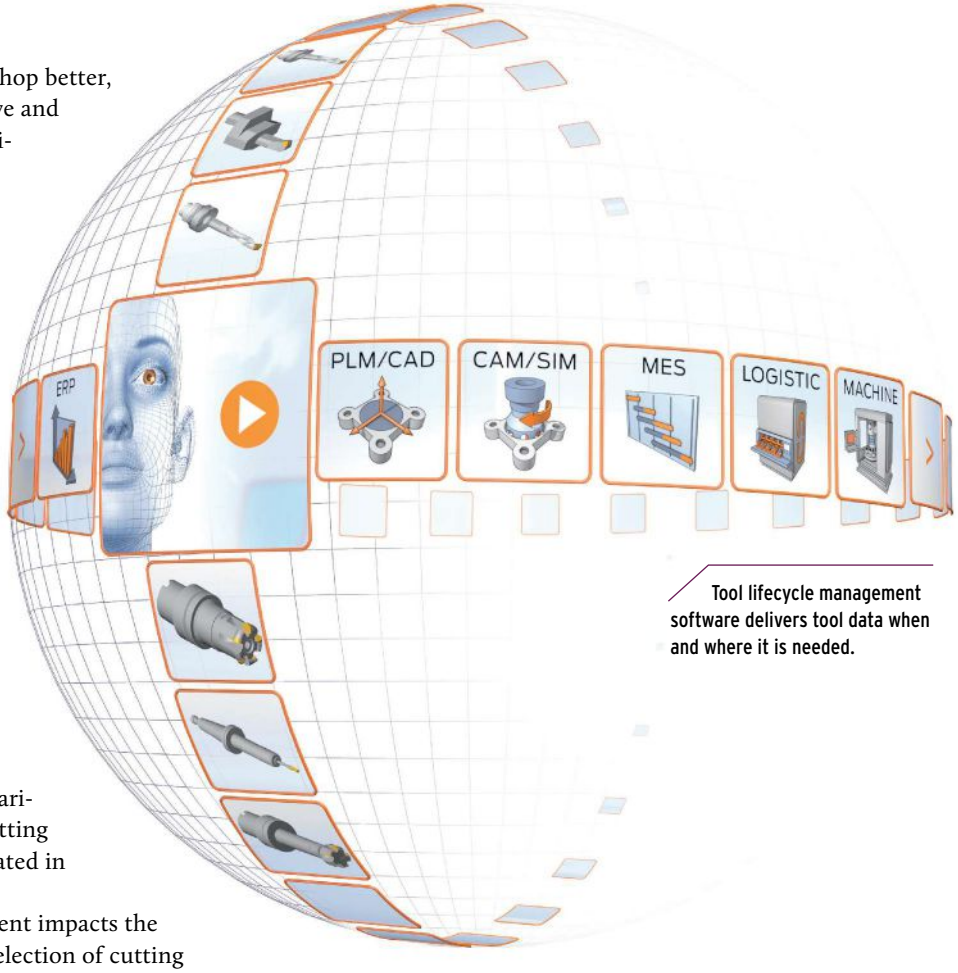
By Dan Speidel

CUTTING TOOL DATA WHEN YOU NEED IT

From the tool crib to enterprise resource planning systems, tool lifecycle management breaks down expensive data silos.



Images courtesy of TDM Systems.

Tool lifecycle management software delivers tool data when and where it is needed.

There are a lot ways to make a shop better, more efficient, more productive and more profitable, but one practical method that is often overlooked is tool lifecycle management. This is about more than cutting tools. Fundamentally, it's about data: ensuring that cutting tool data is available where and when it is needed. It links CAM systems, presetting and crib systems, and machine controls. It can also extend upstream to the planning and execution levels, including production, planning and control systems (PPS), and enterprise resource planning (ERP) and manufacturing execution (MES) systems.

To extend so widely, tool lifecycle management software must be "open" and able to supply numerous import and export interfaces. It also must be able to integrate data from various sources, such as catalogs from cutting tool manufacturers or 3D models created in house, into a centralized database.

Ultimately, tool lifecycle management impacts the entire machining process, from the selection of cutting tools to their use in production planning to seamless transfer and use on the shop floor. Information from the individual process steps continuously flows back to a centralized database, creating a growing mass of valuable data that's accessible throughout the networked system.

Standards for this exchange of cutting tool data is important. They include ISO 13399, a set of international standards that enables cutting tool manufacturers to use the same language to describe their products in a digital format; generic tool catalog (GTC), a complement to ISO 13399 that enables productive data exchange between cutting tool

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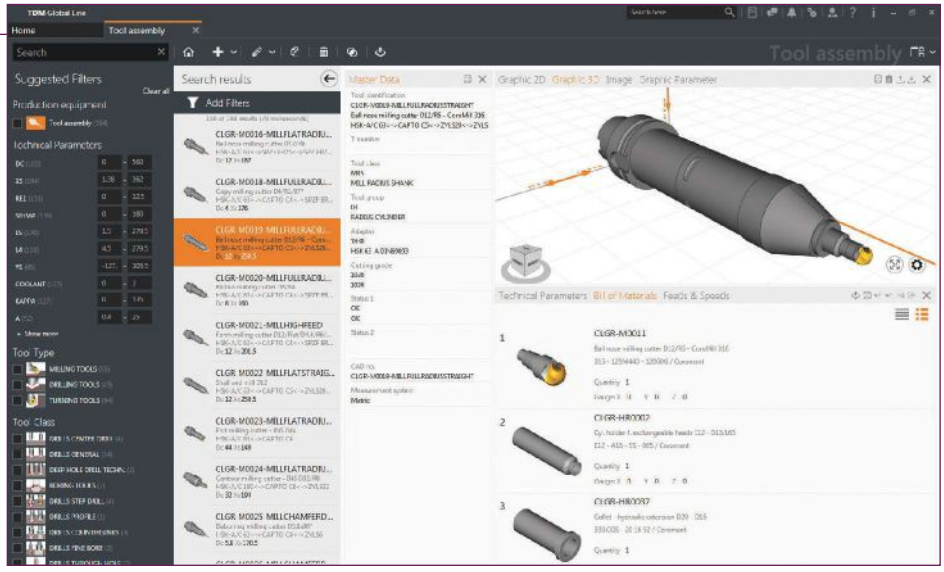

Tool lifecycle management software manages assemblies of tools typically used in mold and die applications. Assemblies like a milling ballnose can be visualized in 3D, and all items are listed and managed in 3D as well.

vendors and applications; and MTConnect, a standard that enables manufacturing equipment to provide data in a structured XML format rather than proprietary formats.

These standards are only part of the solution, however. Because it is not just storing the data, but efficiently searching for and finding the right data that is critical, as well as providing that data to other systems that need it. The right tool lifecycle management software should have options that extend from managing the tool crib to interfacing with other systems, such as those for purchasing or CAM programming.

Examining the Problem

Companies often rely on a CAM system's generic cutting tool models, but they may pay a price for that. How many times have you seen programmers leave their desks and go to the shop floor to ask, "Do we have something like this?" Remember, if your NC programmers can't search the access database for information about the contents of the tool crib, they will need to get up and physically look for the cutting tool or tools in question. The result is lost time.

Using actual cutting tool graphics contained in tool lifecycle management software, not generic cutting tool models, takes the guesswork and uncertainty out of cutting tool creation. When individual cutting tool assemblies and items are specifically identified, you can achieve efficient and repeatable accuracy. This will be particularly evident in high-speed milling, where knowledge of cutting tool weight and balance are critical to success.

Other questions that arise during cutting tool selection include which tools are best suited for which process steps? Which combinations are most efficient? Tool lifecycle management software helps designers quickly answer these questions by providing basic information on cutting tools and their potential applications. Along with helping with cutting tool selection for each NC operation, the software stores geometry and cutting data for each cutting tool assembly, makes 3D tool graphics available for NC and simulation analyses, and saves cutting tool lists from the NC programs for future use. In addition, the recording of cutting data, machining conditions and best practices permits the optimization of cutting tool use in future applications.

When it comes to presetting, precision is important. Tool lifecycle management software offers presetters access to the nominal data for each cutting tool assembly and then transfers the actual measured data back to the software so that the database can be continually fine-tuned. The cutting tool data and NC programs, together with the actual preset tool data, simultaneously are sent to the correct machine via direct numerical control (DNC).

Radio frequency identification (RFID) chips are another possibility for transferring tool data to the machine. Machine downtime reduction and damage prevention through electronic generation of machine-specific tool offsets, based on the actual tool data, are two benefits of connecting presetting in your tool lifecycle management software.

Centralizing Data

Information contained in higher-level systems such as MES often operate as isolated "silos" of data. For example, purchasing has its own silo, CAM has its own silo, and tool cribs have their own silo. This means that a great deal of time is wasted recreating data. A central database for that information is needed. It will not replace your purchasing system or CAM system, but tool lifecycle management software can become the easily accessed repository for vital cutting tooling data. You can have one central data point that these systems are directly

connected to or an online interface to the same information. Keep in mind that the centralized database replaces the cost of all these homegrown systems or silos that must be maintained, so total cost of ownership is reduced.

Cutting tools are capital-intensive production resources, so a global view of your cutting tooling world using tool lifecycle management software will allow work-in-progress inventory and actual crib inventories to be kept low, orders to be initiated at the ideal time, and cutting tool variety to be minimized. Cutting tools account for 8 to 12 percent of manufacturing cost. Tool lifecycle management software, might allow you to make use of five cutters instead of 20. This reduction in cutting tool variety and vendors reduces overhead and can decrease your cutting tooling budget by 20 to 30 percent.

This centralized database also provides data integrity, reduced effort and total transparency. Direct access to cutting tool data and graphics supports the tool selection in NC programming. Cutting tools can also be selected by tool class/group or machining process, and be sent via the interface to the NC program. Users also have access to geometry data, 2D and 3D graphics of assemblies, feeds and speeds information, and collision data. When the NC program is completed, the cutting tools used in the program can be saved in the tool lifecycle management software, allowing the crib to assemble, preset and deliver the cutting tools to the machine as the programmers intended. And now, with a move to cloud storage, you can run your tool lifecycle management software and access the database on a computer, laptop, smartphone or tablet.

> It is not just storing the data, but efficiently searching for and finding the right data efficiently that is critical, as well as providing that data to other systems that need it.

This is especially applicable for the moldmaking industry, with its extensive use of high-speed milling. In those cases, quick and easy access to CAM simulation tool graphics, collision avoidance and other software tools is particularly valuable. Also, process integrity, precision and reusable asset data supplied by tool lifecycle management software can reduce setup time, particularly on high-end cutting tools, and results in faster time to market. MMT

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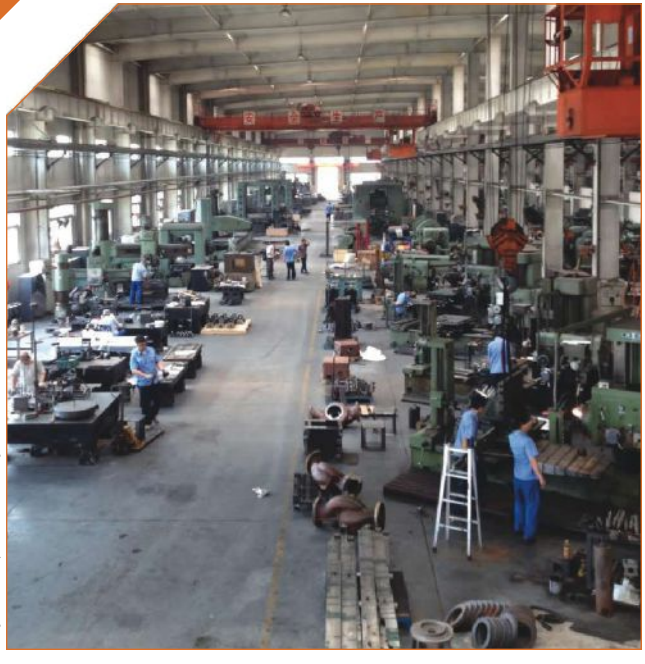
By Rosemary Coates

Exit Planning for Reshoring

Developing a strategy for leaving a foreign location is a crucial part of reshoring that involves re-engineering processes, automating production and understanding all associated costs.



Images courtesy of the Reshoring Institute.

I had a sad meeting recently with the CEO and CFO of an industrial products company. I had to tell them there was very little chance they would ever get their molds back from their Chinese contract manufacturer.

The company wanted to reestablish manufacturing in the United States. It had already selected a U.S. site, but needed help in reestablishing its supply base and shutting down its contract manufacturer's production line in China. The CEO and CFO came to the Reshoring Institute for assistance with extracting their operations from China and reestablishing operations in the U.S. They were anxious to get their molds and tools home to use on the new U.S. production line. They had paid for the creation and development of new injection molds in Shenzhen and believed they owned them. They had also shipped some U.S.-made molds to China, believing that they retained ownership of those, too. After a review of their Chinese manufacturing contract, I could see clearly that they would never get their molds and equipment back.

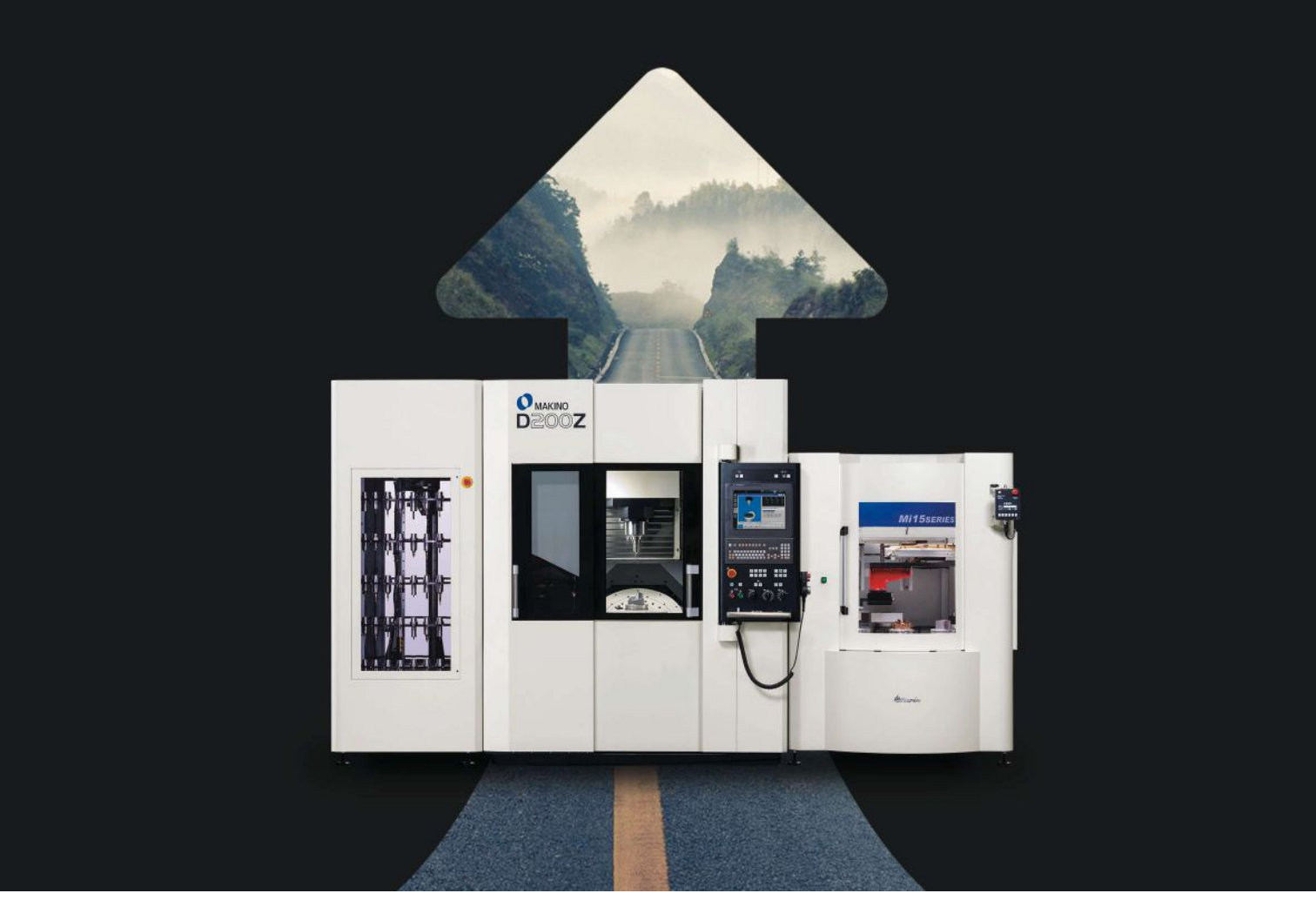
State of Chinese Moldmaking

Moldmaking in China is a fact of manufacturing life. Moldmakers know that having a mold made in China can be as much as 50 to 60 percent cheaper than having one made in the United States. In addition, Chinese original equipment manufacturers and contract manufacturers are likely to have engineers on staff and CAD/CAM software available to design and develop their own molds. Chinese engineers have become proficient at the technical side of mold development. For these reasons, many companies have paid to make molds successfully in China.

We used to be frustrated by low-quality molds, tools and dies from Asia that were often jury-rigged with primitive approaches. Molds like this resulted in finished products of poor quality, production interruptions and endless rework. We have always known that the art and skill in moldmaking was a sophisticated process for the most experienced professionals. In the past, manufacturers often had to produce molds and tools in the U.S. and ship them to production sites in China to assure quality. But over time, the Chinese got much better at these skills and started producing molds and tools on par with global standards.

Today, China graduates many thousands more engineers each year than the U.S. Most of these engineers go to work in the enormous Chinese manufacturing sector. Over the past 25 years, Chinese design and manufacturing engineering has become quite sophisticated, using the latest software, tools and production techniques. U.S. companies sourcing and manufacturing in China now expect high-quality products at low cost, which presents a dilemma for companies trying to reshore.

Molds, tools and dies on a Chinese production line belong to that manufacturer in China. This means that a company attempting to reshore its production will likely leave behind its molds, tools and equipment.



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Molds and products. U.S.-made molds, tools and dies may be shipped to China, they may be developed and produced under design direction by the U.S., or they are fully designed and made in China. However, if they end up at a manufacturing site in China, you may never get them back.

Production assists like molds, tools and dies are typically thought of as part of the Chinese manufacturing infrastructure. Once in place on the production line, these things now "belong" to the manufacturer. At that point, the Chinese simply believe they own it. If a company continues to produce the same product with no new molds in China, this may not be an issue. But if a company decides to reshore its production, the molds, tools and equipment will very likely stay behind.

Even with an OEM agreement and strong contract language, it may be impossible to retrieve production molds and tools. An attorney with experience in Chinese contracts will explain that ownership of molds, tools and other equipment must specifically be called out with serial numbers in the initial contract, and should be written in Chinese language. All parties must sign and confirm the contract. Even then, it will likely be difficult to enforce. Some companies have tried to require a deposit before equipment is shipped to China for production, but this approach is rarely successful.

> Economical reshoring means that all costs of leaving a foreign location are considered, including leaving molds and equipment behind, paying out employment contracts, reestablishing the supply base and finding skilled workers in the United States.

Contracts in China are viewed and interpreted differently from the Western world. In China, a contract is just a baseline or starting point for the relationship between two parties. In the Western world, a contract is viewed as the memorialization of all the negotiated terms. Those in the U.S. may believe they have protected their rights to equipment ownership, while those in China think the contractual language is just the starting point for further discussion once the equipment is being used.

In addition to having developed or delivered molds to a Chinese OEM, a company has also taught the manufacturer how to make its product and where the raw materials are sourced. A Chinese manufacturer can (and most likely will) use their customer's molds and continue to produce the exact same product under a different label, long after the U.S. company has exited China. Chinese manufacturers will continue to produce former product styles and aging products and sell them to developing countries under a different brand or label. Markets for aging products and previous models in other developing countries may continue to be strong for some time.

One strategy that we regularly encourage is for companies to make only old product models in China, leaving all new model production in the United States or in Western Europe where patent and copyright laws are the strongest. Another effective approach is to source subassemblies or component parts from different regions so that no contract manufacturer has a complete blueprint of how to manufacture the finished product.

People, permits and supply chain. Molds and processes are not the only "gotchas" when leaving a foreign location. Companies must also consider employment contracts and must obtain the proper permits from the Chinese government to shut down a factory.

The rebuilding of a company's supplier base can also be a lengthy process in the

U.S. As companies moved production offshore in the 1990s and early 2000s, the raw materials and component suppliers also moved offshore. This means that finding qualified U.S. suppliers can be a bigger task than many realize. Helping suppliers reshore or finding new U.S. suppliers can take as long as 18 to 24 months.

Finding workers with experience and the needed skills is yet another part of reshoring that lengthens the process. Most U.S.-based manufacturers are painfully aware of current skills shortages in welding, machine operations, mold, tool and die making and engineering. Community colleges across the United States have stepped up to fill these gaps and provide skills and education for people interested in manufacturing. Manufacturing jobs pay relatively well and demand for skilled workers is high, which creates attractive opportunities for those who do not want to pursue a four-year degree.

Reshoring is the right thing to do to rebuild the middle class in the U.S. and bring jobs back, if it is economically feasible. This means that all costs of leaving a foreign location must be considered, including leaving molds and equipment behind, paying out employment contracts, reestablishing the supply base and finding skilled workers in the United States. MMT

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By Cynthia Kustush

This article is part of a series highlighting ways in which schools, businesses and trade organizations are working together to shape the next generation of manufacturing professionals.

Supplier-Based Training Programs Fuel Mold Industry Needs

Moldmaking industry supplier companies are establishing workforce development programs to help increase the flow of new talent for themselves and for the industry at large.

Workforce development for manufacturing has found its way back into the nation's consciousness, but the focus is primarily on mainstream companies, not moldmakers and certainly not their suppliers. And what about those suppliers? They are responsible for developing and bringing to market the technologies necessary for the entire mold lifecycle from software to repair. It's critical that these suppliers maintain a skilled workforce too.

The companies featured here represent many supplier-side original equipment manufacturers and the workforce development programs they have developed, for themselves and for the industry at large, to help ensure manufacturing's future.

Inspiring Tomorrow's Mold Designers

Autodesk (San Rafael, California) states on its website that "today's challenges will be solved by tomorrow's designers." This statement explains why the design and engineering software company established the Autodesk Design Academy, a program to prepare the next generation of engineers and designers. "We have made a commitment company-wide to foster those skills and create a pipeline of new talent," says Matt Pierce, senior manager of Americas, Autodesk Education Experiences. "It began three years ago, when we made our software completely free to schools," he says. "At one time, schools were a significant source of revenue, but we know that's a barrier, especially for smaller institutions where the cost of current software can be overwhelming."

While giving teaching institutions free access to Autodesk products is significant, Pierce says it was only the beginning of what has become a huge, company-wide initiative. "We created our Design Academy program and website to provide downloadable courseware modules, videos to coach teachers, homework exercises and more—a virtual one-stop shop for all an instructor might need to engage and inspire students," he

Image courtesy of Autodesk Inc.

This group of smiling faces belongs to aspiring designers at the University of California, Berkeley, during their ME 110: Intro to Product Development class. Autodesk's Jeff Lee, program manager, is a guest lecturer and provides instruction on how to use the company's Fusion 360 product development software.

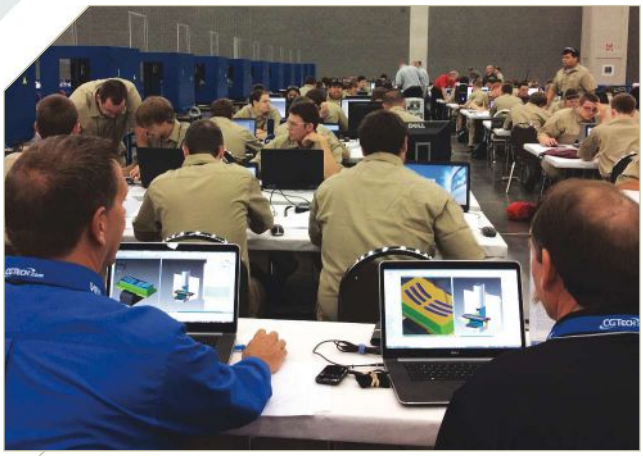

Image courtesy of CGTech.

CGTech Technical Support Engineers look on as students work on converting their CAD files to NC code, which were then checked using Vericut, CNC machine simulation, verification and analysis software during the 2016 SkillsUSA/NIMS event.

Image courtesy of Edro.

Dr. Chris Rottmair (left), who leads EDRO's technical and production team in Conshohocken, Pennsylvania, teaches apprentices John O'Brien, Michael Muthoka, Chris Farnin and Rob Curran the difference between direct-fire and convectional furnaces, and how one determines cycle times based on gauge and material grade.

says. In addition, Pierce leads a team of 11 experts who travel to academic institutions across North America to help professors, school administrators and students become proficient in design skills and techniques. The company also hires about 30 students each year to help train instructors. The position is similar to being a teacher's assistant in college. There's an emphasis on project-based learning, because collaboration and creativity are very much a part of how injection molded parts are designed, and these overarching skills are needed in today's working environment. "We also act as a liaison between the education system and our commercial customers, who often ask us where to find new talent," Pierce says.

Teaching Programming with Verification

CGTech (Irvine, California) is a supplier of Vericut, an NC verification, optimization and simulation software. CGTech has partnered with institutions of higher learning to promote manufacturing as a career for most of its near 30 years in business, according to Jim Huddy, national sales manager. "We have several hundred education customers in North America and nearly 1,000 worldwide," he says.

By "education customers," Huddy is referring to vocational high schools, trade schools and universities that participate in CGTech's Educational Program, which provides schools with 30 seats of Vericut software and training for an annual fee of $1,000. The comprehensive package provides all the modules (CAD/CAM, tooling and model interfaces) and licenses that schools need to run a results-oriented training program. "Each school's program varies by campus and by industry," Huddy says. "However, they can verify and optimize NC code for virtually any machining process, including moldmaking."

Tim McDonald is the tech support manager for North America. He manages the company's team of 21 technicians, who are based throughout the United States and Canada. They arrange a custom Vericut Machine Configuration (VMC) to use with a school's particular machines and then provide training on the use of Vericut for educators who, in turn, will train their students. "With skilled labor at a premium, not everyone is catching programming errors by hand. We want them to know how important it is to verify their programming before they hit the shop floor," McDonald says.

> We have to look at the big picture. With skilled labor at a premium, not everyone is catching programming errors by hand.

In addition, CGTech technical support engineers participate as judges for the CNC milling and CNC lathe machining events at the National Leadership and Skills Conference (NLSC) SkillsUSA national competition. "The weeklong event draws more than 16,000 participants and is designed to help prepare students for joining the workforce," Huddy says. Using Vericut, judges evaluate the accuracy of the NC programs created by student teams while ensuring their programs run without violating safety standards or damaging machines. Judges evaluate each category to measure the students' level of understanding of CNC programming, including writing CNC programs, interpreting prints and measuring parts.

Training Metallurgical, Engineering and Technical Experts

Edro (Walnut, California) is a supplier of custom mold bases, specialty steels and aluminum. Its leadership recognizes that in today's moldmaking industry, many unique and innovative

Veterans Training at Vincennes University Helps Fill Skills Gap

Haas Automation (Oxnard, California) may be a household name in manufacturing, but many are not as familiar with the Gene Haas Foundation and its mission to help fill the skills gap. In fact, many machinists entering manufacturing over the last decade probably honed their skills on a Haas CNC machine or attended classes at one of the growing number of Haas Technical Education Centers. Among them is a special segment of the population that has come to represent part of the solution for workforce development: U.S. military veterans. In partnership with Vincennes University (VU) in Vincennes, Indiana, the Gene Haas Foundation presented a $1.5 million grant to help build the Gene Haas Training and Education Center to house the university's CNC machinist training programs in Lebanon, Indiana.

According to David Tucker, vice president for workforce development and community services at the university, the idea to focus on veterans came out of a meeting with representatives of the Haas Factory Outlet and Haas Automation, where they were discussing a new 15-week training curriculum. "We were discussing the program when somebody says, what about veterans? At that time, Indiana had a veteran unemployment rate of 18 percent—three times the state average," Tucker says. "We agreed we would work with veterans, and we began convening educators, Haas team members and employer partners. Haas assisted with bringing in other partners with whom we wouldn't have had access otherwise, such as Mitutoyo, Mastercam and Sandvik Coromant." The 20,000-square-foot facility houses classrooms, a fully-equipped metrology lab, a CNC machine shop/classroom that features six Haas vertical machining centers, six Haas CNC lathes, a manual engine lathe, a surface grinder, a Bridgeport knee mill, a simulator room where instruction on Haas controls is provided and an industrial maintenance lab. It was opened in time for the 2015-2016 school year.

Tucker says that because mold shops are so military- and veteran-friendly, the school regularly reminds employer partners about the program and asks them for referrals. "We know they know somebody, whether it's a relative or an employee, who is a veteran and would be an ideal candidate, but they don't have the skills. Well, now we've got an answer that only takes 15 weeks as opposed to two years."

The candidate who Tucker says VU and Haas can help the most is the person who was in the army and in the infantry and didn't gain any practical skills. "They weren't working on machines," he says. "They come out of the service and think, 'now what do I do?' They don't realize they gained skills that are valuable in this industry, such as teamwork, being mission-driven, pulling 20-hour shifts and working under some difficult conditions. That's a machine shop!"

For veterans who aren't employed and don't have the resources to pay for training (and that has been all of them so far, according to Tucker), the Gene Haas foundation may be the answer as it has provided more than $380,000 in scholarship support in addition to the $1.5 million grant that helped build the school. Another organization, Lightweight Innovations for Tomorrow (LIFT), is a department-of-defense-funded program based in Detroit that has contributed $200,000 to help cover the financial gap for veterans attending VU.

Image courtesy of the Gene Haas Foundation.

Pictured here is the first class of military veterans to graduate from the CNC machinist training program offered at Vincennes University's Gene Haas Training Center in Lebanon, Indiana.

mold materials and process technologies are coming to market that require a specifically trained workforce. According to Mike Guscott, apprentice program manager at Edro, personnel development and training is a key part of the company's ongoing strategy and focus. Edro therefore developed an 18-month apprenticeship program that provides a strong foundation for each individual. It is based on in-house education at any of the company's many global locations. The program covers mold steels and aluminum, including the company's RoyAlloy stainless product, as well as customer site visits so that students can learn problem-solving and the ability to make sales calls.

North American moldmakers need to be well informed on the best materials and processes available, helping them to produce high-performance plastic mold tooling and stay ahead in today's globally competitive marketplace. To be able to assist, Edro apprentices are instructed on the various types of mold designs, molding operations and specific steels and heat treatments

> Our goal is to help the individual develop and become a well-rounded and successful professional in today's plastic molding and moldmaking industries.

required for each application. Hands-on instruction in machining, heat-treatment and surface coatings are also covered in detail. For sales training, the apprenticeship covers territory planning, time management, market evaluation, budgeting and sales.

Additionally, Edro regularly cooperates with several universities, including Penn State University in State College, Pennsylvania, Lehigh University in Lehigh, Pennsylvania, and Concordia University in Chicago, Illinois, to

select and hire motivated metallurgical, engineering and technical graduates. Penn State, for example, positively reviewed Edro's apprentice proposal and recommended suitable student candidates to contact and meet during the university's annual career fair. "We try to discuss each student's ambitions and narrow the field to a few outstanding individuals who will become the next generation of professional sales engineers, product specialists and metallurgical technicians who will support the tooling industry in the years to come," Guscott says. "We have also discussed the possibility of getting Penn State to participate with us on projects such as material testing and evaluation. Ultimately, our goal is to help the individual develop and become a well-rounded and successful professional in today's plastic molding and moldmaking industries."

Image courtesy of Hasco.

Precision metalworking is just one piece of practical training that is offered as part of Hasco's apprentice program. The company also supports programs at technical high schools and universities around the world.

Training for Company and Customers

Hasco America Inc. (Fletcher, North Carolina) has a long tradition of apprenticeship programs that have helped keep its own workforce amply staffed since it began selling such items as mold bases, plates and components in Germany in 1924. About 45 years ago, Hasco also created a two-year machinist program and a three-year moldmaker apprentice program, which together have trained more than 400 young people to become moldmakers and CNC machine operators.

In 2011, Hasco launched its People Development Program to further train and develop current employees for success. A notable part of the program includes what the company calls SEED. Rene Eisenring, general manager, says, "In German, SEED translates to selbstständig (self-contained), eigenverantwortlich (responsible), ergebnisorintiert (results-oriented) and denker (thinker)." "We try to build independent, self-responsible, results-oriented thinkers who can and will solve problems and challenges on their own."

> We try to build independent, self-responsible, results-oriented thinkers.

Annual events such as Girls' Day, where middle school girls visit Hasco and learn about manufacturing, help attract future employees. "We show them that fascination with technical matters is not restricted to men," Eisenring says. "In the training workshop, the girls can demonstrate both their skills and dexterity."

Another annual event, Designer Day, gives students and customers hands-on and theoretical training on how best to use the mold plates and components in mold designing and building.

Additionally, Hasco supports programs at technical high schools and universities around the world. "We provide teachers with technical information, free technical books and catalogs, and we offer highly-reduced or free parts and components that they can use to teach classes," Eisenring says. Hasco, for example, delivered six small, complete mold bases at no cost to the Sussex County Technical School in Sparta Township, New Jersey. The class used them to build six different molds. Students designed them in 3D and used CAM to machine the plates and parts. At the end of the semester, the students put the finished tools into an injection molding press and produced plastic parts.

"With Clemson University in Clemson, South Carolina, we provided initial training at our facility in Fletcher, North Carolina for some of their instructors who are working on developing new, lightweight plastic parts for the automotive industry," Eisenring says. "We also provided mold plates and components to them at a very reduced cost to allow them to successfully build their first mold in 2016."

Image courtesy of Okuma America Corp.

Okuma America's long-standing partnership with Central Piedmont Community College (CPCC) in Charlotte, North Carolina, recently took a big step forward with the donation of this MC-V4020 CNC vertical machining center and other equipment used to train up-and-coming skilled machinists.

Enabling Employment for Life through Mechatronics Training

CNC machine tool supplier Okuma America Corp. (Charlotte, North Carolina) is contacted regularly by companies in need of skilled CNC operators, especially those who can run five-axis machines. Brittany Russell, PHR and training program manager, says, "These jobs require skills that are so critical in today's manufacturing industry. We call it employment for life. If you have the skills, you will be a highly-valued member of any manufacturing company's team, and Okuma is helping create pipelines for future talent."

One way the company is actively involved in workforce development is through its long-standing partnership with Central Piedmont Community College (CPCC), which is also in Charlotte. The college and Okuma have been working together on curriculum and mechatronic aspects of manufacturing education since the 1980s, and CPCC is one of the top community colleges in the nation for machine tool technology. "We made sure they had access to mechatronics (mechanical and electrical control technologies) over the years by consigning CNC mills, lathes and other equipment needed for learn-

ing the latest machining technologies," Russell says.

In June 2016, Okuma donated an MC-V4020 CNC vertical machining center and an ES-L8II CNC lathe to the engineering technology programs at CPCC. The donation, which includes software updates and tech support, took the partnership to next level and provides students with the machining skills and practical experiences that are necessary to pursue careers in today's high-technology industries.

> We call it employment for life. If you have the skills, you will be a highly-valued member of any manufacturing company's team.

Okuma hosts events geared toward awareness of manufacturing and the importance of partnerships at its Partners in THINC facility. Okuma has also been very helpful in setting up customer site visits for students. College-credit-worthy co-ops and paid internships with Okuma are valued opportunities for CPCC students who are looking to hone their skills in a real-world shop environment. Chris Paynter, Dean of STEM programs at CPCC, says, "Basically, they use their work-based learning experiences as they work to finish their degrees." Okuma currently offers this program for field service technicians, but co-op students also learn by performing finish work on machines prior to delivery to customers to learn how CNC machines are built and how they operate.

Image courtesy of OSG USA Inc.

Tim O'Sullivan, OSG USA quality assurance manager, speaks with high school students during a plant tour at the company's Manufacturing Expo.

Using Cutting Tools to Shape the Talent Pipeline

OSG USA Inc. (Irving, Texas), a supplier of drills, taps, end mills and indexable cutting tools, has been actively building relationships with high schools, community colleges, trade schools and universities in the Chicago area for 49 years. Paul Wilhelm, human resources generalist, says this strategy has helped establish and maintain a "talent pipeline" for the company's manufacturing and engineering positions. These relationships are also meant to create awareness of careers in manufacturing, he says, adding, "We work with local schools and organizations to plan and execute plant tours for faculty and their students to learn about our business structure and manufacturing operations in Bensenville, Illinois."

We work with local schools and organizations to plan and execute plant tours for faculty and their students to learn about our business structure and manufacturing operations.

OSG also organizes the tours so that they correspond with the audience's field of study, such as CNC operation/setup, engineering and so on. The tours give examples of career paths that an entry-level hire can expect to follow. In addition to hosting students and instructors, OSG also donates tools like drills, endmills and taps to local colleges. The company is currently working on developing a scholarship award that would be given annually to students enrolled in machining, manufacturing or engineering-related studies at vocational schools, technical schools or traditional schools of higher education.

OSG regularly participates in local career-related events like the College of DuPage Manufacturing Expo, which usually occurs each fall. During the event, groups of high school students visit exhibitors' booths to learn about each company's products and business. "It's a unique way to raise awareness of manufacturing in younger people who may be undecided about whether they will go to college or what they want to do for a career," Wilhelm says. "We hired a part-time employee from Fenton High School in Bensenville who we met through this event."

For current employees, OSG established an internal training and education program called OSG Group University, which involves classroom training conducted for employees by employees and on company time. "We offer between 50 and 60 classes per year, with topics ranging from business communication skills to presentation skills to basic and advanced engineering concepts and our tool manufacturing process," Wilhelm says. "Department managers often are our subject-matter experts who are the instructors, while our company's executive team, together with all management personnel, advises on the focus for OSG Group University curriculum."

Training Laser-Sharp Apprentices

TRUMPF North America (Farmington, Connecticut), a supplier of machine tools and laser systems, was one of nine U.S. companies recognized by the National Fund for Workforce Development as a 2017 Young Adult Employer Champion. Dr. Christine Benz, training manager, was instrumental in launching the company's Machine Tool Technician apprenticeship three years ago to help speed up the recruitment of new talent for difficult-to-fill field service engineer positions.

According to Benz, Trumpf's field service engineers must possess good mechanical skills, a background in electronics and pneumatics and troubleshooting skills. Good interpersonal skills are also essential because these engineers are the

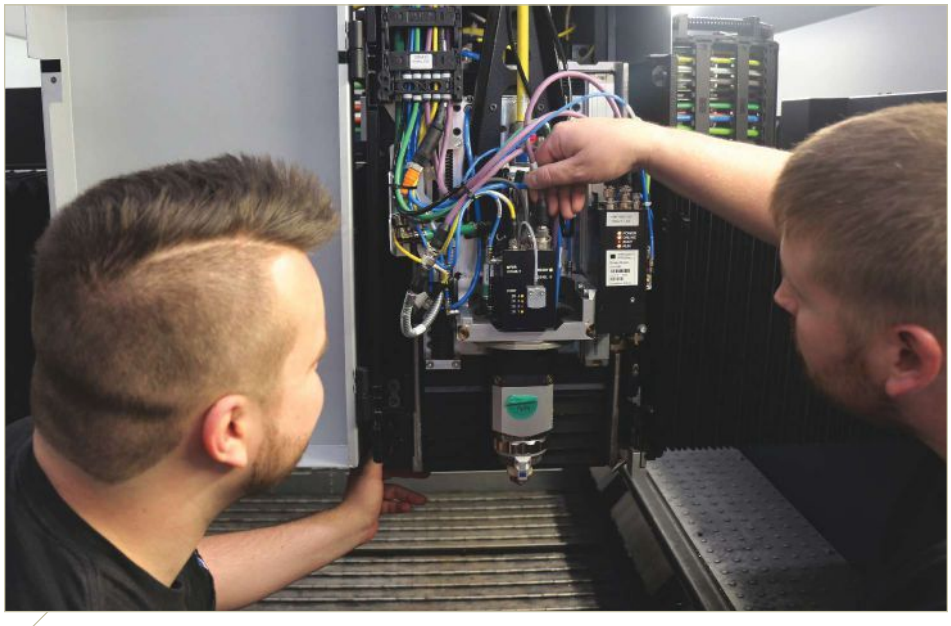

Image courtesy of Trumpf North America.

Trumpf currently has 13 machines dedicated to training, and apprentices spend quite a bit of time in the training center, often alongside customers, learning the ins and outs of how the machines work, how to program and run them, as well as how to troubleshoot them.

face of Trumpf. Benz cites valuable relationships with career counselors from local high schools, technical high schools and community colleges as the number one resource for applicants to the apprenticeship program.

The company's two-year program is divided into four semesters, each focusing on a different part of what recruits will ultimately do in their new careers. During the first semester, apprentices are immersed in all things Trumpf, and they spend time in every department. For example, they may spend up to five months in engineering and production, for example, where they shadow jobs, read work instructions and study. They gradually take on more responsibility until they can complete a set of tasks in the machine assembly line totally unsupervised. The second semester focuses on learning the ins and outs of the press brake, punch press and laser machines that Trumpf manufactures. The company currently has 13 machines dedicated to training, including a 2D laser machine with integrated automation and a TruMark Series marking laser machine. The third semester is dedicated solely to laser technologies and how the 2D laser cutters work. In the fourth semester, trainees begin traveling with experienced service engineers in the field.

> Get involved, because this skills gap is not going away anytime soon.

Uniquely, apprentices spend a great deal of time in the training center, alongside Trumpf customers, learning how to program and run the machines. Other classes teach them how to disassemble a machine and put it back together, to repair and to troubleshoot. Throughout the apprenticeship, trainees attend college with the goal of completing a certificate program or earning at least a two-year degree. Trumpf will soon introduce a new Advanced Manufacturing Technician program for laser and machine. "The message I keep sending to our fellow manufacturers is get involved, because this skills gap is not going away anytime soon," Benz says. MMT

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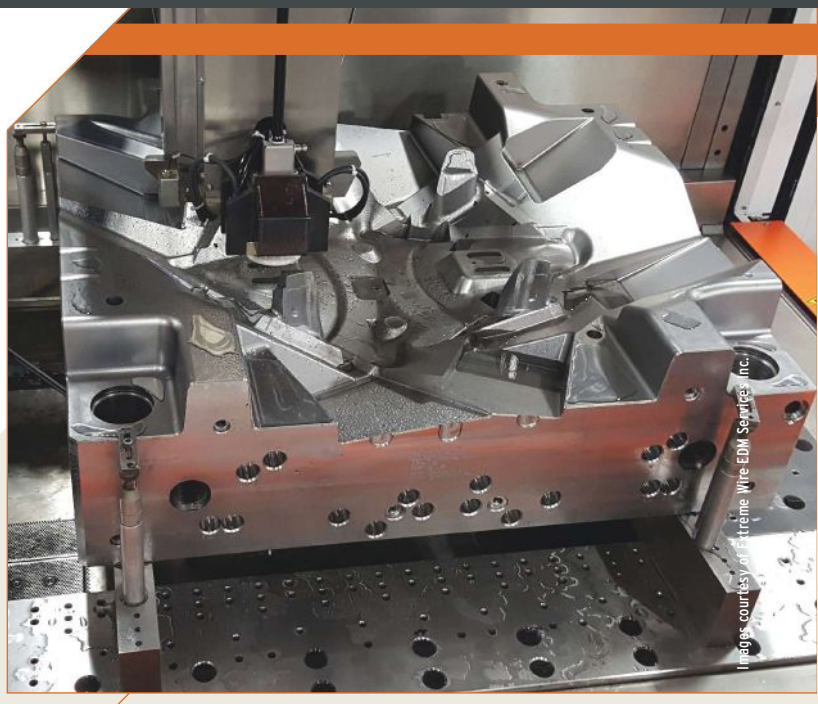
Extra Large Wire EDM Capacity Places Shop on Pathway for Growth



Setting up a mold in Extreme Wire EDM Services' extra-large AgieCharmilles CUT P 1250 wire EDM from GF Machining Solutions. This mold provides a good example of the type of drastic contours that the Grandville, Michigan company frequently cuts for its moldmaking customers.

By Cynthia Kustush

Extreme Wire EDM Service Inc. is an all-AgieCharmilles EDM shop that strives to grow by taking on large wire EDM jobs that require details most other shops can't or won't do, like wire EDM lathing. According to Brian Bernt, vice president, another way to grow is to offer the same services, but on much bigger projects, offering customers a diverse range of services in industries that represent new territory for Extreme. The company's latest equipment purchase is an AgieCharmilles CUT P 1250 wire EDM from GF Machining Solutions (Lincolnshire, Illinois). It provides capabilities that are right in step with the philosophy of Bernt and his brother, Karl. In fact, GF Machining Solutions confirms that Extreme was the first in the United States to be able to purchase the machine. It may still be the only shop to have done so as the model was just unveiled publicly in July 2017.

Extreme was founded in 1997 in Grand Rapids, Michigan. Extreme started with one Charmilles 290 Robofil non-submerged wire EDM. Today, Extreme has 10 wire EDMs, including the CUT P 1250, which was delivered in July 2016. The company also recently moved into a new, 12,000-square-foot facility in Grandville, Michigan to accommodate the growth made possible by the CUT P 1250. Extreme's clientele comprises about 80 percent mold builders who require wire EDM services to machine pockets for lifters, ejector pins, core pins and so on. Its clients also require wire EDM services to machine pockets for sub-insert cutting for molds that will manufacture parts for cars, appliances and other consumer products. "Mold manufacturing is a very exacting process, so we're seeing a lot of very precise work and much bigger workpieces than before," Bernt says.

EXTREME WIRE EDM SERVICE INC.

PROBLEM: Turned away large jobs because of insufficient EDM capacity.

SOLUTION: Purchased an AgieCharmilles CUT P 1250, currently the largest wire EDM from GF Machining Solutions.

RESULTS: Now has capacity to take large jobs and grow customer base and company.

EDM Size is Paramount

One issue that many machinists face is having a part that is bigger than the cutting envelope, which Extreme experienced with increasing frequency before the CUT P 1250 purchase. "It's an ongoing problem because no matter how big a machine we buy, there's always a larger job coming in. In some cases, we could only fit half of the block or part into the envelope. We would cut that end of it, and then take it out and re-set it up for the other half to be cut, which eats up time and leaves a lot of room for mistakes and other hiccups," Bernt says. Setups can take half an hour or a full hour each, depending on the difficulty of the project. If a job needs to run overnight, only part of the workpiece can be cut, which leaves the balance sitting there until morning. The constant need for larger, more efficient machining capability pushed Extreme to approach GF Machining for a larger wire EDM solution.

"We began talking with our GF Machining representative about designing a machine that would give us the ability to take on much larger work. It took a few years of research and development before a large AgieCharmilles wire EDM was available that had the features we wanted and needed, like the ability to cut tapers to the full height of the machine, a hardened table and collision protection as standard," he says.

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A shop-floor view shows that Extreme Wire EDM is an all-AgieCharmilles wire EDM company. In addition, it is the first—and currently the only—U.S. company to own the CUT P 1250, which can be seen on the back wall, center, of this image. GF Machining Solutions just unveiled the new wire EDM to the North American market last July, but Extreme has owned one for more than a year now.

"Before we took delivery of the CUT P 1250, we had to turn away anything taller than 20 inches and anything longer than 43 inches. This is because the upper head on our next-largest wire EDM, an AgieCharmilles FI 640 CC, wouldn't go any higher than 20 inches, and its doors are only 43 inches wide," Bernt says. Sometimes, big workpieces were loaded into a machine with a forklift, which required setting the workpiece on rails above the table. "It wasn't much of a solution, though, because we were losing Z height from having to raise the part up onto the rails," he says. For example, if the rails are 5 inches high, the machinist could only fit a part that is 15 inches tall into the machine.

Raising the workpiece off the table also reduces the EDM's flushing system efficacy. As the wire cuts, the upper and lower heads direct high-pressure water along the cutting wire to keep cutting paths clear of the micro-sized steel particles. Raising the workpiece off the table reduces the ability to flush particles, causing the machine to compensate by decreasing its cutting speed. This, in turn, increases the cutting time and may also compromise cutting accuracy as a result.

Conversely, the CUT P 1250 has doors that lower all the way around the front and sides, which allows Extreme's machinists to load up workpieces as large as 90.551 x 51.181 x 29.528 inches from virtually any angle. "We can now set parts up to 90 inches in X and 54 inches in Y right on the table," Bernt says. Even better, flushing is no longer an issue because the heads remain close to the workpiece. Plus, the increased capacity that the CUT P 1250 offers saves time and increases opportunities for Extreme. "It is hard to measure benefits to things like time and money because we've never had this kind of capacity in the past. Still, I will say that not having to do multiple setups or deal with rails and forklifts saves a lot of time."

Extreme also has customers who need wire EDM services for large steel cylinders typical of the food and oil industries. "Before we had the CUT P 1250, customers would give us the large cylinders cut in half so we could do the work, and then they would dowel the cylinders back together. Now they don't have to do that. With the capacity of the CUT P 1250,

Big Taper-Cutting Capability is Key

In addition to needing a very large capacity wire EDM to grow its business, Extreme Wire EDM Services Inc. knew that its new AgieCharmilles CUT P 1250 offered another valuable feature: the ability to cut tapers to the full height of the machine.

The heads on a wire EDM are like arms and hold the wire above the table and below it for cutting. Most other machines only offer limited side head movement to cut tapers between 5 and 30 degrees. More and more frequently, Extreme has needed to cut these angles at greater heights, which requires greater side head movement. On these occasions, Extreme has also needed heads that can move apart more than the typical four or five inches to achieve four-axis cutting and taper cuts. "It's because the heads are tied together, which is fine when you have short and small parts. But, if you raise the head up higher, the degree of your angle lessens," Bernt says. "The 1250 provides heads that are fully independent, so you can move the heads up and out as far as you want and still maintain the angle for taller parts."

GF Machining Solutions offers the Profil-Expert feature on all CUT P Series machines. According to GF Machining, the Profil-Expert feature automatically adapts the machining parameters and the cut path for rough and skim passes to provide better control of fine details and to ensure positioning and contour accuracies of ±2 µm, regardless of the workpiece height. By contrast, the Taper-Expert technology cuts angles from 0 to 30 degrees to maximum Z heights. "We've even been able to cut 45-degree angles on the 1250. Being able to cut tapers on large parts is so much faster and easier with the 1250," Bernt says.

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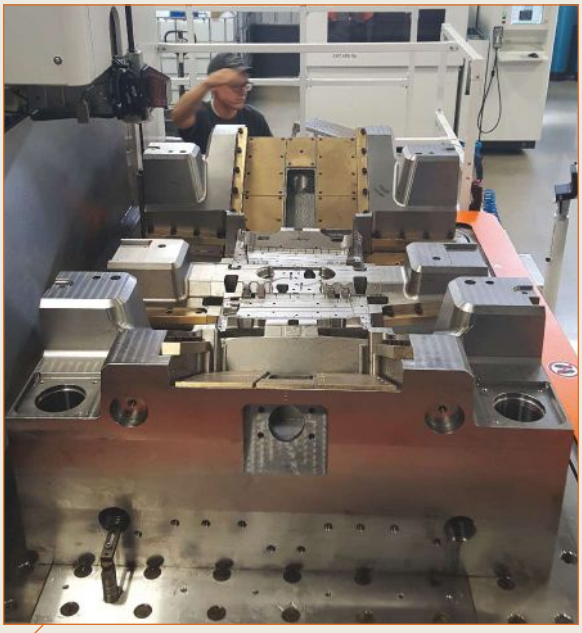
Hardened Table, More Taps Ensure Precision

Extreme Wire EDM Services Inc. only uses GF Machining Solutions' AgieCharmilles-brand wire EDMs. Brian Bernt, vice president, says that there is one specific feature that these machines offer over most other options: the hardened steel table.

"Many competing brands have soft tables," Bernt says. "If all your blocks are hard steel and you set one on a soft table and push the block, you are going to scratch the table. Everything is based off the table, including your accuracy, your Z height and the tapers." If there is a burr or a scratch on the table, that burr or scratch will prevent the block from lying flat. In a business where tolerances must precisely meet customers' specifications, Extreme can't risk the integrity of the tables. "You might be able to buy an EDM with a soft table for less money, but it can cost you later if that table is damaged," he says.

Additionally, while it's common practice to set many smaller parts into the work area using clamping systems and tooling fixtures to secure them, about 70 to 80 percent of the molds with which Extreme works measure 35 x 28 inches (on average). Setting them on the table is therefore a must, as is securing them with taps. Before taking delivery of its CUT P 1250, Extreme had several more taps added to the perimeter of the table to provide more clamping space for the large blocks. "Only having taps around the first couple inches of the table limits our ability to move parts around in the envelope and set up jobs properly," Bernt says. "It also limits the size of the workpieces that we can machine. If you have large parts sitting on that table, and all your taps are on the edge of the envelope, then you have covered your taps, and you cannot cut an unsecured workpiece."



This image shows a very large block set up in the AgieCharmilles CUT P 1250 EDM. Notice how the extra taps Extreme Wire EDM had installed help secure such a large workpiece to ensure cutting accuracy and speed, not to mention protect the table itself from damage.

we've cut a 28-inch-long keyway into a cylinder with no need for additional steps. We have also cut slots on the inside of a steel tube for a massive drill or auger," Bernt says.

After a year of ownership, the mega CUT P 1250 has made a great impact on the company. Bernt says, "This machine has opened up a whole new category of work we could not do before. We can foresee growing the company by as much as 20 to 30 percent over the next few years because of our ability to take on larger jobs. We may even invest in a second 1250 down the road." MMT

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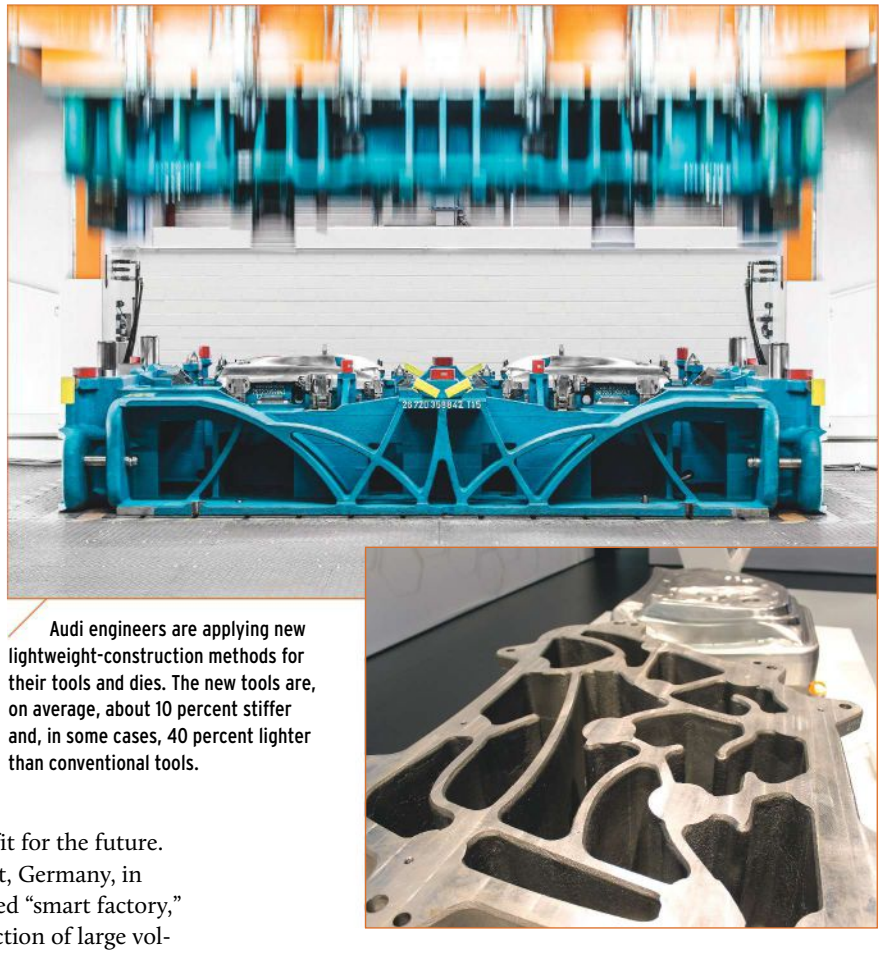
Driving a New Generation of **Toolmaking**

By Barbara Schulz

Germany is an industrial titan and the eurozone's economic powerhouse. Its products, especially its cars, stand for quality and high performance. Audi, BMW and Mercedes-Benz account for 80 percent of the global luxury car market. Will Germany still lead the automotive industry when the world shifts to self-driving, electric cars, and software overtakes engines as a vehicle's most important component? As cars and machines are increasingly mediated by software and digital technologies, will the German automotive industry be left with nothing but panels, windows, seats and wheels?

Probably not. German manufacturers work not only on electric mobility and new drive concepts, but on a future of networked factories and connected robots that are deployed in fully automated production as well.



Audi engineers are applying new lightweight-construction methods for their tools and dies. The new tools are, on average, about 10 percent stiffer and, in some cases, 40 percent lighter than conventional tools.

Images courtesy of Audi Toolmaking.

Audi's Smart Factory

Audi is one car manufacturer making its production—including its toolmaking—fit for the future. At Audi Techday Smart Factory in Ingolstadt, Germany, in November 2016, Audi said that in its so-called "smart factory," big data (the creation and intelligent connection of large volumes of data) will facilitate data-driven and thus highly flexible and highly efficient manufacturing. In a smart factory, machinery and equipment can improve processes through automation and self-optimization. The structure of the smart factory includes a combination of production, information and communication technologies with the potential for integration across the entire manufacturing supply chain.

For example, Audi no longer builds its cars on an assembly line. Audi implemented this change in response to a growing model of diversity, which makes it increasingly complicated to master the complexity in a rigid sequential process. Instead, Audi uses a method called *modular assembly.* The idea behind modular assembly is production without assembly lines, broken down into individual work stages. One or two workers occupy the new assembly stations. They work steadily and at a continuous pace, because they no longer need to adapt their activities to the speed of the line. And, workers do not have to move with the car on a conveyor; they can work in one place.

In addition to this major venture, Audi is pursuing many other exciting production projects, from virtual reality glasses to metal 3D printing. These projects take place at the Audi Toolmaking division in Ingolstadt, Germany.

Audi Toolmaking covers the entire process chain of sheet metal production. The division supplies Audi as well as other brands of the Volkswagen Group with dies, molds and manufacturing equipment. Audi Toolmaking currently employs more than 2,000 people at its current five locations in Ingolstadt (Germany), Neckarsulm (Germany), Barcelona (Spain), Győr (Hungary) and Beijing (China). Apart from Beijing, each location produces its own tools, bodyshells and fixtures. Nearly every Volkswagen Group brand uses Audi's dies.

Audi's unique design, including its sharp edges and tight tolerances, differentiates its cars and production process from many other car manufacturers around the globe. Jörg Spindler, head of Audi Toolmaking, says that "the only way to achieve those complex geometries is through a close cooperation between our toolmaking, design and production departments.

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It's also essential that know-how from the production team is directly fed back to the early design stages. The production of every car starts in the press shop, involving immense forces and highly complex functions. Approximately 750,000 parts are produced at the four Audi press shops worldwide."

The press shop and toolmaking group have always worked closely together at Audi. The Competence Center for Plan Equipment and Forming Technology, which unites the two divisions, has further intensified their collaboration since January 2017.

The Audi Toolmaking division is home to the company's newly established, metal 3D printing center.

Toolmaking at Its Core

"Toolmaking has always been one of Audi's core competences," Spindler says. "We are constantly pushing the boundaries of what is technically feasible to lay the foundation for our high-quality car bodies and to remain globally competitive."

This dedication earned the team the "Toolmaker of the Year" award in 2015, which is annually awarded by a jury in Aachen, Germany. Specifically, Audi Toolmaking's diverse innovations impressed the jury. Features like intelligent tools that independently control themselves (to safeguard the precision of sheet metal parts measured in hundredths of millimeters), new lightweight dies and metal additive manufacturing (AM) all impressed the panel.

Intelligent tools. Intelligent tools are equipped with sensors that automatically control the flow of material. Sensors make the process inside the tool visible, identifying how the material is flowing and what forces are being exerted on the blank. This data shows whether the processes are remaining within the narrow window that the engineers have defined. If not, an actuator in the tool autonomously adjusts the distribution of forces within the tool. This enables Audi to ensure precision to within hundredths of a millimeter.

A computer manages the work that the intelligent tool performs and receives its information from up to 24 sensors, such as laser sensors that measure flange feed with extreme precision using triangulation. "In this way, we exploit all physical possibilities of the forming process," Spindler says. "We are currently using intelligent tools in 12 vehicle projects and five more are planned."

Audi is currently working on using the data from intelligent tools as well as systems that detect part quality to consequently track all pressed parts to have the capacity to react quickly to changes in body construction, for instance.

Light tools. Presses are among the heaviest machines in the production process and can weigh up to 45 tons. The massive dies to deep-draw door panels, for instance, add to the overall weight. They have a large, repetitive and reciprocating movement, which increases a press's mass dynamics. A lighter tool reduces the dynamics so that momentum and vibration decrease and precision increases.

As a result, Audi engineers are now applying new lightweight-construction methods for their tools and dies. The design of the cast-iron housing now follows bionic principles, where free shapes that are reminiscent of natural geometries, such as those found in leaves or skeletons, ensure a lighter, optimized design. Furthermore, some components are made of aluminum and plastics. This reduces the overall weight by as much as 20 percent and the energy requirement by about 10 percent.

A conventional press tool's load-bearing structure is usually designed conservatively. Part of the framework includes massive horizontal and vertical struts between the lower and upper panels of the base, which cross at right angles and are designed to resist compression. Their design is adapted as well as possible to the special loads acting on the tool in the press. The vertical ribs provide stiffening where the strongest forces act. With the deep drawing process or first stage of forming, those forces can be up to 20,000 kilo newtons.

Audi started developing its new generation of tools five years ago. In the first step, the engineers replaced the right-angled struts in the base of the large-scale tools, which are up to 5 meters long and 2.5 meters wide, with arc-shaped structures. In the second step, they designed free shapes reminiscent of natural geometries. Some of the struts are twisted, others change

their profile several times over their lengths. As a result, the new tools are, on average, about 10 percent stiffer and, in some cases, 40 percent lighter than conventional tools.

With no detrimental effects on quality, this allows the number of strokes in the press, which is between nine and 18 per minute, to be increased by one to two. The bottom line is that about 10 percent less energy is required for the press process and for the transportation between tool changes. Audi's specialists estimate that the use of each new tool, assuming it has a lifetime of seven years, can reduce CO_2 emissions by an average of at least 10 percent.

Additive manufactured, optimized design. Additive manufacturing offers similar design optimizations for car components, tools and molds. The Audi Toolmaking division is home to a newly established Metal 3D Printing Center. Here, specialists from Audi Toolmaking collaborate closely with experts from the Casting Technical Center of Production Planning in Ingolstadt. There, 15 casting engineers from Neckarsulm and Ingolstadt develop new technologies and produce small series magnesium and aluminum die-cast parts like chassis components. The center hosts two cold chamber die-casting plants as well as aluminum and magnesium smelting systems.

In cooperation with the Technical Development division, the Casting Technical Center uses its three metal printers to produce steel and aluminum parts for testing in engines and suspension. The Technical Development division in Ingolstadt houses nearly 9,000 employees at its approximately 82.8-acre complex. Another 1,700 employees work in Neckarsulm.

With 3D metal printers in the Casting Technical Center, the goal is to better understand printed aluminum materials and the production technology. Various automobile parts are produced, like space-frame components that integrate fluid containers and suspension components. Also, Audi has recently entered a development partnership with EOS. "With their additive manufacturing technology, we can integrate internal structures and functions in tools that has not been possible with conventional manufacturing. Now we can quickly and economically produce components using lightweight construction, especially with components in small batches," Spindler says.

Additionally, Audi will focus on producing parts and vehicle components more cost-effectively with inserts for die casting molds and hot-forming tools that use conformal cooling. This optimized cooling performance can reduce cycle time by 20 percent, decreasing energy consumption and cost.

Audi's toolmaking division is well prepared for future challenges. The entire industry faces enormous challenges in the fields of powertrains and digitization, and Audi is not resting on its laurels. MMT

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Apprentice Training Series: **Manual Machining**

By Ryan Pohl

I have had the good fortune of working closely with thousands of skilled CNC machinists, die makers, moldmakers, fixture builders, designers and engineers throughout the course of my career. One thing I've learned is that those who have extensive training and experience with manual machining equipment possess a distinct advantage in their ability to innovate and problem solve. That moved me to advocate for mandating in-depth manual machine training as part of every apprenticeship program that involves machining.

Here are a few essential components of a manual machining class:

Safety. First and foremost, the class should address machine-specific safety rules. General shop safety rules are typically not specific enough when referring to manual equipment work. A simple Google search of "machine shop safety" will offer up any number of excellent sites to help one develop machine-specific safety rules for a class or to give the apprentices.

Drill press. The manual drill press has abilities that many often overlook. It is a versatile machine that can get a machinist out of a jam quickly and accurately, if the machinist knows how to use it appropriately. With the proper layout techniques and job setup, a good machinist can easily drill and ream a hole within a 0.002-inch location tolerance. Using a manual drill press is therefore a good exercise for students, and it is why I require students to use one in my classes. I ask each student to create a block sample in such a way that requires all the standard skills of using a drill press, like layout, prick-punch, center-punch, center drilling, drilling, reaming, chamfering, countersinking, tapping and counterboring. Students then check each hole for accurate location, proper form and function.

Perhaps it is because of the pride I have as a machinist that I believe that every person who works with metal-cutting machines should know how to sharpen a high-speed steel drill bit.

Job setup is another critical task to emphasize in training. The apprentice must understand when and when not to use vises, strap clamps, angle plates or any other setups.

Pedestal grinder. Perhaps it is because of the pride I have as machinist that I believe that every person who works with metal-cutting machines should know how to sharpen a high-speed steel drill bit. All too often I hear machinists questioning why they would need to know that when a drill doctor is available. Learning how to sharpen a drill bit by hand teaches the machinist how steel is cut. It also teaches the machinist the importance of relief and approach angles, chip evacuation and the overall function of a metal cutting tool.

Image courtesy of Praeco Skills.

A surface grinder is essential for manual machine training, as it gives a machinist an appreciation for accuracy, tolerances and surface finish.

Manual mill. Fifteen years ago, while the educational world debated whether to eliminate manual machining from shop classes and offer CNC machining only, a friend and mentor argued that learning to use the manual mill requires involvement of more human senses than other types of machining. That immersion of the senses helps students to retain what they learn.

For example, when turning the handles of a manual mill a machinist can see the cut, hear the cut, feel the cut and even smell the cut. This creates a powerful association that helps the machinist recognize cutter wear, surface finish and vibration issues quicker on a CNC machine. Engagement of the senses makes machinists more intuitive. Learning a manual milling machine also teaches the student more about the variables that can affect part accuracy, such as setup and head squareness.

Practically speaking, every student should be able to perform certain machining tasks. This includes tramming the head of a mill, setting up and indicating a precision vise and angle plate, using strap clamps, recognizing the differences between climb and conventional cutting, understanding the reasons a machinist does not climb cut on a manual mill, squaring a block, cutting slots, performing all drilling operations, compensating for backlash and most of all, holding a tight tolerance.

Engine lathe. The ability to run an engine lathe is one of the most useful skills to have during a "panic" situation in the

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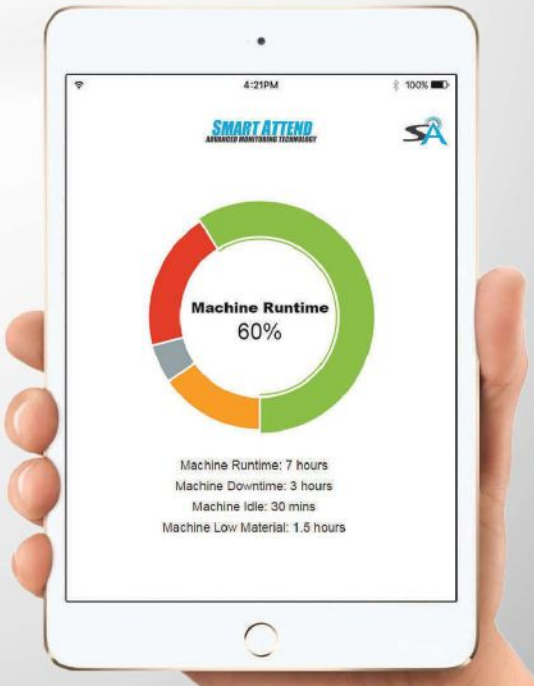

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mold shop. Moldmakers do not use lathes often in the shop other than for special applications. Still, taking the time to learn how to turn an accurate part properly and pick up some additional skills is worth the effort, particularly when there isn't time to special order a part. The basics of learning the engine lathe should include mastering all drilling operations: facing, turning a diameter, turning a taper, and internal and external threading and boring.

Surface grinder. The surface grinder is my final recommendation for manual machine training because it gives the machinist an appreciation for accuracy, tolerances and surface finish. At a minimum, the student should learn to dress a wheel with a diamond dresser, set up a job, block the job in when necessary, square a block with or without using an angle plate, set up and grind angles with a sine plate and grind pins.

Projects are key for helping students learn the skills required on each individual machine. Many shop classes have students make 1-2-3 blocks, angle plates, hammer heads and hammer handles, which end up as useful tools in the shop. I strongly encourage one functional project that requires the use of all the machines, like a precision vise, for example. This teaches students the importance of tolerances and requires them to manufacture complimentary parts that must function with other parts. The vise requires squared blocks, milled and surface ground angles, a threaded rod and numerous other details that incorporate manual machining skills on multiple machines.

The multitude of variables involved in running a manual machine also teaches students to problem solve logically. Above all, running manual equipment teaches students patience, which in turn teaches students the appropriate use of aggression and finesse when machining. After years of teaching, I can say that everything students learn on a manual machine will translate to improved skills on a CNC machine as a moldmaker, designer or engineer. MMT

LEARN MORE

For more from Ryan Pohl about on-the-floor learning, visit short.moldmakingtechnology.com/floor

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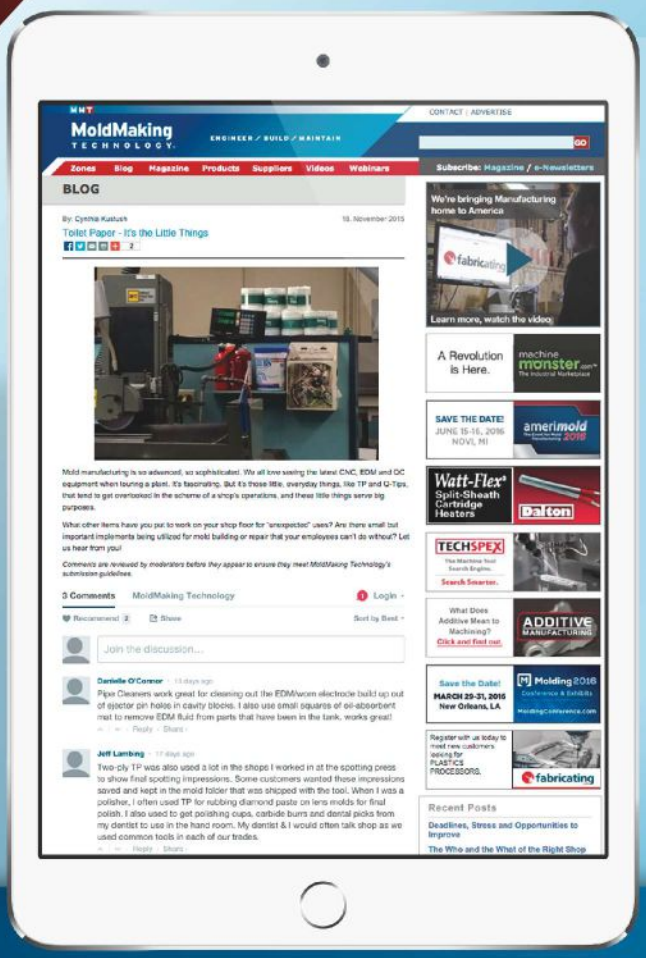

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Income Tax Nexus: Are You Protected?

By Michael J. Devereux II, CPA, CMP

Are you trialing molds at customer locations in other states? If so, you may have engaged in an unprotected activity under Public Law 86-272. Therefore, you may be subject to income tax in the state where you have trialed the mold.

Trialing or sampling molds at customer locations in other states is just one of the activities that may result in the creation of nexus to states other than the one where a shop is based. A company creates a "nexus" with a state when that company has sufficient physical presence in the state for that state to subject the company to taxes.

Here are some recommended dos and don'ts when seeking protection under Public Law 86-272.

Public Law 86-272

The Interstate Income Act of 1959, more commonly known as Public Law 86-272, governs interstate commerce, or the sale of tangible personal property across state lines, and protects companies that engage in such interstate commerce (including molds) from additional taxes. However, protected activities are limited. Essentially, protection covers the mere solicitation of sales that occur outside of the state where a company is located. Protection does not cover activities like trialing or sampling molds.

Public Law 86-272 only provides immunity to the solicitation to sell personal property. Therefore, the law generally affords protection to molds, dies and other things that mold shops sell to their customers in other states. However, mold shops may be engaging in other types of activities that are not protected under this law. In those cases, mold shops create an income tax nexus to other states. If a mold builder creates an income tax nexus in another state, the mold builder may be required to file an income tax return in the state for which it has created the nexus.

The term "mere solicitation" is somewhat vague. In *Wisconsin Department of Revenue v. William Wrigley, Jr., Co.* (1992), the Supreme Court of the United States weighed in on its meaning by looking to various dictionary definitions. The court found that "mere solicitation" includes both explicit requests for orders and "any speech or conduct that implicitly invites an order." Soliciting an order does not mean accepting or facilitating an order. Therefore, if mold shop employees are merely soliciting sales in other states, but they approve and fill the orders in the state where the mold shop is located, then Public Law 86-272 likely protects those activities.

If the law protects the activity, then the throwback rule applies to that sale. The throwback rule refers to sales that are taxed in the seller's home state. Conversely, sales involving unprotected activities are not subject to the throwback rule, and may then be taxable in the state of the customer. In these instances, the mold builder must file an income tax return in the state of the customer.

Protected activities. These activities do not necessarily trigger income tax nexus, and may include the following:

- Soliciting orders for sales or advertising.
- Passing on orders to the home office.
- Coordinating shipment or delivery of new molds, without payment or other consideration.
- Carrying promotional materials for display or distribution.
- Exhibiting at trade shows, so long as orders are not accepted or facilitated.
- Recruiting or training sales personnel.
- Using personal property, such as cell phones, computers, or computer software to carry out protected solicitation.

Alone, these activities should not create an income tax nexus within a state, as the law deems them as mere solicitations of sales.

Unprotected activities. Public Law 86-272 does not protect these activities, which may include:

- Trialing of a new mold at the customer's location.
- Approving or accepting orders.
- Securing deposits on the sale of a new mold.
- Providing warranty services or repairs to molds.
- Installing or hanging new molds.
- Providing technical assistance or service, such as engineering assistance or design services related to new molds. For example, mold builders should consider whether they are sending tooling engineers to a customer's site outside of their state to assist in the design of a new mold.

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- Conducting seminars or training courses on the technical use of a new mold.
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- Collecting delinquent accounts.
- Repossessing molds.
- Maintaining a parts department.
- Maintaining a warehouse or meeting place for employees.
- Maintaining a sales or technical office.
- Providing a telephone listing or other public listing within the state. For example, mold builders should consider whether contact information is listed on the website.

LEARN MORE

For more from Michael Devereux on nexus issues, visit
short.moldmakingtechnology.com/nexus

Generally, these unprotected activities will mean the mold shop has income tax nexus in the state in which the activity occurs. It is therefore likely that the law will require mold shops engaging in these activities to file an income tax return in that state.

Interstate Commerce. Public Law 86-272 does not apply to foreign entities. Although, many states may apply the same or similar standards in determining whether an entity must file an income tax return within its state. Also, companies that are incorporated under the laws of a state automatically have income tax nexus within the state and are required to file an income tax return in the company's state of incorporation.

Protected and unprotected activities are determined on a year-by-year basis and many states apply these tests to unitary business groups. That is, the state will look to see if a related company performed any of the unprotected activities in determining whether a mold shop has nexus within its state. Of course, each state has its own nuances and case law. Therefore, a periodic state review of these tax matters is advisable. MMT

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How do you define five-axis machining as it pertains to your company?

Don: Graphic Tool elected to pursue five-axis machining for several reasons. We wanted the ability to machine five sides of six-sided geometry in one set up, which saves us valuable time. The machine's rigid construction and five-axis capability enables both soft and hard milling operations. Plus, we can run regular, 3D-milling routines, 3+1 or 3+2. Or, if required, we can run true five-axis milling, which expands our capabilities. Our FANUC articulating arm robot loads custom-made pallets that can hold many different workpiece shapes and sizes. This functionality allows us to perform unattended machining on multiple inserts in both a soft and hard state. We use the first-article inspection process to validate the program and, once proven, we use the robotics to feed the components through the programmed routine. This methodology allows us to run many components (soft or hard) totally unattended through the process. We routinely machine a large volume of identical inserts, rough them out and then finish them by hard milling after heat treating them to a close tolerance. We are capturing this as unattended time, which we monitor very closely. All of this lends itself to how we define five-axis milling at Graphic Tool.

Ed: Five-axis machining provides us with infinite possibilities in effectively processing part sizes and shapes. The term "five-axis" refers to the number of directions in which the cutting tool can move. On a five-axis machining center, the cutting tool moves across the X, Y and Z linear axes and rotates on the A and B axes to approach the work piece from any direction. In other words, you can process five sides of a part in a single setup. This saves time and money and ensures accuracy like never before.

For which types of jobs or workpieces do you use five-axis machines and why?

Don: Graphic uses its five-axis machines to perform five-sided machining on cores and cavities or on a variety of mold components. We purchase our steel with extra stock on one of the six sides (usually, the bottom surface of the component) so we can more easily secure the material directly to the machine pallet, magnet or in a vise. Another example is machining spiral water lines on water jackets or drilling water lines on angles. In the case of drilling water lines on angles, we would use 3+1 drilling or 3+2 machining for compound angled water lines all in the same set up. We can machine very complex undercuts that would otherwise require a time consuming and expensive electrode set, EDM operation with additional polishing. We routinely perform and finish hard-milling operations to a 0.0002 inch tolerance with total reliability. This is done as three-axis machining, or 3+1 or 3+2 machining, depending on the complexity of the geometry and the most efficient set of machining parameters for that given project. On some occasions, we finished the entire insert in our DMG MORI DMC 75V-Linear five-axis machining center and then proceeded directly to polishing.

Ed: We know all mating parts must connect precisely with others. The slightest imperfection from one clip feature on the instrument panel of a vehicle, for example, means that the glove box does not line up with the H-Vac system behind it. Before you know it, the avalanche has begun. It's for this reason that we use our five-axis machines for all our lifters, inserts, slides and details that require the level of accuracy that we need but cannot get from using other machining resources that we have. We feel we have tuned our five-axis machines to run as fast and accurately as possible, using the machine and tooling to their optimum performance.

EDITOR'S NOTES

In this column, *MoldMaking Technology* invited this year's Leadtime Leader winner and honorable mention shops to share some of their thoughts about some hot industry topics.

For more information on how to enter our Leadtime Leader Awards program, or if you have a question for any of the Leadtime Leaders, please e-mail Christina Fuges at cfuges@gardnerweb.com, or visit short.moldmakingtechnology.com/leader

Based on your experience, share some "lessons learned" about five-axis machining processes and technology, and describe any aspects that you feel could be improved for moldmaking.

Don: First, select a machine tool company that has an experienced staff of factory-trained technicians who really know how to service your machine tool and can provide fast, efficient service. Additionally, select a supplier that has a trained person on staff who understands the intricate, specialized software and post processors of the five-axis machine that you will purchase. Next, consider selecting a five-axis machine tool controller that will permit you to perform certain basic programming functions at the machine tool and will help make your off-line programmer available for other tasks. Then purchase a five-axis machining vise, which will enable you to machine much closer to the part and reach places that would otherwise be inaccessible with more conventional fixtures. You will not need to extend your cutting tools nearly as far from their tool holder as you usually do, which results in a more rigid machining environment.

Graphic Tool makes extensive use of magnetic tables to hold its workpieces and vises, and Graphic Tool frequently uses shrink-fit toolholders. (We use collets and conventional toolholders for roughing only.) Both strategies result in much closer tolerances. The shrink-fit technology helps to increase machine spindle life and decrease spindle runout.

Finally, we highly recommend cross-training. The typical five-axis machine is an expensive piece of equipment, so it needs to be kept running. Cross training is an insurance policy that a purchaser of any highly complex, state-of-the-art equipment purchase should consider.

Ed: We have several five-axis machines, but it took time to learn how to maximize our use of them and figure out how to leverage the results we need. We investigated numerous cutter styles, speeds and feed rates depending on what material and function we were using. We try to optimize every situation as it comes up so that we know exactly what we're going to get when the item is finished. At this point in time, we feel every piece that comes off our five-axis machines is spot on, and that level of optimization in our mold builds allows us to fit items faster and with less manual work. In turn, we achieve repeatability, which gives us consistency should the customer ever have a problem with any component in our tools and needs us to perform the work again. MMT

July 2017 – 55.2

Index Up 16 Percent from One Year Ago

For July 2017, the Gardner Business Intelligence Moldmaking Index was 55.2. This reading shows that the Moldmaking Index has fallen slightly for a second month after it registered a new five-year high at 58.3 in May. Through the first seven months of 2017, the Moldmaking Index averaged 55.8, which is a 16-percent increase from the same period one year ago.

The new orders, production, supplier deliveries and employment components increased this month's Moldmaking Index while backlog and exports decreased it. Examining custom processor responses only, the result for July was 52.4, which is down sharply from June's five-year high reading of 59.1.

Both production and new order components have fallen since June, but in the year-to-date period they have increased nearly 6 percent and 16 percent, respectively. The turnaround in new orders, after a deep fall into contractionary territory in 2016, may explain partially the recent spikes in backlog readings. The GBI team closely monitors backlog, as backlog is often thought to be a bellwether of capacity utilization and machine tool sales.

For current industry reports and data, visit **gardnerweb.com/economics/blog**

During the past 12 months, the exports component has averaged 49.0 and has trended flatly. Fluctuations in currency markets can impact the relative pricing between foreign and domestically produced goods, so GBI closely monitors foreign exchange rates.

The spread between material prices components, at 65.4, and prices received components, at 51.2, increased in July. Material prices in the year-to-date period averaged 67.8, which was due in part to material prices reaching a new multi-year high in February. In contrast, prices received has stayed roughly within a five-point range between 55 and 50. While these two measures are not used to calculate the Moldmaking Index, they demonstrate how inflationary forces impact business profitability.

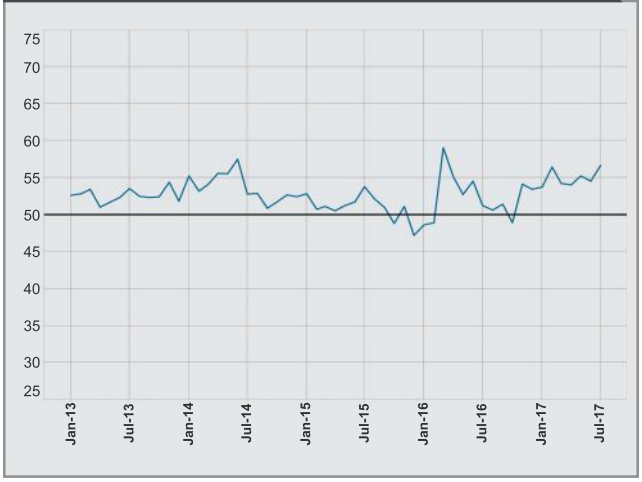
A greater number of moldmakers and custom processors report an increase in hiring. This has increased the employment readings 10 percent since July 2016. MMT

FOR MORE INFORMATION

Michael Guckes, Chief Economist, Gardner Business Media Inc.
mguckes@gardnerweb.com / gardnerweb.com/economics/blog

Moldmaking and Custom Processors Business Indexes

Employment



New Orders and Production

By Michael Guckes

AUTOMOTIVE & CONSUMER PRODUCTS

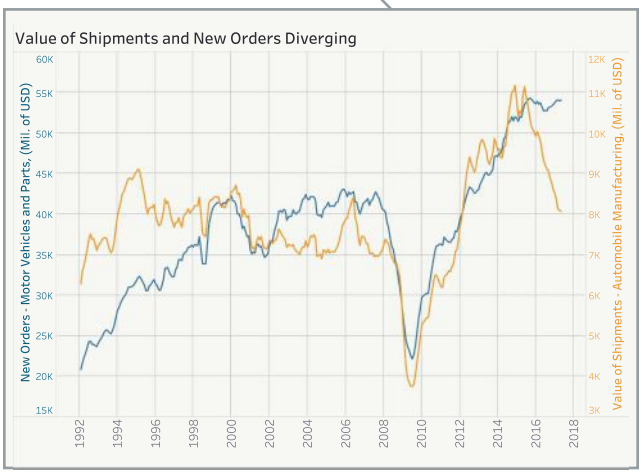
Automotive Shipment Values Falling Despite Strong New Orders

The annual rate of total vehicle sales nearly doubled between February 2009 and May 2015, increasing from 9.2 to 18.1 million units. This is an impressive feat for a pillar of the U.S. economy. The industry's second notable feat was sustaining that hefty sales level for nearly two more years. Last year ended at an annualized production rate of 18.7 million units.

Automotive industry data shows a disconnect between the value of shipments, which has fallen sharply in the last year, and new orders. The 2017 average ratio of the value of new orders is 6.6x greater than shipments–one third higher than the average ratio since 1992 of 4.9x.

This means that the dollar value of new orders is more than six times greater than the value of concurrent shipments, the long-run ratio of which is 4.9. These results suggest that manufacturers may be hedging their output despite strong new order demand.

Among possible reasons for the pull back is the industry's struggle to earn profits in the sedan and small car markets. According to J.D. Power, incentives in 2017 are expected to exceed $4,000, a near 15-percent increase over 2016 incentive levels. Automotive credit data shows several signs that give cause for concern as well. Because of the growing popularity and availability of 72- and 84-month duration automotive loans in recent years, more owners are finding themselves with negative equity in their vehicle, as the vehicle depreciates faster than their loan balance. The combination of low interest rates and lengthy loan durations make financing payments extremely affordable.

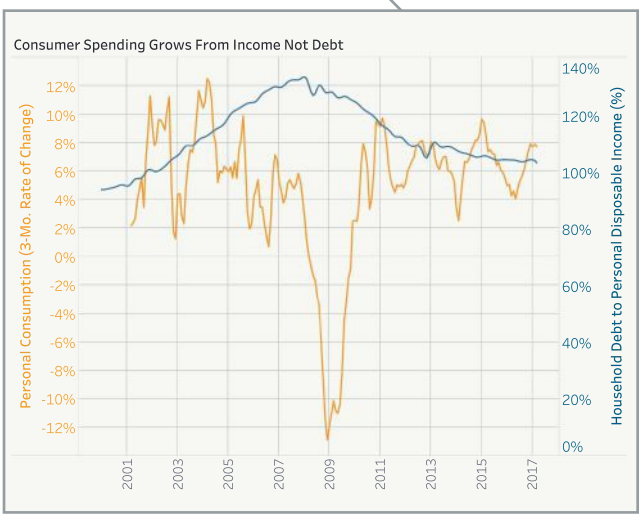


Consumer Metrics Point to a Strong Future

Gardner Business Intelligence's (GBI) review of consumer confidence, employment and credit markets all point to a strong 2017 for consumer spending. Improved confidence in the economy has already yielded additional spending. Inflation-adjusted data for 2017 through April shows consumer spending on durable goods and total personal consumption increased by 4.9 percent and 7.2 percent, respectively. The increase in spending on durable goods is a result of growth in disposable personal income. The current ratio of household debt to personal disposable income at 103.2 percent is not significantly different than the 2015-2016 average of 104.1 percent.

Data from the Consumer Confidence Indexes measuring the present situation and future expectations both point to an economy of confident consumers. The index measuring the present situation, which increased sharply after the November presidential election, has continued to increase. For the first months of 2017, it averaged 137.9 as compared to 115.4 for the same period in 2016. Expectations data available through May 2017 indicate that consumer outlooks are significantly higher than for the same period in 2016. During the first five months of 2016, the index of Consumer Confidence Expectations averaged 81.4. By comparison, the index averaged 104.7 for the same period in 2017.

There is an opportunity for automotive original equipment manufacturers to continue producing at such elevated volumes. But, there are many financial factors that could constrict potential buyers from purchasing new vehicles in the future. It is for this reason that OEMs may be hedging their bets and holding back on shipment levels. MMT



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FOR MORE INFORMATION:
Michael Guckes, Chief Economist, Gardner Business Media Inc.
mguckes@gardnerweb.com / gardnerweb.com/economics/blog

On Display at WESTEC – September 12-14, Los Angeles, California – *westeconline.com*

End Mill Material Improves Edge Strength, Sharpness, Durability

YG-1 Tool Co. offers the Only One powdered metal composition (HSS-PM60) for its end mills, designed to provide high performance in unstable and "less-than-perfect" setups. A new coating is said to enhance the best features of end mills for difficult applications. Where rigidity is lost and catastrophic failure is common, this technology is said to offer better toughness than high speed steel (HSS) and cobalt, while maintaining similar wear resistance to solid carbide. Improved edge strength, sharpness and durability make Only One a good choice for high-temperature nickel-based alloys like Inconel. To accommodate difficult and unstable machining conditions without the cost of solid carbide, Only One tools are offered in roughing, finishing, variable-helix, center-cutting, ballnose, long and short geometries.

YG-1 Tool Co. / yg1usa.com / Booth 1347

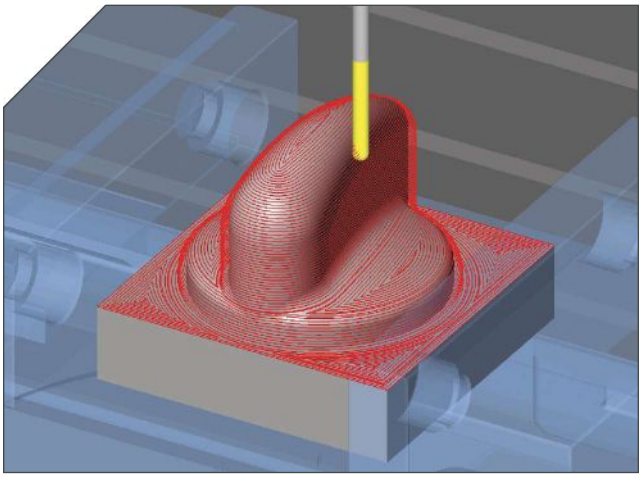
Vises and Grippers Designed for Production and Five-Axis Machining

Fixtureworks will display vises, grippers and gripper pads at WESTEC 2017. The company will also feature a full line of fixturing accessories at the show. Fixtureworks says that TriMax Production Vises offer the benefits users need to maximize a machine's potential with multiple part clamping, quick change components and easy adjustment. Vises are suited for production, five-axis and machinist applications.

TG GripSerts carbide gripper inserts are designed for ultra low-profile clamping with no dovetail workpiece preparation. With serrations designed for steel, hardened steel, titanium and aluminum, these patented triangular grippers feature two rows of teeth at different angles to maximize the pull-down effect. The TG GripSerts workholding grippers are integrated with the TriMax vises, ideal for upgrading existing vise jaws.

The GP Series rubber gripper pads are useful as industrial grade contact wear points for automation and positioning applications. They are constructed of black nitrile rubber that is molded to a 1/16" aluminum backing that can be mounted flat or that can be contoured or formed to round or sharp corners. The pads are highly customizable and easily replaceable. Fixtureworks offers them in strips, and they come in smooth, fine hatch or course hatch with standard pad heights of 1/4" and 1/2".

Fixtureworks / fixtureworks.net / Booth 809



CAD/CAM Software Gets Improvements for Closed-Cavity Milling

DP Technology's Esprit 2017 software release features simplified user interaction, smarter toolpath technology and faster programmability partly by upgrading the machine and toolpath performance of Esprit ProfitMilling inside closed cavities. In addition, ProfitMilling optimizes the initial channel width for faster achievement of programmed feed rates and fewer machine decelerations. The 2017 release also features increased simulation speed, enhanced CAD file support, advanced tool settings and new five-axis programming features. Compatible with a full range of machine tools, Esprit delivers full-spectrum programming for two- to five-axis milling, turning, wire EDM, multitasking, Swiss turning, and high-speed three- and five-axis machining.

DP Technology Corp. – ESPIRIT / espritcam.com / Booth 1207

Coating on Turning-Grade Inserts Resists Adhesion, Microchipping

Sumitomo will showcase its line of AC1030U turning grade inserts for precision machining, which are available in many geometries, including the company's GND grooving line. The inserts have an Absotech Bronze PVD coating and a substrate, which are designed to create a high-quality cutting edge, resist adhesion and microchipping, and result in better surface finish.

Sumitomo Electric Carbide Inc. / sumicarbide.com / Booth 2725

CAD/CAM Software Gets Streamlined User Interface

Autodesk will present the 2018 versions of its major CAD/CAM software including PowerMill. The major new update is a ribbon-style user interface. Users will still be able to easily find and access important tools, but the 2018 versions categorize functionality into similar groupings, with the most commonly-used features located front and center. The new interface is designed to provide an improved user experience and help shorten the learning curve. Dynamic machine control enables users to dynamically change the five-axis motion of tool paths using a virtual machine twin. This new update allows users to make localized edits to regions of tool paths for improved control of CNC machine motion while minimizing programming time.

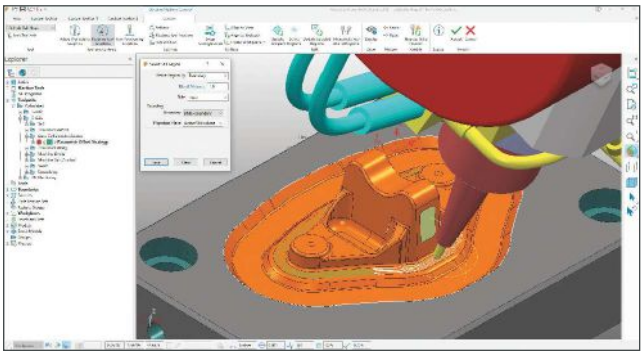
PowerMill now provides a higher-quality simulation image that can be zoomed, panned and rotated, enabling users to review the quality of their programs and, ultimately, provide greater confidence that the stock is being machined as specified.

The software also includes enhanced turning abilities, including collision checking, editable tool paths and a greater choice of leads and links, which in turn provide users with increased flexibility and control.

New 2D strategies simplify the programming of prismatic pockets and bosses. Improvements help reduce the time taken to program 2D parts while also helping to minimize the need to use multiple CAM programs.

The company will also present the 2018 version of FeatureCAM software, which also sports the new ribbon-style user interface.

Autodesk Inc. / autodesk.com/solutions/manufacturing / Booth 1423



Toolholding Collet System Uses Mechanics to Create Grip Force

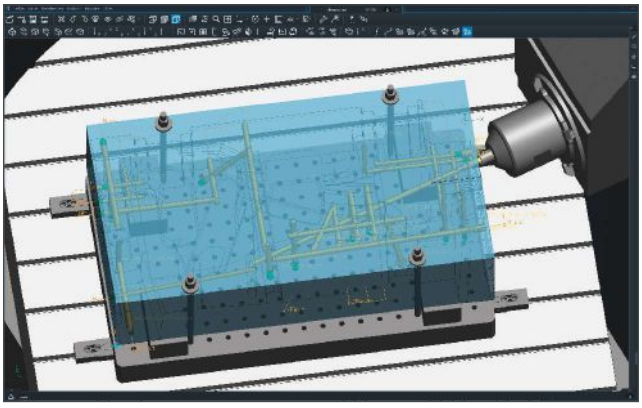
At WESTEC 2017, **Rego-Fix** says that visitors can see how the powRgrip toolholding collet system generates clamping forces equally as strong, if not stronger, than shrink-fit holders. The powRgrip system consists of three main components–holder, collet and press fit assembly mounting unit–that work together to generate what Rego-Fix describes as superior clamping force, high-vibration dampening and extreme precision. Unlike other clamping systems for which heat or hydraulics are used to expand the material, the powRgrip uses the mechanical properties of the holder material to generate gripping force with tool run-out below 0.0001". Interchangeable collets are available from 0.125-1.000". They are available in metric sizes as well, and they hold both carbide and high speed steel tools.

The powRgrip system takes less than 10 seconds to press in a tool or to remove a tool from the holder. Because the system does not rely on heat, machinists can use the tools immediately after a tool change. Cycle testing of the system exceeded 20,000 insertions and removals. The powRgrip product line offers several ancillary technologies and accessories. Large powRgrip PG 32 collets are especially well suited for machining components that are made from Inconel and titanium. The large powRgrip PG 32 collets are also well suited for Rego-Fix secuRgrip technology, which combines powRgrip's gripping strength with a patented locking key system.

Xtended Length Toolholders also enable operators to tackle machining applications that require longer reach or present clearance challenges. Likewise, computer, communication and consumer electronics manufacturers can tackle the specific demands of small complex parts and molds with the slim-nose PG6 toolholders. These toolholders enable machinists to access difficult-to-reach features when drilling or milling.

REGO-FIX Tool Corp. / rego-fix.com / Booth 2840

On Display at WESTEC – September 12-14, Los Angeles, California – *westeconline.com*



Latest Software Has New Features for Deep-Hole Drilling

Tebis America will display the latest release of its Version 4.0 at WESTEC 2017. Version 4.0 has enhanced features. For example, it can create area curves during part comparison to enable better detection and limitation of modified areas. The new function creates nonoverlapping shifted surfaces from any curves at defined angles.

In addition, users can automatically morph parts together with the most complex trimming curves in surface morphing. The new release fully retains geometry of the original curves and transfers the color properties 1-1. Also, users can include curves in surface morphing.

In the latest Version 4.0, deep-hole drilling in the CAM area has better orientation to support automated calculation and machining. The software also comes with a new tool type that has an extended set of cutting data and special speeds, feed rates, cooling types and depth sections that deep-hole drilling requires.

The latest issue of Version 4.0 has simpler toolpath definition in five-axis milling. Additionally, the software has improved function operating convenience. The release includes options for fast vector smoothing and for tilt-optimized calculation of toolpaths. These features are available even without the manual definition of vectors.

Tebis America Inc. / tebis.com / Booth 1823

Computer Tomographs Provide Flexibility with Speed, Large Measuring Ranges

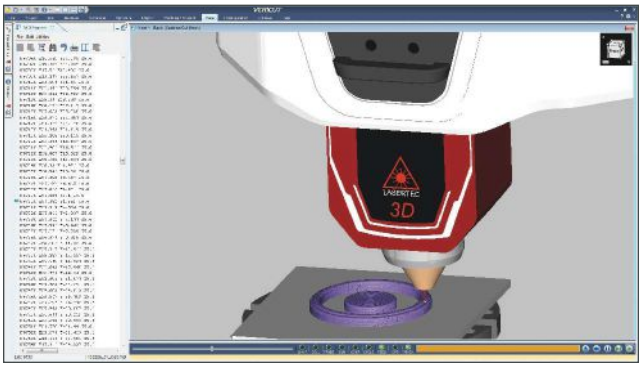
Zeiss will highlight its Metrotom 800, which has an extended performance spectrum, and its Metrotom 1500. These computer tomographs are designed to address companies' need for flexibility as new materials and hybrid processes are developed, with features including speed and large measuring ranges.

Zeiss Industrial Metrology US HQ / zeiss.com/metrology / Booth 1803

Software's AM Module Simulates Hybrid Manufacturing Processes

CGTech will demonstrate the newest version of its CNC machine simulation, verification and optimization software, Vericut 8.1. The software includes an additive manufacturing module for hybrid CNC machines, which simulates both additive and traditional machining processes in any order to help identify potential problems that can occur when integrating additive methods. Users can also access history stored with Vericut's droplet technology, which can save programmers time in identifying the sources of errors. The module checks laser cladding and material deposition, detects collisions between the machine and part, and finds errors, voids and misplaced material. The software also simulates the postprocessed NC code that is used to drive the machine and ensures proper usage of AM functions and laser parameters for accuracy.

CGTech / cgtech.com / Booth 1927



MoldMaking TECHNOLOGY

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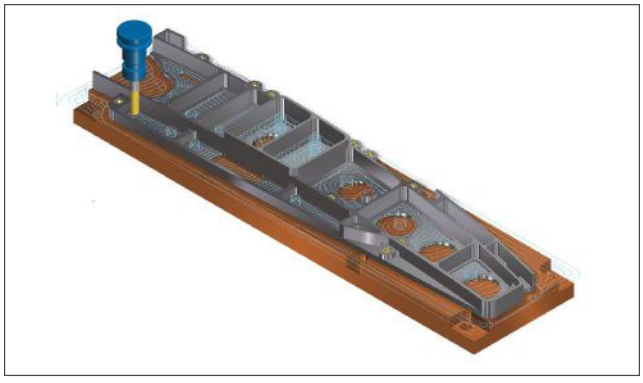


CAD/CAM Software Update Includes New 2D/3D Milling Features

Mastercam 2018 introduces new 2D/3D milling features, design improvements and turning and mill-turn enhancements. Stock awareness has been added to select 2D tool paths and enable tool motion on the top, bottom or both values of the stock. This provides safer and more optimized tool motion. The workflow for all 3D High Speed tool paths has been streamlined and gives users fine control over where to cut. High-speed Hybrid tool paths now offer smoothing controls and deliver a finer finish.

Mastercam's new Chip Break control prevents problems in stringy material like aluminum or plastic by enabling users to set length and time conditions, and retract and dwell options. Mill-Turn machine definitions now contain tailstock and quill components, tailored to user's machines.

A new set of turning strategies automate toolpath generation and support for Sandvik Coromant's CoroTurn Prime inserts and PrimeTurning method. PrimeTurning is said to provide higher metal removal rates, productivity gains and increased tool life in a variety of materials.

Mastercam – CNC Software Inc. / mastercam.com / Booth 1715

Machining Centers for Small-Lot, High-Mix/Low-Volume Applications

Southwestern Industries' Trak machines are said to increase productivity in shops that engage in small-lot or high-mix/low-volume work. Products designed for the former application include the Trak family of knee mills, bed mills, lathes and knee mill retrofits. Machines designed for the latter application include the Trak 20P portable VMC and Trak LPM vertical machining center, both of which contain built-in Jergens ball locks to facilitate quick change-overs. All Trak machines feature powerful but easy-to-learn ProtoTrak CNCs that reduce setup times and provide for increased workforce flexibility, the company says.

Southwestern Industries Inc. / southwesternindustries.com / Booth 1703

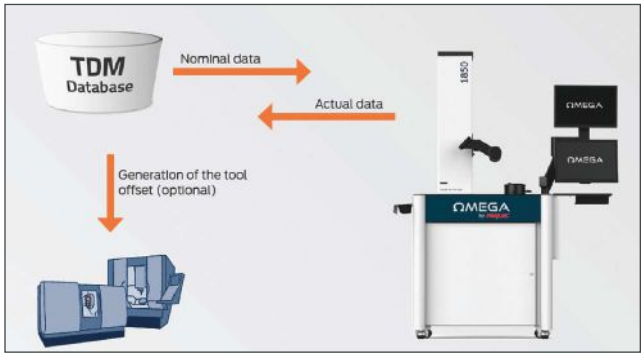
For more Westec products, visit moldmakingtechnology.com/products/new

Tool Presetting Machines Reduce Setup Times by 70 Percent

Haimer will feature its Microset tool presetting machines, which are said to streamline tool setting processes to reduce set up times by as much as 70 percent, minimizing idle time and increasing machine utilization. The company says that key features of the presetting machines are its ease of use, simple software, and stable, cast-iron base. Haimer offers a range of Microset products for different applications and budgets, including the Uno series and the Vio series.

Other technologies and products featured will include power clamp shrink-fit machines, shrink-fit toolholders and collet chucks, tool dynamic balancing machines, Safe-Lock and Duo-Lock technologies, 3D sensors, and the Cool Flash coolant delivery system.

Haimer USA / haimer-usa.com / Booth 2303

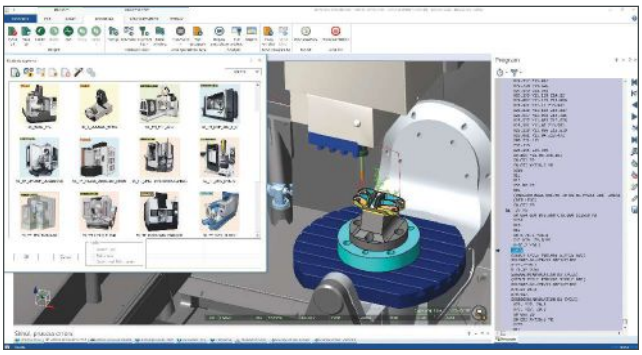


Software Helps Users Implement Industry 4.0

At WESTEC 2017, **TDM Systems** will display its newest software, "TDM next generation," which offers new introductory options as well as highly integrated, global system integration. TDM next generation is a platform that can be used to operate all existing TDM modules and TDM Global Line modules simultaneously. TDM Systems says that the software's enhanced performance, worldwide networking and easy scalability helps users implement Industry 4.0.

TDM next generation enables its customers to completely renew and modernize their TDM solutions without a complex system change. The new, modern three-tier architecture increases both performance and process reliability and simultaneously reduces installation and service effort. Additional features include simplified interface handling, easy use of on-demand and browser-based solutions and the combined use of standard and engineering solutions. TDM Systems will exhibit together with its partner, OmegaTMM.

TDM Systems / tdmsystems.com / Booth 2446



Simulation Software Reduces Debugging, Improves Cycle Times

Spring Technologies will demonstrate its NCSIMUL Solutions simulation software, highlighting the NCSIMUL Machine and NCSIMUL 4CAM modules. The 2017 version of the software is designed to provide ease of use, flexibility and automation for manufacturers to move toward Industry 4.0. New features include new probing strategies, support for turning after milling which enables one-click NC machine turnaround, cutting tool management with 3D definitions, one-click project update, project export and import, automatic performance analysis, and automatic graphic detection of machining risk zones and less-than-optimal cutting conditions.

NCSIMUL Machine is designed to provide realistic CNC simulation of the machining process. Users can simulate, verify, optimize and review programs based on the characteristics of the machine tools. Three-dimensional graphics help prevent machining crashes while algorithms and embedded process-based knowledge optimize cutting conditions. The software provides machining verification in three steps: investigating and correcting coding errors, simulating to locate collisions and correct motion errors, and validating the part cut and result. The company says that the software can reduce debugging time, improve cycle times and process optimization efficiencies and prevent spindle collisions, tool breakage and scrap.

Spring has also optimized its 4CAM add-on module so that it is more efficient and supports best practices with existing CAM products. The new version is designed to be a reliable, flexible, secured and automated tool for selecting which production resources to deploy.

SPRING Technologies Inc. / ncsimul.com / Booth 2538

Various Shop Management, Monitoring Software, Hardware on Display

Shop Floor Automations (SFA) will display software and hardware solutions intended to help manufacturers increase productivity, OEE and profits without buying new machines or downsizing their workforce in order to afford upgrades. The company's USB-to-CNC hardware options, such as the portable USB Connect and WiFi USB Connect, enable connecting machines to Ethernet- and wireless-enabled devices. Predator DNC software enables users to control and secure thousands of CNC programs. The company also offers graphical job scheduling products enabling live changes to production schedules and real-time jobs lists.

Shop Floor Automations / shopfloorautomations.com / Booth 1935

Laser Trackers with Mobile Device Control Enable Portablity

Faro will exhibit its Vantage S and Vantage E laser trackers, which offer mobile device control and portability for efficiency and ease of use in part and assembly inspection, machine installation, metrology-guided alignment, and reverse engineering. The company will also feature its RemoteControlsTM workflow, which is said to simplify operations such as target acquisition and accuracy checks, and eliminate locking onto the laser beam with simple gestures.

Faro Technologies Inc. / faro.com / Booths 2319, 1809

Collaborative Robots Load, Unload Machines Without Need for Barriers

FANUC America will demonstrate machine load/unload with its CR-7iA tabletop size collaborative robot equipped with iRVision. During the demonstration, the robot will pick up a part and load it into a lathe's chuck, then remove the part from the chuck and place it back onto a part tray, showing how a collaborative robot can be used for machine tool loading and unloading. The cell will have area scanners running at full speed when the operator is outside of the cell. The CR-7iA, CR-7iA/L, CR-4iA and larger CR-35iA collaborative robots are equipped with highly sensitive contact detection, enabling them to share workstations with people and perform more strenuous tasks or repetitive operations without industrial safety barriers, the company says.

The CR-7iA offers a 717-mm reach and 7-kg payload; the CR-7iA/L offers the same payload with a 911=mm reach; and the CR-4iA has a 550-mm reach and 4-kg payload. The design for the compact collaborative robots is based on the LR Mate-series of mini material-handling robots and they are said to be ideal for small part sorting and assembly, inspection, machine tending and part delivery.

FANUC America Corp. / fanucamerica.com / Booth 803

On Display at EMO — September 18-23, Hannover, Germany — *emo-hannover.de/home*

End Mills Designed for Titanium, Stainless Steel, Nickel-Based Alloys

YG-1 will showcase its TitanoxPower end mills for titanium, stainless steel and nickel-based alloys. They are available in a variety of corner radii and flute options, and the true double-core design is said to provide optimal performance while roughing, semi-finishing and finishing. The roughing tooth pattern is said to enable maximum material removal rate while slotting, pocketing and profiling. The smooth variable helix and pitch are designed to quiet tough material while semi-finishing and finishing.

YG-1 Tool Co. / yg1usa.com / Booth E03

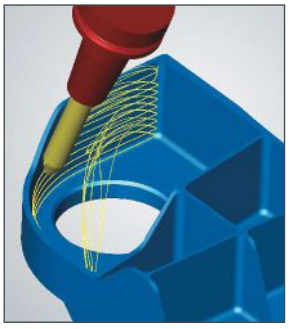
Machines Grind Super Hard Materials

Agathon will introduce a line of machines designed for super hard materials, including PCD. The machines are designed to provide flexibility, higher productivity, and time and cost savings in small- and medium-batch precision manufacturing. The company will also showcase its AGC+5 control software for its indexable insert grinding machines, which provides users with an adaptive grinding process. This process is designed for rapid optimization of grinding operations while improving the production of already defined and optimized parts.

Agathon Machine Tools Inc. / agathon.ch / Booth C62

CAM Software Provides Strategies for Roughing, Finishing, Drilling

Open Mind Technologies will present HyperMill Maxx Machining and other new CAM software solutions. Maxx Machining provides strategies for roughing, finishing and drilling, covering machining functions including 2.5D through five-axis milling and drilling, mill-turn, and specialty applications. Based on the Volumill toolkit, the roughing function has been applied to 2.5D pocketing, 3D roughing and five-axis roughing, and is said to be suited for engine casings and radial components such as the tire molds. The drilling function enables five-axis helical motion to open pockets, with chip removal using standard end mills. The finishing function applies conical barrel cutters to large planar, ruled or general surfaces. The large radius on conical barrel tools allow significantly wider step-over, while the tool's conical surface enables short cutters to be used. In addition, holders are assured with a collision detection process. The system also enables the user to control the contact point to increase cutter life or to help reach in specific areas.



The company will also debut a virtual machining center solution that uses NC code after the postprocessor run as a basis for the simulation, ensuring that virtual machine movements correspond precisely to real machine movement, and display its HyperMill 2018.1 software release.

Open Mind Technologies USA Inc. / openmind-tech.com / Booth A08

Flexible Gage Software Integrates with CNC Machine Tools

Renishaw will exhibit its software for the Equator flexible gage, which allows users to fully integrate the system with CNC machine tools, its contact scanning system for CNC machine tools, its on-machine and mobile apps which are designed to simplify the use of machine tool probing, an enhanced non-contact tool setter for machining centers, a multi-probe optical interface system, a surface finish probe for coordinate measuring machines, and software that enhances the functionality of Renishaw's XM-60 multi-axis calibration system. The company will also show its machining cell concept, which has the ability to monitor key process inputs and analyze data can improve manufacturing processes and facilitate increased productivity and higher accuracy. In addition, Renishaw will have a booth in the Additive Manufacturing Zone at hall 27, stand A72, where it will demonstrate its build file preparation software, QuantAM 2017, which was designed for Renishaw's metal AM systems, RenAM 500M and AM 400.

Renishaw Inc. / renishaw.com / Booth B46

Roughing Strategy Consistently Removes Hard, Tough Material

Vero Software will feature its Waveform roughing strategy, which is available in the company's WorkNC software for CNCs. It is designed to consistently remove hard and tough materials while increasing tool life and productivity. The company will also feature the Advanced Toolform Technology in WorkNC, which uses modern tool geometries for HFC applications. Additionally, Vero will exhibit WorkXplore, which is designed to perform part diagnostics, create assembly instructions and prepare the production of 3D models.

Vero Software / verosoftware.com / Booth B20

Digital Tools Offer Cutting Tool Users Options

Walter says that it is striving to achieve Industry 4.0, the advantages of which it intends to show to consumers at EMO 2017. Walter will show apps and digital tools in its booth. The company works in close collaboration with Comara, a Walter associate that specializes in data and networking. Visitors will be able to make use of the numerous intuitive touchscreens and tool displays to learn more about digitization, networking and connectivity.

Walter USA LLC / walter-tools.com/us

Simulation Displays Real-Time Data Collection and Analysis Marposs Corporation

At EMO 2017, **Marposs** will simulate two production lines: one for shaft type and one for block type workpieces. Each line will display solutions for the various stages of production that Marposs says can save time, reduce cost and improve quality.

Visitors can see each stage of the production line. The first stage is at the foundry, where Marposs' newly developed technology will monitor the workpieces' thermal die surface. The final stage is the final inspection and will display automatic solutions for quality checks. Because Marposs will simulate a real manufacturing plant, the company will demonstrate an Industry 4.0 area that displays real-time data collection and analysis from the units in the booth.

Marposs Corp. / marposs.com / Booth B34

On Display at EMO – September 18-23, Hannover, Germany

Carbide Application Equipment Coats Large Parts Quickly

Rocklin Manufacturing Co. will exhibit its Rocklinizer carbide application equipment, which deposits titanium carbide, tungsten carbide and Rockhard electrode onto metals, tools and dies. The spark deposition process is said to alleviate metal-on-metal wear, enhance gripping, help maintain dimensions and extend the life of machinery. The portable 950 model deposits as little as 0.0001" to 0.0100" and higher onto the base material, and is said to be controllable within 0.0001" by digital machine setting for precision.

The unit is designed for fast application speed, which is ideal for coating large parts and dies. The company says that a 5-in. coating takes less than one minute via high-speed settings. The process can be slowed for more delicate operations.

Rocklin Manufacturing Co. / rocklinmanufacturingco.com / Booth A36

VMCs Can be Connected to Form Smart Production Line

Okuma will demonstrate its MU-S600V five-axis vertical machining center, which enables five-face machining of workpieces as large as 600 mm in diameter. Several machine tools of its type can be connected to form a compact smart production line, allowing for a fully automated transfer of workpieces from one machine to the next and eliminating downtime between processing stages. The production line layouts can be adjusted to accommodate changes in volume or lead time. The company will also feature its Laser Ex line of five- axis vertical machining centers, which are capable of milling, turning, grinding, laser metal deposition and heat treatment of a range of workpiece sizes and shapes, and its Multus multitasking machine for stable, heavy-duty cutting with low spindle speeds.

Okuma America Corp. / okuma.com / Booth D20

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TIP

MOLD MATERIAL

Welding Pre-hardened 40 Rockwell Material

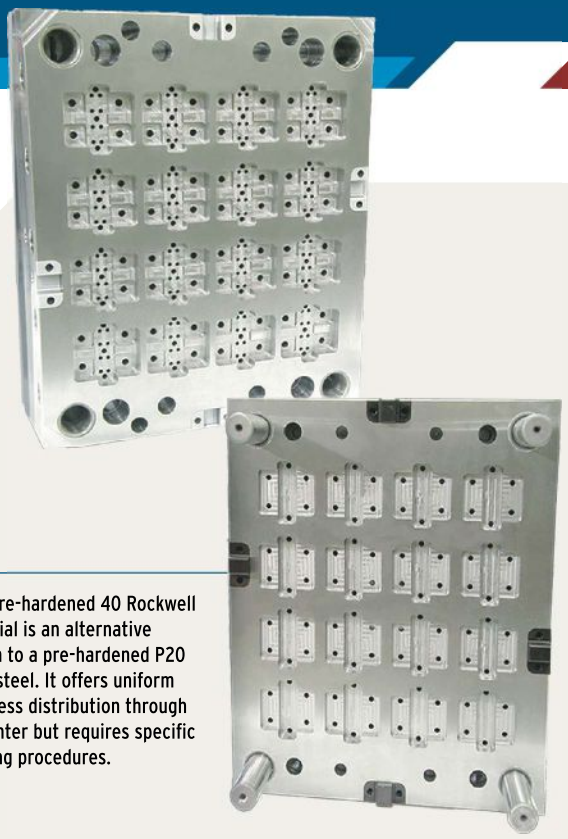

Image courtesy of PCS Company.

Pre-hardened 40 Rockwell material is an alternative option to a pre-hardened P20 mold steel. It offers uniform hardness distribution through its center but requires specific welding procedures.

By Paul Britton

Welding pre-hardened 40 Rockwell material requires certain conditions and considerations. Here are some tips for employing safe shop welding practices.

Prior to making a welding repair, slowly heat the workpiece in a furnace or with a gas burner to between 600°F and 750°F. Heat the workpiece from the bottom if a gas burner is used. Maintain uniform temperatures within the recommended range during the entire repair. It is ideal to heat the mold in a furnace to achieve uniform temperatures. This is easy to do for small molds but may not be practical for large molds.

Localized preheating is the most effective option for large molds. All the same, adhere to the following steps:

- Maintain the preheat temperature at least 2 inches away from the area that will be welded in all directions.
- Use an oxygen-propane gas burner with a low-flame temperature.
- Heat the mold carefully and gradually while keeping 18 inches between the flame and the mold surface.
- Apply a temperature choke or a surface contact thermometer to accurately measure the preheating temperature.
- Reheat as necessary during welding to maintain a temperature above 600°F.

The recommended welding parameters for pre-hardened 40 Rockwell material are as follows:

Rod Diameter	Electrode Diameter	Current/Amps
0.0470"	0.0470"	40~70
0.0630"	0.0630"	70~150
0.0946"	0.0946"	150~250

Only use pre-hardened 40 Rockwell copper-coated welding rods, which are copper-coated for either TIG or Heli-Arc welding.

Technique Pointers

- Use DC normal polarity.
- Use lowest possible amperage for the job.
- Use backhand welding.
- Use smallest diameter rod possible.
- Weld small beads.
- Peen weld as necessary.
- Proceed immediately to post-weld heating when welding is complete.

When you are ready to begin your weld, ensure that the mold is free of oil, rust, scale residue or any other potential contaminants. Completely remove all cracks and surface treatments. Remove sufficient stock, and ensure only sound material remains to repair any cracks. Round all sharp or square corners to a minimum radius of 0.120 inch, and dress corners where stock was removed by rounding them to a minimum radius of 0.120 inch.

Once welding is complete, it is time for post-weld heating. This requires the following procedure as it will ensure the welded section is completely restored to a uniform hardness:

- Heat the weld-repaired workpiece to between 860°F and 940°F.
- Hold this range for a minimum of one hour to re-age the material. Conduct the re-aging process immediately after welding.
- Heat with a furnace or a gas burner. If a gas burner is used, heat from the bottom, but keep the entire welded area and 2 inches surrounding the weld in the post-heat temperature range for a minimum of one hour.
- Cool slowly to room temperature.
- Perform post-weld heating after every three layers of weld buildup to alleviate welding stress and avoid over-aging of the adjacent parent metal. MMT

CONTRIBUTOR

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