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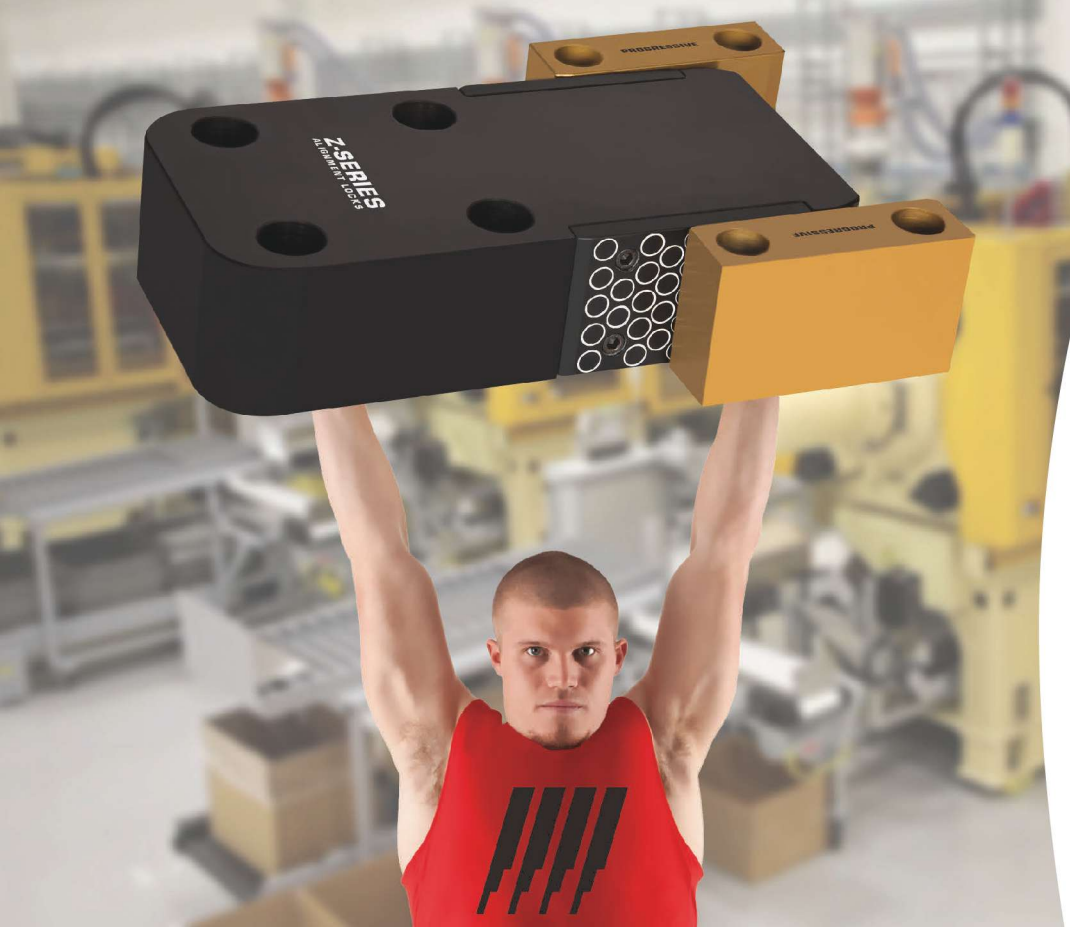

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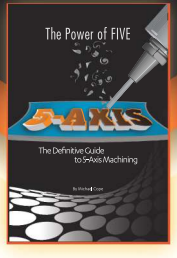

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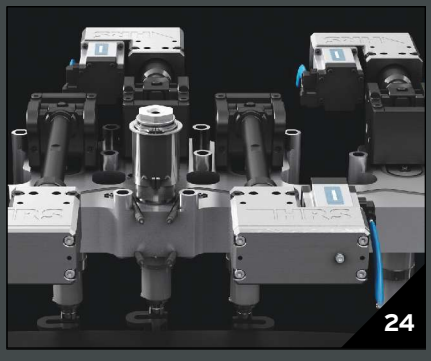

Features

Departments

ON THE COVER

Image courtesy of Haimer USA and Hermle Machine Co. This month's cover shows a die cast mold cavity being machined from hardened H11 tool steel at 48 Rockwell-C on a five-axis Hermle C42 vertical machining center. The finishing tool path included this 6-millimeter carbide ball-nose end mill, which was held in a Haimer Power Mini shrink fit holder running at 14,000 rpm with a 60 ipm feed rate. The more robust anti-vibration design of the Haimer tool holder combined with the rigidity and fluidity of the advanced Hermle machine tool resulted in a true mirror finish on the final product, which was machined within a tolerance of 5 microns. See the related story on **page 14**.

Images courtesy of (left to right) Marposs, HRS Flow and MoldTrax.

VIDEO ACCESS

5 TRICKS OF THE TRADE
Great Tips from This Issue

1. Fast and Furious
A fast fourier transform changes vibration data based on time values to frequency values and is useful for preventive maintenance applications because wear tends to increase both amplitude and frequency.
PG. 18.

2. Scalable Solutions
A range of scalable technologies enables hot runners to be supplied with simple pin-position sensing capabilities that can later be upgraded to other levels of pin control.
PG. 24.

3. Laser Focused
Laser sintering is useful for making sintering density changes in molding applications that require the placement of porous structures to facilitate gas venting. It also enables the production of deep features, eliminating EDM.
PG. 30.

4. Data Downer
When data entry and retrieval are physically difficult or cumbersome, the repair technician will avoid the task entirely or only enter a short statement about the work that was performed on the mold.
PG. 36.

5. Drinking Effects
Ballscrew drunkenness can lead to several negative outcomes, which includes things like machine tool inaccuracy and premature wear on ballscrews, mating nuts and guiderails.
PG. 48.

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Collaborate to Educate

Collaboration takes many forms, but one of the most powerful is when companies work together to educate others. This is something that I have seen quite often throughout my years covering the moldmaking industry. Most recently, for example, is a joint effort between ROI Industries and Injection Molding Solutions to develop a traveling conference that gives molders and moldmakers a new understanding of the events that occur in and along the melt delivery system. Those events include watt-to-mass ratio, time to reach setpoint, wattage distribution, end loss, heat sink and point of temperature control, all of which impact the ability to achieve an optimized process via scientific molding principles.

Then there's MoldTrax and the AIM Institute, which joined forces on a workshop to explore strategies to optimize mold performance, maintain efficiency, maximize part quality and minimize machine downtime. Last but not least, Progressive Components and Incoe came together to produce a tech day to share the importance of monitoring molds to benchmark key performance indicators to improve overall company performance. So, you might be thinking, *why focus only on collaboration within the plastics side of moldmaking?* I have one word for you: NPE!

With this triennial event only three months away, I have plastics on the brain. The show calls to mind the variety of collaborations that are set to occur on the NPE show floor among moldmakers, molders and equipment manufacturers. Not only will these collaborations market each company's wares and capabilities, they will educate attendees on new processes, strategies and technologies.

For example, Mold Craft worked with Wittmann Battenfeld to organize a demonstration of the technology behind ±0.0001-inch precision-tolerance micro molding of POK parts that weigh only 0.007 grams. Mold Craft will be molding a 100-µm filter screen, using a two-cavity, three-plate micro mold with one "A" side and two "B" sides, featuring 0.004-inch by 0.004-inch shut offs and 0.002-inch radii on a MicroPower 15t precision press with a rotary platen, end of arm tooling and a robot with a camera.

M.R. Mold & Engineering (M.R. Mold) has multiple partnerships resulting in three scheduled collaborative demonstrations, including a four-cavity in-mold slitting duckbill mold running in Krauss Maffei's KM 51-55PX silicone molding machine. M.R. Mold will also run a four-cavity magnifying glass tool in Toyo's Si110-6 horizontal silicone molding machine. To top it off, M.R. Mold will run an optically clear two-cavity mold in Milacron's Roboshot Alpha molding machine using Zeiger Industries' LSR plug-n-play conversion kit.

Other exciting collaborations are under development for the show, but we will bring you a full report during and after the event. *MMT* will be exhibiting in the Moldmaking Zone, so be sure to stop by. If you are collaborating to educate, send me an email at cfuges@gardnerweb.com, or call 513-338-2187, and we will help spread the word. MMT

Christina Fuges

Christina M. Fuges
Editorial Director

Follow MMT on: Follow @MMT_ChristinaF

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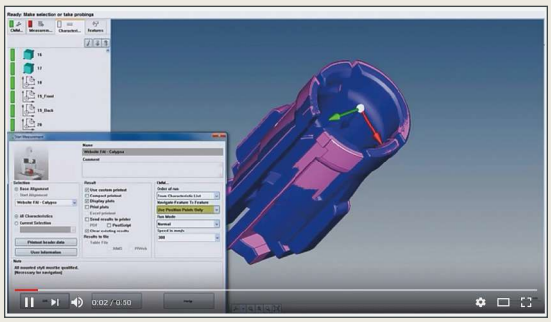

VIDEO: CT Scanning Reduces Cost of FAIs

CT scanning services provide accurate, high-resolution internal and external measurements performed about seven times faster and at significant savings. Check out this dimensional inspection from 3D ProScan.
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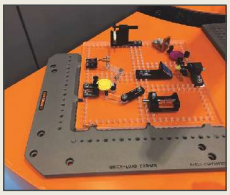

BLOG: Innovations Bring Process Control Solutions

Senior Editor Cyndi Kustush shares insights from her trip to Renishaw's North American headquarters during which she saw additive, inspection and measurement technologies that moldmakers can use to advance and better control their processes.
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SLIDESHOW: All about Aluminum

Managing Editor Karen Cornelissen helps readers brush up on their knowledge of aluminum, its benefits, the challenges it poses for moldmaking and strategies for overcoming those challenges with this technology slideshow.
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WEBINAR: Maximize Results with Copper Alloy Molds

This popular, archived webinar focuses on the various copper alloys used in the plastic molding industry and identifies the strengths and weaknesses of each. Customer Technical Services Manager Bob Kusner covers qualities that make a good mold, high thermal conductivity, using a copper alloy and special fabrication issues.
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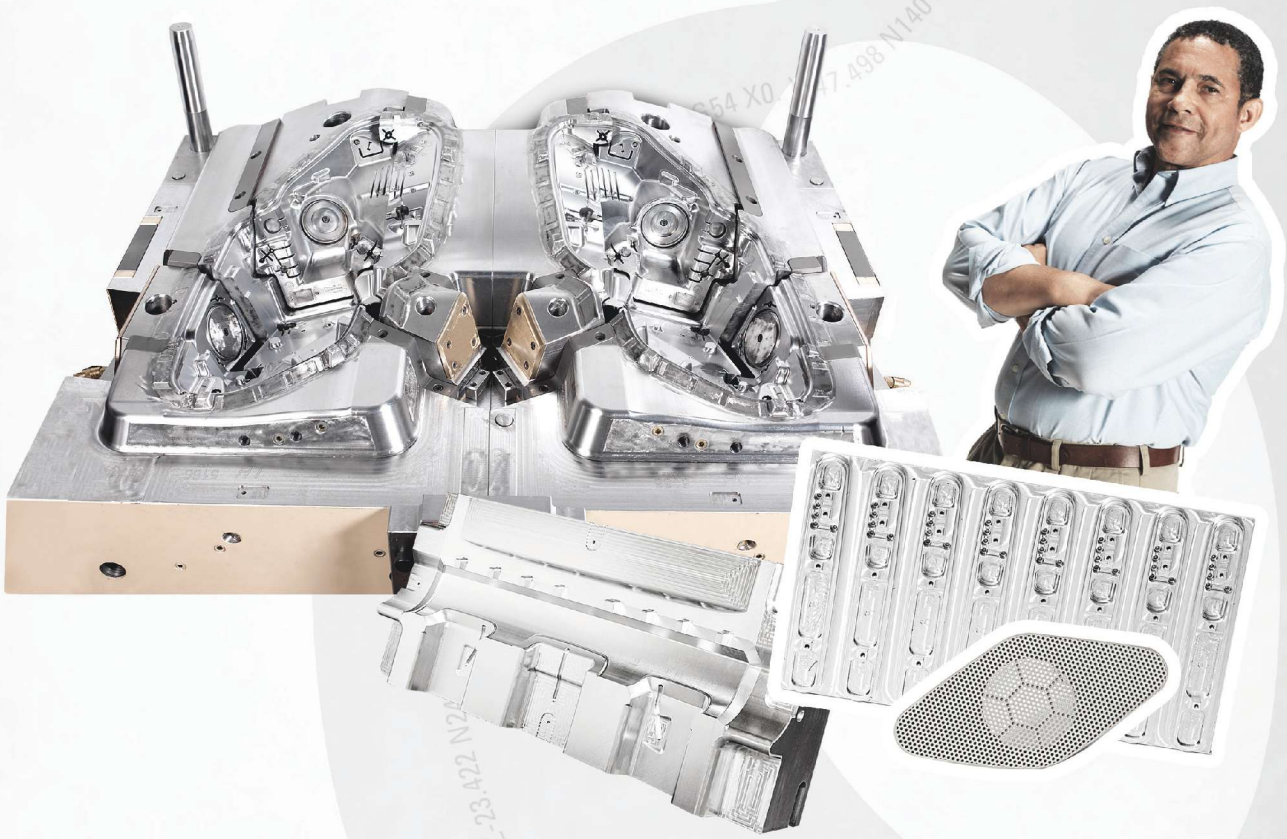

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WHEN YOU MAKE WHAT MATTERS

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Using Nontraditional Technology

Gabe Meldrum
Plant Manager
International Mold Corp.
Clinton Township, Michigan

Gabe Meldrum, MMT *EAB member and a plant manager at International Mold Corp. (IMC), shares one of his top priorities: finding new and better ways of doing things. Gabe has been very involved with researching new or nontraditional technologies and processes to help the company grow.*

If you are still making molds as you did 10 years ago, your shop is going to find it hard to compete. New and different approaches to manufacturing are vital for growth. Finding the appropriate technology is the first step. The ultimate considerations are speed and cost. Is this new process or technology faster? Is it less expensive? Answering those questions requires research and a deep dive into the specifics of a new product, process or piece of equipment. It also requires sharing that information with coworkers to gain their buy-in. The next step is determining the best way to implement that process or technology into the current way of doing things.

For example, IMC's waterjet process. It all started with a revelation that there must be a faster and better way to manufacture 2D components. Machinists were spending a lot of time on the CNC machines cutting 2D shapes with very generous tolerances, instead of cutting 3D contours on these large expensive mills. As an alternative, the company decided to outsource flame-cutting or burnouts. However, when the workpiece returned to the shop, it had a very hard, nasty scale left behind from the flame, which needed to be machined off anyway. This made the process expensive and slow. IMC then investigated and invested in a waterjet machine, which is faster, provides a clean, straight finish and does not add extra stress on the material being cut. Plus, with a waterjet, a shop can keep the slug (or scrap) and reuse it rather than recycling chips from a mill. Today, IMC continues to find ways to use its waterjet machine.

Another nontraditional process worth investigating is additive manufacturing. This technology is on the rise and will eventually make its way into every mold shop. CNC toolpaths and CAD are other great examples, which have the support of software developers who spend a lot of time and money to make processes faster and better. (A note of caution: if you are not paying the software maintenance fee and using the advancements as they come out, you will be left behind.) Cutting tools also are evolving as new coatings and geometries are developed to improve performance.

The key to finding a new or nontraditional technology is maintaining an open mind, involving the team by asking questions and not dismissing an idea because of the person who offered it (even a floor sweeper can have a great idea). Never stop improving. Once you think you are the best or that there is nothing better you could be doing, your neighbor will come by and eat your lunch. MMT

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A Conversation with ...

Eden Tool Co.

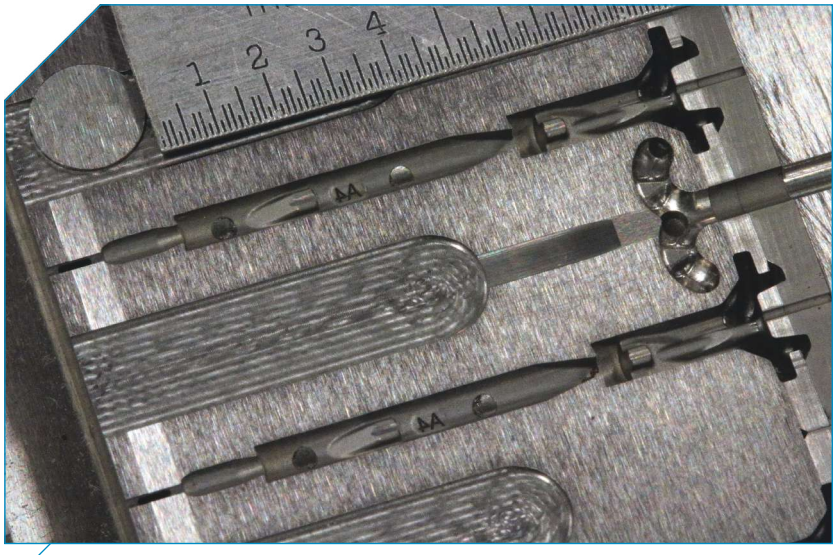

Image courtesy of Eden Tool Co.

Eden Tool Co. works with its customers to design small medical parts to accommodate the hard-milling process because it virtually eliminates secondary hand work like EDM and polishing. This mold cavity illustrates the details and sizes of mold cavities typically machined using 100-percent hard milling at Eden Tool Co.

What is unique about how Eden Tool Co. applies hard-milling processes to the creation of molds?

Mike Eden, president: The real value of hard milling in the way that we do it is in the consistency that it provides from cavity to cavity, which can be measured in microns rather than in tenths. It delivers major benefits pertaining to mold validation, especially with medical industry customers who make small, complex parts. For example, one of the first molds we built that used 100-percent hard milling was an eight-cavity mold. That mold was designed to make a part that is like a hollow ring, with a diameter of about 2.000 inches. A representative from Beaumont Technologies was undertaking the mold capability studies for my customer at the time that my customer first sampled the mold. Our hard-milling approach really got the attention of the Beaumont Technologies representative because there was less than 1 percent of cavity-to-cavity variation. He told me he would have been satisfied if it was less than 5 percent. It proved to us that hard milling, while not right for every job, was critical for our future success.

After that, we began educating all our customers about the advantages of hard milling, and we began working with them on the front end to make their part designs friendlier for hard milling. Whenever possible, we will use hard milling on 100 percent of a job with no hand work required. Our customers see the advantage of hard milling and look to us for design help for manufacturability. They follow our recommendations for simple geometry changes if the part design allows, so we can implement 100-percent hard milling of a cavity and core when we see fit. Most of the time, we ask for only a slight increase in radii, usually in non-critical areas, to help us use hard milling. It is not a full redesign of our customers' parts. But, there are some things we just can't get around, so we might hard-mill about 85 percent of a job and then use EDM on the rest. We will always try to hard-mill the main features of a part to ensure that they are the same from cavity to cavity with very little in dimensional differences. This ensures that we can give customers brand-new, replaceable cavity stacks two years down the road with minimal revalidation required on their end, just by utilizing our systems and processes.

Why do you think your hard-milling process has been a competitive advantage for Eden Tool Co.?

Eden: Offering hard-milling services and understanding the mold validation process and the capability studies have been huge advantages for us over most shops. Lots of people say that they hard-mill, but today the term "hard milling" is totally different than it used to be because it refers to a process and not just milling hardened steel like most people think. Before, I never imagined I would rather cut on a piece

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- Added hard milling to its list of capabilities in 2007, which has played a vital role in the company's growth.

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of steel with a hardness of 55RC than finish-mill on a piece of P20, but I do. To show how unusual that is, a representative from a cutting tool manufacturer once said to me, "Mike, with my job, I get into a lot of high-end shops across the country. Do you realize that there are probably only five or six companies in the country that use the hard-milling process to the extreme that you do?"

We see a big disconnect with tool shops when they look at part tolerance as compared to CPK's, especially in the medical market where manufacturers are producing small parts. There is a big difference between the two, and that is huge to the medical people. For example, some people look at a CPK as a regular tolerance, but it is not. Just because that part has a 0.002-inch tolerance does not mean that the whole 0.002-inch tolerance is usable to make the capability study. Some might say, "Well, it's within tolerance," but it is not. Everything must balance out, and if one part is at the high end of the tolerance, but the other four parts are at the low end, the capability study is not working—the part will never make CPK. The key is to machine everything that can possibly be machined in the mold so that everything is identical in the way that the plastic is delivered to the part and to the molding area.

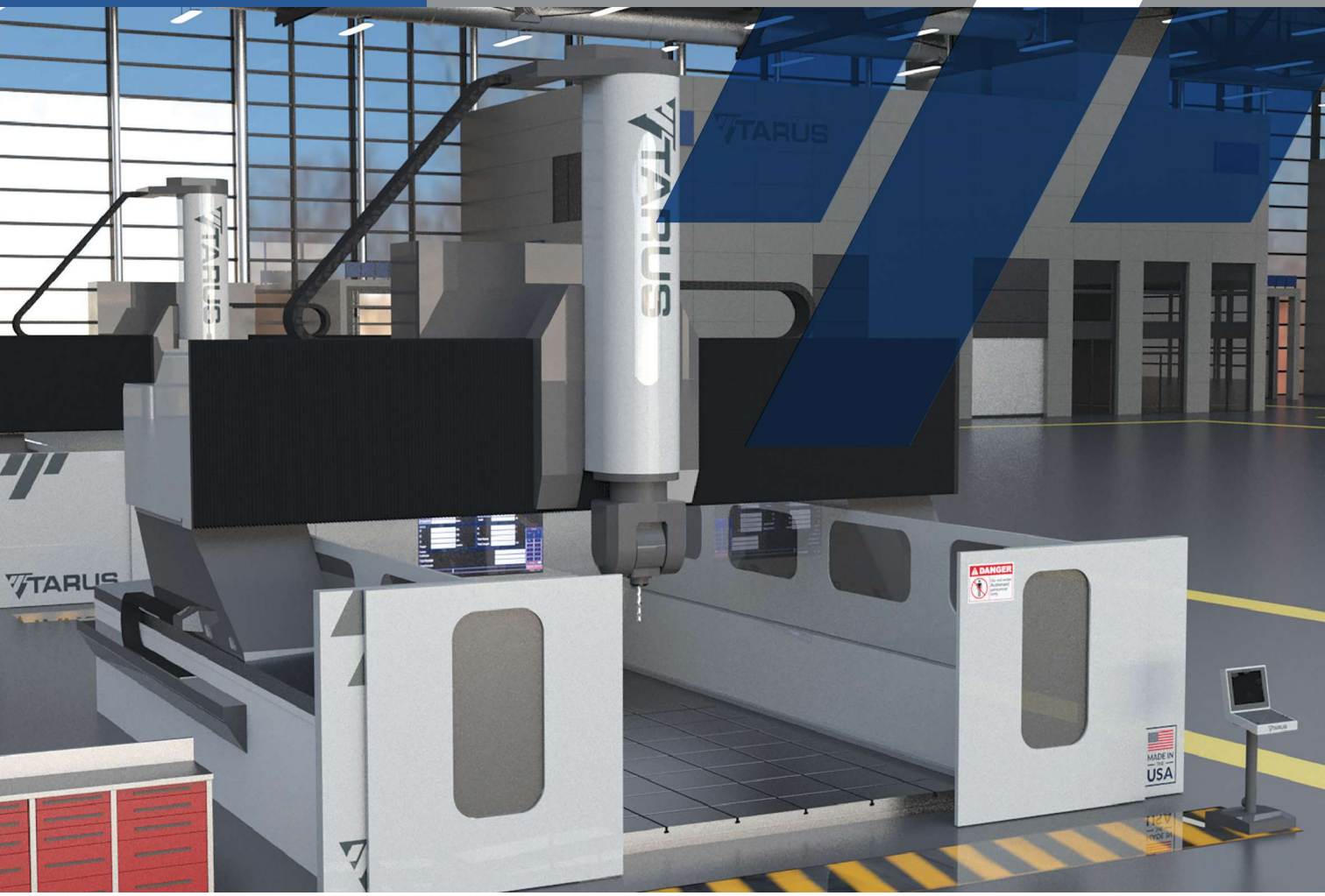
Please share an example of a job where hard milling was especially key to a customer's project.

Because of its hard-milling expertise, Eden Tool Co. has been involved in several big and successful molding projects throughout the years. One of the most memorable was a project we did for Alcon in which we built all the single-cavity prototypes for a safety handle used on its ClearCut Safety Knives line. We received an award for our work on the project, but when it came to the production tools, they split the molds up between us and another shop. We got our job done quickly. Alcon found that the other shop struggled with their molds. They could not get the required tolerances and make the capability studies. The difference was that they burned everything, and we hard-milled everything. Our mold was more expensive because we laid it out differently and had more parts on it, but we did it so that we could machine everything and have more control over the critical-to-part areas. We wound up getting PO's for all the production molds. That was a pretty cool feeling.

Are you looking to expand your hard-milling capabilities?

Currently, we use a Creative Evolution HSD 500 VMC for our hard-milling work. It is a high-speed machining center with a maximum spindle speed of 30,000 rpm. But, it's not necessarily the machine itself that makes the difference, though it's important. It's the process a shop puts around it. It's also in the control used and how a shop uses it. The control on our Creative machine is fast, and it was first available in the 1990s. It has been only in the past eight to 10 years that some other manufacturers' controls have caught up to it. It's that fast.

At Eden Tool Co., we are in the process of evaluating new machining centers by Yasda and Makino. We also are looking at implementing the new laser measuring technology, which we believe would be a huge benefit to our customers because we can provide them with very accurate data measurements for each critical tooling component. Combining this with the proper documentation, we can replicate spare tooling several years down the road without having to fully revalidate the mold, given that the customer's ISO certification is written that way. Instead, we would only have to validate the mold steel or the components being used, which would save time and money. Additionally, we are looking to get into mold sampling, which we currently outsource. MMT



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By Drew Strauchen

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

Why You Need a Tool Presetter

Reduce machine idle time with fast, accurate, repeatable, offline cutting tool measurements.

Images courtesy of Haimer USA.

This customizable tool presetter for fully automatic, high-end tool presetting offers a modular concept that makes it possible to preset tools up to 39.37 inches in length and diameter. It also has a second vertical camera for measuring the center of rotation.

The greatest expense in any manufacturing facility is time. Burden rates, combined with overhead machine rates, represent approximately 50 percent of manufacturing costs. This is probably not surprising, but despite this fact, many shops continue to place a disproportionate amount of focus on reducing tooling spend. In comparison to burden and overhead machine rates, tooling spend only represents a fraction of the manufacturing cost (4–5 percent). And when facilities do examine time savings, they often place the emphasis on machining cycle times.

One frequently overlooked time-killer is that of setup. Setup is defined as the time it takes to get parts loaded and located and tools set with offsets that compensate for variables such as gage length, diameter and runout into the machine control. The old-school method of tool setup involves manually intensive operations, often using a multitude of different tools and methods of varying accuracy to extract desired measurements. On average, the time to set one tool using these types of methods is approximately five minutes. When shops employ methods such as feelers and test cuts to determine sizes, setting time can be much longer than the average five minutes per tool.

If setup moved at the incredible speed of three minutes per tool, the conservative cost to set up five machines over the course of a year is $189,000. If there are more machines, longer setup times, more shifts or more setups per machine in the same scenario, the cost will be significantly higher. This is the breakdown of cost for such a scenario:

- Setup time for 20-tool capacity machine = 1 hour (for a three-minute setup)
- Setup cost for five machines = $375 (for an average shop rate of $75 per hour)
- Shop rate combines average direct labor costs and overhead rates
- Setup time per year = 2,520 hours (assuming there are 252 working days per year)
- Setup cost per year (at 2 shifts and 1 setup per shift) = $189,000

Some may question why overhead rates are included in the shop-rate calculation, and the answer is opportunity cost. Whether the machine is running or sitting idle, it is costing a company money every minute. Therefore, for that company to

A proprietary, no-button, release-by-touch feature is an option on some presetter machines.

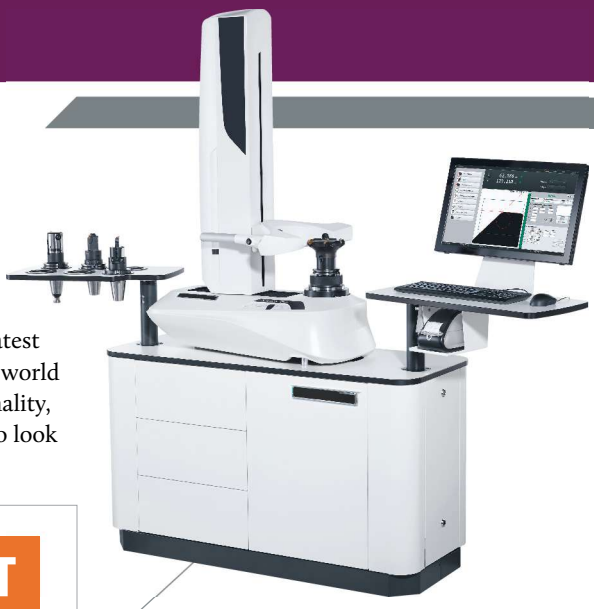
accurately assign cost to time, it also must factor in items like rent, electricity, depreciation and support staff. Through this lens, a shop can get a true snapshot of the opportunity cost. In this case, the opportunity cost is the value or profit that a company forfeits when the machine sits idle for setup.

Set Up a Better Way

It is not possible to eliminate this idle time. But, shops can reduce it using tool presetters. High-quality tool presetters enable shops to take fast, accurate and repeatable measurements for each tool offline. This capability makes it possible for machinists to set tools while the machine is still running, which reduces idle time and increases cost efficiency in the shop. In addition to time and accuracy, the nature of presetting inherently promotes greater emphasis on best practices on ideal ways to store and measure tools. Toolboxes and drawers with random tooling ultimately migrate to more centralized tool-management areas. The important attributes of a presetter are:

1. Accuracy. In the era of Industry 4.0, presetters should be able to maintain repeatable measuring accuracy of 5 microns or better. This usually means that the system should be equipped with an optical measuring device, which is more accurate than physical contact (or indicator) devices.

2. Repeatability. It is not just a function of measuring accuracy, but also of thermal stability. Presetters that use multiple material types in their base construction are more prone to non-uniform thermal expansion in the shop environment, which can require daily, repeated calibrations to output repeatable measurements.



This tool presetter system provides fully automatic tool presetting and measurement that functions independently of the operator (CNC-controlled, three-axis) with a convenient system cabinet and 22-inch touch display standard.

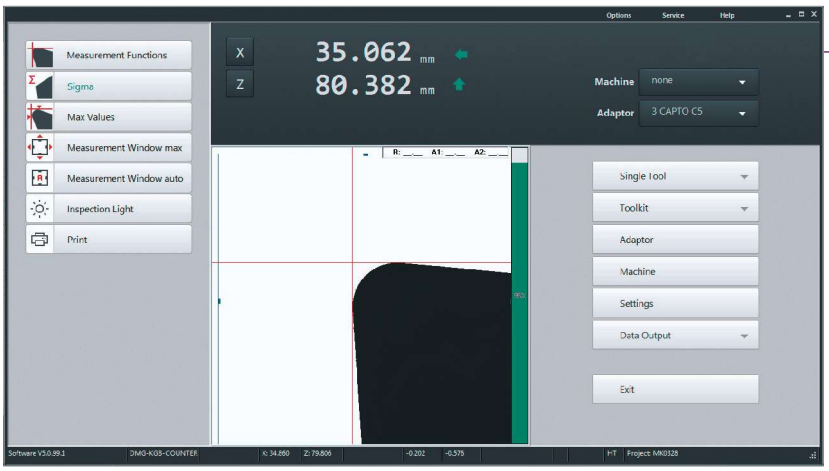
3. Capacity. Before making a purchase, shops should consider the size and weight of their largest tooling assembly. Here is where size matters, so shops want to be sure the machine can handle the maximum weight, height and diameter of the tools they need to measure.

4. Ease of use. Adoption rates in the shop are key. The machine with the greatest capability in the world will end up being one of the largest paperweights in the world if no one can figure out and remember how to use it. When looking at functionality, examine the usability of the software, how many options and screens one has to look at to measure basic dimensions, and the overall ergonomics of the machine.

Higher-end tool presetters will have various functionalities to automate and streamline tool-setting operations, including automatic adapter identification and autofocusing, fully automated tool measuring where the attendant literally just calls up the tool and presses "Go," and automated data communication via integrated post-processing technology or RFID carrier systems. These systems eliminate errors associated with manual data input to the machine control (sometimes called "fat-fingering"), which reduces errors and decreases idle time.

Perhaps the most common misconception about tool presetters is that they are for large production facilities. The truth is that smaller shops need them more. A mold shop is an ideal candidate because a greater variety of jobs and tooling moves through its machines on a weekly basis than in larger production facilities. The frequency of constantly changing setups makes tool presetters in these environments highly cost-effective.

Also, for shops concerned with tooling costs, presetters represent a means to stabilize tool values such as runout. This helps identify and compensate for variances, which dramatically increases tool life. For mold shops using small-diameter tools in hardened steels, this capability can be of particular benefit.



Presetter software should enable fast and simple inspection of complex shapes and features. Look for software with an intuitive operation for quick and precise measurement results, accurate measurement of complex cutters with a precise focus window, user administration and access privileges, a 16:9-formatted display, and automatic measurement lines and contour evaluation.

Tool presetting represents a proven technology that can yield benefits of increased productivity, longer tool life, decreased scrap and greater process reliability for both small and large shops. As the fourth revolution in manufacturing—a digital revolution—continues to evolve, technologies such as tool presetting that enable digitization of manufacturing data will only increase in usage. MMT

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By Jorge L. Peña-Mena

Low-Cost Machine and Process Protection

A modest investment in machine and process monitoring technology can help alleviate the expensive or catastrophic consequences of human and equipment limitations.

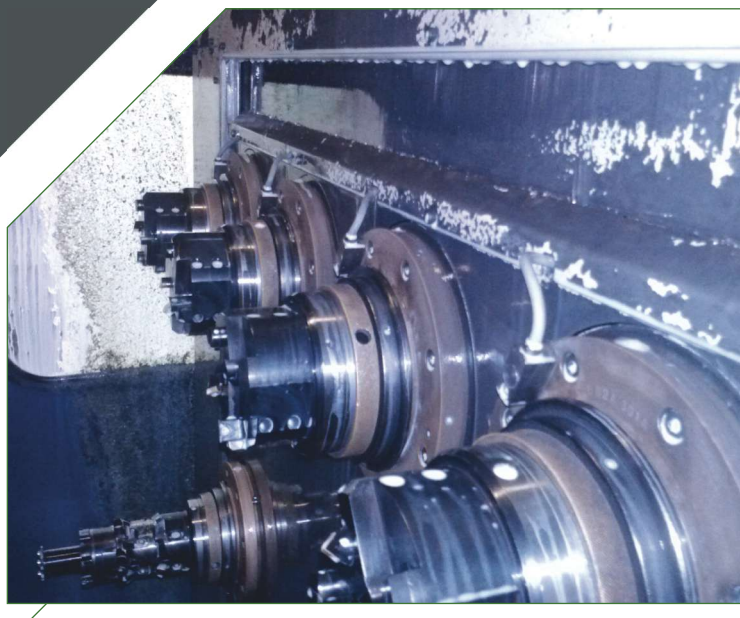

Image courtesy of Marposs.

Machine and process monitoring technology can monitor both machines and machine processes by detecting broken tools and mitigating crashes while providing vital data on the condition of machine components to support predictive and preventive maintenance.

Every shop deals with two universal truths: People are part of the process and make mistakes, and sooner or later, all mechanical devices will either wear out or break. The consequences of both truths can range from merely expensive to catastrophic. A modest investment in machine and process monitoring technology can, and nearly always does, pay large dividends over the long run in sparing moldmakers from the consequences of human error and the breakdown of machines.

Sensors 101

Modern sensor technology comes in one of two forms: micro electro-mechanical systems (MEMS) and piezoelectric devices. Each has a distinct set of capabilities and advantages for machine monitoring applications.

MEMS sensors are miniature machines with integrated electronics that are produced by technologies similar to those used in the manufacturing of semiconductor devices. Because MEMS sensors are highly reliable and are relatively inexpensive, they are widely used in all sorts of electronic devices where their small size, low consumption of power, ease of integration, high level of functionality and superb performance encourage and enable innovation.

The major advantage of a MEMS sensor in a machine-monitoring application is its ability to detect vibration at extremely low amplitudes. For example, a MEMS sensor can detect vibration in a spindle rotating at speeds as low as 2 rpm. Because the signal processing electronics are integrated into a MEMS sensor, MEMS sensors also tend to be less expensive than comparable piezoelectric units.

Piezoelectric sensors use the current that is generated by deforming a crystal to measure the amplitude of a vibration. Piezoelectric sensors are not able to detect low amplitude vibrations nearly as well as MEMS devices. They deliver a non-linear response in that region. However, piezoelectric sensors are extremely rugged and are able to survive crashes generating up to -70 Gs, while most MEMS sensors experience damage at about -18 Gs.

A further advantage of piezoelectric sensors is their ability to respond to vibration and acceleration in three axes instead of one or two for MEMS devices. The combination of ruggedness, 3D sensing, and the ability to serve as both a vibration and crash detection device make piezoelectric sensors the technology of choice for most large machine tools.

Vibration Analysis

While acceleration sensing is the key to crash protection, vibration detection provides the critical inputs for machine-condition monitoring. Every component of a machine tool generates a characteristic vibration profile, which changes predictably over time as it experiences normal wear. By periodically measuring the vibration profile and comparing the

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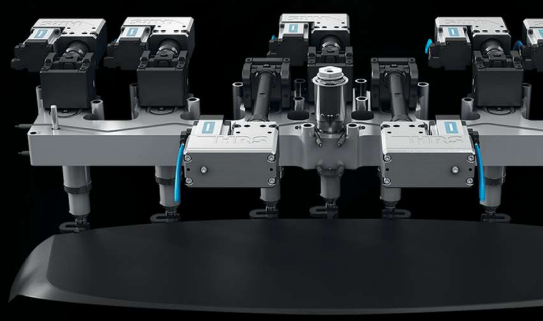

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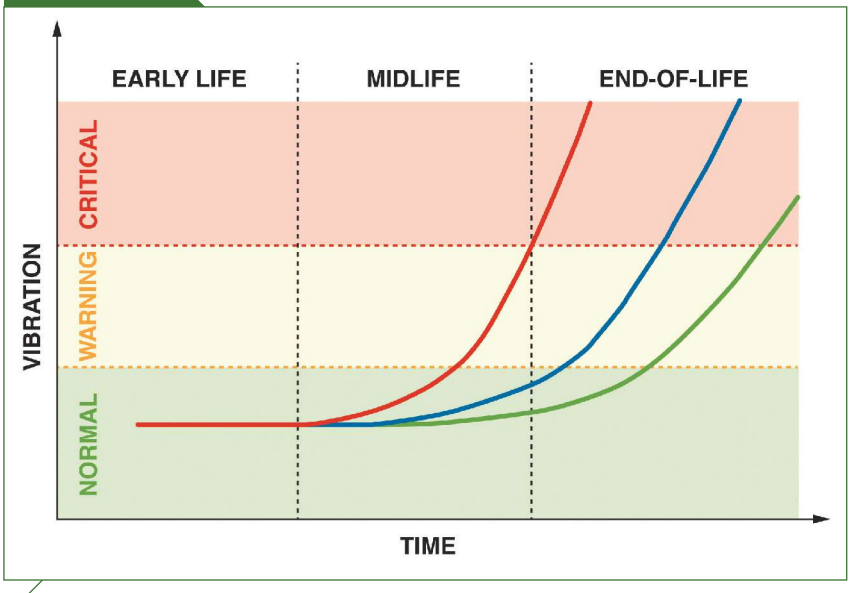
FIGURE 1



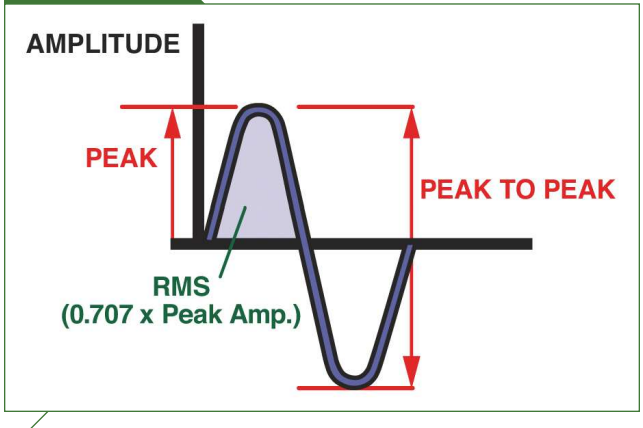
Figures courtesy of Marposs.

The relationship of vibration versus time for a normal wear mechanism.

data over time, one can track component condition and predict the onset of imminent failure.

Figure 1 shows three examples of the vibration-versus-time relationship for a normal wear mechanism. Although it takes time and experience to develop this type of relationship, a well-correlated vibration signature can be a cost-saving alternative to regular maintenance performed at short cycle times. Using actual vibration observations provides an opportunity to take quick action when warning conditions are detected (red curve), while avoiding premature maintenance on machines that have more life remaining (blue and green curves).

FIGURE 2



This is a sample signal that is generated by a micro electro-mechanical system (MEMS) or a piezoelectric sensor device.

A typical application for this technology is placing a sensor on the main bearing casting of a machine tool spindle, since the main bearing is the most common point of failure. The signal that the sensor generates will look something like the idealized trace in **Figure 2**. It is analyzed using the ISO standard procedure for determining the root mean square (RMS) value of the area under one half of the trace. This provides more useful data than merely measuring the peak-to-peak value and is the procedure used in the algorithms in most monitoring software.

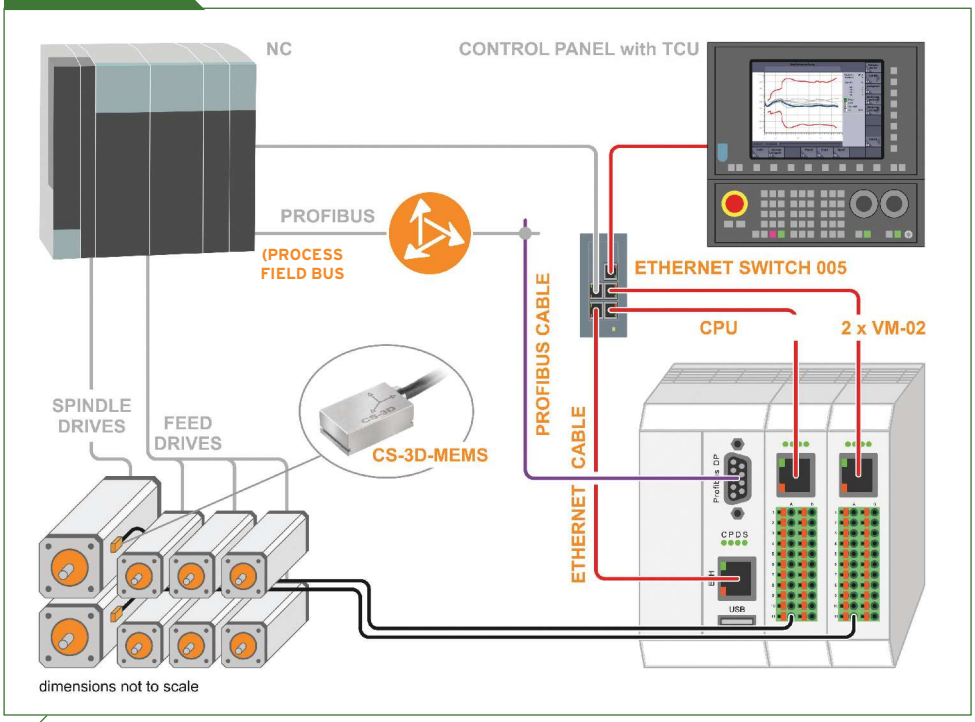
Fourier analysis is another standardized procedure used to normalize vibration data. Fourier analysis represents functions as a sum of simpler trigonometric functions. A fast fourier transform (FFT) changes vibration data based on time values to frequency values. It is useful for preventive maintenance applications because wear tends to increase both amplitude and frequency, which may not be obvious when comparing time-domained signals.

Other Monitoring Technologies

Acceleration detection and vibration analysis technologies are the foundation of any practical machine-monitoring application, but they are by no means the only tools available. Anyone machining high-value workpieces on expensive high-precision machine tools ought to seriously consider moving beyond the basics to a more comprehensive suite of technologies. The best place to start is probably with a true power monitoring application that measures the actual energy consumption of a motor. Current alone is an unreliable measure of motor performance. A combination of current, voltage and the phase difference between them enables a machinist to accurately calculate true power consumption.

The most common application of true power monitoring is on the spindle motor of a machining center. On a large machine, however, this may not be sufficient to provide the necessary protection. Consider, for example, the difference in power consumption between a 4-inch diameter face mill and a 5-millimeter drill on a 50kW spindle. For all practical purposes, the drill will be invisible even to the best true power technology. The answer is to apply true power technology to the axis drive that feeds the drill. That motor will be much smaller, and measuring its power consumption will provide tool condition data and breakage protection on the drill.

FIGURE 3

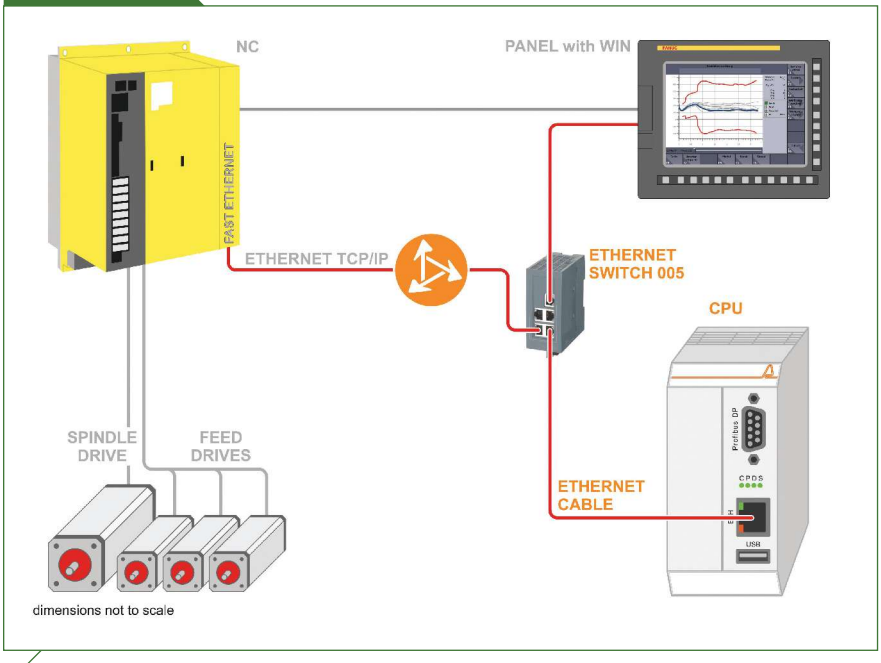


Effective tool condition detection on a multi-spindle head is possible with the right controller, using MEMS vibration-sensing technology in combination with true power monitoring that derives data from seven additional linear axes.

It is also possible to instrument individual toolholders with strain gauge technology. Unlike piezoelectric sensors, strain gauges can be loaded for extended periods of time without drifting. This makes them an excellent solution for gun drilling and tapping applications. For example, there are toolholder-mounted strain gauge units capable of tracing the entire profile of a tapping operation at speeds up to 27,000 rpm. True power monitoring is not effective in such an application because most of the power that is supplied to the motor is actually consumed in the motor under those conditions, making it extremely difficult to differentiate the power that is consumed by the tap.

Multi-spindle heads are another specialized situation that often require different monitoring technologies. In practical terms, true power monitoring of the spindle motor can be effective in detecting tool condition or breakage on a multi-spindle head using up to four identical tools (see **Figure 3**). Anything beyond that will probably require an alternative technology. In those cases, acoustic monitoring is the most common choice. As long as the tool diameter does not vary by more than 20 percent, an acoustic monitor can detect breakage in a multi-spindle head with many more than four tools. If the diameter varies by more than 20 percent, multiple monitors may be necessary.

FIGURE 4



Most of the added components are in the electrical cabinet, simplifying the installation of this control system.

It is possible to monitor motor torque without using sensors on machines by using several specific controllers. Digital torque adapter technology uses a proprietary interface to collect data directly from the control central processing unit (CPU) and processes it to generate graphic torque values. The system, which is commonly used in Europe, can monitor multiple axes and deliver all the functionality of a sensor-based system.

Putting Monitoring to Work

Modern machine and process monitoring technology is as easy to implement as a retrofit solution. For example, installing a true power monitor on a vertical machining center typically takes no more than two to three hours, plus the time needed to program the PLC. A complete crash protection, vibration sensing and tool condition monitoring system might take eight hours to install on the same machine. **Figure 4** shows a generic layout for a comparable system on a machine tool. Since most of the added components are in the electrical cabinet, the actual installation of the control system is quite simple. The digital torque adapter installation is even simpler.

As long as people make mistakes and machines wear out, some form of crash protection and condition monitoring technology will be the first line of defense against expensive and potentially catastrophic consequences. Fortunately, the technology is mature, effective, affordable and easy to implement, so there is no point in waiting to put it to work. MMT

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By Cynthia Kustush

This article is part of a series of roundtable discussions with industry suppliers addressing recent trends in moldmaking, the challenges moldmakers are experiencing and the latest solutions that are or will be available to resolve them.

Hot Runner Technologies Aim to Simplify Moldmakers' Approaches

Hot runner suppliers are developing solutions that remove complexities from the way that moldmakers and molders design, control and maintain their processes.

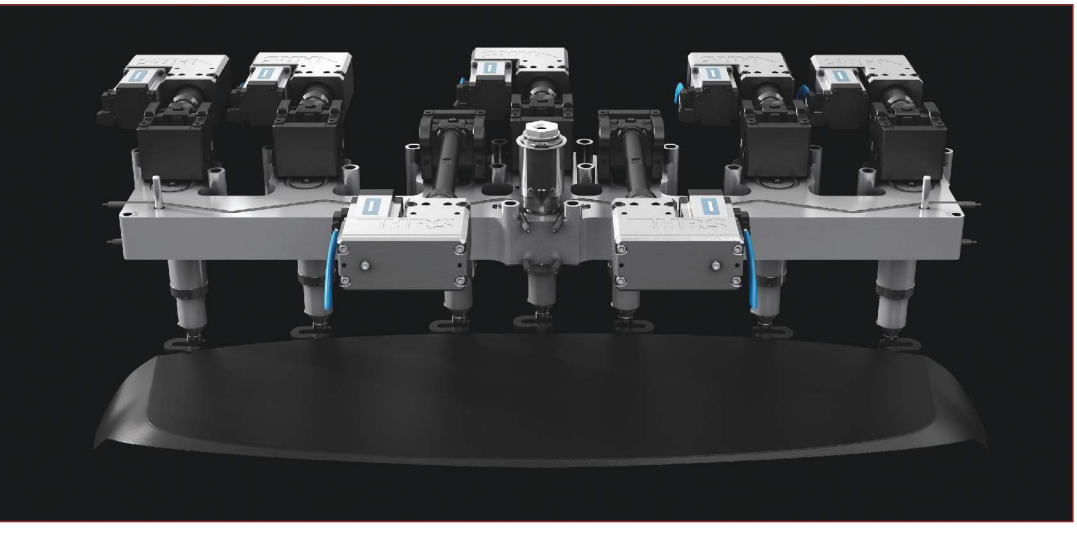

Image courtesy of HRS Flow.

Historically, hot runner systems can be complicated to understand, design and use. They are also among the most expensive components in moldmaking. For both of these reasons and more, *MoldMaking Technology* invited several suppliers of hot runner systems and components to participate in a special roundtable discussion. *MoldMaking Technology* asked each company to identify trends and challenges that their customers are facing, share some solutions or tips that can address them and provide some insight into the coming advancements in hot runner technology.

Advancing the Ways to Control Processes

Bill Rousseau, director of Applications and Technical Services at Synventive Molding Solutions (Peabody, Massachusetts) says that there have been major advances in pin-control technologies that are making it possible to mold parts that were previously un-moldable. "Technologies that range in abilities from simple valve-pin speed reduction to complete control of the movement of the pin are now available," he says. "The challenge is to know when these pin-control technologies are actually needed." Rousseau points out that some companies go to great expense to outfit a mold with one of these technologies only to find that the mold could produce acceptable parts without it. "At that point in time, the money has already been spent and any complexities involved with running the technology remain for the life of the mold," he says. "Our solution to this dilemma is to offer a range of scalable technologies. This approach enables hot runners to be supplied with simple pin-position sensing capabilities that can later be upgraded to other levels of pin control. There is no need to commit to any level of technology until after the parts are produced."

Sudheer Thrissileri, director of Global Hot Runner Systems, for Mold-Masters/Milacron (Georgetown, Ontario) agrees that processors need more precise hot runner control for optimum processing, part quality and gate longevity.

Servo-controlled valve gate hot runner systems will become more and more popular, allowing more precise control over the valve stem's speed and position during actuation. They also provide a larger processing window and, among other benefits, are more energy efficient than their traditional pneumatic or hydraulic counterparts.

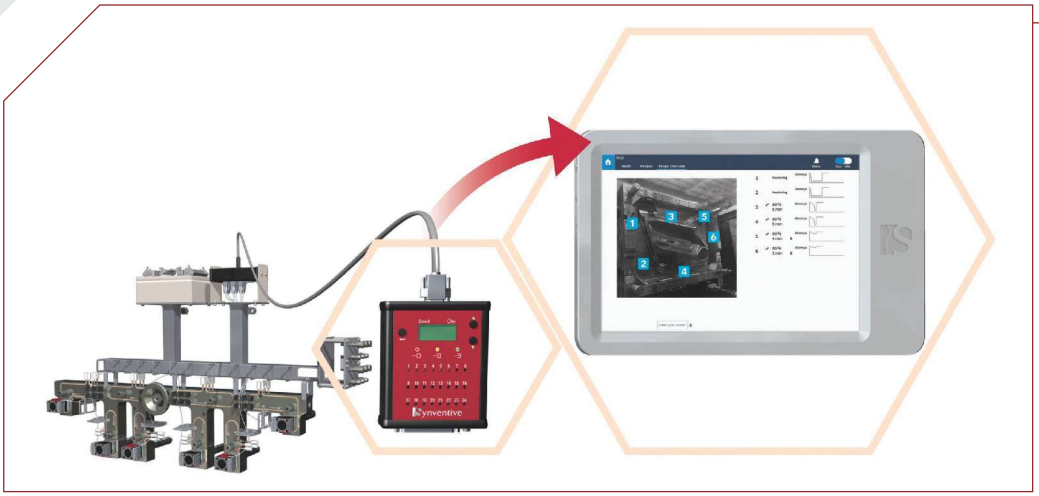

Image courtesy of Synventive Molding Solutions.

Advances in pin-control technologies are making it possible to mold parts that were previously un-moldable. Shown here is an example in which a monitoring device remotely displays the position of the valve pin during the molding process, making it easier to confirm setup or perform troubleshooting. The system is also scalable, meaning the user can start out with simple pin-position sensing capabilities and, if warranted, upgrade to gain more levels of pin control.

"Electric hot runner actuation is proven to provide precise control at both gate-open and gate-close sequences, and molders are trending toward electric valve gates on many applications," he says. "At Fakuma 2017, many hot runner manufacturers showcased this technology."

Robert Harvey, director of Sales North America for HRS Flow (Byron Center, Michigan) says that servo-controlled valve gate systems provide far superior processing flexibility than traditional valve-stem actuation. This is because of the ability to have precise control over the valve stem's speed and position during actuation and the ability to stop it in intermediate positions. Servo-controlled systems also provide for a larger processing window to accommodate competing requirements and conditions, such as the need to process out multiple cosmetic defects that are all distinct from one another. Harvey says that positioning valve pin actuators (cylinders or servos) outboard from the drop and attaching them with a connecting rod provides flexibility in manifold pocket design for additional support and removes cylinders from the area of the hot manifold, which extends the life of the cylinder seals and reduces downtime. "We see the trend only increasing for full, servo valve-stem actuation because of the accuracy of pin actuation and the substantially increased processing window that can be achieved," he says, adding that the elimination of hydraulic lines and hydraulic seals results in reduced maintenance and increased uptime in all cases. "Servo valve-gate actuation also allows for storage of additional process variables, such as stem position and speed, across many cycles."

Craig Reynolds, vice president of Business Development and Americas Service and Sales for Husky Injection Molding Systems Ltd. (Bolton, Ontario) says that the growing use of electric valve gate technology, which he believes will be mainstream soon, is giving molders more process control and repeatability. It also will result in operational cost savings since servo-driven systems use less energy than pneumatic or hydraulic valve gates. "It means that moldmakers will need to find a way to control the electric valve gates that will not require them to become computer programmers," he says.

Making Hot Runner Systems Smarter

Synventive's Bill Rousseau says that another industry trend involves the use of "smart tools" and the Internet of Things (IoT), and while the idea of completely autonomous production plants seems a long way off in the future, there are examples of companies taking those first steps today. "Control systems that now operate independently will start to be integrated, sharing information about the molding process and making appropriate adjustments," he says. "This melding of technologies that are currently separate will make them more powerful and easier to implement and operate."

According to Robert Harvey of HRS Flow, program timelines are being increasingly shortened, requiring very efficient transfer of design information and design execution along with faster manufacturing lead times. "Balancing the stringent quality requirements of more complex parts with operational needs like color changes is requiring more process flexibility from 'smarter' and more capable manifold systems," he says. "These systems are capable of controlling valve-stem speed and position and of providing process feedback."

Providing Comprehensive Customer Service

Brenda Clark, engineering manager for Hasco America Inc. (Fletcher, North Carolina), believes that one of the biggest challenges moldmakers and mold designers face is knowing which hot runner system will support their applications and how to design, build and then maintain the chosen system over the life of the mold. She points out that the level of initial communication between the moldmaker, mold designer and the hot runner supplier is of the utmost

Image courtesy of Incoe Corp.

With many configuration options comes many customer questions, and pricing for hot runner technologies varies significantly today. More than ever before, communication on the front end of a project is key and will help determine the amount of hot runner technology that is required to achieve the optimum part price and performance ratio.

importance. "Having details about individual system components (manifolds, nozzles, heaters and so on) and their spare parts breakdown can be most helpful to the mold designer and the moldmaker," she says. "A good hot runner supplier will provide documentation covering all the components for the complete hot runner system and hot half, including machining requirements, fits and finishes, and the maintenance requirements for every component."

Tim Markham, hot runner coordinator for PCS Company (Fraser, Michigan) says that customers often struggle with correct spacing of cavities and nozzles. They also struggle with choosing the right nozzle size to fill the part as opposed to choosing a nozzle based on the size of the mold. "We encourage our customers to contact us before they design their molds, so we can guide them to the correct nozzle size and tip option to use for their part," he says.

Jim Bott, business development manager for Incoe Corp. (Troy, Michigan) is seeing customers struggle with estimating prices for new or newer customers and getting the timing right on various, required steps in the moldmaking process beyond the actual mold build. "Estimating price can be easily done for existing customers with known, established specifications," he says. "The challenge is providing the proper price estimate for new or newer customers to achieve their required part outcome, because pricing for hot runner technologies varies significantly today and throws the price-per-drop estimate approach out the window." Further, Bott says that getting the timing right on things like hot runner quotes, mold simulation/warp and cool/FEA thermal results, system CAD data results and meeting delivery requirements is extremely important but also challenging. Like Brenda Clark of Hasco, Bott believes that communication on the front end of a project is key. "Hot runner professionals can partner with the moldmaker to conduct a meeting with the molder, in person or via WebEx, to determine the amount of hot runner technology that is required to achieve the optimum part price and performance ratio. That information helps our company's application engineers to establish more quickly an accurate quote for the hot runner solution," he says. Incoe also has added mold filling simulation software and hardware stations and has added more engineers. The company has a long-standing partnership with Beaumont Technologies to offer warp- and cool-engineered analyses. The company also hired additional CAD design engineers to reduce the required time to get the data to the moldmaker.

"Basic mold flow services are available for those applications that require the review of gate options and fill patterns," PCS's Tim Markham says. He adds that for specific resins, it is important to review the various options for molding parts, whether it is a direct gate or gating through a runner, a thermal gate or a valve gate. "We also advise customers not to use a hot runner system in certain applications that run exotic resins," he says.

Overcoming Molding and Gating Challenges

Husky's Craig Reynolds says that moldmakers are facing increasing technical requirements driven by smaller parts (or those that are less than 0.1 grams), tighter quality requirements and more challenging resins like polysulfone (PSU) alloys that are extremely sensitive to heat and that are catastrophic if they degrade in the hot runner. "One example includes Cpk's of greater than 1.66 on critical part dimensions, which are often required to support the parts that interface with other parts in increasingly complex assemblies like drug auto-injectors," he says. "We have invested heavily in applications engineering and designs, and we build our own control systems for temperature, valve gates and servos. Thermal FEA's are also performed on every hot runner system to ensure even, consistent heat profiles."

Sudheer Thrissileri of Mold-Masters also points to trends involving the use of advanced resin types and parts that are more complex to produce. For instance, he points to thinner-walled parts and complexities like stringent requirements on clarity and eliminating gate marks on visible part surfaces—all of which he says forces the industry to develop new techniques in injection molding. This, in turn, leads to the design and development of hot runner systems that can process new resins without dead spots and support applications that require higher injection pressures. For example, he says that the need for quality gate appearances has increased from a functional aspect to a more aesthetic one that requires both moldmakers and hot runner suppliers to design tighter gate area geometry tolerances.

HRS Flow's Robert Harvey sees a trend toward more complex parts as well as parts consolidation from assemblies. Because of this, the number of drops are increasing and often in a staggered pattern, he says, causing more

intricate layouts of water cooling lines and requiring thicker cavity plates that can provide needed support for the mold. Thermally insulated manifold supports are now available, as are gate cooling inserts that make it easier for moldmakers to get water to the gate areas.

PCS's Tim Markham believes cast manifolds will be the wave of the future. "This will give designers the ability to create better balance in the flow channels, with fewer dead areas that can trap degraded resin, and it will enable better color changes," he says. Sudheer Thrissileri of Mold-Masters adds that due to the weight reduction of molded parts, the need for faster cycle times and molds that are expected to run millions of cycles, the robustness of molds becomes more critical. "The use of alloy steels and special coatings for steel that can withstand many years of production will become more the norm than special," he says.

Incoe's Jim Bott says to look for solutions that will improve melt-delivery performance over what is currently available and in a smaller footprint. "This will provide the mold builder with more real estate to implement mold heating and cooling technologies," he says. It will also be possible to reduce or simplify mold machining, he adds. Hasco's Brenda Clark says that spare parts for manifolds, nozzles and heaters are becoming more standardized and easy to access when changeouts are required, such as when a problem arises or simply because of normal wear and tear on the system. Standardization will also help designers design a better mold and give moldmakers critical sizing details for more accurate machining that can alleviate fit or leak issues. "This also will advance the manufacturing of more reliable systems and hot halves for all end users," she says. "Good information in equals great production out!" MMT

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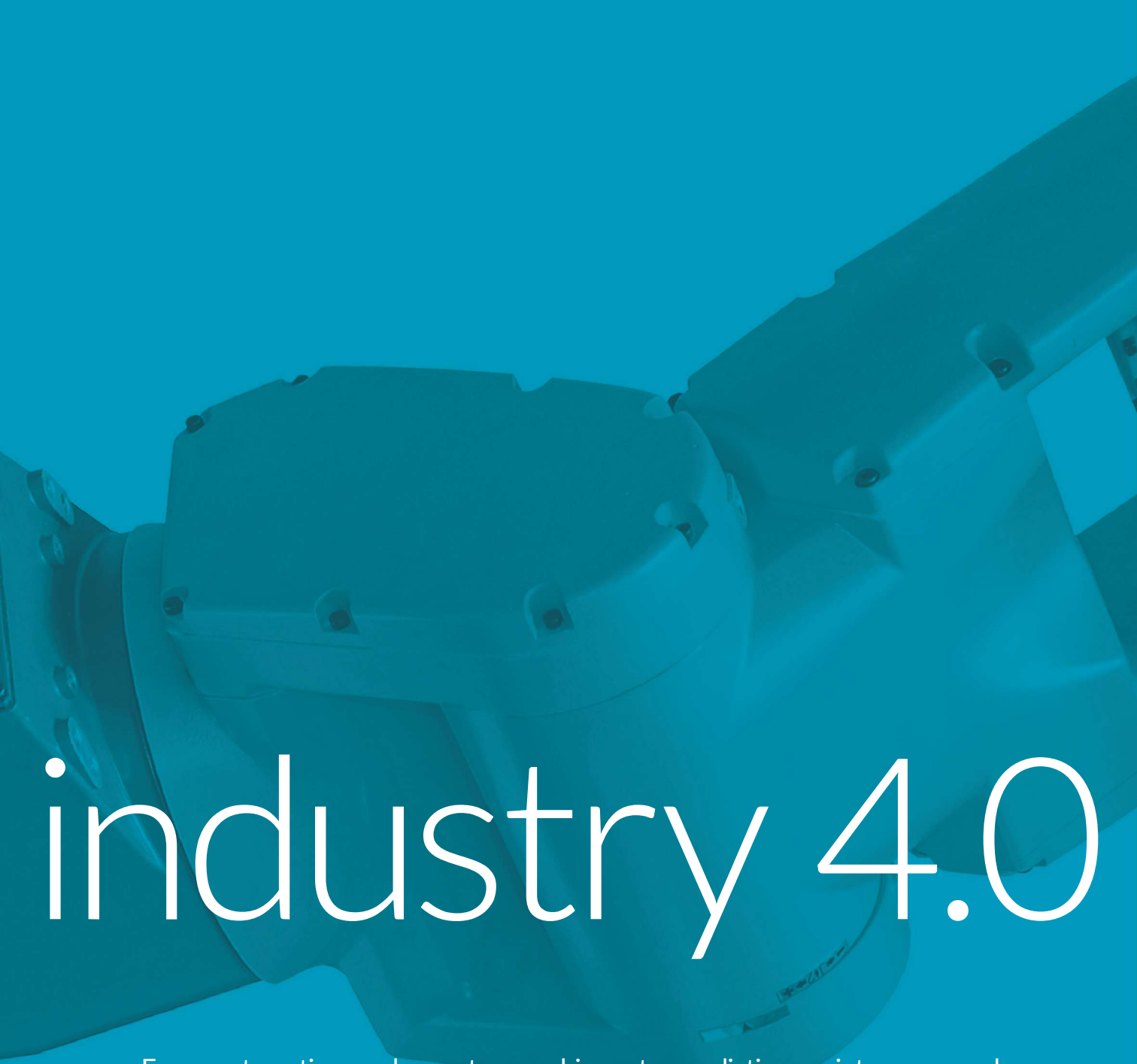

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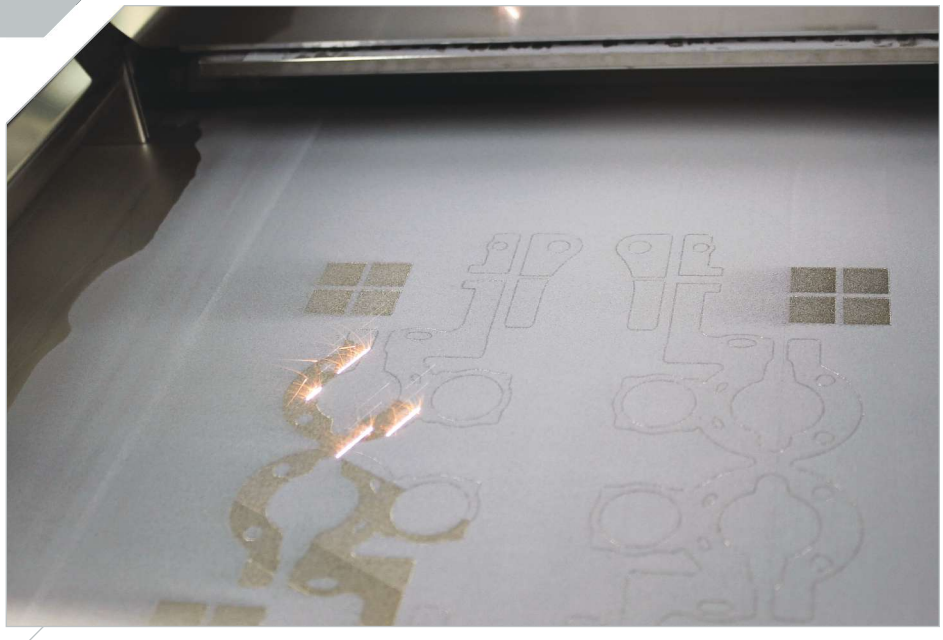
By Barbara Schulz

Additive Manufacturing: Stand-Alone Was Yesterday

Additive manufacturing is no longer considered a stand-alone technology but is being integrated increasingly into existing manufacturing processes.



Images courtesy of Barbara Schulz.

Renishaw says its RenAM 500Q four-laser metal AM system can significantly improve productivity with a build rate ranging to 150 cubic centimeters per hour.

With the growing potential and market size of additive manufacturing (AM), companies are investing in driving development. The range of materials is steadily expanding. Refractory metals and high-performance polymers are expected to become available within the next few years and to enable new applications. R&D in multi-laser systems is working toward creating larger building spaces, which will allow for components to have lengths of approximately 2 to 3 meters. Although initially these larger components are likely to be of lower quality than smaller components, multi-laser systems are expected to catch up fast.

These trends were evident at the Formnext show, which took place this past fall for the third time in Frankfurt, Germany, with 470 exhibitors showcasing an overwhelming number of technologies for tool and moldmaking.

Larger Build Volumes and Multi-Laser Systems

Formnext 2017 offered an optimum platform for AM companies to showcase their developments, including some world-firsts. For example, GE Additive debuted its first piece of GE Additive-branded machinery. The new Additive Technology Large Area System (ATLAS) metal 3D printing machine is a beta technology that teams at GE Additive and Concept Laser developed. It has a build volume of 1.1 by 1.1 by 0.3 meters, and its Z axis is scalable to beyond 1 meter, depending on customers' requests.

Renishaw introduced its RenAM 500Q, a four-laser metal AM system. The company says it can significantly improve productivity. EOS debuted the EOS P 500, a polymer 3D printing system that enables mass production. Trumpf also is ready for series production with its three-laser, 500-W fiber laser TruPrint 5000, which uses laser metal fusion (LMF) technology to build parts. The three lasers are fitted with optics that Trumpf specially designed. The company says that this enables the lasers to operate simultaneously at any point in the system's build chamber.

The industry has given much thought to system automation. For example, the TruPrint 5000 is able to start the manufacturing process automatically, which leads to a robust process with less work for the operator. As soon as the build

cylinder is placed into the system, it moves automatically to its setup and working position. The integrated zero-point clamping system is the basis for downstream process steps such as EDM, milling and turning.

Integration into Existing Processes

The catchphrase is process integration. The future of AM lies in its integration into current manufacturing processes to reduce steps, time to market and costs. The future of AM also lies in the intelligent combination of conventional machining technologies and AM.

AM processes have long been considered stand-alone technologies that did not fit easily into machining process chains. Marketing strategies were suggesting that one either manufactures with conventional subtractive machining technologies or with AM technologies. Many production managers simply never realized that these two worlds can and should be combined to yield the most optimum results.

This is particularly true for moldmaking, where AM has long found its place in the integration of conformal cooling channels in molds and mold inserts. Laser sintering is useful as well for making sintering density changes in molding applications that require the placement of porous structures to facilitate gas venting. In addition, laser sintering enables the production of deep features by building them one layer at a time, eliminating the need to machine these features with EDM.

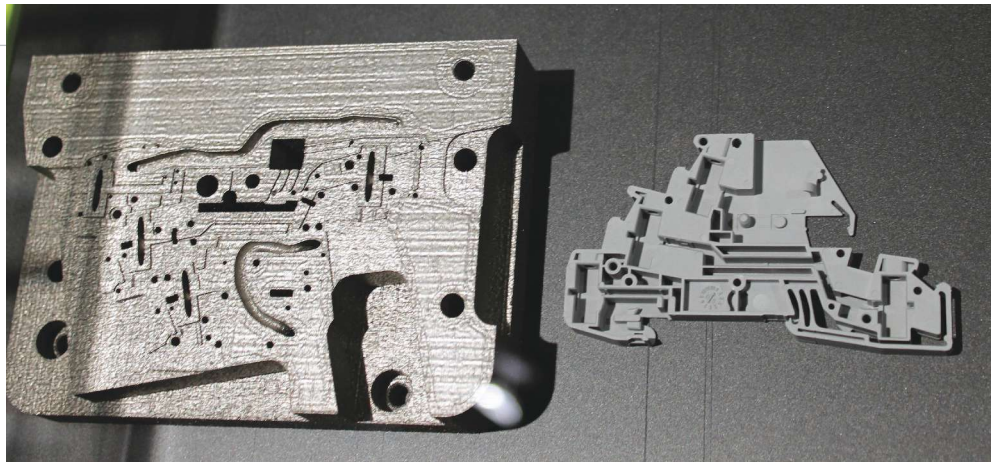
Two companies that realize moldmakers need solutions, not single machines or technologies, are GF Machining Solutions and EOS, and they have partnered to combine their technologies to benefit the moldmaking sector. The AM S 290 Tooling machine, which is based on the EOS M 290 DMLS system, is designed to address the mold and die industry's need to produce innovative mold inserts using AM. GF Machining Solutions and EOS aim to integrate AM machines into the production process of mold inserts, including the necessary software and automation link with downstream machine tools and measuring devices.

The Technical Unit System 3R zero-point clamping solution from GF Machining Solutions works in a similar fashion to the Trumpf zero-point clamping system. The Technical Unit System 3R ensures that the workpiece moves along the various production steps maintaining the same zero-point, eliminating errors and setup times. The system consists of a reference platform (3R Masterpal) and multiple component-specific mini pallets (3R Minipal) on which additively manufactured parts are printed.

This can be particularly useful when manufacturing hybrid parts. The first step in producing hybrid parts is milling or turning where the workpiece is set up, referenced and machined. To add material via selective laser melting (SLM) or other AM processes, the part is placed into the AM machine and usually loses all of its reference points. The same is true for post-processing steps like milling. Using the reference platform eliminates multiple setups and corresponding errors. Since the additive process is quite expensive, conventionally machining the core or the insert and reserving AM only for the parts with conformal cooling channels is a cost-efficient solution for mold shops producing hybrid parts.

Hybrid Machines Offer the Best of Two Worlds

Hybrid AM machines offer a combination of layer-by-layer building and conventional subtractive machining. Consequently, the giants of the wider manufacturing world did not miss the opportunity to showcase their latest developments at Formnext. Companies with something to display included DMG MORI, Matsuura, Hermle, OR Laser and Sodick.



This additively manufactured injection mold was made from 140 layers at 50 microns each (tool steel) with a build time of 45 hours.

Sodick's OPM250L combines direct metal laser sintering (DMLS) with high-speed milling and is primarily designed for moldmakers. In addition to creating conformal cooling channels, the OPM250L enables the machining of workpieces before the additive process is complete. The OPM250L alternates between milling and laser sintering, which reduces the number of parts necessary to build a mold. Sodick also follows the trend of developing products that enable manufacturing at higher speeds. In a setting called "Parallel Mode," the OPM250L can grow parts at three locations simultaneously. Sodick designed the OPM250L to require only a single beam to accomplish that task. Sodick explains that this is because laser sintering equipment must take fumes and shape deviation into consideration when generating the laser path. For this reason, the laser unit is not necessarily utilized at full capacity during processing. In parallel mode, the machine makes optimal use of the laser unit by targeting multiple locations concurrently.

Additively manufactured molds or mold inserts do not replace traditional moldmaking by any means. The question is: How do shops complement their existing portfolios?

Matsuura showcased its latest hybrid machine, the Lumex Avance 60, which opens this technology to bigger applications in new industries, such as aerospace and automotive, accommodating a maximum workpiece size of 600 by 600 by 500 millimeters and a maximum weight of 1,300 kilograms. New products are available for those who do not want to go big. For instance, OR Laser, a German laser systems manufacturer, debuted the Orlas Creator hybrid, an SLM machine with the added benefit of three-axis milling to create net parts. The machine combines the build platform of the original Creator, an SLM machine that OR Laser launched at Formnext 2016, with a 250-Watt laser and processing speeds of 3,500 millimeters per second. The Orlas Creator hybrid would fit even a small workshop environment.

Tomorrow's Injection Molds

Protiq, part of the Phoenix Contact Group, showcased an injection mold that the company developed with the design freedom of AM in mind. The injection mold leverages simulation and numerical optimization to address the structural, thermal and manufacturing aspects of designing an injection mold. Designed for in-house use at Phoenix, the mold is 75 percent lighter than the original tool that the company created a couple of years ago with traditional methods.

Conformal cooling was integrated into the AM process, which reduced the cycle time by 3.2 seconds. "It is one of the fastest tools we have ever built at Phoenix," Protiq Managing Director Dr. Ralf Gärtner says. "Of course, the topology optimization in this mold doesn't necessarily make sense for all kinds of tools, like 128-cavity molds. Additively manufactured molds or mold inserts do not replace traditional moldmaking by any means. The question is: How do shops complement their existing portfolios?" MMT

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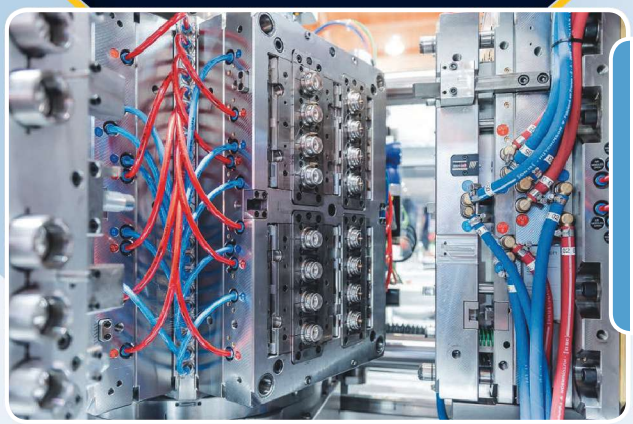

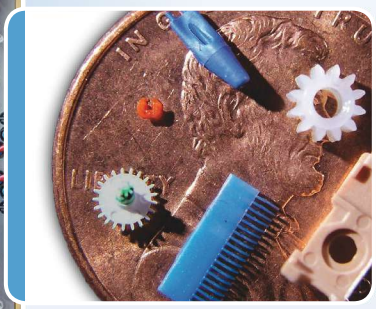

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Getting Physical with Data

By Steve Johnson

In the constant quest to bring usable data to mold repair shops, the focus has always been on the type of data to collect, the person responsible for each part of the data collection process and the most effective way to use the data. The discussion always centers on the data system itself. For example, discussion focuses on items like system databases, data storage, data availability, proper security, backup and navigation. An essential item missing from that list is the physical side of data collection and usage.

The reason this aspect is often neglected is because it does not sound like a real issue. A shop can simply stick a laptop on a mobile stand and use it or put a computer and small monitor on a desk in the corner. That will work, right? Well, not quite. As with everything in the trades, it is the nuances that help identify the right tools and the right way to use them, so it is no different with computers, keyboards and monitors.

Sit or Stand?

For office personnel, there is plenty written about the ergonomics of computer placement relative to the person using it. For example, much has been written about the best location or position of the person to the screen and keyboard, the proper viewing distance and angle for a specific monitor size and the most appropriate chair style for prolonged computer work. These are important ergonomic and health considerations for those who work mostly at their desk. However, the average mold repair technician is on his or her feet all day and does not have the time or desire to park at a desk several times a day to enter or retrieve data.

Images courtesy of MoldTrax.

A mobile computer station (left) as opposed to a mobile stand (right) should have a suitable height and weight for stability, shelving for additional equipment and large, soft, lockable rubber wheels to ease movement around the shop.

Information gathering for trades people must be considered in the same manner, if shops want them to consistently input and use accurate data every day, during an average mold preventive maintenance (PM), cleaning and repair. When data entry and retrieval are physically difficult or cumbersome, the repair technician will avoid the task entirely or only enter a short statement about the work that was performed on the mold, such as "fixed it," "completed" or "done."

At our training center, we explain why proper data collection and usage is a critical aspect of any molder's ability to efficiently produce quality parts on time. Attendees are required to complete specific forms all throughout a hot runner or mold repair exercise and to note also any repair procedure or mold condition that they deem important. They have a choice to fill out the forms manually and then enter the data at the end of the day, or log directly into the data system and complete the forms electronically as they go.

It is intriguing that many attendees choose to wait until the repair is finished and then collect the manually completed forms and head to the computer to enter the information. Even with our mobile stands (which are 38 inches in height), which enable them to roll the computer next to the mold for on-the-fly entries and image viewing, most attendees do not bother to enter data directly. Even a few of the younger technicians, who have historically demonstrated a high comfort level with the keyboard, rarely rolled the laptops to the benches while they worked.

We polled the attendees about this outcome and here are some of the concerns that they voiced:

- **Viewing**. The 15-inch laptop screen's low angle and distance from the user while users stood made the screen difficult to view and required them to hunch. The mobile stand was roughly 4 inches too short for the average attendee (5'11").
- **Typing.** The keyboard is waist high, making it too low to type comfortably.
- **Safety.** Moving the lightly built mobile stand safely around the shop without tipping it was a challenge. The stand's legs protruded from the bottom and were easily kicked or tripped over when parked around the benches.
- **Power.** The laptops required charging every four hours, which effectively chained them to a wall. Some attendees moved the laptop to a desk and sat to type, but they quickly grow weary of the back and forth between the desk, chair and bench to verify and document the data.

These concerns prompted us to design a mobile "documentation station" which repair technicians would want to use and which would promote entering data on the fly versus waiting until the end of the day. We were convinced that once we made entering and accessing the information physically easier,

documentation would be more valuable and eventually ingrained into the daily maintenance process.

The Documentation Station Breakdown

Mobile Computer Stand. A documentation (doc) station must have the correct stand type with room to place other necessary equipment. Many mobile stands are available, but only a few would work well in a shop environment. The station stand must be strong, stable and lightweight to move safely around the shop. It must have a relatively small footprint with no legs or casters protruding from the bottom. It also should have a suitable height and weight for stability, shelving for additional equipment and large, soft, lockable rubber wheels to ease movement around a typical shop floor, over floor mats and other small debris without catching and tipping.

The goal is one documentation station for every two benches. Ideally, one per bench. This ensures that no one is waiting to use it, which is the point of consistent data entry.

After much research, we recommend a stand from Unline. It is 24 inches wide by 18 inches deep, stands 42 inches tall and has two additional shelves to hold a laptop or desktop computer, printer and a battery pack. The slide-out keyboard tray puts the keyboard at 40 inches, which is the ideal height for the average individual to use while standing. For taller technicians, the wireless keyboard can be placed on the top surface (which is at 42 inches). Both heights work nicely if the user wants to sit on a standard height bar stool (at 30 inches) while working at the station.

24-Inch Monitor. Small screens (at 15 inches or smaller, or the screens on phones) do not cut it when entering or viewing maintenance data. Squinting, scrolling and zooming make them painful to use. We recommend a 24-inch monitor for easy viewing and less scrolling. These monitors are worth the expense to reduce eyestrain and continuous zooming to view image details. These monitors can be mounted on extension posts and bolted to the back of the stand, which makes it possible to fasten the screen more securely, preventing someone or something from accidentally knocking it off while the station moves around the shop. This puts the monitor at eye level, or about 20 inches from the user. It can also be tilted to a more comfortable viewing position, if necessary.

Desktop or Laptop. A laptop or desktop may be readily available in most companies, as many have old, unused desktops. If that is not the case, a shop does not need a large-screen, high-dollar laptop with a ton of programs. The machine will serve only as a means to access an enterprise resource planning system or other maintenance workorder system and to view images stored on the network or simultaneously at multiple stations without using terminal services. A wireless internet connection might be necessary.

Battery Pack. The battery power pack (CyberPower) enables the doc station to be completely mobile and untethered from a wall. This easily rechargeable battery can power the 24-inch monitor and the laptop for up to eight hours. It is quite heavy, which helps to balance the stand and to prevent tipping.

Wireless Keyboard and Mouse. These typical attachments are inexpensive purchases that are readily available. Using a full-sized keyboard is helpful for those who are not the most proficient typists.

Printer. For a complete workstation, we recommend including an ink-jet printer to print worksheets and not simply rely on when the "community printer" is available. It is possible to run the printer from battery pack power only when the printer is in use, so draining the battery is not an issue. Inexpensive printers are available, but we recommend the Brother printer. It is just the right size to fit on the bottom shelf and has a flip-up keyboard for easy viewing, which workers can push out of the way when they are not using it.

The total cost of this full system is about $1,500. It could be less if the company already has some of the components on hand. As inexpensive as these are, we prefer one doc station for every two benches. Ideally, one per bench. This ensures that no one is waiting to use it, which is the point of consistent data entry.

The location of the doc station is also important to alleviate any risk of damage. For shops concerned about inadvertent water, oil, cleaning spray, dirt or other contaminant damage, simply wrap the stand with a heavy mill plastic sheet and secure it with magnets or install sections of plastic laminate around each shelf. Use protective covers for keyboards and monitor screens as well.

We unveiled the documentation station at Moldtrax Maintenance Solutions during a hot runner course late last year, and it received great reviews. Attendees pulled the stations right up to their benches during a manifold teardown and took advantage of many images and disassembly instructions while they were working. Data entry became so convenient that a couple of teams created step-by-step disassembly guides for their respective manifolds, complete with captioned images.

Mold performance and maintenance/repair data is one of the most valuable tools in a shop. Shops need to use data every day on every mold, not just when molds crash. Do not discount the physical side of using this tool. MMT

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Steve Johnson is president of MoldTrax Maintenance Solutions, which provides specialized course work, hands-on bench training, maintenance software, maintenance products, toolroom design and maintenance efficiency auditing.

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Molding **Personal Goodwill**

By Adam J. Herman, CPA/ABV/CFF, CVA, ASA, CFE and Michael J. Devereux II, CPA, CMP

The issue of who owns goodwill (an individual or a company) has important tax and economic consequences. Personal goodwill can make a big difference when determining the value of a mold shop that is for sale. Personal goodwill represents intangible economic characteristics and the related intangible asset value that is attributable to an individual's reputation, specific skills and knowledge, personal relationships, judgment, expertise, experience, personality, past success and management style.

An employee or shareholder of a corporation can own goodwill separately from the corporation if customers value the owner or employee (rather than the corporation) as the center of their commercial relationship. This is commonplace for mid-size and small mold shops. Personal goodwill characteristics are generally considered inseparable from the individual.

This is not the case for company goodwill, which represents those intangible economic characteristics and the related intangible asset value that is attributable to the business entity. Company goodwill examples include the company's name, reputation, research efforts, location, facility, phone number, customer list and trained and assembled workforce.

Tax Impact

One major reason to value the level of personal goodwill in a business is because of the double taxation involved in the sale of assets that C Corporations hold. In the sale of a C Corporation's assets, all gains are taxed at the corporate tax rate, which has a top rate of 35 percent. Soon the rate will be 21 percent, under the tax reform bill. The C Corporation must then distribute the proceeds of the sale to the shareholder. The proceeds are then taxed again at the shareholder level, typically at the capital gains tax rate of 23.8 percent (which is the qualified dividend rate of 20 percent plus the 3.8 percent Medicare surtax). However, if personal goodwill can be carved out of the sale and attributed to the business owner, and not as an asset of the corporation, the gain allocable to the personal goodwill from the sale is only taxed once, as personal assets of the shareholder are taxed at the capital gains rate of 23.8 percent.

Economic Impact

When the C Corporation has more than one owner, the economic impact of the sale can be affected if a portion of the purchase price is allocable to personal goodwill, and that personal goodwill is not proportionate with the ownership interests. For example, Adam and Mike each own 50 percent of XYZ Mold Builders, which is taxed as a C Corporation in the sale of all of the assets for $4 million. In allocating the purchase, the valuator determined that $3 million is allocable to the business' assets, $750,000 to Adam's goodwill and $250,000 to Mike's goodwill. In this example, Adam will recognize greater proceeds from the sale, since more of the purchase price was allocated to the personal goodwill that he owned.

Available Guidance

The most frequently cited personal goodwill case is *Martin Ice Cream, Petitioner v. Commissioner of Internal Revenue, Respondent,* the 1998 court decision that gives authority to the separate treatment of personal and business goodwill. Arnold Strassberg, an ice cream industry veteran, and his son Martin jointly owned a wholesale ice cream company. The two disagreed about how the business should be run, so they divided the company in two.

Arnold decided to sell his side of the business to Häagen-Dazs for $1.5 million. Relative to the taxes associated with the sale, Martin Ice Cream contended that the majority of the value was actually the personal goodwill Arnold had built over a long industry career. As personal goodwill, the gains would be taxed at Arnold Strassberg's capital gains rate. The IRS contended that the sale proceeds should be attributed to Martin Ice Cream and taxed at the corporate rate.

The tax court ruled against the IRS, agreeing that these intangible assets were the property of the shareholder. So, the value of those assets was not included in the value of the corporate sale. The Martin Ice Cream case underscores the opportunities available for significant tax savings in a business sale. Carefully evaluating corporate and personal assets can help shop owners avoid a major tax burden.

Final Factor

In the sale of a business, personal goodwill itself cannot be transferred. However, the rights to one's goodwill can be transferred. If an individual signs a non-compete or any other employment agreement, his or her personal goodwill may actually be considered an asset of the company. Therefore, verify that the key individual(s) did not sign a non-compete or any other employment agreement before trying to allocate personal goodwill. MMT

CONTRIBUTOR

Adam J. Herman, CPA/ABV/CFF, CVA, ASA, CFE, is a partner and chief visionary officer for Mueller Prost LC who regularly advises manufacturers in the exit of their businesses. Michael J. Devereux II, CPA, CMP is a partner and director of Manufacturing, Distribution and Plastics Industry Services at Mueller Prost LC.

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Index Completes One of Its Best Years

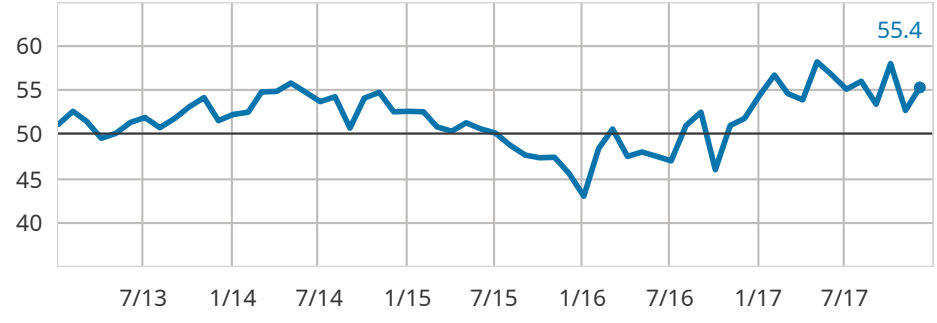
Employment and New Orders Lift Index, at 55.4 in December

Registering 55.4 for December, the Gardner Business Index (GBI): Moldmaking expanded at a faster pace than during the previous month. For the calendar year, the Moldmaking Index averaged 55.5, marking 2017 as the best calendar year for the Moldmaking Index since its inception. During the year, the Moldmaking Index exceeded a reading of 55 in seven of the 12 months. Before 2017, the Moldmaking Index had exceeded a reading of at least 55 for only one month in both 2012 and 2014. In comparison to the same month one year ago, the Moldmaking Index increased by 6.5 percent. Gardner Intelligence's review of the underlying data for the month indicates that employment, new orders and exports lifted the Moldmaking Index higher while production, supplier deliveries and backlog pulled the Moldmaking Index lower. No components of the Moldmaking Index contracted during the month. Gardner Intelligence is monitoring the unusually sharp slowing in the growth of supplier deliveries, which has fallen nearly 10 points since reaching a high of over 64 in October. Conversely, exports registered its strongest expansionary reading on record during December. MMT

ABOUT THE AUTHOR

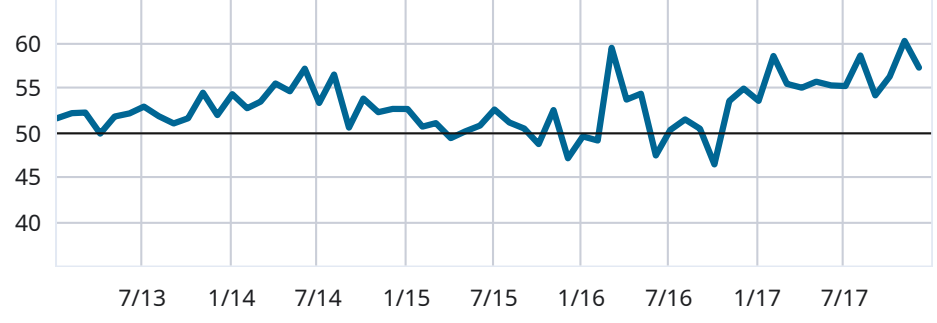
Michael Guckes is the chief economist for Gardner Intelligence, a division of Gardner Business Media (Cincinnati, Ohio, United States). He has performed economic analysis, modeling and forecasting work for nearly 20 years among a range of industries. He is available at mguckes@gardnerweb.com.

Moldmaking Index



December's reading for the Moldmaking Index was only slightly below the calendar-year average of 55.5, making 2017 the best year in recorded history for the Moldmaking Index. December was a highly unusual month, as survey respondents cited contracting supplier deliveries and a strong expansion in exports.

Employment (3-Month Moving Average)



Employment readings throughout 2017 signaled increasing demand for workers in the moldmaking industry. Custom processors also reported similarly strong growth in employment, with the greatest increase in employment occurring during the last quarter of the year.

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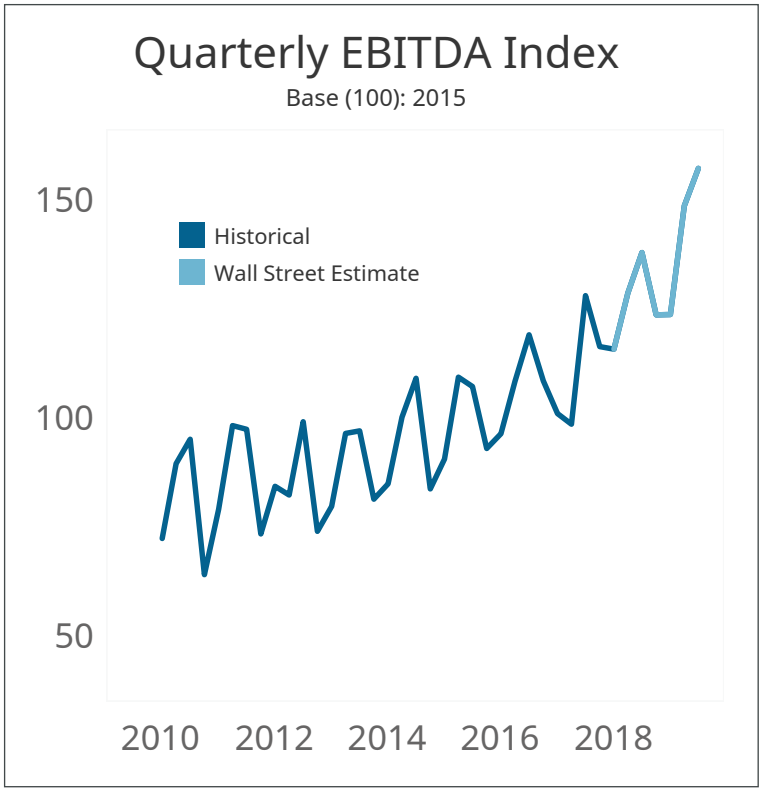
Wall Street Sees Growth in the Packaging Industry

Equities analysts predict 2018 and 2019 double-digit EBITDA growth.

It is difficult to directly measure data on packaging and containers because of the permeation of packaging and containers products in everyday consumer activities and because of the permeation of those products along many—if not most—supply chains in a multitude of industries. Therefore, Gardner Intelligence has built customized tools that collect and analyze the quarterly business results of publicly-traded firms in the plastics and containers industry to provide those serving this industry with more up-to-date information.

In examining the financial data of publicly traded U.S. packaging and container manufacturers of plastic and rubber products, it is apparent that revenues for the group grew 7.1 percent between the third quarter of 2016 (3Q2016) and the third quarter of 2017 (3Q2017). Appending Wall Street estimates to this historical data, revenues are expected to increase 2.6 percent and 6.1 percent respectively for the 12-month periods ending in 3Q2018 and in 3Q2019. Taking an extended look at inflation-adjusted (or "real") historical and forecasted revenues for the period from 2000 to 2020, one will see that the growth rate of real revenues increased around 2012 and is projected to continue to grow at that faster rate through at least early 2019. Forecasted financial values are natively reported in nominal terms. All metrics that are defined in 'real' terms have been adjusted to 2015-dollar terms. Gardner Intelligence applies a 2.5-percent annual deflator to forecasted values to more accurately blend inflation-adjusted historical and forecasted figures.



Data source: YCharts

Revenues for publicly traded U.S. packaging and container manufacturers of plastic and rubber products grew 7.1 percent between the third quarter of 2016 and the third quarter of 2017.

Additionally, examining Wall Street consensus projections for Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA), we see that these same packaging firms are predicted to see EBITDA growth of 5.1 percent between 3Q2017 and 3Q2018 and an impressive 11.1 percent between 3Q2018 and 3Q2019. Gardner pays close attention to EBITDA because of the importance of end-users' profitability in determining their ability to purchase capital equipment. Gardner attributes these robust forecasts to the expected strength of the U.S. and world economies, driven by strong consumer spending and low unemployment over the forecasted period. MMT

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MOLD COMPONENTS

Three-Plate Latch System Installs and Adjusts Easily

Designed for simplicity and positive plate pulling, the three-plate latch system from **Alba** installs easily. The system mounts externally, so the latch and cam plate assembly provide for easy adjustment of the plate stroke. External mounting also provides for easy adjustment of positive-plate stop positions. The company says that a socket head cap screw can easily adjust the LS01 and LS02 cam plates while they are still in the machine. Since the latch and the cam plate are separately attached to the mold, there is no possibility of over-stroking the machine and causing mold damage. Alba offers this system in a variety of sizes to meet a variety of applications.

ALBA Enterprises Inc. /

Centering Unit Is Flat for High-Precision Centering of Inserts

Meusburger says it designed this centering element as small as possible to achieve the exact centering of the individual inserts, but still equipped the centering unit with technical refinements. The E 1307 fine centering unit is flat and features a compact design with defined installation positions, which prevents incorrect mounting of the respective centering parts. The hardened and DLC-coated fine centering unit ensures minimal wear and is ideal for use in cleanrooms. The large chamfer on the contact surface of the centering parts makes it possible for corner radii on the insert and at the same time facilitates assembly. In addition, the withdrawal thread facilitates disassembly. The E 1307 is available in two versions with two sizes each. The E 13076 comes with mounting holes as a ready-to-use variant, and the E 13070 comes without mounting holes for individual adjustment to the required dimensions on a specific insert.

Meusburger US Inc. Standard Molds / 704-526-0330 / meusburger.com

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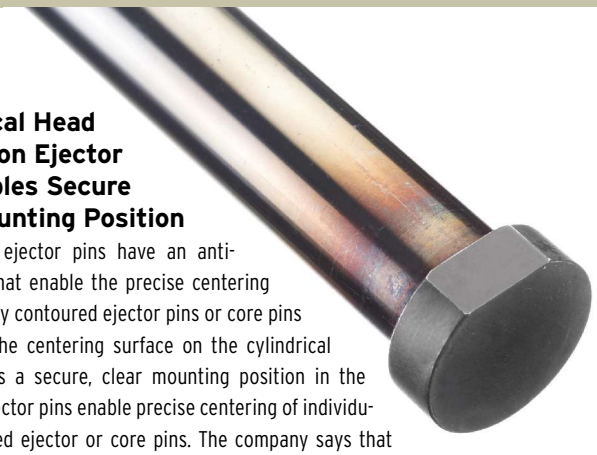

Cylindrical Head Surface on Ejector Pin Enables Secure Mold Mounting Position

Hasco Z410 ejector pins have an anti-twist head that enable the precise centering of individually contoured ejector pins or core pins in a mold. The centering surface on the cylindrical head permits a secure, clear mounting position in the mold. The ejector pins enable precise centering of individually contoured ejector or core pins. The company says that with a suitable design for the counterbore, the head geometry can also fulfill the function of a standard DIN ejector pin if that is necessary.

Hasco says that the simple mounting geometry of the ejector pins enable perfect repeat accuracy of their installation, offering a precise and positive fit. They thus ensure clear-cut positioning. The surface area of the ejector head can be used in full, guaranteeing maximum stability. Hasco supplies the new ejector pins in hardened, hot-working steel. The pins can be further processed to suit individual requirements, including through additional heat treatment such as nitriding or from an additional coating. All sizes are available from stock.

HASCO America Inc. / 828-650-2600 / hasco.com

Improved Mold Monitoring System Technology Eases Data Monitoring

Recent advancements of CVe Live include an enhanced dashboard that provides a snapshot of a company's entire fleet of tools and a customizable tool tab that displays tool information and performance metrics, including efficiency and cycle-time averages for the trailing hour, 24-hour and week-long periods. Advancements also include a tablet feature that enables presses to be assigned to a tablet, providing machine operators a portable and simplified interface to enter rejects and downtime codes.

Additionally, CVe Live now has an exceptions dashboard for manufacturing cells, which shows content that is intended to be displayed on a large TV or monitor and keeps track of any exceptions that occur on the machines that are assigned to the dashboard. The data transfer option provides for any data that CVe Live collects to be manually or automatically output to an Excel or JSON file, simplifying the transfer of data to existing systems.

AST Technology, a subsidiary of **Progressive Components**, develops and supports CVe Live. AST Technology designed the product to integrate with a company's existing systems. CVe Live is configurable to automatically export any of the data collected or information that is entered by users.

AST Technology / 847-487-1000 / asttech.com

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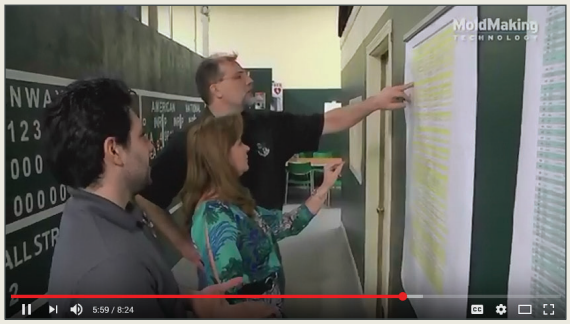
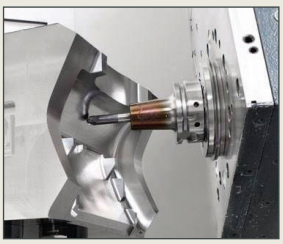


YouTube™ *Videos*

This year marks the 15th anniversary of *MMT*'s Leadtime Leader Awards, so it seems fitting to revisit one of our past winners. youtube.com/c/moldmakingtechnology

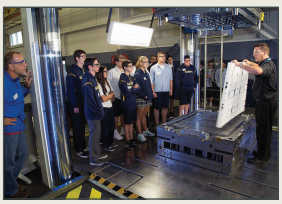
Popular Posts

Haimer reviews some of the most common pre- and in-process attributes that machinists should consider, as they pertain to process efficiency and reliability. facebook.com/moldmakingtechnology



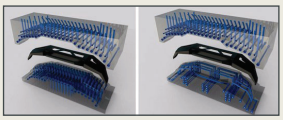
@MMTMag *Hot Tweets*

MMT's Cyndi Kustush shares how Cavalier Tool and Manufacturing left a lasting impression with students, instructors and parents during a tour. twitter.com/MMTmag



Conversations

MMT's Christina Fuges speaks with Pat Zaffino of Conformal Cooling Solutions about the evolution of an additive-metals technology to create an accurate 3D object on an existing 3D contour surface. linkedin.com/company/moldmakingtechnology



MACHINING

Ballscrew Inspection Considerations

By Robb Hudson

Ballscrews in a machining center are not likely on a moldmaker's checklist. However, since ballscrews are akin to a car's transmission, they should make the list. They drive the linear axes of any machine tool and hopefully in the desired direction. Ballscrews play an important role in machine tool design for mold manufacturing, as they help deliver the high-cutting load forces necessary for roughing and for achieving the superior surface finishes and tight tolerances molds require today.

For example, mold-base manufacturing demands a heavy-duty machining center with comparably large, accurate ballscrews of at least 3 inches to exert the tremendous forces and cutting loads associated with removing large amounts of material. The linear axes need significant thrust capability to drive those axes through the cut and do so in a stable, consistent manner to avoid backlash and chatter, which can lead to premature cutting tool failure.

Moldmakers who are producing smaller cavity and insert-type molds with intricate details requiring tight tolerances and superior surface finishes demand significantly higher feedrates and more rapid axial reversals during machining. Ballscrews play an important role here. The rapid reversals are often dynamic, and the ballscrew and corresponding nut need to respond accordingly. A specially designed ballscrew and mating nut can better deliver that rapid reversal of any given axis.

When considering a machine tool for moldmaking, consider the roughing and finishing requirements for the application at hand. Ask the supplier to peel back the cover of the machine to see the "transmission." Examine the design, pitch and diameter of the ballscrew. Depending on the application, two ballscrews and two servo motors are optimal on an axis to deliver the thrust requirement and the proper dampening for that particular axis. It also is important to verify ballscrew size. Ensure that they are not undersized or oversized based on what the machine will be doing and the load it will be carrying. Also consider whether the ballscrews will be able to accelerate, decelerate and change direction instantaneously.

If a ballscrew is not manufactured to a very high standard and put through several rigorous quality checks, an axis may be moving in an undesirable fashion. The ballscrew itself may have an accuracy and repeatability problem, or the load force exerted on that axis may not be evenly distributed. So, instead of pushing that axis in a straight and concentric fashion, the ballscrew attempts to move at an angle. This causes undue stress and premature wear on the ballscrew. Also, if there is an excessive amount of runout in the ballscrew, or if the threads of the ballscrew are not machined in, hardened and ground concentric to the cylindricity of the ballscrew shaft itself, then the component experiences "ballscrew drunkenness," which reflects the difference between the theoretical ball path and the actual ball path. The actual and the theoretical paths need to be as close together as possible, as any deviation will cause wear, which degrades the machine's positional characteristics over time.

Image courtesy of Mitsui Seiki USA, Inc.

Ballscrews drive the linear axes of any machine tool in the desired direction and are key to delivering high cutting load forces that molds require.

Ballscrew drunkenness can lead to several negative outcomes, including machine tool inaccuracy, premature ballscrew, mating nut or guiderail wear (whether it is a box guideway or a linear guiderail). Therefore, some machine tool builders ensure that the ballscrews used in their machines are put through several arduous quality checks and are manufactured to an exacting standard, such as the use of a special machine to check ballscrew drunkenness. This tool ensures that the thread of the ballscrew is machined in a very concentric fashion to the major diameter of the ballscrew itself. This puts the ballscrew pitch and lead exactly where they should be and makes the thread equal and concentric all the way around the ballscrew. MMT

CONTRIBUTOR

Robb Hudson is CEO of Mitsui Seiki USA, Inc.

FOR MORE INFORMATION

Mitsui Seiki USA, Inc. / 201-337-1300 / mitsuiseiki.com

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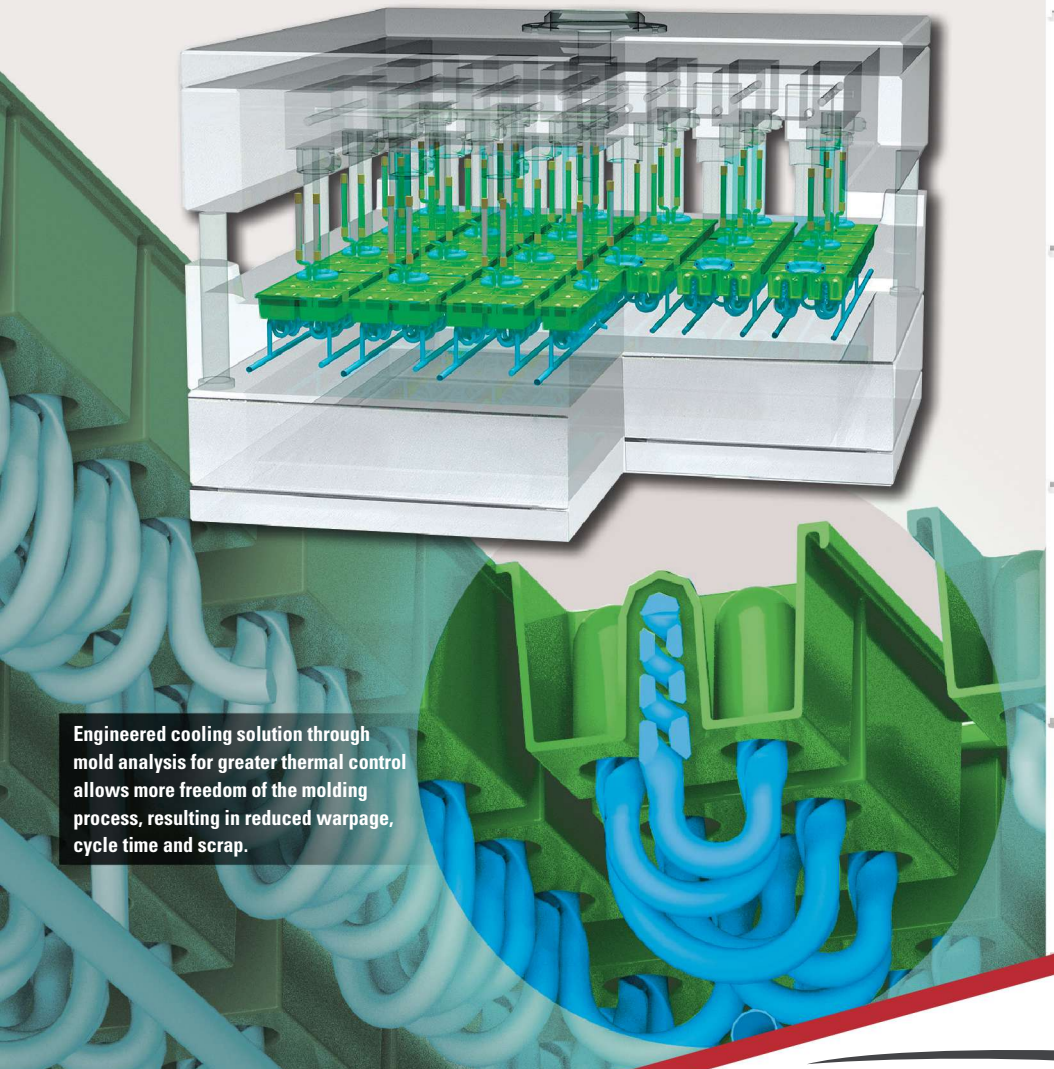

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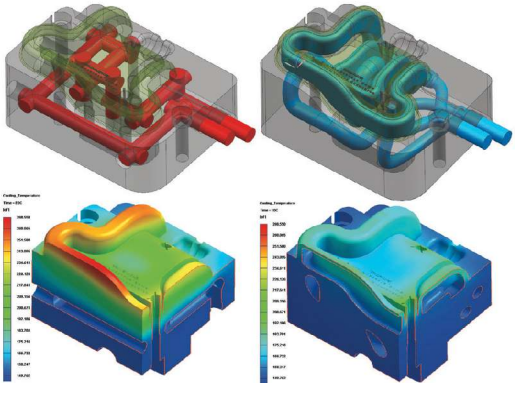

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