Modern Machine Shop

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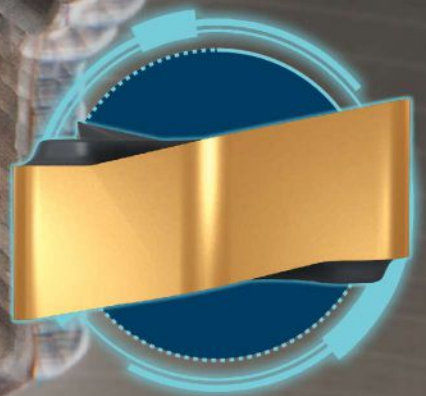

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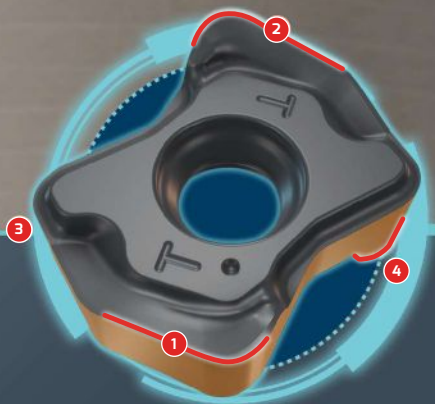

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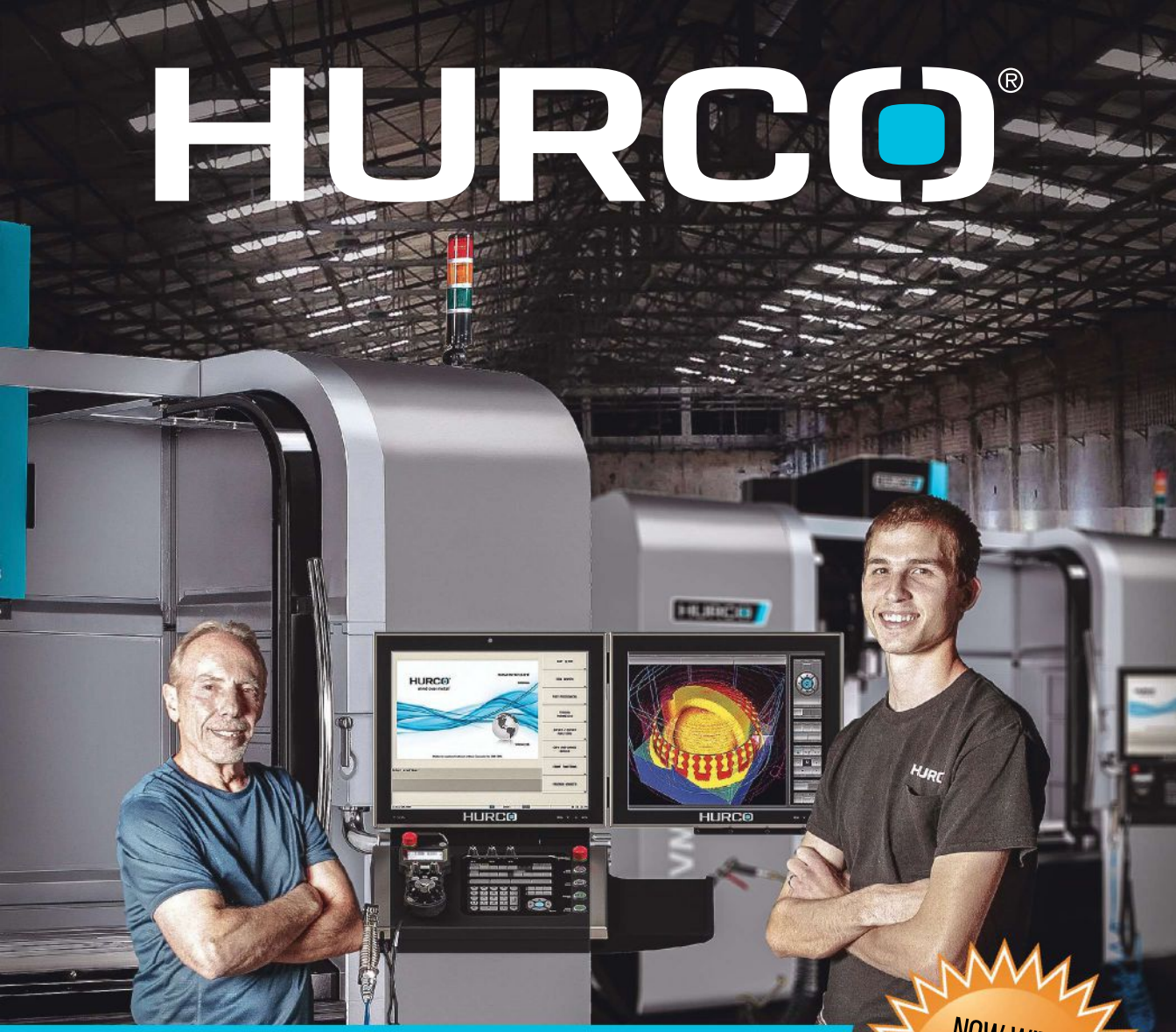

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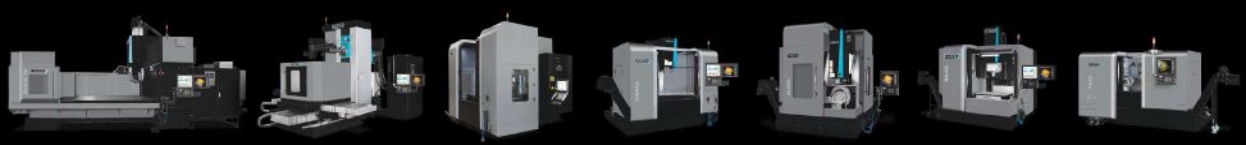

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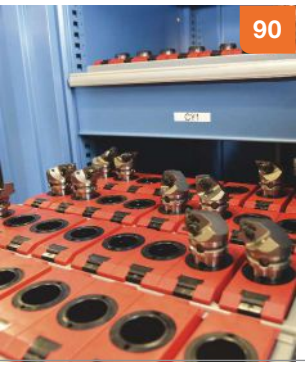

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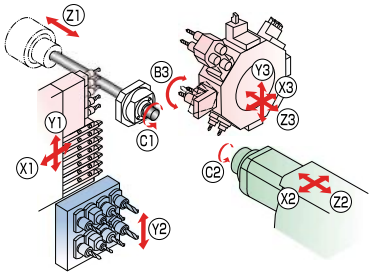

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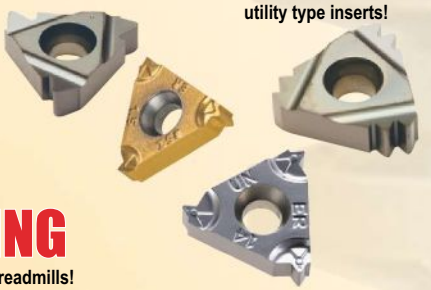

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At Amerimold, Editor-in-Chief Peter Zelinski checks in with Jingdiao North America. The machine tool maker also makes its own control and CAM software, all to realize a system tailored to precision die/mold machining. The result is precisely fitted components as-machined, no hand work required. gbm.media/showfloor

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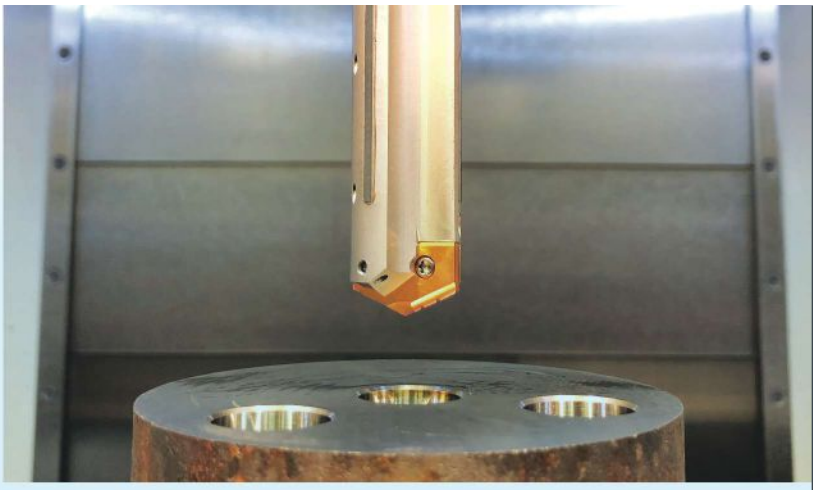

3 MIN.

VIDEO

Tips for Applying Replaceable-Tip Drills

The online version of last issue's deep-hole drilling feature from Matt Danford includes a video detailing how to make the most of replaceable-tip drills like Allied's T-A Stealth product. These deep-hole drills are said to create holes straight and smooth enough to make finishing tools unnecessary.

WATCH: gbm.media/drillrules

ADDITIONAL WEB EXTRAS

7 MIN.

VIDEO | Learn How to Read Machining Force Profiles

To the knowledgeable observer, force profiles can be useful for diagnosing the challenges of an application involving a difficult workpiece material or an unstable process.

WATCH: gbm.media/tsolve1

3 MIN.

VIDEO | Andretti Autosport Machinist Talks Workholding

Charlie Mitchell talks with Big Kaiser about using its Unilock zero-point pallets to turn his shop into a fast-paced operation in order to keep up with the last-minute turnover demands of racers.

WATCH: gbm.media/mitchell

12 MIN.

VIDEO | Solving the Skilled Labor Problem by Changing Culture

Westminster Tool used to have a skilled labor problem, but now it has a waiting list. What made this possible was a dramatic culture shift deliberately taken by the company's owner and founder. The results speak for themselves.

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How AI Will Influence CNC Machining

pzelinski@mmsonline.com

Peter Zelinski
EDITOR-IN-CHIEF
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A recent meeting of mathematicians and manufacturing experts focused on the promise of self-aware production.

At the University of North Carolina Charlotte (UNCC), I recently attended the debut of a new machining-related event where machining had to be explained to some attendees. The inaugural meeting of the Consortium for Self-Aware Machining and Metrology (CSAM) brought together manufacturing experts with mathematicians having little basic familiarity with machining operations, all with the goal of advancing the development of, in the words of meeting organizer Dr. Tony Schmitz, "production systems with the ability to know their own state and respond." In short, this was a conference focused on uniting machining with artificial intelligence (AI).

Of course, the manufacturing people in attendance needed basic instruction also. I was one of those. The hope of applying AI to manufacturing is still in its early stages, and one of the first steps is just to figure out what one might mean for the other. After absorbing the meeting's day and a half of expert presentations and roundtable discussions, here are the insights I took away:

WE WILL SKIP AHEAD 100 YEARS

How machine learning is allowing additive manufacturing to be mastered: gbm.media/aiam.

1. AI is not new, but it is current now because of large data sets and the power to process them.

Dr. Noel Greis of North Carolina State University explained this point. AI needs data. Today, we have not only increasingly cheap and effective sensors for gathering data, but also graphics processing units (GPUs) for rapid calculation. She says the origin moment for contemporary AI came in 2009, when a deep learning network (see next point) was trained using an Nvidia GPU.

2. In manufacturing, AI generally refers to machine learning; the current mainstream is deep learning.

Unlike automation, in which the response to any input is anticipated and programmed, machine learning involves automatically seeking patterns in data through large-scale calculation in order to self-select appropriate responses. Deep learning is a category of machine learning that goes, well, deeper. Machine learning parses data using algorithms that directly need human guidance. But deep learning structures algorithms in layers, creating a learning system in which the findings at one layer advance and improve the decision-making power of another layer.

3. Just the terminology is tough.

I watched PhD professors at the CSAM meeting struggle over whether they were correctly applying terms such as machine learning, deep learning and neural networks. As a result, I feel no shame if a mathematician says my definitions in the preceding paragraph fall short in some way.

4. A weakness of machine learning is its lack of explanatory power.

Machine learning finds correlations, not explanations, and correlation does not always imply cause and effect. Dr. Sambit Bhattacharya of Fayetteville State University explained how a potential vulnerability of machine learning is in the way it "makes spurious conclusions look deceptively good." Thus, Dr. Schmitz explained how the application of AI to machining research at UNCC has involved a hybrid approach in which programming based on the physical understanding of the system guides the data learning from the outset.

5. AI reveals the true nature of metrology.

We tend to think of measurement and inspection as the judge of the process, sizing up a feature to see whether it passes or fails. But metrology's greater power is in process control, not quality assurance. AI needs data, and metrology is the science of converting manufacturing events and outcomes into data. »

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6. With AI, we will discover cause-and-effect relationships we have never seen before.

This point is the flip side of point 4. AI cannot give us explanations, but it will reveal phenomena that deserve explanation. One realm in which I am aware that this is happening is additive manufacturing (AM). The variables affecting an additive build are numerous and the interrelationships among inputs and outputs are not well understood. As a result, machine learning is being used to more quickly discover the powers of different parameters. Correlations will be found and used in AM before they are explained.

7. AI allows experiments that would not otherwise be possible.

In a panel discussion, Dr. John Foltz of ATI Specialty Materials described the role of AI in materials development. Experimentation involving AI provides a way to, in a virtual sense, change one microstructure property to investigate the effect while holding all other properties constant. Physical reality provides no way to do this.

8. Big organizations have an advantage.

No one explicitly stated this point about AI, but it occurred to me as I listened to Dr. Jaydeep Karandikar of GE Global Research. He described the possibility of developing more sophisticated tool life predictions within GE by drawing information from every GE machined part. AI needs data, and big organizations potentially have a lot more data to marshal.

9. AI is an alternative to tribal knowledge.

Dr. Mike Vogler of Caterpillar sees promise in AI for workforce development. A wave of young new hires coming into manufacturing is producing a green workforce. In the absence of sufficient senior employees to guide them via tribal knowledge, he asks, "How do we augment the inexperienced worker?" AI is an answer, with its ability to learn and suggest correct responses in situations that otherwise might be too nuanced to be anticipated in formal programming or procedures.

10. Basic infrastructure is still needed.

What will it take to realize the full promise of AI in machining? A lot, but much of what is still needed is fundamental rather than elaborate. Dr. Foltz identified this. "We need the right sensors on machines to get us the data we need," he says. Similarly, he pointed to the need for graphical interfaces for AI systems so that these tools can be applied more easily instead of requiring coding.

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Will I See You at the Top Shops Conference?

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EXECUTIVE EDITOR
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Next month's event will present advanced machining and business concepts you can implement in your shop soon after returning home. Plus, I'll make it worth your while to bring someone else with you.

I'm excited about our third annual Top Shops Conference for a few reasons. First, the event, which runs September 9-11, will take place in my hometown of Cincinnati, Ohio, where I've lived my whole life. Second, I'm stoked that the speaker lineup will cover a range of timely and helpful topics. Third, I'm able to extend a $100 discount to each additional person from your shop who plans to attend the event with you.

The conference is a natural offshoot of our annual Top Shops benchmarking program. Its goal is to present practical yet advanced shopfloor and front-office ideas that shops can apply at their facilities soon after returning to help grow their businesses.

Use the promo code KORN during registration at topshopsevent.com to receive a $100 discount for each additional event attendee from your shop.

The event kicks off on Tuesday, September 9, with an opening reception where I hope you'll have a "pop" on us and network with some of your peers. The following day and a half include various keynotes, presentations and panel discussions with the entire audience on topics such as trends we've spotted over our nine Top Shops benchmarking surveys, data-driven manufacturing, additive manufacturing, workforce development and robotic automation. I will also moderate a discussion with representatives from this year's four Top Shops Honors Program winning companies (**highlighted on page 82**) to hear about strategies they have implemented to meet their various manufacturing challenges. There's a strong chance those are the same types of challenges you are facing in your own operation.

In addition, those days will include two concurrently running tracks from which to choose — one related to business/human resources practices and the other related to machining/shopfloor technology. That's why it's valuable to bring a colleague with you. For example, one of you can attend a presentation about the technical aspects of advanced five-axis machining while the other learns about more effective ways to estimate and quote jobs. Or, one of you can find out about the myriad ways to benefit from on-machine probing while the other hears about techniques for effectively marketing your shop. You can choose from among 18 such presentations.

Visit topshopsevent.com to see the entire conference schedule and register for the event, which will take place at the Duke Energy Convention Center in downtown Cincinnati. And if you can bring one or more other people from your shop, have them enter the promo code **KORN** when registering for each of them to receive a $100 discount. In addition to the conference sessions, registration includes a general Top Shops benchmarking report of 2019 survey findings, event presentation materials and access to the manufacturer's exhibit area. I hope to see you in Cincy.

TECHNOLOGY EYE CANDY

See what technology past Top Shops were eyeing at last year's event: gbm.media/panel.

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Grow with Your Data

Following a few basic principles can help shops get a return on their machine monitoring systems without losing faith first.

mdanford@mmsonline.com

Matt Danford
SENIOR EDITOR
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Machine monitoring technology can be easy to justify, but a shop can lose faith if it moves too fast through the early stages. "When you're blind to everything, the knee-jerk reaction is to want all the data, but it can become overwhelming," says Josh Davids, CEO of monitoring system developer Scytec. "People stop believing in the data, and the system becomes worthless."

Instead, he says CNC machining businesses should "grow with their data." That is, they should adopt a deliberately incremental approach, expanding their monitoring and analysis capabilities as they expand their understanding of what data to collect and what do with it. Based on a recent conversation with Mr. Davids, shops hoping to grow with their data should keep the following principles in mind:

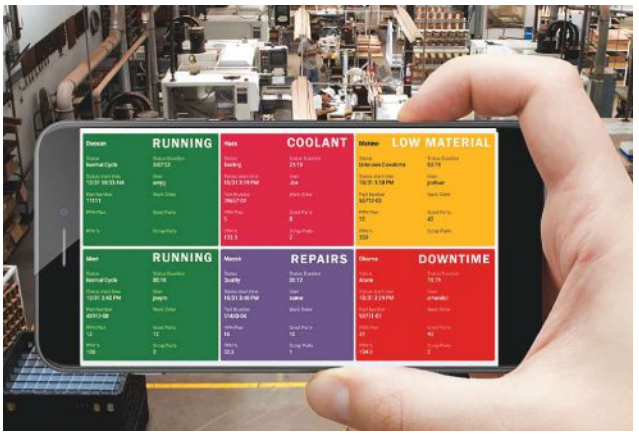
Words Matter

One important initial step is simply defining terms. For example, saying a machine is "in cycle" can mean different things in different contexts. For accounting purposes, all that matters is how long it takes to make a part. On the shop floor, however, considering the machine to be in cycle during a slight interruption like a tool change could mask improvement opportunities by making it difficult to evaluate the effects of any change in the process. There are also differences from shop to shop. For instance, counting tool changes as downtime might make more sense for a high-mix, low-volume shop than a high-production operation.

Depending on a shop's goals, using the wrong definitions can reduce the value of deeper data analytics. Consider overall equipment effectiveness (OEE), a metric that is widely considered one of the most valuable indicators of both machine and shop-wide performance. One of the three percentages that are multiplied together to calculate OEE is the amount of time a machine spends running at full capacity and capability. Whether tool changes factor into runtimes can affect not only the final OEE percentage, but also trust in the data. "If no one is on the same page about what downtime means, OEE is meaningless," Mr. Davids says.

Some Fruit Hangs Low

With a common framework of definitions and goals, shops can grow in their data use by taking advantage of simple value-adds like their machine monitoring system as a communication tool. These systems should eliminate discussions about, say, who was responsible for a part's delay in transit from machine tool to CMM, or a part sitting for an inordinate amount of time »



Utilizing information from a monitoring system like Scytec's DataXChange can inform valuable downstream analysis, but only with a common understanding of what the data represents and why.
Photo: Scytec

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after CMM inspection. Personnel should be checking off their portions of the job in a shopfloor interface. Such capability may be basic. However, making it work requires keeping everyone on the same page about what is being collected as well as making this sort of communication part of the daily routine, which can be a matter of culture.

Another initial recommendation is to focus on the yellow — that is, the graph color that typically indicates when a machine is neither in cycle (green) nor in need of attention (red). Efforts to eliminate the yellow always result in more green. Returning to the previous example, considering tool changes as "yellow" time facilitates the kinds of experiments required to make those changes faster. When process managers are satisfied, tool changes might return to the green zone. From there, shopfloor personnel could direct their attention to what remains of the yellow bands in machine utilization graphs.

Technology Isn't a Growth Barrier

Once a shop is ready to push machine monitoring capability beyond easy value-adds, decision-makers may find themselves discussing new and unfamiliar developments. However, things might not be as complicated as they seem.

Consider edge computing. Edge computing refers to analyzing data at the point where it is collected ("on the edge"). Such capability might be useful if, say, a shop wants to monitor M0 stop codes, but defense regulations prevent sending G code for sensitive parts to the cloud. In other cases, a shop might want its monitoring system to interface with enterprise resource planning software or other systems hosted locally.

Making this happen is not difficult, Mr. Davids says. Edge computing essentially means "on one's own computer," and modern PCs are more than capable of handling any number crunching a machine shop may require of an otherwise cloud-based monitoring system. The primary challenges of leveraging edge computing to grow with one's data are still largely about the basics: that is, interpreting the data, responding accordingly, and, perhaps most importantly, allowing sufficient time to evaluate results.

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The Motivated Workforce

Whatever your approach is to establish a motivated workforce, the end result can benefit your organization and its leadership.

WAYNE S. CHANESKI | COLUMNIST

A motivated workforce operates so effectively that things just get done. These employees have the desire, willingness and energy to produce at a high level without needing to be told what to do, how to do it, who should do what, when it needs to be done or what the end result should be. Organizations lucky enough to have a motivated workforce can do some pretty spectacular things time and time again.

There are two schools of thought about how to establish a motivated workforce. One is that you hire only motivated people. The other is that you can, and must, motivate employees. Both approaches make sense, and both present challenges for organizational leadership.

Hiring the Motivated

The approach of only hiring people who are already motivated requires expending a great deal of effort, and as much time as is necessary, to find the right people. As not every candidate fits into the "right people" category, the recruiting process can be a challenge. Too often, companies are under pressure to fill key positions quickly, which can lead to settling for a candidate who is less than ideal. If we pursue the path of only hiring motivated people, leaders must resist the temptation to settle. If they are not convinced that a candidate has the motivational characteristics being sought, leaders have to be willing to say "no" instead of trying to find ways to say "yes."

NO HIRING PROBLEM

A dramatic culture shift allowed this shop to change what it looks for in employees. Watch: gbm.media/emotionint.

So, when faced with the reality of time constraints, how can we be confident we are hiring the right motivated person who will be passionate about the job and willing to do whatever it takes to succeed? Certain interview questions can help in assessing someone's level of motivation, such as:

- Describe the work environment in which you are most effective.
- What career goals have you set? Which have you achieved?
- How do you define success in your current job?
- What have you seen that motivated some of your coworker's performance?
- What role does your boss play in your motivation?
- What have you done to stay motivated in your recent jobs?

Some say that the best candidates to fill a position are those who are already employed. Therefore, an organization's current recruiting process may need to be modified to ensure that it includes enough search activities to increase the pool of motivated candidates.

For sure, when you hire a motivated employee, the leadership role can focus on inspiring that employee and maintaining his or her high level of energy. With a motivated employee, there is little need for frequent follow up and discussions about accountability.

Motivating Employees

The approach of recognizing that employees can and must be motivated assumes that leaders can do just that. For some, this is second nature. However, not every leader is comfortable trying to motivate others, especially leaders who have come from a "only hire the motivated" environment. Motivating others requires effort, much of which is subsequent to the hiring process. »

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At times, leaders may inherit responsibility for areas of the organization consisting of talented, yet not well-motivated employees. As it would be impractical to replace all employees in such areas, a leader must strive to increase motivation within the group. While there have been hundreds of books written about how to motivate employees, one of my favorites, "100 Ways to Motivate Others" by Steve Chandler, offers some practical, proven techniques including:

- Be the cause, not the effect. What do we want to *cause* to happen today?
- Manage agreements, not people. Make agreements (commitments people make to you) on what needs to be done and manage performance of those agreements.
- Know your purpose. It does no good to do useless things well.
- Don't criticize upper management. It's just a "cop out."
- Score the performance. Find the right metrics and use them to show everyone how you are doing.
- Give up the need to be right and focus on achieving something.

Other actions leaders can take to motivate their workforce are:

- Stay positive. The way a leader behaves is reflected in how employees behave. If leaders are not positive, how can they expect their employees to be?
- Let employees make decisions. Only by making decisions will employees learn from their own successes and failures and become comfortable to make more decisions.
- Encourage collaboration. Employees who feel they are contributing to the organization in a meaningful way are likely to exhibit desire, willingness and energy.
- Be willing to try something different. This exposes employees to the effect that change can have, with the ultimate objective of making them more open to change and likely even promoting change in the future.

AUTHOR | Wayne S. Chaneski
President, Smart Manufacturing Solutions

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The Versatility of Snap Gages

The many design modifications available in snap gages enable them to measure some of the most difficult dimensions, right at the point of manufacture.

GEORGE SCHUETZ | COLUMNIST

Insert a workpiece into a snap gage and you will understand how these extremely effective, fairly simple tools for checking precision ODs got their name. You have to push deliberately to get the part past the leading edges of the anvils, but once you have overcome the gaging force, the part slips back against the backstop, contacting it with a good, healthy "snap."

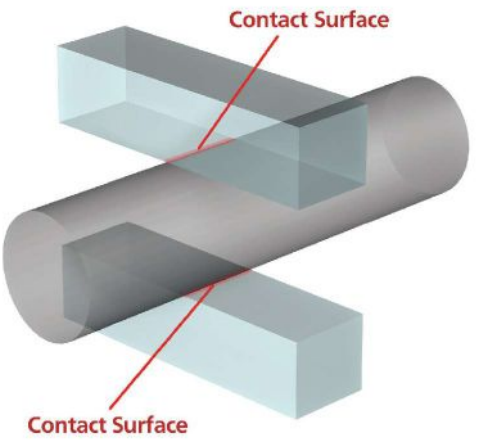
Snap gages are handheld to measure workpiece ODs on the machine, or they can be mounted on stands for use with small parts. The heart of the tool is a simple C-frame casting, and measurements rely on a direct, in-line, 1:1 transfer of motion. These factors make snap gages simple, robust, reliable and inexpensive.

The earliest snap gages of the fixed, or go/no-go, variety did the job well enough, and thousands are still in use. However, fixed gages did not provide the measurement data so often required for monitoring the manufacturing process. Adjustable snap gages incorporate a settable upper anvil with an indicating readout. Indicating snap gages are able to measure an indicator's limits of resolution, and because they are comparative gages (they read to zero), they give the user valuable information about machining process.

Before selecting and using an adjustable snap gage, users must decide what feature on the OD they are going to measure. This information is critical in deciding what type of anvils to use on the snap gage.

Two flat anvils are the most common style for adjustable snap gages. These anvils show the effective, or maximum, OD of the part being measured. Also, when looking for the effective size of a shaft that must mate with a bore, flat anvils are typically the answer. They will show the maximum OD without picking up surface depressions that, within limits, are not likely to matter. As a result, exploration of the shaft need not be complex.

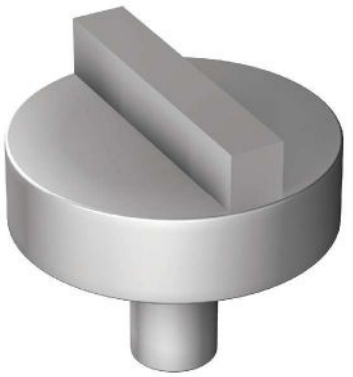
Snap gages with flat anvils provide other benefits as a result of the gage's line-to-line contact with the work (see diagram below).



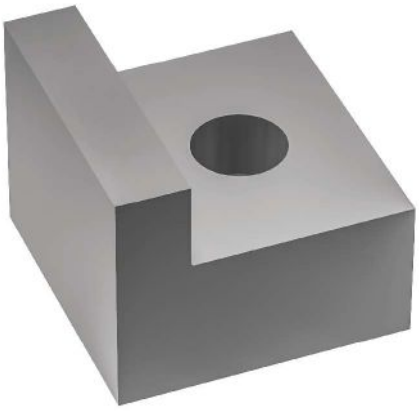
Flat anvil snap gages can produce reliable results with a relatively inexperienced operator since the two flat anvils tend to seat the gage positively on the work. The relatively large restoring force of the two flat anvils tends to overcome any tilt applied to the gage by the operator. While this seating ability becomes less as the work diameter increases, it is effective for the large majority of work sizes for which indicating snap gages are used. This is one of the key points in selecting a snap gage for use at the point of manufacture — ease of use and little operator influence result in more reliable measurement results.

When two flat anvils are used, backstop adjustment is not critical. As long as the work is located between the two broad measuring surfaces, a reading of the true diameter will be obtained.

Of course, only two flat anvils will measure right »



Anvils may be straddle-milled to provide two narrow rectangular measuring surfaces for gaging narrow grooves in shafts.



They can also be milled to provide similar measuring surfaces offset to one side of the anvils for checking grooves up against a shoulder.

next to a shoulder.

With a flat anvil snap gage, as with any other gage, there are fewer critical factors involved when you set the gage with a master the same shape as the workpiece. This establishes the same conditions of contact in both instances.

However, not all parts have long, continuous diameters. For this reason, a variety of snap anvils are available to broaden the scope of snap-gage applications. Above are just two examples of the many modifications possible in snap gaging.

AUTHOR | George Schuetz
Director of Precision Gages, Mahr Inc.

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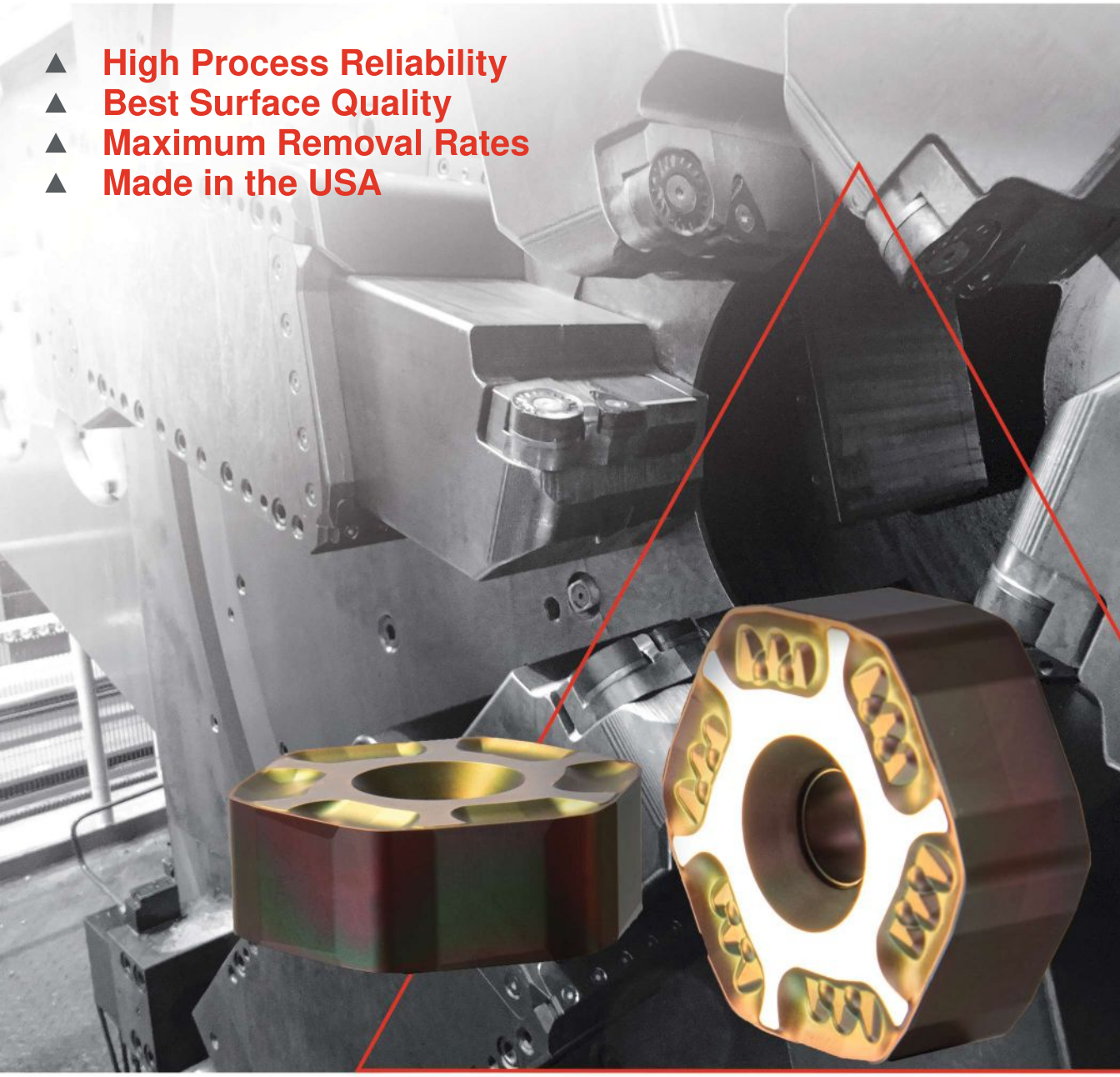

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7 CNC Parameters You Should Know

Parameters tell the CNC every little detail about the specific machine tool being used, and how all CNC features and functions are to be utilized.

MIKE LYNCH | COLUMNIST

Parameters specify settings for every CNC feature and function, and there are hundreds, even thousands, for any CNC. When discussing parameters, I always reiterate the importance of backing them up. As the person using the CNC, you are responsible for doing so. Today's CNCs make it easy to back up to a flash drive, so there is no excuse not to do so. Plus, having your parameter backup can save hours, if not days, in the case of a CNC failure.

Nearly every CNC-related issue involves a parameter setting. Indeed, if the machine is misbehaving in any way, it is likely that an erroneous parameter setting is to blame. There are certain parameters that every CNC user should know related to safety, efficiency and simplifying machine usage. My examples are for FANUC CNCs, but all CNCs have similar parameter settings.

1. Initialized states. Certain G-code modes are automatically instated when you power-on a machine tool. Absolute or incremental (G90/G91); inch or metric (G20/G21); rapid or linear motion (G00/G01); plane selection XY, XZ or YZ (G17/G18/G19); and feed per minute or feed per revolution (G94/G95), among others, are G-code modes that can can be specified through parameters.

Nearly every CNC-related issue involves a parameter setting.

2. Canned cycles. Most of these parameters control efficiency. For example, the machining center chip-breaking peck drilling cycle (G73) has a parameter that controls retract amount between pecks. The larger this value, the more time it will take to machine a hole. In similar fashion, the deep-hole pecking cycle has a parameter that controls the clearance amount between pecks. Also, the turning center multiple repetitive cycle for rough turning and boring (G71) has a parameter that controls how far the tool will retract (still feeding) between roughing passes.

3. Data entry. A parameter controls whether a value without a decimal point will be taken as a whole number or with fixed format. If set to a whole number, a coordinate value of 10 in the inch mode will be taken as 10 inches. In fixed-format mode, it will be taken as 0.0010 inch. This can affect program compatibility among machines and operator entries when making sizing adjustments. Another parameter sets the maximum size of a wear offset adjustment. Having this parameter set to 0.02 inch, for example, can help minimize operator entry mistakes.

4. Communications and file loading. Parameters control the methods by which programs can be transferred to and from the CNC as well as the device/media being used. Common choices include a flash drive, memory card, ethernet or serial port. Another parameter determines when the CNC will stop loading programs: at an end of program word (like M30) or the end-of-file delimiter (%).

5. Program protection. Parameters are available to keep specified programs from being modified, deleted and/or displayed. This lets you protect important programs, such as probing programs, sub-programs and custom macros. »

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6. User defined G and M codes. Parameters let you specify that a chosen G or M code (like G101 or M87) will execute pre-determined CNC programs. This is important when developing custom macros for canned-cycle applications. Another custom-macro-related parameter lets you control the behavior of single block when executing logic and arithmetic commands: skipping them or executing them one by one.

7. Inch-Metric conversion. A parameter controls what happens when you switch measurement system modes. With one choice, the CNC simply moves the decimal point to the right or left (no true conversion). A value of 10.0000 inches becomes 100.000 millimeters. With the other, all values, including axis positions and offset settings, are converted. A value of 10.0000 inches becomes 254.000 millimeters.

Finding a parameter in question

Knowing (or suspecting) that a parameter affects a given issue is just the beginning of correcting the issue. You must be able to find the parameter in question. Most CNC manufacturers document related parameters in a group, but since there are so many of them, it still can be difficult to find the one that is related to your particular issue.

While you can get a parameter list and start foraging through them, a better way is to consult the documentation (programming manual, operation manual, etc.) that describes the feature that is troubling you. For the peck-drilling cycle parameters, for instance, reference the G73 and G83 descriptions. You will find descriptions of all related parameters.

Programming parameter changes

The most common way to change parameter settings is to do so manually, using the display screen and MDI panel keyboard. But you can program changes for program-related parameters. With the G73 peck drilling retract amount for example, it may be necessary to use a setting of 0.005 inch for one cutting tool in a program and 0.010 inch for another. FANUC CNCs utilize the data setting command (G10) for this purpose.

AUTHOR | Mike Lynch
Founder and President, CNC Concepts Inc.

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How Vat Photopolymerization Started It All

This was the first additive manufacturing process to be successfully commercialized.

TIMOTHY W. SIMPSON | COLUMNIST

ASTM/ISO standards define seven basic additive manufacturing (AM) processes. Let's begin by looking at vat photopolymerization. This process was introduced to the market in the late 1980s by 3D Systems and called stereolithography, based on Chuck Hull's patent for the technology. Even though others had invented aspects of the technology earlier, Mr. Hull is credited by many as "The Father of 3D Printing" because he was the first to bring the technology to market. Thirty years later, he remains very active in the industry, serving as CTO for 3D Systems and deriving new AM technology from his initial patent application.

Vat photopolymerization uses a light source to activate a photopolymer, which is basically a liquid "goo" that hardens when hit by the right wavelength and intensity of light. Early systems had a large vat of liquid photopolymer (hence the name) that was selectively hardened by a laser layer-by-layer to form the part. Material advancements now enable digital light projection (DLP) systems — the same ones used to project movies on your wall from your computer — to initiate the cross-linking that hardens the polymers into a solid object. DLP systems are significantly faster than laser-based systems because you can solidify a whole layer at once versus waiting for the laser to trace and fill in the image in each layer. This is why newcomers like Carbon can additively manufacture soles for Adidas so quickly. Its patented Continuous Liquid Interface Production (CLIP) technology enables its systems to look like they are pulling a part out of a puddle just like you might see in a movie.

Vat photopolymerization's high resolution makes layering effects almost invisible, as seen in this side-by-side comparison of a Vortic watch case printed on a FormLabs Form2 (clear) and laser powder-bed fusion (metal). The vertical lines still remain, however, due to tesselation effects when converting from CAD to STL file format.

Where can you find this 30-year-old AM technology? It has become commonplace in quite a few places now. While Adidas is ramping up production of its FutureCraft 4D shoes via Carbon's AM platform, Invisalign has been using 3D Systems stereolithography machines to make molds for custom braces for decades. The company reportedly makes more than 320,000 parts per day, showing that AM technology can be scaled to higher volumes when there is a good business case. Not surprisingly, many dentists' offices are now buying and using vat photopolymerization systems to additively manufacture custom crowns, dentures, implants and more directly in their offices using Food and Drug Administration-approved AM materials. Meanwhile, companies like Sonova are using EnvisionTec's vat photopolymerization systems to additively manufacture custom hearing aids, transforming the hearing instrument industry thanks to AM's ability to produce custom parts on demand with very high resolution.

While 3D Systems, Carbon, EnvisionTec and others are chasing production-scale systems, companies like FormLabs have shifted the discussion to »

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the other end of the spectrum, namely, affordable desktop systems for everyday users. FormLabs launched on KickStarter, a crowd-funding website designed to help bring fledgling projects and a lot of start-ups to life, and quickly raised nearly $3 million. The company was inundated with orders, which led to numerous delays as it ramped up production, but the company ultimately succeed in bringing vat photopolymerization to desktops. The boxy amber-covered silver systems are becoming ubiquitous, and I find one in nearly every makerspace that I have visited. Meanwhile, FormLabs has continued to raise venture funding, develop new materials and launch improved systems. It recently introduced its third-generation system, the Form3, and is offering materials such as "Tough," which has all sorts of uses for tooling, fixtures and jigs in machine shops and on the factory floor. Recently, the company even partnered with Gillette for RazorMaker, allowing users to additively manufacture custom razor blade handles on their systems before being made available on-demand to other consumers.

AM 101

How CLIP works and how it's different from stereolithography: gbm.media/clip.

As the first additive manufacturing process, vat photopolymerization has come a long way the past three decades. It offers the highest resolution of many AM processes. In many parts, it is nearly impossible to see the layering or staircasing effects that plague other AM processes. Build volumes continue to get bigger, and the latest advancements in software and hardware, combined with new advancements in materials, have opened new avenues for commercialization and profitability. Producing consumer items such as braces, crowns, hearing aids, razor blade handles and soles for your running shoes, vat photopolymerization has shown us that AM is capable of scaling to volume production and making custom products on demand — and sometimes at the same time. How many manufacturing technologies can claim that distinction?

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Stay Positive Regarding Our Future Workforce

The future of machining relies on our success in attracting and retaining a skilled workforce.

THOMAS G. MARINI | CONTRIBUTOR

I'm certain everyone reading these words is well aware of the lack of qualified, skilled and productive employees in the workplace. You are dealing with that reality every day. The reasons are myriad. Blame the skills gap, the global economy, our school system or even millennials (I don't blame them) if you wish. We all have many stories involving new hires who can't seem to come to work every day or can't seem to run at rate. When they actually do make parts, they don't meet tolerance. We label these individuals with various negative descriptors. Some we call untrainable, others non-caring, and then there are the ones we simply call lazy. While it's obvious that these workers have a negative impact on productivity and quality, I'm seeing a more worrisome problem developing in machine shops. It's that owners like myself, general managers, lead people and frontline supervisors are becoming more jaded, cynical and skeptical toward potential job candidates and new hires.

We need to break the cycle of "doom and gloom." We can recognize that our industry is facing hiring challenges while taking steps to do something about it.

Trust me, I get it. The frustration has been building for some time now. Over the last two years, I've interviewed and hired more than 30 employees, many of whom showed hope and promise early on, but ultimately didn't work out. Shop leadership and long-term employees ask me why I don't just find "better workers," as though I am somehow avoiding good workers on purpose. I reply with, "We are hiring from the same talent pool as every other shop and doing the best we can." But are we? While everyday experiences seem to validate our frustration, our conversations are actually reinforcing it. Talks with our cutting tool salesperson, steel supplier and local machine tool dealer all revolve around the fact that it's impossible to find "good employees." We share our tales of woe, and they relay how they hear the same thing at every shop they visit.

We need to break this spiral of doom and gloom. I'm not asking everyone to suspend reality and pretend we are not facing some serious challenges, but I am asking that everyone begin to become engaged and take action in a way that may not have been necessary with past generations. Where we find employees, how we train them and the way we interact with them on a daily basis will require new ways of thinking. I include myself in this challenge.

Consider these few questions:

- Are you considering individuals who may not have taken the conventional path to a career in manufacturing? Someone with solid character, work ethic and attitude that you can train may end up as the better employee in the long run.
- Have you considered diverse candidates with backgrounds different than your own? Are you willing to embrace those individuals?
- Are you actively reaching out and engaging young people either by visiting your local schools or hosting student events at your workplace? »

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• Do you have a robust interview process that seeks to learn about the candidate and inform them about your business, the role they would play, as well as job expectations?

• Are you treating new hires as individuals? Do you and current employees show some level of understanding, caring and compassion toward them as they are trying to progress on the job?

• Do you have an onboarding plan to engage and connect with new employees?

• Do you have a robust training program? Are current team members who have been with you the longest sharing their knowledge and work experience, or do they see it as a waste of time, "since this person probably won't work out or listen to my advice anyway?"

• We all know how to give negative feedback. How much positive feedback is provided to new team members? Are you looking for the positive?

• Have you told your team how much the future depends on the ability to attract and retain new talent?

• Have you set up incentive programs that encourage current employees to grow and develop the next generation of workers?

We need to build future employees, because we are no longer able to take out a help wanted ad and "buy" them.

It's time for our industry to realize we need to build future employees, because we are no longer able to take out a help wanted ad and "buy" them. It may not seem like the ideal situation, but it is our reality. And, yes, it will involve effort and hard work. But since the future of machining relies on our success in attracting and retaining a skilled workforce, what other choice do we really have?

ABOUT THE CONTRIBUTOR

Tom is the president and CEO of Marini Manufacturing, which was founded in 1952 as a small machine shop and has since grown into a modern provider of precision-machined components and assemblies. More at marinimfg.com.

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Oerlikon partnered with a small aerospace startup based out of the UK called Lena Space to help the company use additive manufacturing to unlock new and efficient designs for key components of its systems, like this rocket nozzle. By 3D printing the nozzle, Lena was able to manufacture the entire nozzle as one piece while introducing regenerative cooling channels that would traditionally be brazed or welded, adding additional weight to the part.

A Dramatic Debut and Key Collaborations at the Paris Air Show

BRENT DONALDSON | SENIOR EDITOR

Soaring aerobatics, multi-billion-dollar deals and extensive displays of aerospace technology make the biennial Paris Air Show the aviation world's signature event. This year, 315,000 visitors — including 276 official delegates from 98 countries — took in 2,453 exhibitions and signed roughly $140 billion worth of contracts and letters of intent. While the rivalry between Boeing and Airbus typically dominates headlines at the show, that rivalry was clouded by recent headlines surrounding Boeing's 737 MAX after two recent crashes grounded the aircraft worldwide. While the two largest aerospace manufacturing companies in the world ended up securing a healthy $78 billion in orders — $34 billion for Boeing and $44 billion for Airbus — each was eclipsed by a record haul for GE Aviation. »

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GE Aviation Announces GE9X

On the show's opening day, David Joyce, GE Aviation's president and CEO, debuted the company's GE9X engine to a packed room in the company's pavilion near the Le Bourget airfield. The engine is a massive, high-bypass turbofan that boasts 304 additively manufactured parts integrated into seven multi-part structures. The GE9X — the largest, most fuel-efficient engine the company has ever produced — represents the first time the company has placed multiple additive manufacturing (AM) materials and modalities into production toward a single aviation application, creating what the company calls a first-of-its-kind industrialized aerospace supply chain for AM.

Oerlikon's Two Announcements

While the press releases and news announcements by aerospace manufacturers and suppliers flew fast and furious throughout the show, one company stood out for making two major announcements during the show's first 48 hours. Oerlikon, a multinational technology group widely known throughout the aerospace sector for its surface solutions, advanced materials and materials processing, announced a partnership with MT Aerospace that is ultimately aimed at accelerating the adoption of metal 3D printing. The following day, Safran, Oerlikon, the French National Center for Scientific Research and the University of Limoges announced the creation in Limoges of a joint research laboratory, Protheis, and a technology platform, Safir — two complementary organizations specialized in surface treatments for aerospace applications.

On the second day of the show, I sat down with Dan Johns, Oerlikon AM's chief technology officer, who talked about the value the company places on partnerships such as these, especially in the AM arena. (Oerlikon AM is the additive manufacturing division of the company.) Case in point: Oerlikon's partnership with a small aerospace startup based out of the UK called Lena Space. Lena develops aerospace technology with an eye toward end-to-end »

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rocket propulsion systems for launch vehicles that could bring satellites or other payloads into orbit. With Oerlikon AM's assistance, the company used additive manufacturing to unlock new and efficient designs for key components of its systems, like its rocket nozzle. By 3D printing the nozzle, Lena was able to manufacture the entire nozzle as one piece while introducing regenerative cooling channels that would traditionally be brazed or welded, adding additional weight to the part.

| International Paris Air Show | siae.fr/en

NTMA Partners with Blockchain Supply Chain Firm

SyncFab, a manufacturing blockchain provider for parts suppliers and buyers, has announced a strategic partnership with the National Tooling and Machining Association (NTMA). The new relationship will grant access to SyncFab's advanced manufacturing blockchain platform for over 1,300 NTMA members across the United States.

SyncFab uses blockchained "smart contracts" and data-driven methods to optimize the external supply chain available to OEM buyers. New users will be able to build from an extensive parts library where all previously ordered parts are available for reorder. The system allows for the commercial procurement of manufactured parts backed by the security and speed that blockchain is said to offer. Orders are secure, instant, and streamlined, the company says.

Buyers reward manufacturers for quotes and manufacturers reward buyers for reorders, says SyncFab. Small, local manufacturers are said to be placed on a level playing field against large firms, since no quotes get special treatment within the network. In addition, SyncFab's platform captures partner information to offer time-sensitive status updates and data related to the production process and supply chain planning.

"The goals of our partnership are to better understand the availability and capabilities of suppliers, integrate them with our blockchain solution, improve »

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- Tailstock travel: 6.5"
- Tailstock barrel diameter: 3"
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- Diametral pitches: (21) 8 to 44 DP
- Longitudinal feed range: 0.0015" to 0.04"
- Cross feed range: 0.00075" to 0.02
- Spindle motor: 15 HP, TEFC induction
- Voltage/Amps: 440V, 3-Phase
- Coolant motor: 1/8 HP, TEFC induction
- Approximate shipping weight: 5952 lbs.

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SB1047F $24,500 $3,400 shipping

14" X 40" GUNSMITHING GEARHEAD LATHE

- Motor: 2 HP, 220V, single-phase, 10 Amps, 60 Hz, 1725 RPM
- Swing over bed: 14"
- Swing over gap: 19¾"
- Swing over cross slide: 8 13/16"
- Distance between centers: 40"
- Spindle bore: 1.57" (40mm)
- Spindle nose: D1-5 camlock
- Spindle nose taper: MT#5
- Cross slide travel: 6 1/16"
- Width of bed: 7⅜"
- Approx. shipping weight: 1550 lbs.

G0709 ~~$5795.00~~ SALE $4995.00 $299 shipping

9" X 48" HIGH PRECISION VARIABLE-SPEED VERTICAL MILL

- Motor: 3 HP, 220V, 3-phase, 8.5 Amps
- Motor RPM: 1725 • Power transfer: Cogged belt
- Spindle taper: R-8 • Spindle travel: 5"
- Table size: 9" x 48" • Table travel (longitudinal): 29"
- Table travel (cross): 12" • Knee travel (vertical): 16"
- Tram travel: 13" • Ram swivel: 360°
- Max. dist. spindle to table: 18"
- Head swivel: 90° left & right
- T-slots: 3 on 2½" centers, ⅝" wide • Spindle speeds: Variable • Range of speeds: 60–5000 RPM
- Table size: 10" x 50" x 4⅛" • Base footprint: 26" x 24"
- Approximate shipping weight: 2352 lbs.

G0667X ~~$9950.00~~ SALE $8750.00 $395 shipping

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- Cutting capacities: 90° round 11 13/16", 90° rectangular 11 13/16" x 14"
- Floor-to-table height: 27"
- Machine dimensions: 83"L x 43"W x 55"H
- Base footprint: 56" x 28"
- Weight: 1800 lbs.

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- Swing over cross slide: 10"
- Dist. between centers: 40"
- Spindle nose: D1-6 camlock
- Spindle nose taper: MT#6
- Spindle bore: 2.0625"
- Tailstock barrel taper: MT#4
- Tailstock barrel travel: 4¾"
- Cross slide travel: 8½"
- Compound travel: 5½"
- Number of spindle speeds: 16
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- Distance between centers: 40"
- Swing over gap: 20.94"
- Swing over saddle: 12"
- Spindle bore: 1.57" (40mm)
- Spindle nose taper: MT#5
- Spindle nose: D1-5 camlock
- Cross slide travel: 7"
- Spindle speeds: 116, 50–2570 RPM
- Bed width: 13¾"
- Range of threads (metric): 39 @ 0.2–14mm
- Approximate shipping weight: 2684 lbs.

G0740 ~~$12,995.00~~ SALE $10,397 $375 shipping

18" X 60" LATHE 440V

- Spindle motor: 10 HP, 3-phase, 440V
- Coolant motor: 1/8 HP
- Swing over bed: 18.11"
- Swing over gap: 27.95"
- Distance between centers: 60"
- Spindle bore: 3.125"
- Spindle nose: D1-8 camlock
- Spindle taper: MT #7
- Cross slide travel: 11"
- Compound travel: 5.39"
- Carriage travel: 79"
- Inch threads: (38) 2 to 72 TPI
- Spindle speeds:Variable from 18 to 1800 RPM
- Approximate shipping weight: 5424 lbs.

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security and capacity utilization, and provide a more seamless experience with OEM purchasing departments that need to plan for contingencies in their supply chain," says Jeremy Goodwin, SyncFab's founding CEO.

"We are really excited about our new partnership with SyncFab. Access to SyncFab's advanced manufacturing blockchain platform is a great advantage for our members," says Doug DeRose, interim president of NTMA. "With an extensive parts library and fast, easy and secure reordering, blockchain technology can make a huge impact on supply chain management for NTMA members."

National Tooling and Machining Association
800-248-6862 | ntma.org
SyncFab | 310-957-5200 | syncfab.com

Yamazaki Mazak's Leadership Transitions on 100th Anniversary

In a transition of leadership, Yamazaki Mazak's current president, Tomohisa Yamazaki, has become the company's chairman while Takashi Yamazaki, formerly vice president, has been named the new president. This change coincides with the company's 100th anniversary.

During a press conference in Nagoya, Japan, Takashi Yamazaki described the approach he would bring as president: "Many evaluate the company's virtue with the revenue figure, but I won't be just pursuing that. With 100 years of company history, we would like to continue providing customers in the world greater technologies and better products."

Takashi Yamazaki will continue to act as the vice chairman of the Japanese Machine Tool Builders' Association (JMTBA) and stated that he "will stay involved in making decisions regarding medium and long-term plans and support the new leadership from a broader perspective."

Prior to joining Yamazaki Mazak in 1990, Takashi Yamazaki earned his bachelor's degree in business from Xavier University, in Ohio. He became a managing director in 1999 and vice president in 2013. In his remarks to reporters, he »

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discussed the company's role in an increasingly globalized manufacturing market and his plan for promoting new technologies and products to further strengthen the company's legacy.

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Protolabs Moving into Production-Level Additive Manufacturing Work

Protolabs has launched production capabilities for its metal 3D printing service. The new capabilities use secondary processes to improve the strength, dimensional accuracy and cosmetic appearance of metal parts. As part of the launch, enhanced inspection reporting is also being made available.

"We see it every day. The designers and engineers we work with in industries like aerospace and medtech are choosing additive manufacturing for complex components in high-requirement applications," says Greg Thompson, global product manager for 3D printing. "These new production capabilities help them optimize their designs to enhance performance, reduce costs and consolidate supply chains, and do so much faster than ever before."

Protolabs uses direct metal laser sintering (DMLS) technology (which is ISO 9001 and AS9100D certified) to 3D print metal production parts. Once parts are built, several secondary options like post-process machining, tapping, reaming and heat treatments are available, along with quality control measures like powder analysis, material traceability and process validation.

The production launch spotlights Protolabs' effort to advance in industrial 3D printing beyond prototyping. The company has joined GE's Additive Manufacturing Network and MIT's Additive Manufacturing Consortium to facilitate this push. The company has also added capacity to support its growth with more than 25 GE Additive Concept Laser Mlab and M2 machines for DMLS production.

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Methods Machine Tools Opens Precision Test Cut Facility

Methods Machine Tools' new Precision Center in Massachusetts is said to be the first of its kind in North America for precision machining. The test cut center will enable Methods' customers to arrive at accurate and efficient machining solutions for complex components, saving them trial and error in their operations.

Designed and built by Methods, the center offers a climate-controlled environment that monitors and maintains temperature, air pressure and humidity. To maintain environmental stability, the Precision Center features a secured airlock entrance and exit. The building also has meter-deep isolation pads with vertical and horizontal steel reinforcements for machining stability.

"North American manufacturers can send parts, tooling and material to our Precision Center without having to go outside the country. Intricate, challenging, tight-tolerance and confidential test parts can be made right here in the U.S.," says Jerry Rex, president and CEO.

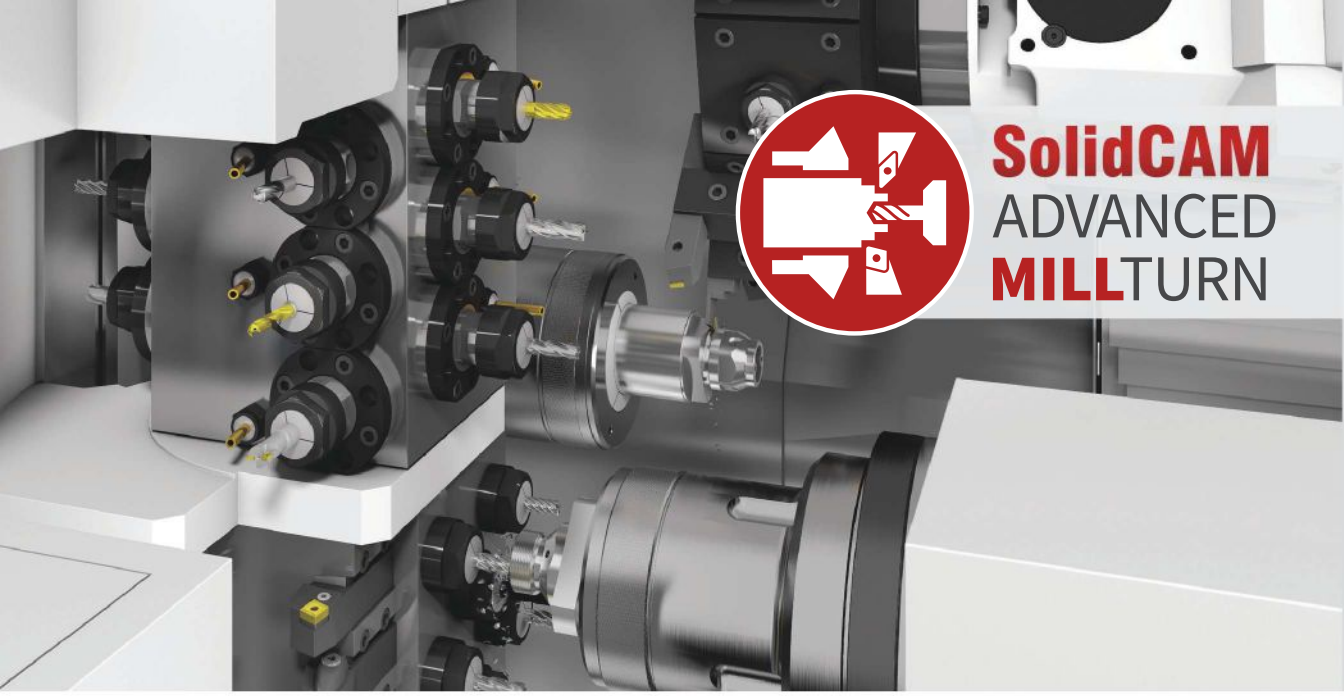
Methods Machine Tools Inc. | 877-668-4262 methodsmachine.com

Heidenhain Opens TNC-CNC Academy

Heidenhain has opened its TNC-CNC Academy in the Chicago area. The expanded CNC training center is available for users of all levels, including those interested in five-axis machining. All classes are taught by Heidenhain specialists with years of CAM experience.

The company states that completing these classes will allow TNC users to improve their efficiency and the accuracy of the parts they machine by going beyond the standard features and functions provided by a CAM postprocessor. The academy offers service classes for service teams to practice troubleshooting and repairs of Heidenhain components on real machine tools, including practice on five-axis high precision machining centers equipped with spindle speeds of up to 42,000 rpm.

Heidenhain Corp. 800-233-0388 heidenhain.us



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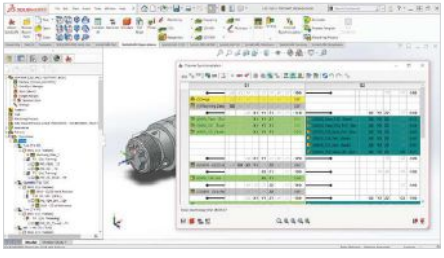

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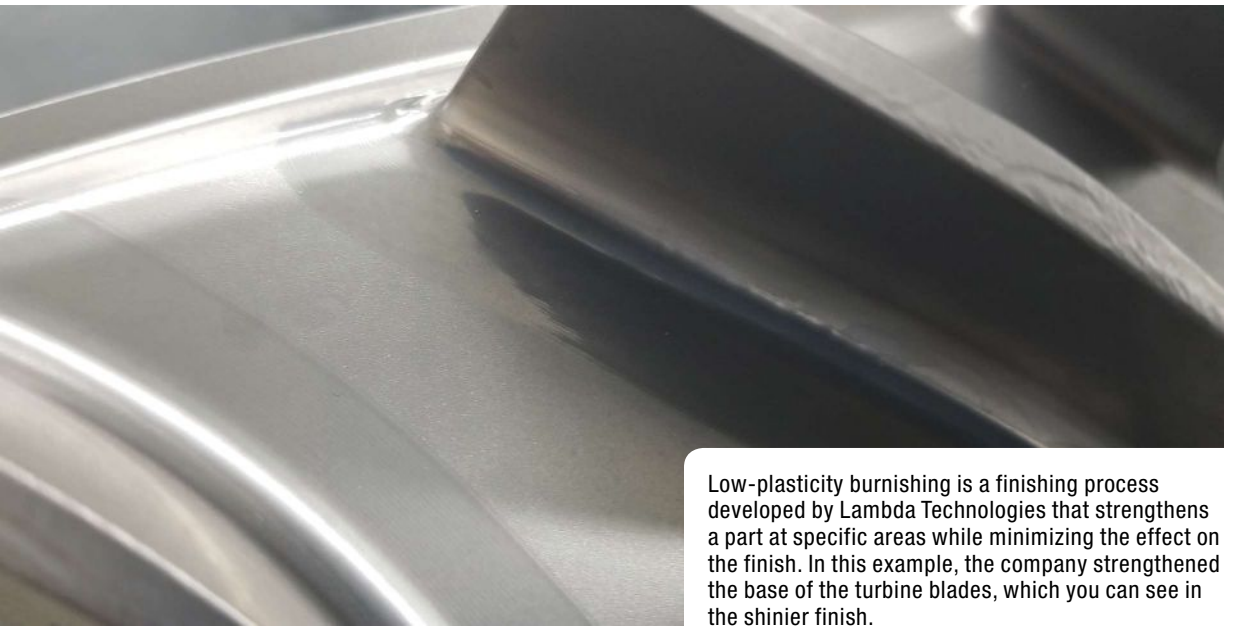
When Metal Feels Under Pressure (In a Good Way)

Lambda Technologies' low-plasticity burnishing process strengthens machined metal parts to extend product lifespans without compromising part geometry.

ELI PLASKETT | ASSISTANT EDITOR



Low-plasticity burnishing is a finishing process developed by Lambda Technologies that strengthens a part at specific areas while minimizing the effect on the finish. In this example, the company strengthened the base of the turbine blades, which you can see in the shinier finish.

At first glance, the machine shop in the back of Lambda Technologies, a Cincinnati-based manufacturing company, seems pretty average. It has a suite of vertical machining centers (VMCs) whirring away as workers busily hop from station to station. Compared to most shops, however, it's relatively quiet. That's because the majority of the VMCs are not actually cutting material.

For those, the buzzing of cutting tools slicing into metal is replaced by the comparatively subdued whirring of hydraulics. A sharp eye might also notice that the controls for those

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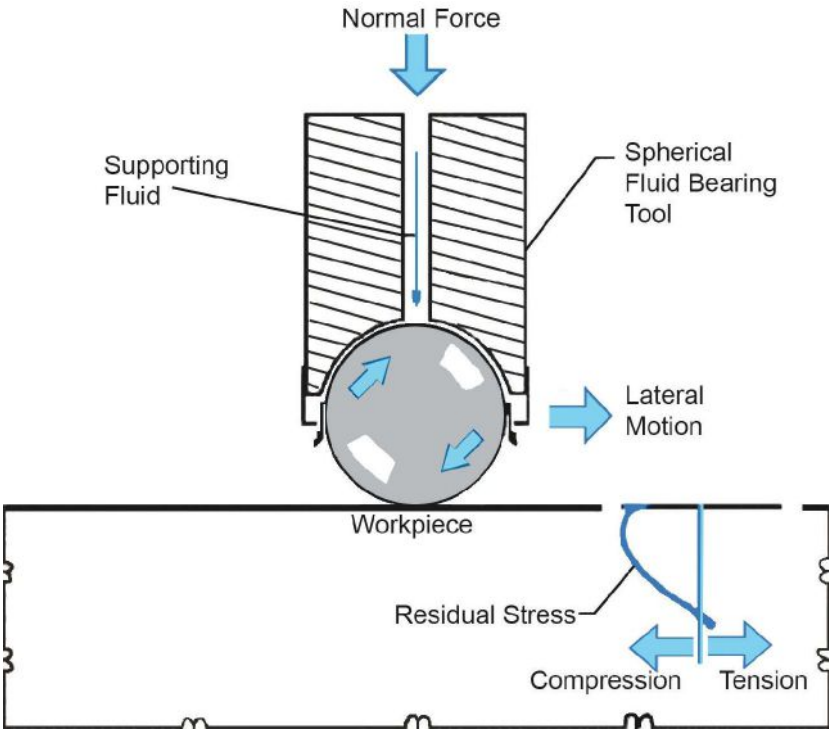

This diagram shows the hydrostatic roller-burnishing tool. This tool provides just enough pressure to exceed the workpiece material yield point at the proper amount for effective burnishing.

machines bear none of the logos of major CNC manufacturers. They, like the hydraulic pumps attached to the modified five-axis machines, are custom designs the company has developed over the years for the signature metal-finishing process it offers customers: low-plasticity burnishing (LPB).

LPB is a burnishing process in which the pressure applied to the workpiece using a hydrostatic roller-bearing tool of Lambda's own design just exceeds the material's yield point. The process requires extensive metallurgical knowledge in addition to precise control of burnishing tool positioning and pressure. Maintaining this expertise has enabled Lambda to significantly lengthen the working life of parts without significantly altering the shape or tolerance of the part. While not a new process, LPB has proven its effectiveness over recent years, even achieving Federal Aviation Administration (FAA) acceptance for repair and alteration of commerrcial aircraft components.

And this all came about from a trip to Disney World.

An Origin Story

According to Lambda Operations Manager Michael Prevéy, the idea behind the company's surface treatment system was born during a family trip to Disney World in the '90s. Looking across the lake in the center of Epcot, his father, the company's CEO and Director of Engineering Paul Prevéy, saw the geodesic dome of Spaceship Earth sticking up over the water. From that image, he conceived and developed the idea of his hydrostatic burnishing tool.

The elder Mr. Prevéy co-founded the company as Lambda Research Group in 1977 with Professor B. D. Cullity, an expert in the industrial use of X-ray technology. It initially specialized in material testing using X-ray diffraction and other technologies, focusing largely on measuring residual stress in metals and ceramics. In the late '90s, Mr. Prevéy began developing surface treatment solutions based on the company's institutional knowledge about material stresses.

The diagram above shows the hydrostatic roller-burnishing tool, which enables a high degree of control over the process. This tool enables the

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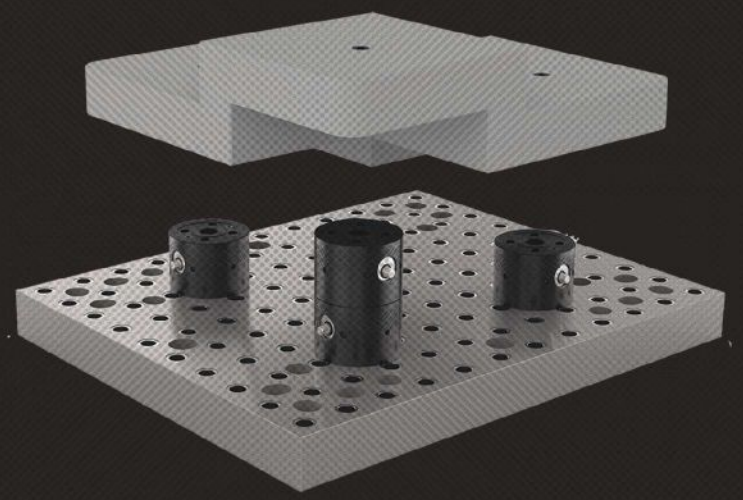

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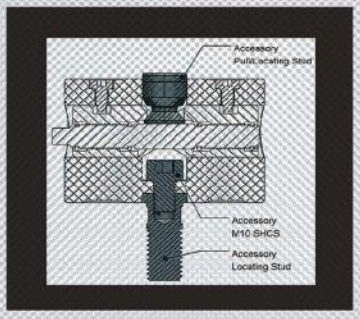

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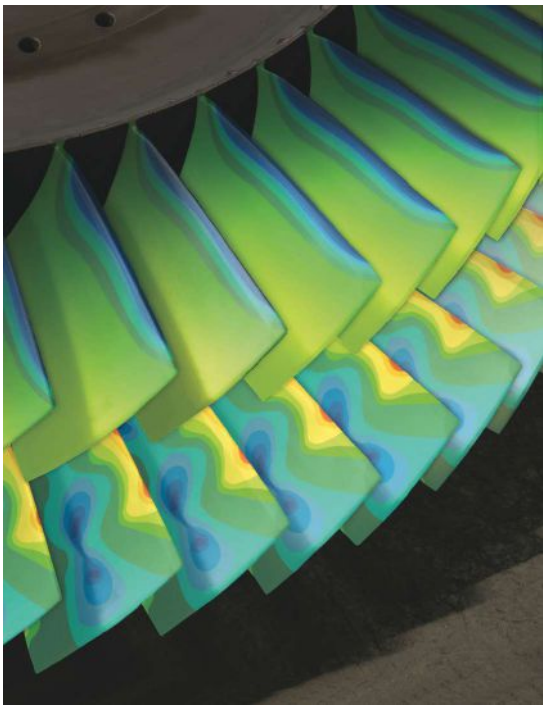
company to apply just enough pressure to exceed the yield point at which the material deforms plastically.

The burnishing tool envisioned that day at Disney is a hydrostatic roller burnisher design. Coolant is pumped through the machine tool's spindle and into the tool to hold the roller bearing in place using an in-house hydraulic system and custom toolholder. The company says consistent pressure maintaining the position of the bearing enables the process to achieve high burnishing precision. After developing the LPB process, the elder Mr. Pevéy then formed a second division, Surface Enhancement Technologies, in order to implement it. Through this division, Lambda contracts with other companies to perform LPB operations on parts in addition to selling and leasing burnishing tools to those customers who have high enough part volumes to make dedicating a machine tool to burnishing economical.

So far, Disney has not demanded royalties.

So far.



Every job Lambda takes on involves a complete analysis of the material and stresses. Pictured here is an FEA of a turbine, which enables the company to identify points of high stress.

Pressure, Pushing Down on Steel

The "plasticity" in "low-plasticity burnishing" refers to plastic deformation. Let's have a quick physics lesson: Deformation refers to changes in the shape of an object under pressure. Solid objects are capable of both elastic and plastic deformation, with the object reverting to its original shape under elastic deformation and losing its original shape under plastic deformation.

Materials will spring back into shape unless the applied pressure is great enough to cross the threshold or yield point into plastic deformation.

Like other burnishing processes, LPB strengthens a part by compressing a layer of metal so that it resists fatigue, preventing cracks from forming deeper in the part. Thanks to the precision provided by the company's hydrostatic roller-burnishing tool, it is able to apply just enough pressure to slightly exceed the yield point by an appropriate amount.

By exercising this degree of control, the tool avoids breaking the material's crystal lattices. This is important because broken crystal lattices, which can be caused by other surface treatment operations such as shot peening, can revert back to normal when exposed to high temperatures, losing the benefits of the surface treatment. In addition, the burnishing tool is designed to work with any CNC-controlled machine, including robots, machining centers, lathes and even five-axis machine tools. This enables the company to strengthen parts with complex, contoured geometry at their weakest points.

Testing Your Metal for Its Mettle

Developing an LPB process for a given application requires a keen understanding of the material. Dr. N. Jayaraman, who has degrees in metallurgical engineering and physics, contracts with Lambda as its materials expert. "The goal of LPB is to sculpt the residual stresses in the part to prevent cracks from being able to form," he says. "To do this effectively, one must know the yield point of any material one works with." Because the company dedicates resources to understanding the material properties of many alloys, it can burnish a variety of metals, including difficult-to-machine metals like titanium and Inconel.

According to Michael Prevéy, understanding stress is vital in approaching a burnishing application. "The compression we produce creates an equilibrating tension in the rest of the part," he says. "This means that the stress we introduce is spread out evenly through the volume of the

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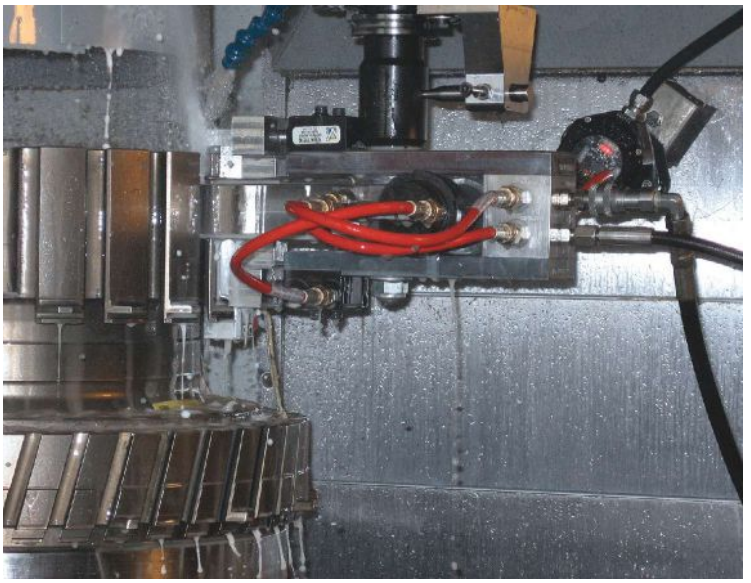
non-compressed areas." With stress spreading out, the greater volume the part, the less concentrated the stress is in the underlayer. Conversely, the stress does not spread out as much in smaller parts.

To understand the stresses of the part, Lambda performs finite element analysis (FEA). "We perform a full scan and FEA of the part," Mr. Prevéy says. "Using that, we can look at the magnitude and locations of part stresses to understand where burnishing will do the most good." Going even further, Mr. Prevéy says the company can sculpt the stress patterns in the part, assisted by the multi-axis capabilities of the burnishing process. By mapping the stresses in three dimensions, the company says it can lengthen the life of many parts by a factor of 1,000.

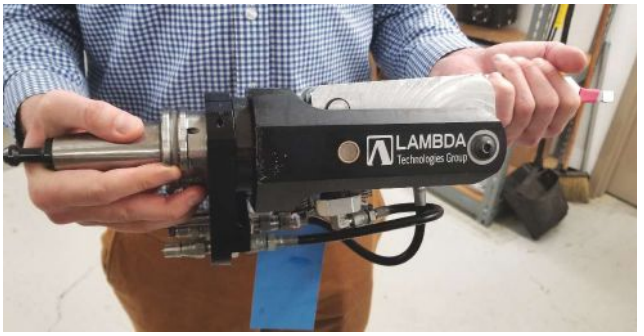


Lambda treats the LPC1 vanes in the Pegasus engines of U.S. Marine Corps' AV-8B Harrier jets. To strengthen the airfoil along the inborn trailing edge, the company developed a burnishing tool that hooks around the airfoil, with the ball bearing facing sideways from the toolholder.

Customized Solutions for Improving Product Life

While Lambda sells and leases its LPB tools, it usually performs the burnishing operations for customers itself on its modified VMCs. It uses presetters and touch probes during setup to maintain accuracy and reliability, and it has developed its own custom toolchangers to meet customer needs for certain complex parts, designed around the need to connect the tool to the hydraulic system. As the LPB process requires only positioning and pressure, the company is not limited to simple geometries, and it can perform both wet and dry applications depending on the application.

The tool consists of a customized tip that contains the roller bearing and a body that plugs directly into the toolholder and hydraulic system. The hydraulic tubes run through the body to run fluid to the tip, which can be customized by hooking it or extending it to fit into difficult-to-reach geometries. The coolant holds the bearing in place regardless of the angle of the tip or pressure necessary for burnishing. During the burnishing process, the bearing rolls freely, while the hydraulic pressure keeps it from shifting its position.



The tool consists of a body that plugs directly into the toolholder and a customized tip that contains the roller bearing. The hydraulic system channels fluid through the body and into the tip, holding the roller bearing in place.

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The company uses a suite of VMCs both to produce its burnishing tool and to perform burnishing operations. According to Operations Manager Michael Prevéy, performing burnishing on five-axis machines enables Lambda to treat almost any part geometry.

Lambda machines many of its LPB tool components on a suite of Haas VMCs located near the modified burnishing machines. Many of the tools it produces are customized to specific applications, such as those that treat the first stage low-pressure compressor (LPC1) vanes for the Pegasus engines that power the U.S. Marine Corps' AV-8B Harrier jets. To strengthen the LPC1 airfoils along the inboard trailing edge, the company developed a burnishing tool that hooks backward, with the ball bearing facing back toward the toolholder. This design enables the tool to reach behind the flared edges of the airfoil.

"Every job we do requires custom work," Mr. Prevéy says. "We analyze the material, then test its stresses. After that, we plan burnishing passes that strengthen it at precisely the points necessary, and that might mean designing a custom tool or workholding to reach those points." The results, however, speak loudly, Mr. Prevéy says. "The last time a part we treated broke during a fatigue test, a turbine snapped at a completely different area than the customer was worried about," he says. "Apparently, the part had never lasted long enough for cracks to form in that location before."

Achieving FAA Certification With Practical Demonstrations

The LPB process now has AMoC certification from the FAA. The company earned this certification in 2013 after Delta Air Lines contacted it when the costs of maintaining its MD-88 main landing gear began to stack up. Vibrational stress over time had caused cracks to form in many of the MD-88 shock-strut cylinders. While Delta had retrofitted the landing gear with damping systems to avoid future cracks from forming, ensuring the existing cracks did not cause operational failures took a great deal of time and money. Further, replacing the cylinders would have cost more than $80,000 apiece. With many units in the field, the costs were prohibitive.

Lambda worked with an FAA Designated Engineering Representative to provide and test the LPB treatment for the MD-88 cylinders. During testing, Lambda met or exceeded the goals set by the FAA, and the company designed a robotic system to process the landing gear cylinders without removing them from aircraft. This performance earned the process an AMoC certification, and Delta contracted Lambda to treat the shock-strut cylinders. According to Lambda, Delta saved more than $10 million in inspection costs, not including the potential costs of flight delays and part replacements.

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Electropolishing Demands a Plan

Manufacturers considering this non-contact finishing process should expect test runs and close collaboration with service providers before production begins.

EDITED BY **MATT DANFORD** | SENIOR EDITOR

A surgical drill bit before and after electropolishing.

Electric current often outperforms physical media in fine finishing operations. However, CNC machine shops considering electropolishing must be careful to ensure metal parts retain sufficient levels of stock.

According to Chicago-area service provider Able Electropolishing, this non-contact, fine-finishing process generally removes between 0.0005 and 0.001 inch of material. How much depends on a manufacturer's goals, which might range from achieving a certain roughness average (Ra) value, a shiny finish, micro-burr removal, to passivation for improved resistance to corrosion, contaminants or fatigue. Manufacturers should also keep in mind that electropolishing material removal can be controlled to within 0.0001 to 0.0002 inch. Adding this range to machining tolerances can provide a general indication of how much stock to leave after machining.

However, achieving the desired result requires

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Electropolishing by the Numbers	
0.0005" to 0.001"	EP material removal range
±0.0001" to ±0.0002"	EP material removal tolerance
32 – 4 Ra	Achievable EP'ed surface finish
50%	Maximum Ra improvement before surface erodes
0.001", 0.0015"	EP material removal for 50% boost in stainless, carbon steels

thinking deeper than these general guidelines. Other considerations include:

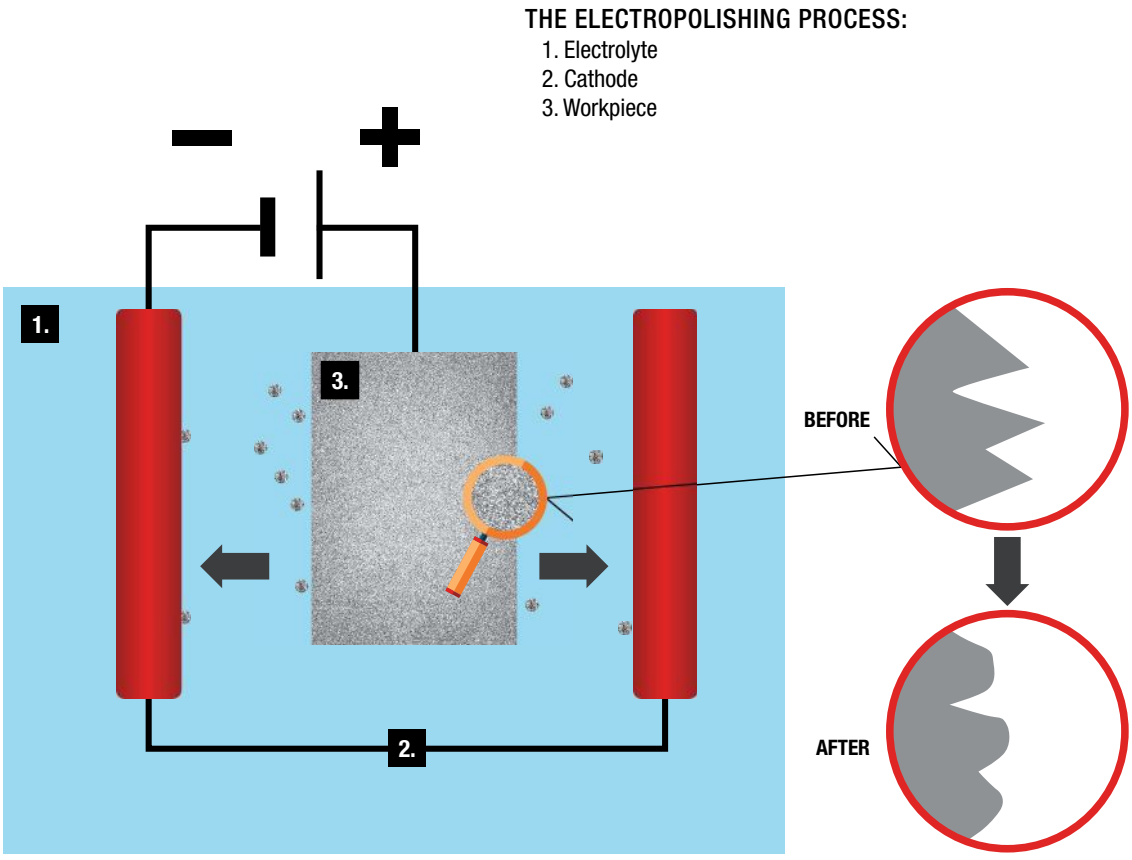
Machining Specifications

Electropolishing service providers must understand which areas of a part require the most precision because electropolishing is an indiscriminate material remover. Racks of workpieces, positively charged to serve as anodes, are bathed in an electrolyte solution along with negatively charged cathodes. DC current flowing from anode to cathode draws minute fragments of material away from all part surfaces at once. Depending on geometry and other part characteristics, current density at any given point on the surface can vary. As a result, some areas of the rack-mounted parts can shed more material than others. Designing fixtures that ensure uniform current density and avoid leaving critical features undersized — the true art of electropolishing — requires pre-production sampling.

Material

Pre-production sampling is also critical for revealing how different alloy formulations react to the process. Alloys suitable for electropolishing include aluminum formulations, brass, copper materials, carbon steel, stainless steel, titanium, and nickel- and tungsten-based metals. Generally, alloys require removing more stock than non-alloys to achieve the desired result, but precise levels depend heavily on the specifics of the material formulation. For instance, a failed salt-spray corrosion-resistance test after sampling might lead a manufacturer to choose an alternative composition.

A vegetable peeler blade before and after electropolishing.



Desired Surface Characteristics

To say that electropolishing provides a "smooth, shiny surface" would be accurate, but it is important to distinguish between those two terms. Electropolishing's effect on a part's shininess, or brightness, is affected primarily by the material's chromium-to-iron ratio. However, a part can appear shiny without being smooth. Ra, a common a measure of smoothness, is defined by the average distance between the microscopic peaks and valleys that constitute all surfaces. Electropolishing creates a leveling effect (thus reducing Ra and making the surface smoother) by shaving the peaks. The slower and more controlled the process, the smoother the resulting surface. However, not all shiny parts must be smooth. Manufacturers must be clear about their goals from the outset.

Stock Level Limits

Generally, the more stock removed, the better the results of electropolishing, but only to a certain point. Once a surface's peaks have been shaved away, the current begins to cut into valleys as well. The surface begins to erode and become rougher rather than smoother.

What does this mean for CNC machine shops? The smoother the part is prior to finishing, the better the result that can be achieved with electropolishing. For example, according to the 50% guideline in the chart above, 16 Ra is the best possible result with a part that has been machined to 32 Ra. If specifications call for 8 Ra, the part would have to be ground, or undergo some other finishing process, to achieve at least 16 Ra first.

VIDEO PRIMER

View a quick presentation on the basics of electropolishing: gbm.media/ep.

Based on an article by Scott Potter, vice president of sales at Able Electropolishing Co.

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The Emco Mecof PowerMill represents a $3.4 million investment by Baker Industries to expand its capacity to serve OEM and Tier-One customers' largest machining projects, typically for the aerospace and automotive sectors. The entire installation took more than two years.

MEET COLOSSUS:

An Inside Look at One of the Largest Five-Axis Machining Centers in the U.S.

My behind-the-scenes tour on the shop floor of Baker Industries began and ended with its Emco Mecof PowerMill, one of the biggest five-axis machining centers in the United States. The tour also shed light on the company's highly aggressive approach to new equipment purchases.

BRENT DONALDSON | SENIOR EDITOR

By the time your company invests $3.4 million and 11 months to dig a 45-by-75-by-7-foot pit, fills it with crushed stone and concrete, and tops that with a massive five-axis machine, it is more than likely your operation has experience machining extremely large parts.

That is certainly the case for Baker Industries, a subcontract manufacturer that primarily serves the OEM and Tier-One aerospace and automotive sectors. Baker Industries is located on a vast industrial campus housing several complexes in the Detroit suburb of Macomb, Michigan. And inside one nondescript building on the corner of campus you'll find a true metal giant — a five-axis vertical machining center with a work table large enough to double as a car pad for a fleet of full-size SUVs.

Baker Industries' newest and biggest machine is the Emco Mecof PowerMill, an investment that has expanded the company's capacity to serve its customers' largest machining projects. The installation process was necessarily complex, starting with the removal of 1.2 million pounds of concrete and earth to excavate the gargantuan pit. Each truckload of the nearly 2 million pounds of crushed stone and concrete had to be individually sampled by inspectors to ensure it was the right consistency — an extra precaution for a

Installation of the PowerMill began with the removal of 1.2 million pounds of concrete and earth to excavate this 45-by-75-by-7-foot pit. Each truckload of the nearly 2 million pounds of crushed stone and concrete had to be individually sampled by inspectors to ensure it was the right consistency — an extra precaution for a reinforced foundation that has to remain stable beneath an overhead gantry that alone weighs more than 100,000 pounds. The PowerMill's table has a load capacity of 2.6 million pounds.

reinforced foundation that has to remain stable beneath an overhead gantry that alone weighs more than 100,000 pounds. The bridge and columns of the PowerMill seem to travel effortlessly along a 52-by-20-by-10-foot XYZ work envelope.

There is a reason that Baker Industries is one of the only companies in the U.S. that has invested in a machine of this size, and that reason has everything to do with experience. Before the company brought the PowerMill online, it had already been operating a 32-foot horizontal five-axis Emco EcoMill as well as a handful of Breton five-axis machines that measure up to 27 feet along the X axis. As Baker Industries program engineer Jerry Kablak pointed out during my recent visit to the company, maintaining a tolerance of two-thousandths of an inch for a part that measures 30 feet or longer involves more than just scalability. It involves extensive training and the incremental knowledge that comes with years of experience with uniquely complex setups and programming. Here is how that experience became evident during my visit, when the PowerMill was in the final machining stages of a large aerostructure component that was more than 40 feet long.

GROWING PAINS

Scalability trumps the traditional goal of simply boosting employee headcount: gbm.media/scale.

Setting the Stage

The first thing you notice on Baker Industries' sprawling campus, where nearly 300 employees work across five facilities and 250,000 square feet of space, is the security measures that have been put in place. As Mr. Kablak explains, these measures extend not only for the employees' safety, but also for the company's data and equipment. Each of the five buildings on campus is accessible only to certain employees, which is not unusual. But while walking through the

building that houses most of its machining centers, it is hard not to notice that most of the make and model numbers of the machines have been covered with Baker Industries' own logos — an extra layer of information security to guard against prying eyes.

When walking through this building, you can almost see an evolution in size and scope taking place among company's 35 CNC machines, from smaller vertical three-axis mills, to the (much) larger Breton five-axis machines, to the massive Emco EcoMill. But, situated between a massive American flag and a giant *Modern Machine Shop* "Top Shops" banner (the company won the award in 2018), the PowerMill looms above them all, its footprint occupying nearly half of the building that houses it.

The PowerMill's table has a load capacity of 2.6 million pounds, much greater than the weight of the eight aluminum workpiece plates that stretched across it 40 feet from end-to-end during my visit. When finished, these plates will be assembled together to form a layup mold for an aerostructure component, although no one at Baker Industries was willing to say exactly what the final component was destined to become.

For all of the mass that the PowerMill represents, the machining center giant can achieve almost shocking precision, able to maintain total error of less than 42 microns along its entire 46-foot-long X axis. This is largely due to the laser trackers that are positioned on the gantry's two columns. These trackers can be used to help fine-tune the setup process, then continuously scan the workpiece during machining to ensure accuracy is maintained from beginning to end.

Programming the PowerMill is all the more complex when you consider not only the automated tool changing that the machine is capable of, but also the four separate, interchangeable cutting heads that can be utilized for different operations. These heads are powered by spindle motors that reach up to 18,000 rpm, which enable the machine to handle roughing to semi-finishing to finishing all in one setup. Of course, these capabilities make proper setup all the more vital. As Mr. Kablak told me, locking down the proper setup procedure was one of the biggest learning curves for Baker Industries' larger machining centers. "Even at a smaller scale when you have smaller machines, the same issues are there," he said. "So on a machine like the PowerMill, you can imagine how all of those issues are amplified."

Of course, the nature of the work that requires a machine like the PowerMill is much more likely to be for one-off or low-volume parts, which means that there is no cookie-cutter setup procedure that Baker's machine operators can rely on. Before the company had the PowerMill and EcoMill in place, Mr. Kablak says that he and his colleagues had gained years of experience machining large parts by creating multiple setups for the workpieces,

Four different interchangeable cutting heads powered by spindle motors that reach up to 18,000 rpm enable the machine to handle operations from roughing to finishing all in one setup. The open structure of the overhead gantry enables the spindle to travel 46 feet in the X axis, 20 feet in the Y axis and nearly 10 feet in the Z axis.

Baker Industries was one of *Modern Machine Shop's* 2018 Top Shops winners in the machining technology category. This huge banner hangs proudly behind the PowerMill.

flipping them over and ultimately passing them through the open doors of smaller machining centers.

Baker Industries' general manager Bill Ednie told me that the workpieces being machined on the PowerMill during my visit required more than a week to set up, as well as a lot of forethought about how to ensure that each plate was properly stress-relieved to reduce the risk of warpage before machining operations began. The vacuum grooves on each of the eight plates had already been machined, and the final step before inspection began was to drill the holes that the customer would use to lock the pieces into place for molding operations.

Of course, even though Baker Industries is one of the few companies in the United States to have a machining center of this size, that doesn't mean there will be year-round production needs for parts large enough to take advantage of its size. As Kablak colorfully puts it, the company invested in this monster of a machine, and it needs to be fed. The question then becomes: How do you make sure it does not go hungry? The answer is creativity.

Build It and They Will Come

Here is one example of creative thinking that helps keep the PowerMill fed and its spindles turning. Before the end of my visit, Mr. Ednie pointed out an attachment for the PowerMill that took advantage of Baker Industries' in-house 3D printing capabilities. The company began investing in additive manufacturing (AM) technologies in 2014, and today has seven 3D printers, most of which are Stratasys fused deposition modeling (FDM) machines for plastics, in addition to two EOS direct metal laser sintering (DMLS) machines.

> **"Our first five-axis mill was of modest size and then from there they kind of slowly built up. We never had jobs that were promised to us if we had the (larger) equipment."**

The attachment is a right-angle bracket for a cutting head that contains internal channels for air-cooling passages. By shooting air directly onto the attachment and the workpiece, Mr. Ednie says the cutting head can operate for hundreds of hours on end.

But Mr. Kablak says that the primary method of keeping up with the appetite of a machine like the PowerMill is to set up multiple jobs on its table at once — or to machine a part on one end of the table while setting up another job on the other end. "And I don't mean very small workpieces," he says,

"but things that could potentially fit on a 10- or 20-foot table. We can put three or four of those on this machine, and as we're laser checking while setting up one job, we can be machining since there's so much room there. Feeding the machine has definitely been a challenge, but there is always a way to overcome that challenge." He estimates that this solution accounts for as much as 20% to 30% of the PowerMill's work.

Like the gradually expanding size of the machining centers owned by Baker Industries, the growth of the business itself — from its co-founding by brothers Scott and Kevin Baker as Baker Duplicating in 1992 to the operation it is today — has been incremental. (Note that Baker Industries was acquired by Lincoln Electric this year.) The company did not purchase the PowerMill because of the promises of any single potential customer. Mr. Kablak says that, once the company went public with the news about its investment in this machine, the requests for quotes soon followed — especially with automotive and aerospace customers that require large parts.

"Our first five-axis mill was of modest size," he says, "and then from there, the machine sizes kind of slowly built up. We never had jobs that were promised to us if we had the larger equipment. That never happened. When we make these kinds of investments, we put the word out and wait to get a return on that investment with increased workloads. A lot of it comes down to, if you make the investment, the work somehow does find you."

Still, Mr. Kablak says, he would encourage any company with the capacity to invest in large equipment like the PowerMill to explore the opportunity to diversify its scope of work. The key is to have a core set of customers before making any decisions. "If you're really, really deep in with one customer and then make a big investment like this, if that customer doesn't come through, it could sink you," he says. "So my advice is to have your business plan together, make sure you are diversified with multiple customers, and make sure the opportunities are out there. And then I would say just go for it."

Baker Industries | 586-286-4900
bakerindustriesinc.com

Emco Corp. | 248-313-2700
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Baker Industries' additive manufacturing (AM) center. The company began investing in AM technologies in 2014, and today has seven 3D printers, most of which are Stratasys fused deposition modeling (FDM) machines for plastics, in addition to two EOS direct metal laser sintering (DMLS) machines.

What's Telling About This Year's Top Shops

Here, the 2019 Honors Program winners explain strategies they've used to help them become successful U.S. machining businesses. Plus, you can learn more about them by attending next month's Top Shops Conference.

DEREK KORN | EXECUTIVE EDITOR

After each Top Shops benchmarking survey, I examine what we establish as the top 20% benchmarking group in order to choose an Honors Program winner for each of the four survey categories. I comb through survey responses, websites, blogs, social media channels and other resources that indicate a shop's strength in a particular category before chatting with them to learn more. Here are the winners for our ninth annual survey:

- **MACHINING TECHNOLOGY:**
  STRATON INDUSTRIES (straton.com)
  Stratford, Connecticut
- **SHOPFLOOR PRACTICES:**
  METALQUEST (metalquest.net)
  Hebron, Nebraska
- **BUSINESS STRATEGIES:**
  ACECO PRECISION MANUFACTURING (acecoprecision.com) Boise, Idaho
- **HUMAN RESOURCES:**
  SDP/SI (designatronics.com)
  Hicksville, New York

While each of these companies certainly excel in their respective categories (as you'll read in this article), all of them are also strong in other areas of their businesses. (They are "Top Shops" after all.) For example, Straton has a wealth of in-house machining and manufacturing capabilities to be a "one-stop" shop for customers, but it also has a robust training program. MetalQuest is a leading adopter of data-driven manufacturing and robotic automation, but it also works closely with area trade schools to help develop the next generation of manufacturing talent. AceCo established an employee stock ownership program (ESOP), which spurs its employees — all company owners — to continuously think about ways to improve the organization, but it also has developed competency in highly accurate machining for the semiconductor industry. SDP/SI (Stock Drive Products/Sterling Instrument) has made great strides to break silos and improve communication between employees, but it also has adopted collaborative robotics and 3D printing.

Therein lies the benefit of attending our Top Shops Conference (topshopsevent.com) September 9-11 in Cincinnati: You have the opportunity to learn firsthand from these shops. Part of the program is a panel discussion that I will moderate featuring representatives from each of these four shops. (See the sidebar on page 86 for more event information.) This has been a popular feature of past conferences. Not only will it enable you to hear more about their strategies, strengths, challenges and issues, but also it will give you the opportunity to ask questions. The following gives you a taste of what they might discuss — tactics that have led them to succeed and grow as leading U.S. machining businesses.

COMPLEX PARTS FAST

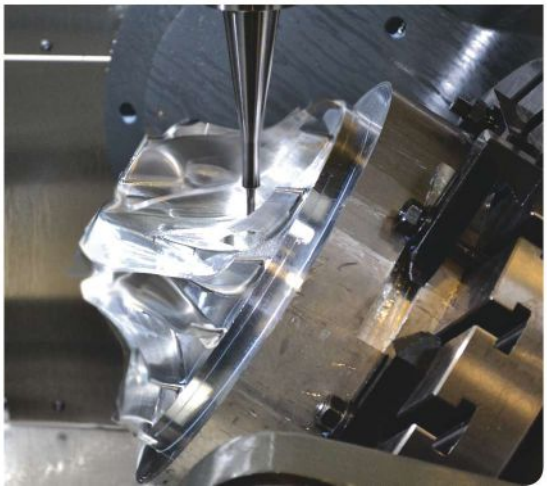
That's **STRATON INDUSTRIES**' business strategy in three words, says David Cremin, company president.

Founded in 1961, Straton has a wealth of machining and manufacturing capabilities. "We have a big array of precision equipment because we want to be a one-stop shop for our big customers, many of which are in the aerospace industry," Mr. Cremin explains. "This helps us maintain control over all aspects of a customer's work in house. That's how we achieve the speed to turn challenging jobs in short order."

Straton, which is ITAR registered, certified to ISO 9001:2015 and AS9100D, and is a Federal Aviation Administration-certified repair station for helicopter and fixed-wing aircraft components, updates its technology annually. The shop invested $1 million last year in new machine tools and supporting software and is close to investing at that level this year. "We read what our customers are looking for and needing machining-wise," Mr. Cremin says. "We also buy according where we feel pressure to add to our already extensive manufacturing capabilities."

To that end, the shop is not married to any one machine tool brand. "We look for specific equipment characteristics we can capitalize on," Mr. Cremin explains. "Having a mix of machines and capabilities is important to being flexible

Honors Program winners in the Top Shops benchmarking program tend to have sophisticated shopfloor equipment and processes as well as programs to spur employee growth. Photo: MetalQuest



TOP: Straton has a range of ancillary capabilities such as stamping, engraving, welding and heat-treating capabilities as well as an array of inspection equipment.

BOTTOM: The shop invested $1 million last year in new machine tools and supporting software and is close to investing at that level this year. Photos: Straton Industries

and accommodating. Because this can present challenges for our shopfloor employees, though, we try to stick to FANUC controls and use SolidWorks and Mastercam for part design and programming throughout. That makes having a machine mix doable."

Straton's equipment list includes HMCs; five-axis machines; wire and sinker EDMs; jig, surface and cylindrical grinders; and VTLs to 46-inch-diameter capacity. The shop also has stamping, engraving, welding and heat-treating capabilities as well as an array of inspection equipment. It is currently considering adding a horizontal boring mill, sensing opportunities for that type of work, and likely will purchase a larger VTL at some point soon.

At least a half dozen of its machines have spindle touch probes. Straton has started retrofitting machines that were not purchased with probes, and new machines it purchases are often ordered with probes. They are primarily used to speed and simplify setups and perform in-process measurements. "As an experiment a few years ago, we ran the same job on two machines, one with a probe and one without," Mr. Cremin says. "The machine with the probe turned that job significantly faster than the other, so that sold us on this technology."

The shop also has a large-format 3D plastic printer that it chiefly uses during the quoting process for new jobs. "Looking at a CAD file of a complex part is one thing, but it's another to actually hold a part in your hands and study it," Mr. Cremin explains. "It helps our machinists and inspectors determine optimal ways to approach the job, design fixtures and so on."

Mr. Cremin says the shop discovers new technology from a few different sources. One is trade publications such as *Modern Machine Shop*. Another is industry trade shows including IMTS and Eastec. The shop also visits its customers to see what equipment they are using or considering. "Ultimately, we ask 'Does this make sense for us?' when evaluating new technology," Mr. Cremin notes. "If we feel it does, there's a good chance we'll pull the trigger on it."

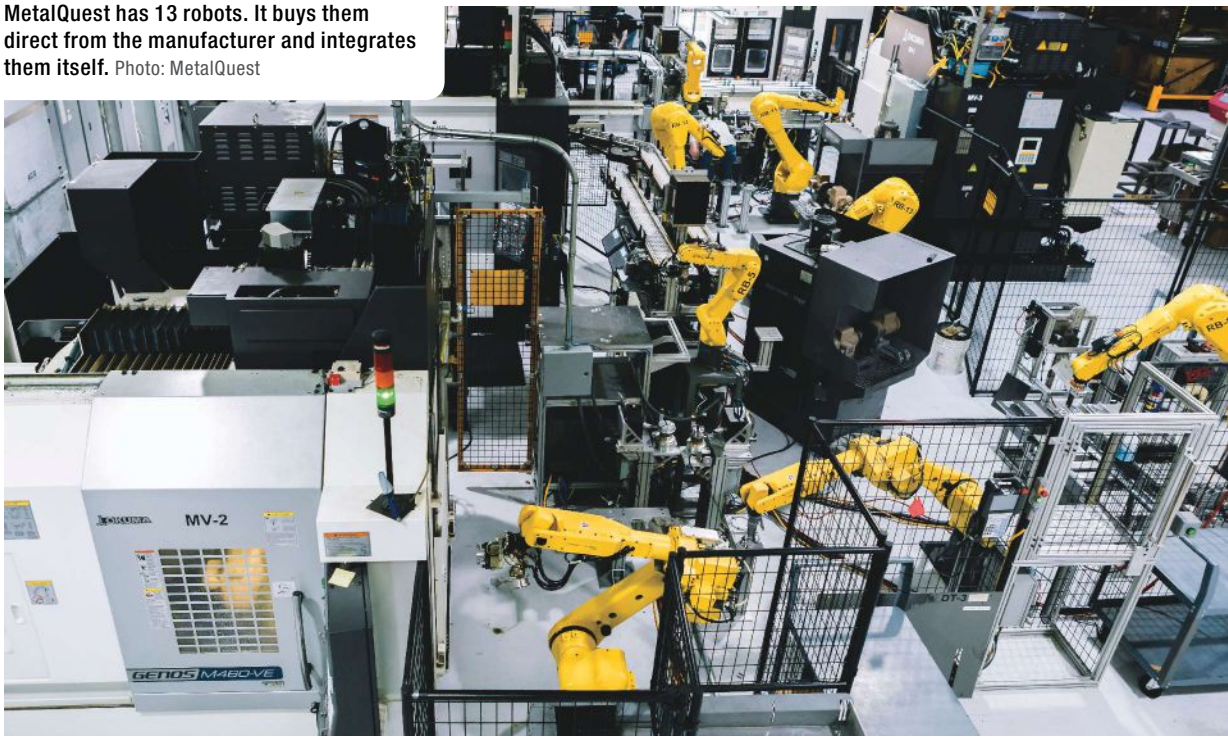
Do You Know How Much Cardboard You Have?

After a quick scan of the custom manufacturing software Scott Volk developed at **METALQUEST**, the shop's VP/COO can tell you exactly how much cardboard he has in stock in his Kennametal ToolBoss vending system. Why is this important? Because unexpectedly running out of cardboard could shut down a multi-machine, multi-robot cell that produces parts called segments from raw material to completed and boxed. This cell is representative of how the shop leverages extensive data collection and robotic automation to its advantage.

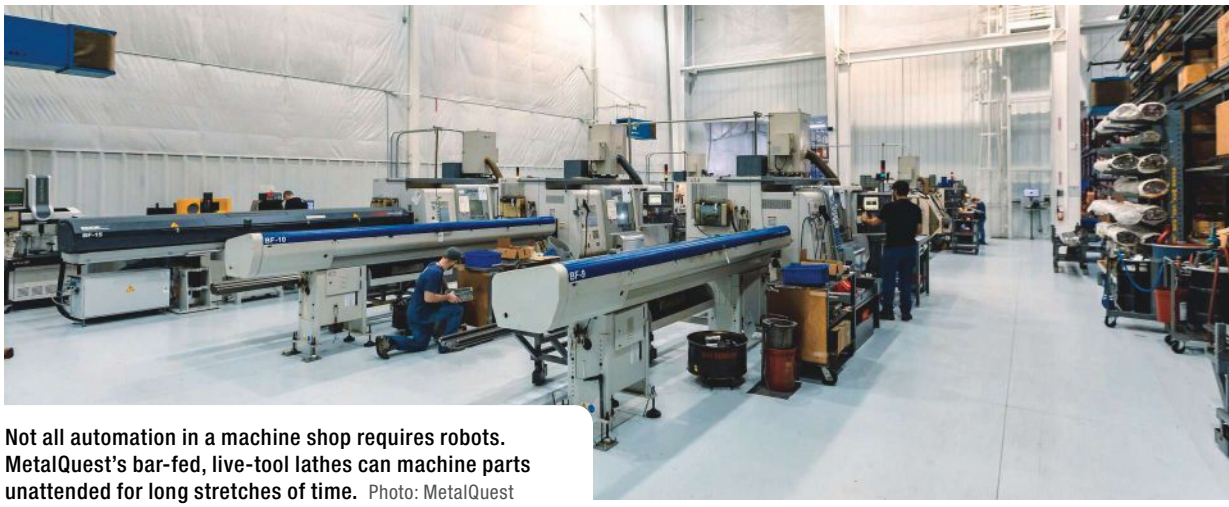
President Scott Harms started MetalQuest in 1996. From day one, the company, which focuses on medium- to high-volume work

— typically for part families — has used advanced equipment to set itself apart from others. “Our first machine was a three-axis CNC lathe to perform turning and milling operations, and that type of multitasking capability became our niche,” Mr. Harms says. “At that time, most shops were still using a mill and two-axis lathe to complete parts. In fact, today, we have just one two-axis lathe in our tool room. All others have some combination of subspindle and live tooling to potentially machine parts complete.”

Six years later, Mr. Volk joined the company and spearheaded the development of the shop’s data-collection software. He started by taking inventory of all raw materials and consumables and bringing in the ToolBoss vending system to manage that. He also continued to grow the software to the point that data collection has been integrated



MetalQuest has 13 robots. It buys them direct from the manufacturer and integrates them itself. Photo: MetalQuest



Not all automation in a machine shop requires robots. MetalQuest’s bar-fed, live-tool lathes can machine parts unattended for long stretches of time. Photo: MetalQuest

into all front-office and shopfloor operational systems.

The software Mr. Volk created ties together a variety of manufacturing tools, including Exact JobBoss ERP, Okuma's Connect Plan machine monitoring system, Hexagon's PC-DMIS measurement software, QC-Calc SPC software, two Zoller tool presetters and the vending system. "All of these elements can communicate with each other," Mr. Volk explains. "Plus, there is just one point of data entry for a process change, such as adding a new type of cutter, and all associated information about the change is then automatically pushed to all other relevant systems."

The software tracks all shop metrics. "If a customer was to send me a packing list number, I could provide any information relative to how that job flowed through our facility from the raw material purchase order to the point of it being received at its facility," Mr. Volk says. "I could even provide the coolant concentration level when the parts were machined if need be. Tracking and analyzing data means we're not making educated guesses here."

MetalQuest also takes a do-it-yourself approach to automation. "We now have 13 robots," Mr. Harms says. "We buy them directly from FANUC and do all the integration ourselves."

For example, the aforementioned segment cell includes a pair of Okuma 2SP-250H CNC turning centers, each having dual forward-facing horizontal spindles and a gantry loader taking parts from one spindle to the other. Each turning center performs OP-10 and 20 work and drops parts on a conveyor. A robot picks parts from the conveyor, delivers them to a de-gaussing station and then to a pin stamping machine for part marking. Another robot delivers those parts to a VMC for a slitting operation. After that, robots are used for deburring, dipping parts in rust preventive, building cardboard boxes with internal dividers and placing parts in the boxes. "Once an operator loads raw material into the cell, there is no other interaction with the cell except to remove filled boxes," Mr. Harms says. A second such cell is nearly complete and online.

"Our employees embrace the robots," he continues. "From day one, we've continuously automated a range of processes, so when we did finally start adding robots, they simply viewed them as just another automation upgrade. They understand we want to stimulate their intellect, not simply have them mindlessly move parts from point A to point B."

Good Things Happen When Employees Become Owners

There are a variety of scenarios that can play out when shop owners become interested in selling their businesses. In 2011, **ACECO**'s owners opted for an ESOP. Sid Sullivan, company president, says that since the transition, the shop's value (based on purchase price) has grown tenfold largely because the employees/owners now have a more vested interest in the operation's performance. The change has also led to greater reinvestment into the business. "It's a win-win-win for the employees, the company and our customers," he says.

AceCo started in 1960 as a job shop. Over

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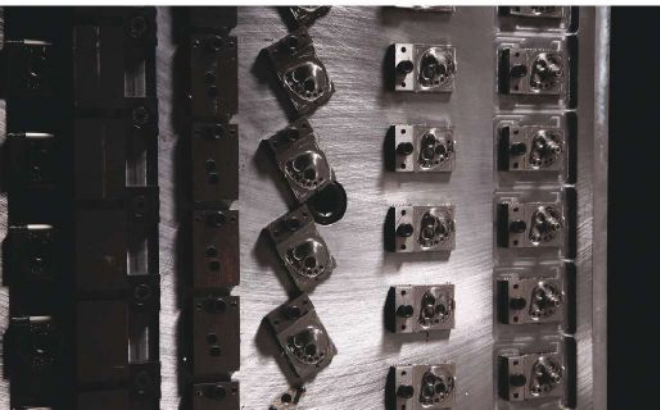
This month's Top Shops event will present advanced machining and business concepts you can implement in your shop soon after returning home. Read my column on page 22.

Take Advantage of My $100 Deal

In addition to keynotes and panel discussions, the three-day Top Shops Conference will include two concurrently running tracks from which to choose — one related to business/human resources practices and the other to machining/shopfloor technology. That's why it's valuable to bring a colleague with you. For example, one of you can attend a presentation about the technical aspects of advanced five-axis machining while the other learns about more effective ways to estimate and quote jobs. Or, one of you can find out about the myriad ways to benefit from on-machine probing while the other hears about techniques for effectively marketing your shop. You can choose from among 18 such presentations.

Visit **topshopsevent.com** to see the entire conference schedule and register for the event. If you bring one or more other people from your shop, have them enter the promo code **KORN** to receive a $100 discount for each additional registrant.



TOP LEFT: Since establishing an employee stock ownership program (ESOP), employees have been more willing to suggest improvement initiatives because they now have a bigger stake in the company's performance.

BOTTOM LEFT: The majority of the company's business is dedicated to providing parts used in equipment to produce semiconductor chips and LCD screens. It also machines parts such as these for medical applications.

TOP RIGHT: AceCo currently is constructing a 92,000-square-foot facility to consolidate some of its present operations. Thanks to the ESOP tax savings, no debt financing is required. Photos: AceCo

the next few decades, the company established competencies in producing planer heads, finger joint knives and other industrial wood knives. This eventually led the company into the food processing knives specifically related to processing — perhaps not surprisingly — French fries and potato chips. In the mid-'80s, local high-tech companies such as Micron Technology required complex parts used in equipment that produced semiconductor memory and microprocessor chips. Shortly after, AceCo started a division dedicated to this industry. Today, the majority of the company's business is dedicated to providing those parts as well as similar ones used in equipment that manufactures LCD and OLED screens. Parts like these require precision machining and high-end equipment. In fact, developing more accurate machining processes has helped semiconductor OEMs to shrink the size of their chips over the years, which remains a continuous goal for them.

In 2011, the company owners decided to sell this division. Prior to establishing the ESOP, consideration was given to possible strategic partners and shopping the business altogether. Mr. Sullivan, who was CFO at the time, proposed an ESOP to protect the company's legacy and reward the employees long-term. "I told them ESOPs create owners, and owners have a stake in the game."

Mr. Sullivan says he anticipated possible employee skepticism when the plan was rolled out. "However, we release the stock price every year, and we have a third party perform an annual valuation on our company," he notes. "Employees can clearly see the impact their hard work and improvement initiatives have on their stock shares, and that motivates them to do even more in that regard."

Eventually, AceCo initiated a formal continuous improvement plan in which, among other initiatives, the company's 180 employees were

encouraged to submit two improvement ideas each year. Mr. Sullivan says having control over what changes might be made is quite different than having someone dictate what those changes might be. "This has been incredibly successful for the company," he notes.

The ESOP has also spurred higher reinvestment in the company. "The U.S. government views an ESOP as a transition plan, a way to continue business," Mr. Sullivan explains. "As a result, the company pays no state or federal taxes, and we can — and do — put that money back into the business. Last year, we reinvested approximately $9 million thanks to the tax savings. When our employees retire, they'll receive the benefits from their ESOP as ordinary income and pay the required taxes. That's what makes this work."

In fact, AceCo currently is constructing a 92,000-square-foot facility that will consolidate some of its present facilities. Thanks to the tax savings, no debt financing will be necessary.

Breaking Silos

Most people know **SDP/SI** because of its 1,500-page catalogs, notes Robert Kufner, company president since 2013. Established in 1950, SDP/SI offers more than 87,000 mechanical components and assemblies as standard items. It also manufactures custom products. Although these are two separate entities, they are branded as one.

Recently, SDP/SI along with Quality Bearings and Components (QBC), and QTC Metric Gears, all divisions of parent company Designatronics, has gone through a number of significant changes. "In the last five years, we've worked through a major ERP system change, revamped our website and online store, and consolidated our four separate operations into one new

SDP/SI says its new manufacturing facility is one of the most modern on the east coast.
Photo: Designatronics

$24 million facility," Mr. Kufner says. "These changes, the new facility in particular, did wonders for improving our internal communication and customer service, and they helped strengthen our overall company culture." In fact, the company was named a top workplace in Long Island by *Newsday* in 2018.

Though branded as one division under Designatronics, SDP/SI (as well as QBC and QTC) functioned as separate businesses. "Picture one long building with a wall down the middle," Mr. Kufner describes. "Although there are similarities between SDP and SI, and both were feeding products to the same catalog, there was no communication between them, and no resources were shared. They were operational silos."

This is no longer the case with the new building, even with SDP functioning as a union shop and SI an open shop. "With the new facility, we were finally able to literally and metaphorically break down the wall between the two entities," Mr. Kufner says. "This did require a good bit of training to facilitate communication between all parties and teach them how to engage with and rely on each other. It also meant we had to trim away some managers who were not helping establish our open culture or on board with our new mission and vision. That's simply the reality of any type of drastic change like this."

In addition to communication training, the company has offered import/export and lean manufacturing training, and has initiated an apprenticeship program. It also offers tuition reimbursement for outside education.

Still, SDP/SI struggles to find new employees. The Long Island area has a large concentration of financial and service firms, but not much in the way of manufacturing or technology. This has spurred the company to consider training those in automotive repair programs to be machinists. It has also had success training engineers who are more comfortable on the shop floor than in an office to be machinists.

SDP/SI was named a top workplace in Long Island by *Newsday* in 2018. Photo: Designatronics

The company also is offering signing bonuses for both new hires and the employees who find them. "An employee who finds us a machine operator will receive a $2,500 bonus as will the new person," Mr. Kufner says. "Similarly, we offer $5,000 bonuses for setup personnel and experienced gear cutters. Finding good people remains our biggest hurdle and biggest threat to growth." This problem also has the company considering acquiring small machine shops in the area to boost capacity.

That said, the new manufacturing facility, which Mr. Kufner says is one of the most modern on the east coast, also serves as a selling point to potential new hires. "We like to bring people in and show off our building with its clean, epoxied floors and environmental control," he says. "It's one way we can change their mind about manufacturing."

Benchmarking Data Your Way

If you didn't participate in this year's Top Shops survey, it is possible to purchase a general report of survey findings from our company's research division, Gardner Intelligence. These are similar to the free custom reports participating shops receive comparing their responses to the others that participated. Gardner Intelligence can also provide an "a la carte" serving of Top Shops data related to the specific types of shops against which you'd like to be benchmarked. Those might be shops only in your region, shops that serve the same industries as yours, shops that are the size of yours — shops that "look like" you. If you are interested in purchasing such a segmented report or a general report, contact Jan Schafer, Gardner Intelligence director of market research, at **jschafer@gardnerweb.com** or 513-527-8952.

Coming to Grips with Live Tools on Y-Axis Lathes

EDITED BY **JEDD COLE** | ASSOCIATE EDITOR

COMPANY
Anthony Machine Inc.

PROBLEM
Trouble maximizing use of Y-axis lathes with live tools

SOLUTION
Turret Adapted Clamping Units from Kennametal

RESULTS
Fast and reliable tool changes, fewer setups to finish parts

Anthony Machine has been using Kennametal's KM quick-change toolholder throughout the shop for years. So when the time came to equip its new Y-axis lathes from DMG MORI with quick-change tooling, they sought out Kennametal's help in tooling up the NLX 3000's tool turrets.

Anthony Machine Inc. is no stranger to Kennametal's KM quick-change tooling. For many years, the shop has used the toolholding connection in its precision machining work for the oil and gas, mining, transportation and power generation industries. However, after the company purchased a pair of NLX 3000 | 1250 universal turning centers from DMG MORI — the shop's first Y-axis, live-tool lathes — the shop's manufacturing team was challenged with making the most of the new machine tool investment, since its tool turret was not friendly to the KM tooling system.

Familiar with the KM Toolholder

With his decade-long relationship with Anthony Machine, Kennametal senior sales engineer Mark Davis was there to help. He explained that the best way to reduce setup times and maximize the new machines' potential would be to equip them with Turret Adapted Clamping Units (TACU), a kind of tool block adapter compatible with the KM quick-change toolholders.

"We offer TACU blocks for both static and driven tools, and can tool up lathes from Okuma, Haas, Mazak, Doosan and of course DMG MORI, with more coming online all the time," Mr. Davis says. "This makes it both easy and cost-effective for »

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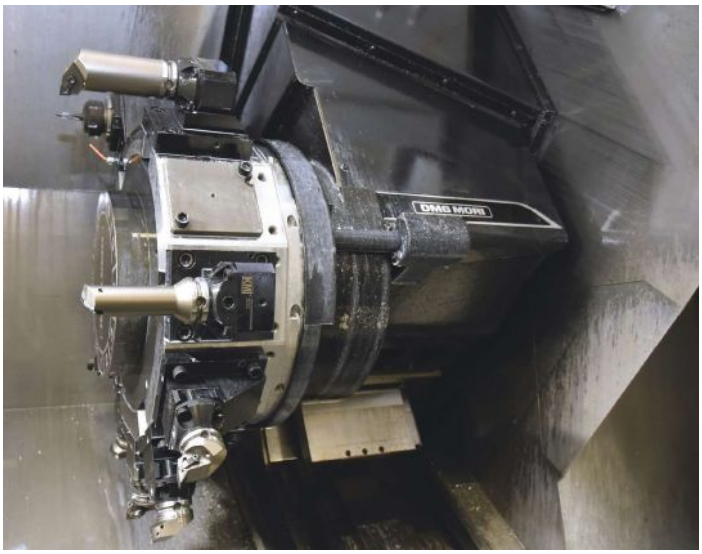


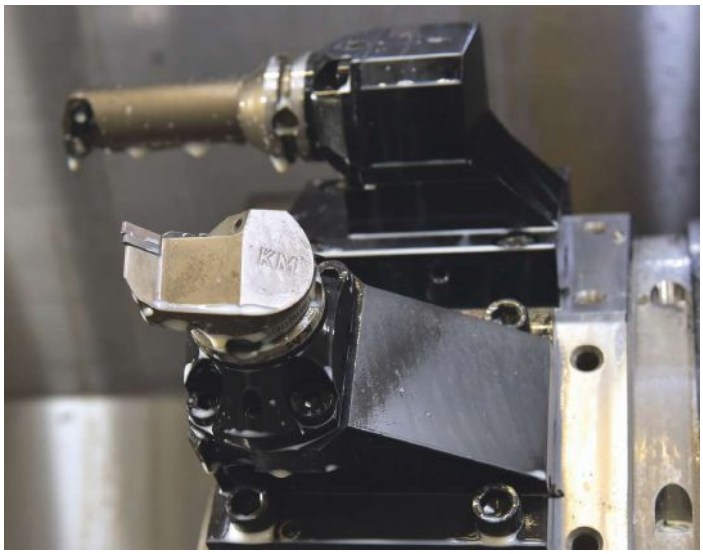
Not only does the TACU block enable use of the accurate KM toolholder, it also adds a bit more space between tools on the turret, which helps to provide needed clearance for complex cuts.

our customers to equip more than 80 models of CNC turning centers with a fast, flexible and accurate quick-change toolholding system."

According to Anthony Machine manufacturing technologist Daniel Goller, the decision to adopt TACU and KM for the new machines was an easy one. "Over the years, we've built a number of KM-equipped custom toolholders for deep boring and other machining operations on our CNC lathes and machining centers, and we use the system on several of the shop's manual turret lathes to overcome limitations with available tool positions," he says. "On more than one occasion, we've earned new business because KM was able to achieve tolerances and surface finishes that others couldn't do with conventional tooling."

Toolholding Differences

Anthony Machine's operations manager Mohsen Saleh was impressed with the combination on



Not only does the TACU block enable use of the accurate KM toolholder, it also adds a bit more space between tools on the turret, which helps to provide needed clearance for complex cuts.

the new machines: "Compared to the traditional wedge-and-screw-style blocks that come standard on most machines, the KM-equipped TACU units are both faster and more accurate. We routinely hold tolerances of 0.0005 inch (0.013 mm), and I'm told that part size doesn't change from one clamping to the next. The turret is less crowded, everything's easier to get at, and you don't have the chatter and deflection that you often find with your typical straight-shank tools and set-screw-type boring bar holders."

"The repeatability is a pretty key factor to the KM connection," Mr. Goller adds. "With the TACU units, it really allows us to fully utilize our new machines in a way that we couldn't do with conventional stick tools."

Mr. Goller contrasts the KM tool connection with a 1-inch square holder on the tool turret. "You've got to make sure that the holder is square. And you will never repeat the same »

TURRETS AND LIVE TOOLING 101

When buying a lathe, after considering what sorts of workpieces the machine must be prepared to handle, it's time to ponder tooling options: gbm.media/turret.

position twice. If you take it out and put another one in, you would have to touch off your tools every time." In contrast, he says, "With the KM connection, you can actually maintain face offsets and take one out and put it back in the same station at a later point, and it will repeat." The tool repeats as precisely to about 0.0005 inch, he says.

"There's also really no way to misorient the tools. I've seen people mount stick tooling 90 degrees off and couldn't have cut with it. With a KM connection, even silly mistakes like that are avoided," Mr. Goller says. That is because the KM system makes contact on the taper and on the face of the tool, which makes it more rigid than a straight-shank tool slid into a slightly oversized bore and held with a screw on one side. Because of the way the KM holder clutches the tool, Mr. Goller says he can trust that the tool is always on center.

Maintaining an Edge

The TACU-plus-KM system's reliable repeatability has enabled the team to overcome the natural space limits of using the lathes' tool turrets. "Everything is a compromise when you only have 12 stations," Mr. Goller says by way of example. "If I tried to add six milling tools, then I suddenly only have six slots left for lathe tools, and sometimes I need more than that." Thanks to the KM's accuracy, he has the option to eliminate virtually an entire milling machine setup over the course of making a given part, because he can swap out one or two of the milling tools during the cycle and effectively use more milling tools than can physically fit on the turret.

Because Anthony Machine's system does not currently have a way to change out tools automatically, Mr. Goller has to do so by hand. But he says that a swap adds only about a minute tops to the total cycle time. "With the torque wrench, it's just a couple turns. It comes out, you put the next one in; a couple »

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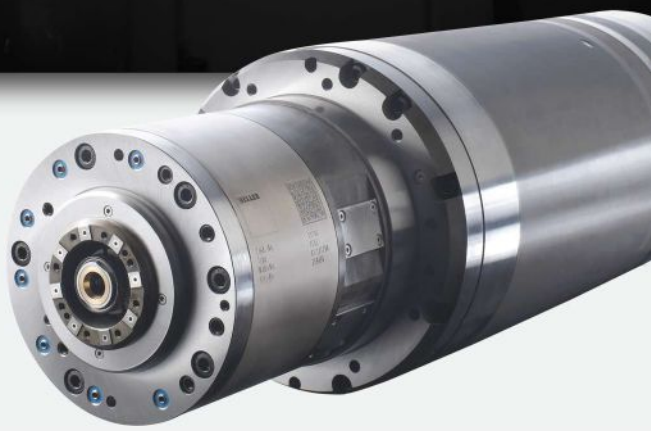

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Operations manager Mohsen Saleh (left) and CNC machinist setter Mark Garland (right) discuss a workpiece produced on one of Anthony Machine's DMG MORI NLX 3000 | 1250 universal turning centers.

more turns, it's torqued back down, and we know that the connection repeats." He points out that a minute is nothing compared to having to set up an entire milling machine operation.

Mr. Saleh summarizes Anthony's recent success with a bit of perspective. "We bought our first CNC machine in 1986," he says. "At that time, we were using a well-known competitive brand, and then Kennametal came knocking. What first struck us was their service-oriented attitude. They've always been willing to come in and work with us on applications which, together with the quality of their products, is why they've since become our preferred tooling supplier."

He concludes, "We're always competing against smaller, lower-cost shops, and in order to continue winning new business in this environment, we have to adopt the latest in advanced tooling and machine tool technology. This is what's given us the edge, and Kennametal is a big part of it."

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Here an employee of Complete Machining Services (CMS) repairs a plastics injection mold with the LaserStar 8700-3 fiber laser welding workstation. Operators can view the welding area through a stereo-microscope with internal crosshairs, which helps them more easily align and weld the parts at the exact required location.

Machine Shop Fills Mold Repair Niche with Fiber Laser

EDITED BY **JEDD COLE** | ASSOCIATE EDITOR

COMPANY
Complete Machining Services Inc.

PROBLEM
Demand for plastics injection mold repair services were beyond shop's welding capabilities

SOLUTION
LaserStar 8700-3 fiber laser

RESULTS
Regular mold repair business acquired

Over the past 15 years, Complete Machining Services (CMS) Inc. has tried to adapt its precision machining and fabricating services to market demands. Accomplishing that has typically involved acquiring increasingly advanced machining centers and other capital equipment, along with new tooling, controls and software upgrades. Recently, the shop recognized a new demand.

"Last year, we began receiving numerous requests for plastics injection mold repair services," says Jeff Dainty, president and CEO. "Beyond our MIG and TIG welders, this was a capability we did not have. It was obvious there was a lack of contract precision laser welding services in the area for plastic injection molds, which was surprising because the largest concentration of moldmakers in North America resides in Windsor, Ontario, and Detroit, Michigan, close to where CMS is located."

Meeting an Industry Demand

As it happened, Mr. Dainty and his manufacturing manager were set to attend the 2018 International Manufacturing Technology Show (IMTS) about a week after recognizing the demand for mold repair services. After researching laser welding systems at the trade show, they settled on LaserStar's 8700-3 universal jig welding workstation, a micro welding laser system.

"When CMS talked to us at IMTS about expanding their capabilities by adding laser welding for plastic injection mold repair and also »

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POINT/COUNTERPOINT

Another shop's experience has shown that pulsed Nd:YAG laser welding has come a long way for this application as well: gbm.media/yag.

tool-and-die maintenance, we explained that they were going to need not just a laser welding machine, but a workstation that provided the flexibility to handle a wide variety of parts and materials," says Gary Paresky, LaserStar regional sales manager. "That meant they needed at least 300-watt capability that could weld aluminum, and that means a fiber laser. Nd:YAG-type (neodymium-doped yttrium aluminum garnet) lasers are typically 200-watt devices. We directed them to our 8700-3 series fiber laser welding workstation, which provides higher peak power."

The fiber laser source on the 8700-3 has a permanently sealed design that protects against dust and dirt, which sometimes is an issue in a job shop environment, Mr. Paresky says. An important feature of the fiber laser is that it produces a sharp, focused light beam that consistently melts a very small area of metal. "The benefit of the technology is that very little heat is generated at the weld point, allowing users like CMS to easily laser weld 0.25 mm from complex, heat-sensitive intricate parts," he adds.

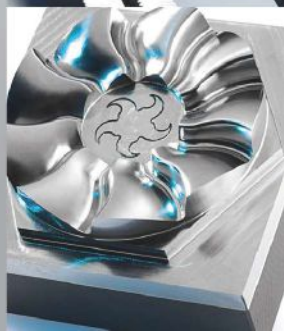
Because CMS needed to maximize the flexibility of the welder, Mr. Dainty opted to add several options to the workstation, including a tower gantry to ease moving the laser next to the molds, a motorized worktable, and a camera and monitor to aid in training operators.

"Fortunately for CMS, we were able to find an operator with experience using LaserStar equipment, so we were able to start putting work through the process right after it was installed, and we are now successfully performing mold repair work for a variety of customers on a weekly basis."

The Mold Repair Advantages of Fiber Laser Welding

When *Modern Machine Shop* heard of CMS's success with LaserStar equipment, we talked with Mr. Paresky about how fiber laser welding is particularly suited to mold repair work. Here is what he said: »

5-AXIS HIGH PRECISION



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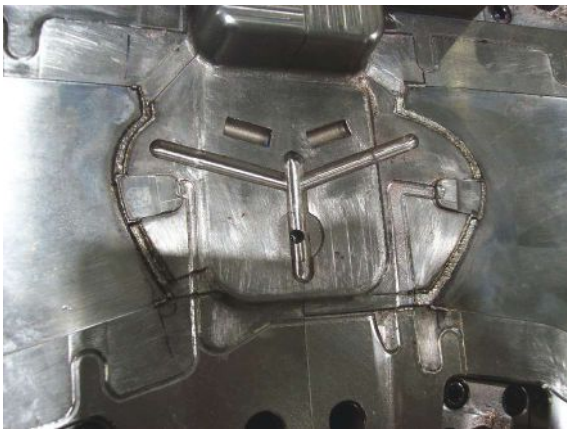

This plastics injection mold for an automotive component has been fiber-laser welded to repair worn and damaged surfaces. Weld repair areas can be seen around the edges of the mold. These surfaces will subsequently be ground and polished to final dimensions.

What is involved with plastic injection mold repair?

Plastic injection molds can be expensive to replace, so using a laser welder to repair them can be a huge cost savings. Typically, the molds develop worn areas after constant use or broken edges requiring repair. On a newly machined mold, there are sometimes porosity voids that need to be filled. The laser welder can be used to address these issues by adding filler wire to repair these defects. Once material is added with the laser welder, a final machining of the area is performed to finish the repair. Laser welding can also repair small molds or those that can be disassembled. X-, Y- and Z-axis and/or rotary capabilities enable precise and straight weld beads to be laid down. For larger molds, the laser welder can be rolled to where it is convenient for the repair to be performed. A gantry tower with X-, Y- and Z-axis motion — like the one CMS acquired — allows the operator to reach into areas that need repair.

What are fiber laser's advantages over MIG and TIG welding technologies?

Unlike MIG and TIG welders, laser welders allow for micro-welding into very tight areas. Because laser welding is a noncontact process, as long »

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Because CMS needed to maximize the flexibility of the LaserStar 8700-3, it opted to add several options to the workstation, including a tower gantry to ease moving the laser next to the molds, a motorized worktable, and a camera and monitor to aid in training operators.

as the operator can see where they need to weld, they can do it with the laser. The laser welder produces a very small heat affected zone (HAZ) because it directs the amount of energy to just where it is needed.

What are fiber laser's advantages over other kinds of laser welders?

Previous-generation technology like flash-lamp-pulsed Nd:YAG laser welders usually have a limit on the maximum power that can be applied — typically 200 watts. Fiber technology can provide 150, 300, 450 or even 600 watts, which allows for the use of heavier filler wire, speeding up the repair process. Aluminum and beryllium typically need higher power in order to produce quality welds, with 300 watts being a common capacity for such applications.

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It Takes More Than Fast Machines to Shorten Lead Times

JULIA HIDER | CONTRIBUTOR

COMPANY
B.C. Instruments

PROBLEM
New, faster machines still didn't solve inspection bottleneck

SOLUTION
Starrett HVR100-Flip inspection system

RESULTS
Inspection time reduced by 75%, meeting customer lead time requirements

Oftentimes, reducing machining time alone is not enough to meet challenging lead times. Shops may need to look at other processes to ensure the parts get to the customer on time. B.C. Instruments (BCI), a company based in Schomberg, Ontario, purchased new machines to keep up with a customer's expedited lead times. But it quickly realized that even with the ability to produce complete parts in less than two minutes, it would not meet lead times if it had to spend three or four minutes inspecting each part. A new inspection system from The L.S. Starrett Co. (Athol, Massachusetts) has increased inspection throughput by 75% to help the company hit its customers' lead times and perform additional inspection tasks.

Bruno Conzelmann established B.C. Instruments in his garage in 1971. Since then, the company has grown to include 150 employees working in six plants across Ontario and a plant in India. Despite this growth, BCI is still family-owned, with Mr. Conzelmann's son Roger currently serving as the company's president. "We're a fast-growing company that takes pride in retaining and taking care of our employees, without a single layoff," says Sean Smith, plant manager for small-diameter turning.

BCI produces precision parts for a range of industries, including aerospace, medical, power generation, nuclear and electronics. The company also produces parts for the injection molding industry, including families of injection molding nozzles. These nozzles can have different thread sizes, »

B.C. Instruments (BCI) has several plants that produce parts for many different industries, including injection molding. The company purchased two new lathes to keep up with a customer's short lead times for injection molding nozzles.

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BCI also purchased a HVR100-Flip digital video inspection system to inspect the injection mold nozzles, as well other parts like this weld fixture. The new inspection system, which the company uses instead of profile projectors for some part families, has increased inspection throughput by 75%.

OD profiles and internal features. They also have tight tolerances, within ±10 microns, Mr. Smith says. He also notes that BCI is the sole supplier of nozzle tips for one customer that has very short lead times. "Demand is high, and our customer is trying to grow by 20 or 30%," he says. The expedited work, combined with a stocking agreement BCI must maintain, puts the company in a challenging situation. To keep up with the work, it purchased two new Citizen lathes, which can machine complete parts in two minutes.

Mr. Smith and quality assurance inspector Brent Cordy knew that the facility was going to need a more efficient inspection system to keep up with the parts coming off the new machines. The company performs 100% inspection on these parts, and Mr. Cordy estimates that inspectors »

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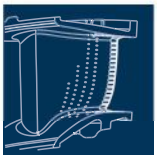

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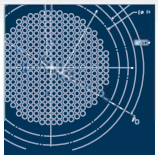

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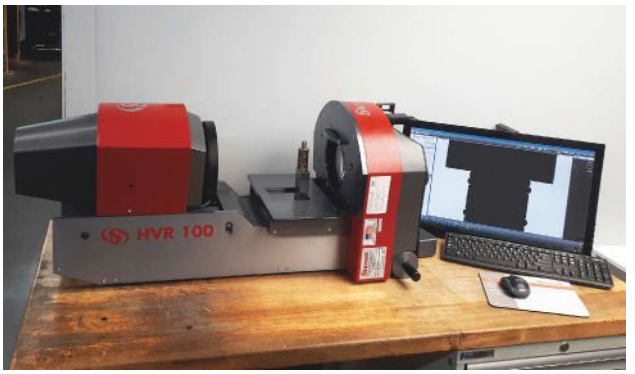


One feature of the Flip system is that it can be used in a horizontal or vertical position. BCI's unit is on a table that enables employees to switch its configuration depending on the size of the part being measured and the fixturing.

spent three to five minutes measuring each part using profile projectors. Facing a bottleneck in inspection, the two launched a continuous improvement project to find a faster system.

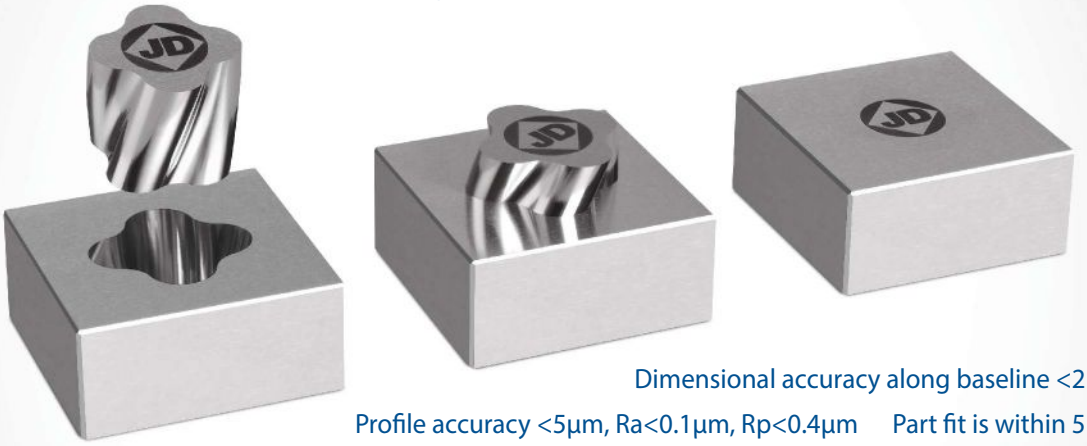
This project led them to the Starrett booth at the 2017 Canadian Manufacturing Technology Show, where they saw the HVR100-Flip digital video inspection system. They were so impressed that they purchased the unit that had been on display one day after leaving. "I didn't let it go back over the border," Mr. Smith jokes.

Increasing Throughput

Mr. Smith and Mr. Cordy say the Flip system has several features that have enabled BCI to increase its inspection throughput:

- **Fast program creation.** According to Mr. Cordy, he and the other BCI inspectors were able to quickly learn the new system. Users can create inspection programs for new parts by tracing them on the system's touchscreen and choosing the correct measurements, angles, distances and line straightness. "It's pretty intuitive," he says. Employees were able to create their own programs in less than a week, and they can now create two or three programs per day. »

Tight tolerances have your "vulnerabilities" in a vice?



Dimensional accuracy along baseline <2μm

Profile accuracy <5μm, Ra<0.1μm, Rp<0.4μm Part fit is within 5μm

Within each set, parts fit every 90 degrees Different part sets fit interchangeably.

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HIGH FIVE

Another high-volume machine shop uses Starrett's vision systems to eliminate inspection bottlenecks: gbm.media/starrett.

• **Automatic part recognition.** Once the program is created, Mr. Cordy says it only takes a few seconds for the system to inspect a part. Automatic part recognition establishes and recognizes the OD feature of the part, pulls up the correct program and inspects the part automatically.

• **Multiple part inspection.** The system also has the capability to inspect multiple parts at the same time. Mr. Smith says BCI can fit as many as 10 injection molding nozzles on the Flip system at once.

System Flexibility

BCI also benefits from the Flip system's versatility:

• **Configuration.** The Starrett Flip can be configured horizontally or vertically, and the company has its system on a table that enables users to switch the orientation based on part size and fixturing. "Depending on the application and what we're checking, sometimes it's easier to do it vertically or horizontally," Mr. Smith says.

• **Custom thread measurement.** The system can also measure threads, which BCI finds especially helpful since the nozzles have external threads that must be checked. The software can also be configured to measure custom thread sizes, which the company uses for parts that are plated after machining.

• **Environment.** The Flip is suited to industrial environments and can be used on the shop floor. BCI has its system located at the front of its shop floor so that a range of employees can access it for different types of inspection. Inspectors can check finished parts, and machinists can also use it to cross-check parts for tool wear and to help calculate offsets.

Far-Reaching Benefits

Overall, Mr. Smith and Mr. Cordy say the Flip system has exceeded their expectations. They estimate that it has increased inspection throughput by 75%. The system is so efficient that the shop is finding other uses for it beyond the nozzles, such as incoming inspections. "We measure a lot of our subcontractors' work," »

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BCI employee Melanie Cockerill measures an injection molding nozzle on the HVR100-Flip. The system automatically establishes and recognizes the OD feature of the part, pulls up the correct program and quickly inspects the part.

Mr. Smith says. "This system has allowed us to get through this type of sample inspection check."

The system is also freeing up employees to take on other work. BCI has 30 "tech support" employees who are qualified in, but not dedicated to, inspection. Since implementing the Starrett Flip system, the company does not need to task these employees with inspections as frequently. Instead, they can work on setting up machines or other continuous improvement projects. BCI, like many other shops, is continually seeking skilled workers, so using its employees as efficiently as possible is important.

ABOUT THE AUTHOR

Julia Hider is an associate editor at *Production Machining* magazine. This article originally appeared on productionmachining.com.

| The L.S. Starrett Co. | 888-674-7443
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| BC Instruments | 905-939-7323
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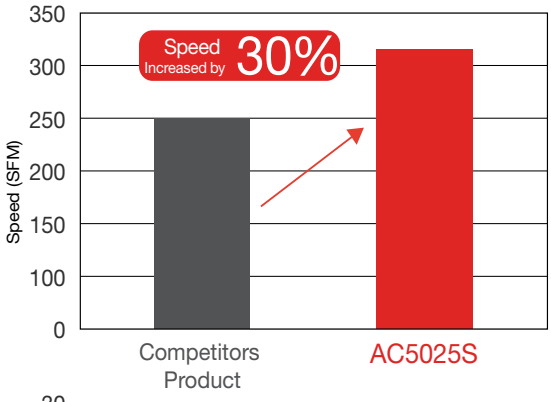
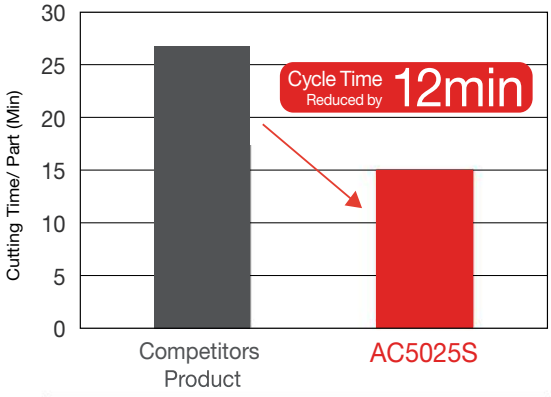
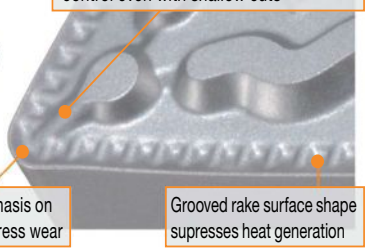




Part Material: Inconel 625 (48-52HRC) - CNMG433
Cutting Conditions: f=0.010" IPR, a_p=0.020", Dry

For Finishing
EEF Type

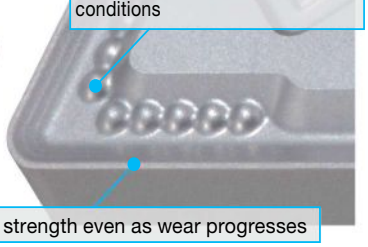


Main chipbreaker exhibits excellent chip control even with shallow cuts

Edge designed with an emphasis on sharpness (20°rake) to suppress wear

Grooved rake surface shape supresses heat generation

For Medium to Rough Cutting
EEG Type



Protruding ball exhibits excellent chip control over a wide range of conditions

Edge shape keeps its strength even as wear progresses

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EEM Type

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JEDD COLE | EDITOR | jcole@mmsonline.com

Tooling and Workholding

Toolholders Prevent Cutter Slippage

Made to fit with existing Powrgrip clamping units, Rego-Fix's heavy duty Securgrip toolholders are designed to prevent cutter pullout during machining operations. The holders use the same balance rings as standard PG holders while enabling increased feed rates and surface finishes with less deflection, the company says. The Securgrip system makes use of the Powrgrip's gripping strength with a special locking system and threaded cap.

The product has a total indicator reading of 0.001" and enables manufacturers to preset their tool heights. Furthermore, users can modify their existing Powrgrip holders for use with the system. Securgrip can be used with Rego-Fix PG 25 or PG 32 holders in all tapers, including CAT, BT, TC, HSK, Capto, and dual-contact Rego Plus.

Rego-Fix Tool Corp. | 317-870-5959 | rego-fix.com

Additively Manufactured Tool Reduces Vibration for Long Overhangs

Sandvik Coromant's CoroMill 390 features an additively manufactured cutter body for lighter overall weight, which reduces vibration and increases rigidity when machining when long overhangs are required.

"When designing our new lightweight CoroMill 390, material was tactically removed to create the optimal cutter design for minimizing mass," explains Thomas Wikgren, manager of product application. "This is called topological optimization, and it makes the cutter more compact and significantly lighter than a conventional version, thus helping machine shops to boost the productivity of their long-overhang milling operations. Moreover, a shorter distance between the damper in the adapter and the cutting edge improves performance and process security."

The company explains that process security is paramount when milling with long overhangs, which is a common requirement in the manufacture of aerospace and oil and gas components. In such cases, vibration can compromise the generation of features such as deep cavities, leading to slower production, shorter tool life and poor surface finish. The lightweight CoroMill 390 is intended to provide a solution to this issue. The tool can be combined with the company's Silent Tools milling adapter to damp vibration.

The CoroMill 390 can perform long-reach face milling, deep shoulder and side milling, cavity milling, and slot milling. The tool is available in diameters of 40 mm (arbor 16 coupling) and 50 mm (arbor 22 coupling). Three or four inserts (size 11) can be specified to suit the application. Differential pitch and internal coolant are provided on all cutters.

Sandvik Coromant Co. | 201-794-5000
coromant.sandvik.com/us

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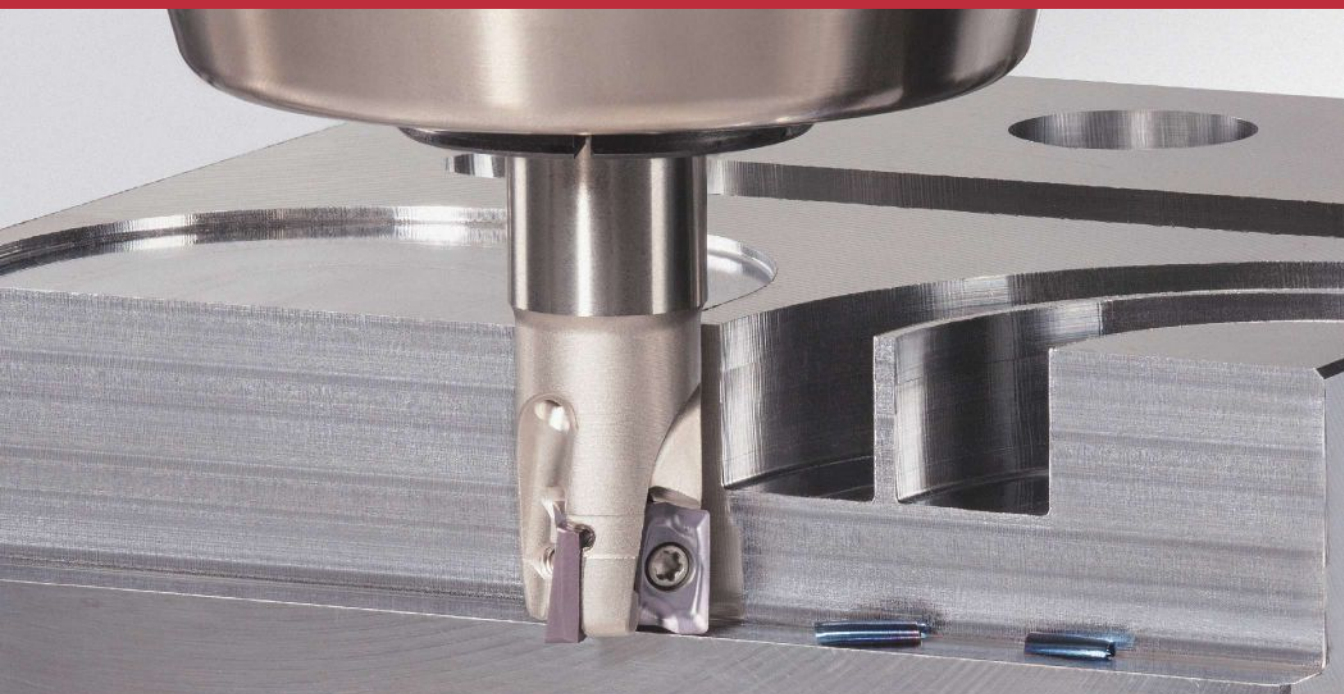

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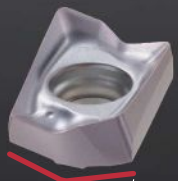

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Threading, Grooving Heads Enable Deep-Hole Turning, Boring

Seco Tool's GL threading and grooving heads for Steadyline turning and boring bars enable deep-hole operations and reduce the risk of scrapping workpieces. The company claims that the heads increase production accuracy, improve surface finishes and reduce downtime from insert indexing and head changes.

Offered in right- and left-hand versions, the heads provide the high repeatability of Seco's GL25 connection. The GL connection's wall thickness allows for centering accuracy and probing repeatability within 5 microns. Additionally, the connection provides increased operational versatility and faster tool changes.

With its vibration damping system, Steadyline turning bars facilitate stable turning and boring on small and large holes as deep as 10×D . For operations within deep-hole diameters as small as 1.181" (30 mm), shops benefit fom the system's reach/overhang capabilities and anti-vibration technology.

Seco Tools LLC | 248-528-5200 | secotools.com/us

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Diamond Turning Inserts Handle Difficult Alloys and Composites

Carmex Precision Tools has introduced diamond turning inserts designed to enable users to machine hard materials faster than with grinding or ceramic tools. These inserts are available with either one or two cutting edges.

The polycrystalline diamond (PCD) inserts are said to excel when machining nonferrous materials such as high-silicon aluminum, copper and brass alloys, magnesium, carbon fiber reinforced plastics (CFRPs), and composites.

The chemical vapor deposition (CVD) inserts are designed for machining aluminum and magnesium alloys, high-silicon aluminum, precious metal alloys, plastics with abrasive fillers, tungsten carbide, and ceramic green compacts. A chipbreaker reduces heat generation and energy consumption, the company says.

The polycrystalline cubic boron nitride (PCBN) inserts provide good surface finish in materials like hardened and heat-treated steels up to 72 HRC, high speed steel (HSS), high alloyed steels hardened to 45 HRC, nickel-based superalloys, gray cast iron, ductile steel and graphite.

Carmex Precision Tools LLC | 262-628-5030 carmexusa.com

Solid Carbide Thread Mills for Exotic Materials

Emuge's Threads-All ZGF-S-Cut Solid Carbide thread mills feature multiple teeth, a helical flute form and a multi-layer TiAlN T46 coating. The tools can produce threads in exotic materials including Inconels, nickel-based superalloys, Monel, titanium and 420 stainless steel because the heat is carried away during chip evacuation and does not stay in contact with the part. The tools can also be used for producing finer threads for aerospace applications such as engines, connecting rods and landing gear.

The thread mills have multiple teeth, the first acting as a rougher and the next two performing finishing. By dividing functions into three cutting edges, speeds and feeds can be increased and threads can be produced in a single pass, the company says. A 10-degree, left-hand helical flute form and chamfer geometry combine to optimize chip evacuation in the forward direction and add strength to the cutting teeth for better tool life and process security. The tools also have multiple flutes for increased tool strength.

The tools are available in lengths of 2×D, with coolant-fed options starting at $^{1}/_{4}$" diameter. One tool makes STI threads for both through and blind holes. The thread mills are offered in inch sizes ranging from No.2 or M3 through $^{7}/_{16}$ or M10.

The Emuge Threads-all ZGF program of sub-micro grain carbide thread mills encompasses solutions to produce internal threads from No. 0-80 (M1) to $^{3}/_{4}$-16. for industries using materials such as stainless steel, titanium and Inconel. Coolant-fed options are available starting at the $^{5}/_{16}$" diameter size. Available in 2×D and 3×D lengths in both miniature and standard thread sizes, the Threads-all family of thread mills offer solutions for difficult applications with full bottoming threading within 1 pitch. Threads-all tools provide control over pitch diameter limits including 2B, 3B, 3BG and all oversize variants. Single plane and multiple plane tools are available.

| Emuge Corp. | 800-323-3013 | emuge.com

Insert Grades Designed for Cast Iron Turning

Walter USA's WKV10 and WKV20 insert grades for the Perform line of turning tools are marketed as versatile and cost-effective for small- and medium-batch applications in cast iron (ISO K). These negative-geometry grades supplement corresponding grades for steels that the company introduced last year.

The inserts are designed to benefit shops that have difficulties measuring the tool life of an insert and change inserts at set intervals. Both the WKV10 and WKV20 grades feature a CVD coating said to be extremely wear-resistant. As such, they can be used for a range of materials and applications.

The grades are available in two geometries: MV7 (medium machining) and RV7 (roughing). In field testing, the inserts demonstrated process reliability with good chip control and tool life.

Along with these new grades for cast iron, Walter has also introduced the FV4 (finishing) and MV4 (medium) positive geometries. These geometries are primarily designed for steel and associated with the WPV10 and WPV20 grades.

Walter USA LLC | 262-347-2400 | walter-tools.com/us

Tangential Shoulder Mill Features a Triangular-Margin Design

Kennametal's Mill 4-12KT tangential shoulder mills apply lower cutting forces and feature a triangular-margin design enabling faster feeds without putting additional stress on the spindle, the company says. The product has tangentially mounted inserts with four cutting edges per insert. Seven-corner radii from 0.016" to 0.122" (0.4 to 3.1 mm) are available along with coolant-through, medium and coarse-pitch cutter bodies ranging from 2" to 8" (50 to 200 mm) in diameter. The axial depth of cut ranges from 0.019" to 0.472" (0.5 to 12 mm).

The milling tools provide lower cutting forces which, according to Tim Marshall, senior global product manager, enable users of lighter-duty, 40-taper machine tools "to feed faster without putting additional stress on the spindle." He adds, "In long-overhang situations, or where part fixturing is less than optimal, lower forces equate to less chatter, reduced edge chipping and smoother surface finishes."

The company says that the tangential insert design takes greater advantage of the strength of the carbide thickness than radially mounted inserts on traditional milling cutters.

Kennametal Inc.-World Headquarters | 800-446-7738
kennametal.com

Hard-Turning Inserts Resist Fracturing and Wear

Tungaloy has added 22 shapes and geometries to its BXA20 line of coated T-CBN inserts designed for hard turning operations. The inserts include wiper geometries and WavyJoint technology to address a broader range of hard part turning needs.The company says that the products are suited for a variety of applications.

The BXA20 insert has a nano-multilayered physical vapor deposition (PVD) coating twice as thick as conventional grades and coated on a polycrystalline cubic boron nitride substrate, adding wear and fracture resistance to the grade.

Tungaloy America Inc. | 800-542-3222
tungaloyamerica.com

Range of Swiss-Type Collets and Guide Bushings Offered

Platinum Tooling Technologies distributes products from Tecnicrafts Industries, a manufacturer of collets and guide bushings for Swiss-type CNC lathes.

Tecnicrafts, located in India, manufactures collets and guide bushings for use on Marubeni Citizen-Cincom, Tsugami, Star, Tornos, Hanwha, Traub, Hardinge, Manurhin-Kmx, Miyano, Nomura and other Swiss-type machine brands.

The collets are offered in steel- and carbide-lined versions with grooved, smooth and serrated bores in standard and long-nose types. Special collets such as V-line, U-line and over-grip collets are designed for positive gripping on delicate parts without leaving marks. Ultra precision (XP) W-type collets are available for tool grinding applications on machines from such brands as Rollomatic, Anca and Ewag. Other collets offered include 5C and 16C types.

Tecnicrafts' guide bushings have a carbide lining, providing a finish bore with a roughness value of less than 0.4 micron. These guide bushings include U-line, extended-nose and long carbide bores (Max Land) for special turning applications.

All collets and guide bushings are offered in standard and ultra-precision grades. The bore profile includes round, square, hexagon, rectangular and profile bores, as per user drawings.

Platinum Tooling | 847-749-0633
platinumtooling.com

JEDD COLE | EDITOR | jcole@mmsonline.com

Systems and Software

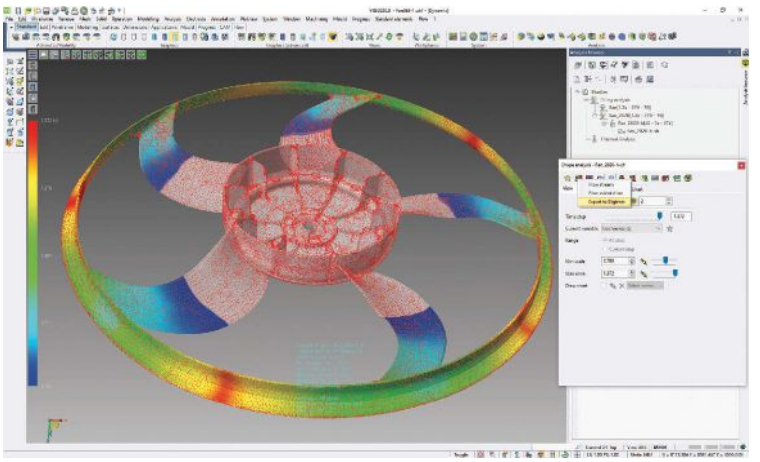
CAD/CAM Software Improves Finite Element Analysis

The latest release of Visi CAD/CAM, from Hexagon Manufacturing Intelligence's Production Software business, is said to improve mold and progressive-die design processes. This release also enhances the Reverse module, specifically designed for the mold and die market.

Part unfolding technology has been introduced in Visi 2020.0, enabling work directly on the original solid part model without needing to extract the model's skin. Sheet metal part recognition now provides an improved graphical representation of the part analyzed by identifying bends, planar faces and features. Product Manager Marco Cafasso says the software's associativity with the original model during the die design process allows the original part to be edited and changes to be made automatically on the study of the part.

Enhancements to the Reverse module provide increased flexibility for reverse and casting processes. Among the features in the module are: clipping plane management for point scanning; planar face and draft analysis on mesh data; adaptation of mesh to boundary; and best fit.

A new Compare feature lets the user compare two entities, such as point clouds, meshes or solids, by checking the relative distance. The graphical results show different colors in reference to the distance ranges. This feature can also show the relative distance between the two selected entities during the comparison.



Visi's Flow Analysis has been improved with new mesh group technology specifically designed for finite element analysis (FEA). It provides a high-quality mesh while reducing computation time by providing new options to adapt and fit the mesh accordingly to the model's shape. Engineers can also graphically identify possible quality issues caused by flow hesitations, and then simulate alternative solutions. The Flow Thermal function has been updated with improved coolant flow rate suggestions.

The direct interface between Visi and MSC Software's Digimat enables the export of data showing a material's local rigidity for the structural FEA process.

Hexagon Manufacturing Intelligence | 800-343-7933 hexagonmetrology.us

Geometric Search Software Increases CAD Productivity

Physna, short for "Physical DNA," is a geometric search engine designed to enable engineers to develop better workflow, find CAD drawings faster, reduce part duplication, and more easily compare part and component drawings.

Whereas CAD programs rely on text-based naming conventions and metatags that might not be consistent across multiple engineers or locations, Physna performs geometric searches in order to find parts quickly and accurately.

Physna is available as a plugin for CAD and PLM software or as a standalone software product. It can be used in the cloud or on site to meet ITAR requirements. Physna works with most file types, the company says, enabling geometric search across multiple CAD platforms.

Physna | 513-914-6800 | physna.com

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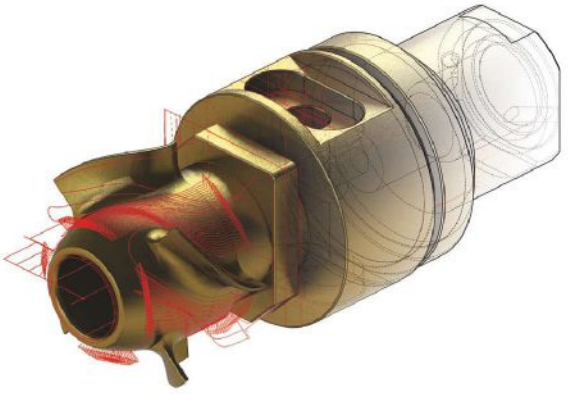

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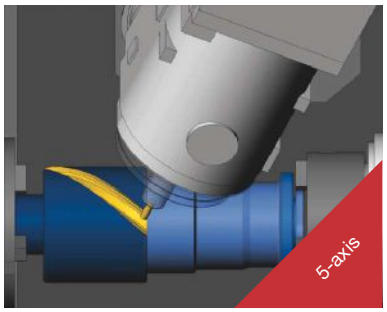

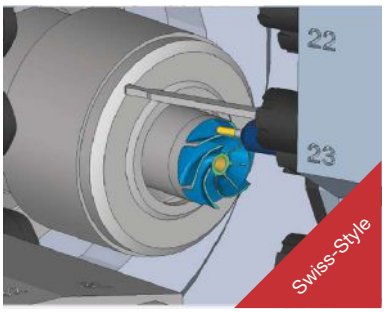

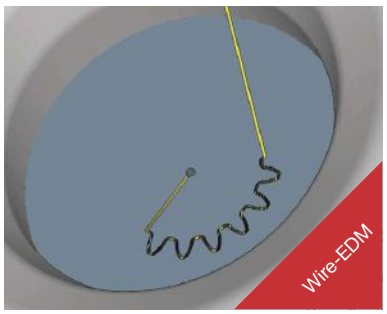

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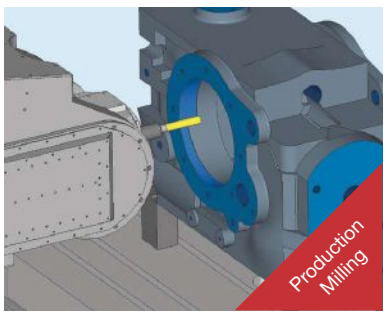

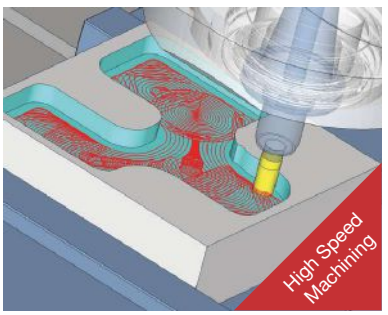

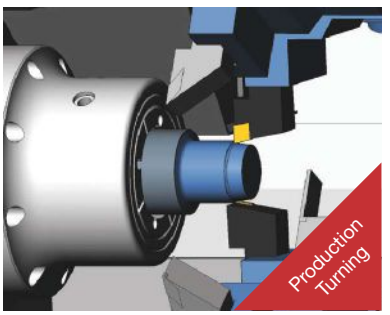

Seamless CAD to CAM interface to machine any part geometry

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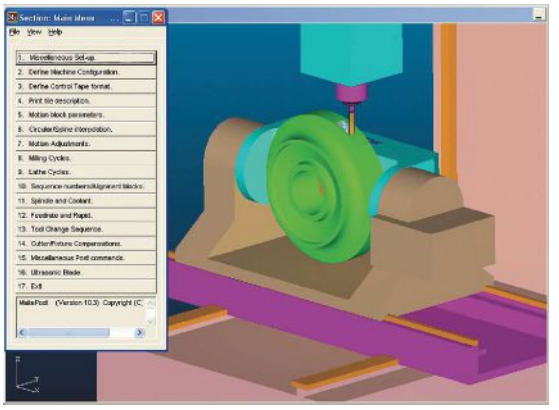

Universal Postprocessor Generates NC Code for Various Machine Tools

NCCS Corp.'s PostWorks 17.2 is a universal postprocessor that generates NC code for a variety of machines. The software is compatible with Heidenhain, Siemens and FANUC controls.

The PostWorks suite includes software to simulate the material removal process and machine kinematics while identifying possible interferences between all relevant components in the machining environment.

Version 17.2 updates the CLRSRF/START,TRFORM,ON command that enables the transformation of the clearance plane through the matrix defined by the external Machine Adjustment File (MAF). The CLRSRF clipping planes retract logic so the tool can be retracted when CLRSRF/STOP or NOMORE are encountered, and the standard retract move can be omitted when the tool moves less than a specified distance between clip plane intersection locations.

This version can also create a tape break sequence when a set number of tape blocks are outputted. The word SEQNO in tape break mode now has added support. The punch file can now be withheld when an APT source input error is encountered. In previous versions, a punch file could only be withheld upon encountering a regular processing error.

Numerical Control Computer Sciences
949-852-3664 | nccs.com

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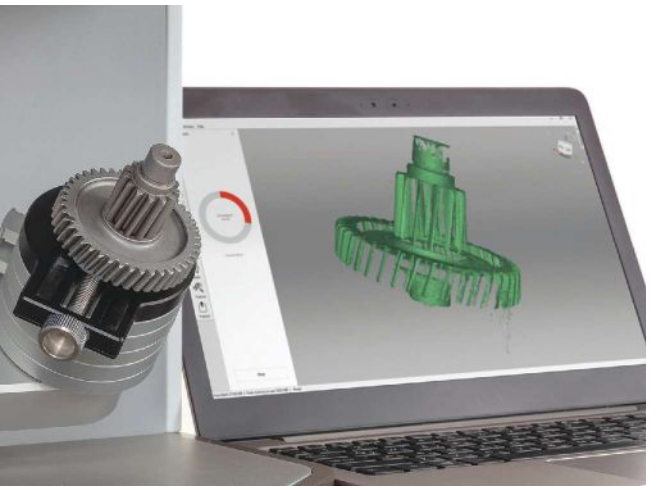
Quality Inspection Software Enhanced for Functionality

Artec Studio 14 performs quality inspection with features such as expanded CAD/CAM functionality and Artec Micro integration. With the software, users of Artec's Ray 3D scanner can perform geometry-only global registration without setting up spheres or 2D targets. Additionally, users can perform hybrid registration using geometry and 2D targets.



When exporting files to SolidWorks or other CAD/CAM applications, users can export unlimited open and closed contours as polylines in CSV or DXF files. This allows for the reverse engineering of simple shapes without the need for intermediary software, the company says.

This version of the software adds PBR-based automatic glare removal. Users can adjust the level of glare removal and can use the dynamic auto-brightness feature to automatically optimize levels during scan previews. The bridge feature enables users to fix holes in scans because it recreates missing geometric data.

The autopilot feature enables users to align their model automatically. The one-click auto-positioning feature enables users to create default positions for scans, and when the file is open in Artec Studio or other software, the scan wil appear in the chosen position.

Artec 3D | 408-275-2823 | artec3d.com

HEIDENHAIN

TNC 640 – High-End Control for Milling and Turning Operations

For the first time, milling and turning are combined in one TNC. With HEIDENHAIN's TNC 640, users can now switch as desired between milling and turning—within the same NC program. Switchover is independent of the machine kinematics. It automatically takes the respective operating mode into account and without any additional action. This new simplicity is complemented by dialog-guided plain language programming, the optimized user interface, powerful programming aids as well as comprehensive cycle packets taken from amply field-proven HEIDENHAIN controls into the TNC 640.

HEIDENHAIN CORPORATION, 333 East State Parkway, Schaumburg, IL 60173 847-490-1191 www.heidenhain.us

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Vibration Sensors Reduce Machine Monitoring Costs

VocalZoom has launched the next generation of its vibration sensors designed to help predict and prevent mechanical failures. Because they can monitor machine health without touching the equipment, VocalZoom sensors cover a greater array of equipment and use cases than traditional predictive maintenance solutions without high factory downtime and deployment costs, the company says.

Many sensors rely on micro-electro-mechanical systems (MEMS) or piezoelectric or acoustic technology that reduce their applicability to various types of machinery. VocalZoom's non-contact vibration sensors, on the other hand, are intended to be easily deployable on both new and old machinery, whether it be wet, hot, moving, hard-to-reach or too small for other sensors.

"The Industrial IoT is only as good as the sensors that monitor machine performance," says Tal Bakish, CEO. "Unfortunately, most IIoT sensors are built on technology that makes predictive maintenance solutions expensive and unreliable for a number of important use cases. Our vibration sensors represent the next generation of predictive maintenance solutions, offering better monitoring at lower cost for up to 70 percent of all industrial machinery."

VocalZoom's vibration sensors use self-mixing laser diode (SMLD) technology to measure the vibrations of a machine. The sensors measure 15 × 6 × 3 mm in size and operate at a distance of up to 3 m away from the machine they are monitoring. The sensors use lasers, which are immune to ambient and environmental noise, rather than mechanical or audio technology. With fewer moving parts and operating without batteries, the sensors require less maintenance than other sensors.

VocalZoom
vocalzoom.com

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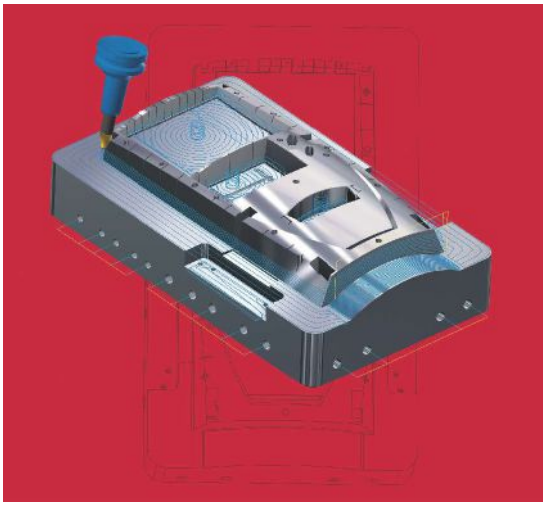
CAM Software Streamlines Machining from Setup to Completion

CNC Software has released Mastercam 2020, which increases machining productivity and reduces production costs with 2D as well as multi-axis milling automation features, CAD and model preparation improvements, improved machine configuration and 3D tooling.

The software provides a series of improvements to automated 2D and five-axis tool paths. The 3D blend tool path is designed to deliver an improved surface finish and to provide stock and holder checking. 3D tooling has also received many usability improvements such as 3D tool icons in tool lists, stop-on-contact functionality when mating insert to holder, and auto-populating compensation point when defining 3D tools.

Mastercam 2020 increases efficiency and reduces job setup time for part machining and programming, according to the company. The software includes the ability to filter inserts and holders by attributes as well as the ability to track associativity. Other enhancements include faster chaining for Wireframe and Solids as well as chain display and behavior improvements.

With improvements to toolpath and machine simulation, toolpath graphics, and other verification and analysis tools, Mastercam 2020 provides programming



security and enables informed decision-making. The software moves the tool to a home position between operations when there is a plane change. Rotary axis positioning allows users to simulate and visualize multi-axis movement of the machine tool, while Skip Drill Cycle Pecking improves cycle time estimates.

Mastercam - CNC Software Inc. | 860-875-5006
mastercam.com

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Machine Monitoring System Identifies Possible Collisions

Marposs' Genior Modular GEMCMS-02 is a compact machine monitoring system designed to identify the potential for machine tool component collisions and crash damage. The GEMCMS-02 can be used as a standalone system or in combination with other Genior Modular solutions, achieving collision detection, process monitoring and parallel process visualization. Minimizing the risk of downtime that can occur by programming, setup or operating errors, it can be integrated into machine tools, robots and other equipment.

As with other Genior Modular products, the GEMCMS-02 is independent of control or machine type and can be retrofitted to existing machines. It provides protection from the first part with no teach cut required, the company says.

The GEMCMS-02 monitors the deformation of the spindle housing structure with a piezo strain sensor that detects irregularities in the production process. It measures elastic deformation in the range of one tenth of a micron and detects both slowly and dynamically increasing forces that can indicate damage potential. It then generates a stop signal within one millisecond, helping to eliminate machine crashes that can result in high repair costs and long down times.

The kit consists of an electronic module, a sensor and a software package for configuration, visualization and data management achieved by connecting an Ethernet cable to a Windows-based industrial PC, Windows-based machine control panel or IPC4 dedicated monitor. There are three operation modes and three limits per mode. Detailed event records including date, time and other signals can be used for further evaluation.

Marposs Corp. | 248-370-0404 | marposs.com

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Analytics App Monitors Multiple Machines

Mitsubishi Electric Automation's Integrated Machine Analytics (IMA) mobile application allows users to monitor their CNC machines through MTConnect, an open standard that makes universal equipment connectivity possible. The application is designed for Mitsubishi Electric machines, but it will work for any MTConnect-compliant CNC.

The IMA mobile app offers real-time monitoring and analysis of CNC functions and will notify the user when changes or anomalies are detected. If users have multiple CNC machines in their facility with an MTConnect-compliant adapter, the application can monitor all of them simultaneously. This allows users to ensure projects are staying on schedule and eliminate potential issues before they become significant.

"Users can enable push notifications to keep tabs on their machines at all times, especially for significant events like machine warnings or alarms," says Justin Kueker, business development manager.

Mitsubishi Electric Automation Inc.
800-950-7781 | us.mitsubishielectric.com/fa/en

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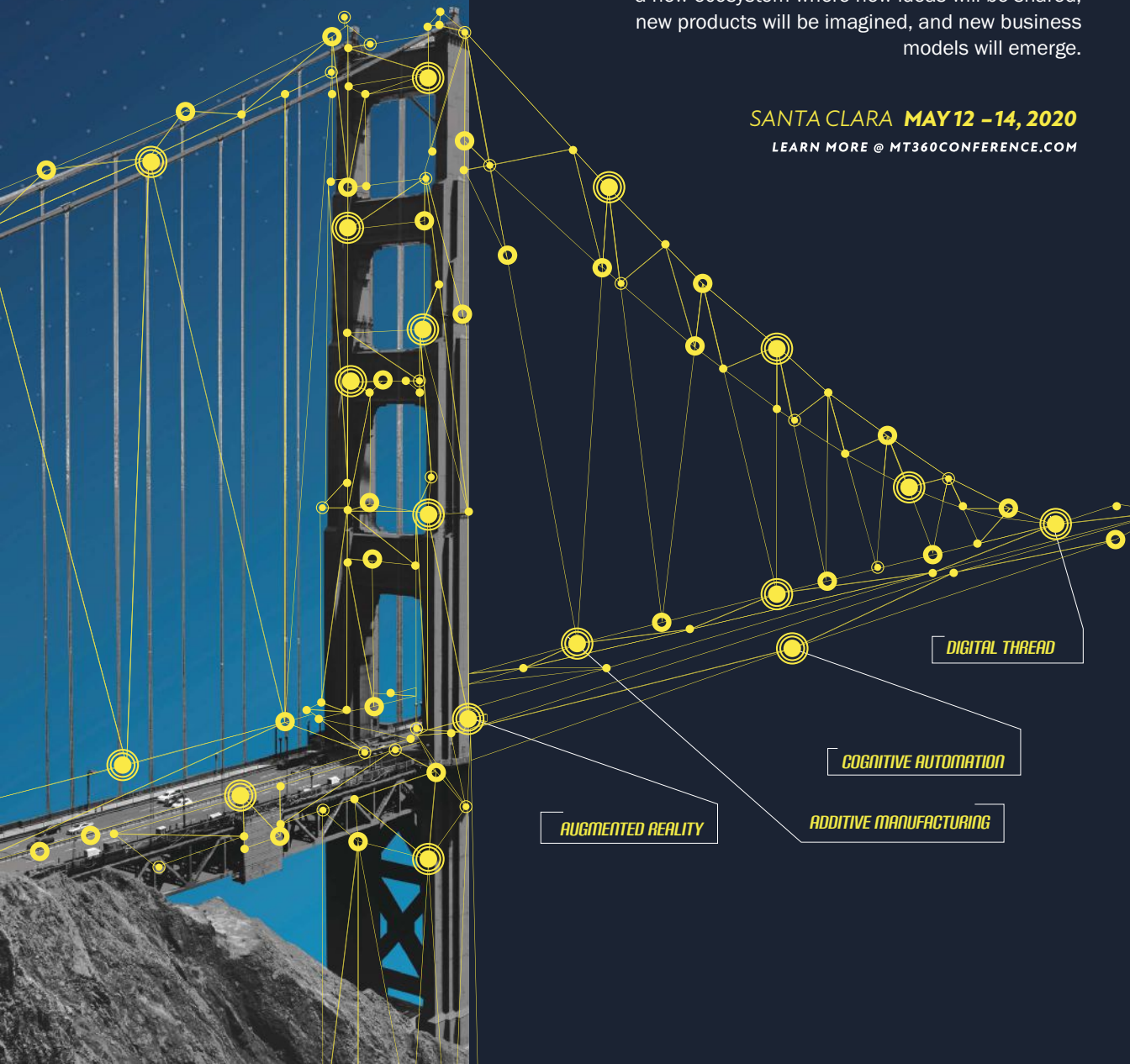

Cloud-Ready Software Portfolio Promotes Production Efficiency

Siemens Opcenter expands on the company's manufacturing operations management (MOM) software by combining products into a cloud-ready portfolio designed to help manufacturers meet demands for production efficiency, quality, visibility and reduced time to production.

The portfolio integrates MOM capabilities including advanced planning and scheduling, manufacturing execution, quality management, manufacturing intelligence and performance, formulation, specification, and laboratory management. Siemens Opcenter combines products including Camstar, SIMATIC IT, Preactor, R&D Suite and QMS. A web-based user interface provides an adaptive user experience and facilitates the implementation of new capabilities and additional components while reducing training efforts, according to the company.

Siemens Opcenter adopts what the company calls an extensibility paradigm, which enables users to deploy, configure, extend and integrate it with other systems across the value chain, including product lifecycle management (PLM), enterprise resource planning (ERP) and shopfloor automation solutions. It provides end-to-end visibility into production, letting decision-makers identify areas for improvement within product design and associated manufacturing processes, making operational adjustments for efficient production.

Opcenter is designed so that users can achieve operational flexibility and run the same applications on mobile devices. The entire portfolio is cloud-ready and can be deployed on-premise, in the cloud or both for potential IT cost reductions and scalability.

Siemens PLM Software | 800-498-5351
plm.automation.siemens.com

JEDD COLE | EDITOR | jcole@mmsonline.com

Modern Equipment Review

SPOTLIGHT | ROBOTS AND AUTOMATION

Standardized Cells Facilitate Entry into Robotic Welding

To help manufacturers adopt new robotic welding capabilities quickly and inexpensively, Acieta has developed FastArc standard weld cells. The new cells are pre-engineered with integrated utilities and a one-piece platform for faster delivery and startup.

"Labor and capacity are both major concerns for manufacturers of all sizes right now. Automated welding is a great way to address those, but finding the time and budget for complex, robotic solutions has been a real challenge," says Pete Rogers, vice president of operations. "The FastArc standard cells eliminate these barriers, so nearly any company can get started with automation and see a return on investment in less than two years."

Four standard cells are available with attachments and upgrade options. FastArc cells come standard with Lincoln Electric or Miller welding equipment, though

other options are available. The Single Zone cell offers a large workzone and automated steel pop-up door for flash protection and operator safety. The Dual Zone cell enables loading and unloading while the robot is welding as well as the ability to weld different parts simultaneously. The Dual Zone Fixed Table cell includes two workzones and automated steel pop-up doors for flash protection. The Dual Zone Turn Table cell features a servo-driven turntable with steel divider guard for fast, accurate and safe rotation between cycles.

| Acieta LLC | 562-576-1103 | acieta.com

Collaborative Robots Offers Speedy Integration and Programming

Featuring built-in vision and a user-friendly, plug-and-play programming interface, the TM-series collaborative robot from Omron Automation is designed to work seamlessly and safely with human workers to enhance productivity. Easily transportable, the robot complies with safety requirements for human-robot collaboration specified in ISO 10218-1 and ISO/TS 15066, and so requires no guarding. A manual teaching function enables operators to use hand guidance rather than code to train the robot to perform almost any repetitive task in any location, including machine tending, screw driving, gluing, soldering, assembly and more.

A flowchart-based programming interface and intuitive teaching reduces installation and setup times compared with traditional industrial robots. No prior robot programming experience is necessary.

An integrated on-arm vision system further reduces setup time. Built-in vision and integrated lighting captures parts with a wide viewing angle. Image sensing functions include pattern matching, barcode reading, color identification and more.

The introduction of the new collaborative robot is geared toward manufacturers seeking to boost production and reduce employee fatigue by automating repetitive tasks.

| Omron Automation Americas | 800-556-6766 | omron247.com

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Robot Cell Manages Two Machine Tools Simultaneously

The Fastems RoboCell One is designed for handling heavy workpieces weighing up to 176 lbs (80 kg). The robot cell can automate two machine tools of the same type: lathes or milling machines.

The RoboCell One can produce different batch sizes of various part types. An optional automated gripper change system enables flexible workpiece handling and new component implementation without interrupting production operations, the company says. The robot can be fitted with single, double or special grippers. As many as six different grippers may be used for handling workpieces in specific production operations.

The robot operates in one linear axis and supplies two machines with workpieces, enabling simultaneous production. To do this, the robot changes its grippers for loading and unloading the unit. The result is optimal use of machine capacity, even when orders are frequently altered, according to Fastems.

The company's Manufacturing Management Software (MMS) automatically plans the production process based on orders given, including the changes of workpieces for batches of different sizes, taking account of all the necessary resources. The software shows the current production status in real time, calculates machine capacities for outstanding orders and shows the operator necessary machine retooling operations.

The operator configures the robot's movements through parametric programming in MMS rather than teaching it. The necessary values and/or parameters for workpiece handling are stored in the control system through the MMS interface, meaning that new parts, master data, and orders can be produced during production operations.

Fastems LLC | 513-779-4614 | fastems.com

CNC System Incorporates Robot Control

Through a cooperative agreement, Siemens and Comau now offer a jointly engineered Sinumerik Run MyRobot/DirectControl product. This product enables robot kinematics to be fully integrated into a CNC system. The Sinumerik CNC controls the articulated robot arm directly with the basis of complex algorithms without the need for a separate robot controller, as the operations are entirely controlled on a second channel of the CNC.

The Sinumerik Run MyRobot DirectControl solution allows the CNC both to control the robot arm drive system and to contain safety functions typically performed by the robot controller.

Integrating control of the robot arm into the CNC is said to help improve path and positioning accuracy as well as reliability. It also yields enhanced dynamic response during robot-aided machining tasks. As a result, the companies claim, the robot is able to undertake more challenging machining assignments, while users receive the advantages of compact hardware, simpler engineering and faster commissioning. Additive manufacturing, fiber placement, machining, carbon fiber reinforced polymer and laser machining are among the sectors the company says this product can benefit.

The major difference between the DirectControl technology and conventional systems is that it performs all the functions previously assigned to the robot control system, making the separate robot controller unnecessary. In addition, Sinumerik Run MyRobot/DirectControl performs all the same functions as the previous Run MyRobot variants.

Comau Robotics spa | 390110049111
comau.com

Siemens Industry Inc. | 800-879-8079
usa.siemens.com/cnc

JEDD COLE | EDITOR | jcole@mmsonline.com

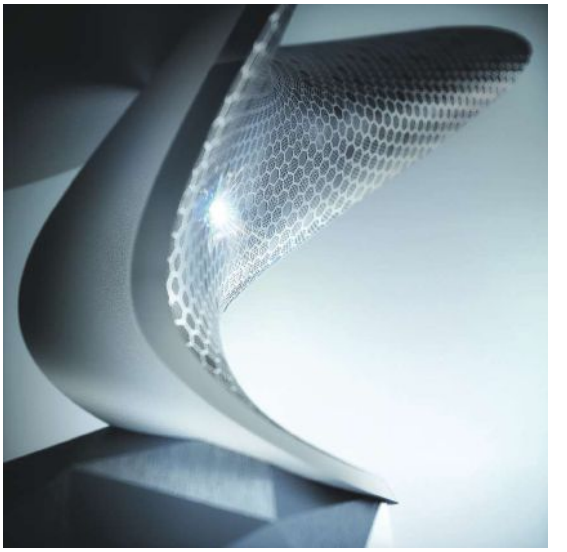
Modern Equipment Review

Laser Texturing Machine Processes Parts with Greater Security

Available from GF Machining Solutions, the AgieCharmilles Laser S series texturing systems are designed to reduce errors and save time on the most challenging surfaces of molds and other parts. According to the company, the systems reduce quality deviations without additional machining process by providing a digital alternative to conventional and manual surface texturing methods.

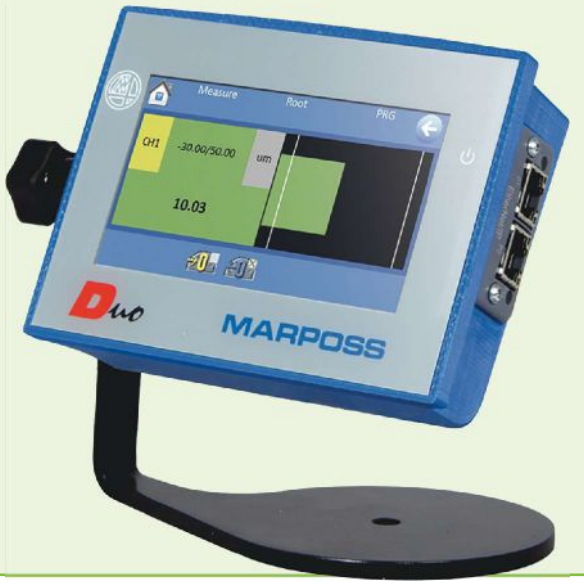
The system is said to make difficult-to-realize designs easier to generate for more creative freedom and faster time to market, especially in industries such as automotive and information and communications technology (ICT).

GF Machining Solutions LLC | 800-282-1336
gfms.com/us



Small Display Unit Can Display Two Measurements

Marposs' Duo is an electronic display unit similar in size to a smartphone. It features a 4.3" touch screen for display and storage of measuring data acquired through one or two sensors. Designed in response to customer needs, it is described as a "something-in-between" display unit that provides quality features at an affordable price.



Duo is well-suited for simple manual applications when only a few measurements are needed on the shop floor at any given time. Featuring two sensor input channels, it can simultaneously display two measurements at once in either analog or digital.

The unit is designed to work with Marposs LVDT/HVT manual gages such as the M1 and M1 Star bore gages, M3 snap gages, M4 and M4 Star ring gages, and Red Crown/Red Crown2 displacement sensors with a measuring range of ±5 mm. Data collected can be exported through the USB port or the optional Fieldbus port.

Marposs Corp. | 248-370-0404 | marposs.com

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Speed Increasers Reduce Spindle Wear, Tear

Platinum Tooling Technologies is now importing Henninger speed increasers for North American customers. Spindle speeder types include mechanical, air and electric motor-driven styles. The speed increasers maximize productivity by achieving the higher spindle rpm required for certain applications, according to the company. In addition, they are said to reduce wear and tear on the machine's spindle when it is not required to run at its maximum speed.

Mechanical speeders are available with gear ratios ranging to 1-8 and with a maximum speed of 50,000 rpm. Air speeders can run continuously at up to 80,000 rpm, and high-frequency motor spindles can maintain up to 80,000 rpm with high torque. The latter also have variable speed options. Many of the speeders have automatic tool-change capabilities. Modular design promotes flexibility, according to the company.

Platinum Tooling | 847-749-0633
platinumtooling.com

Large-Format Marking Machine Eliminates Tile Marking

Laser Marking Technologies LLC has released the Cobalt XD large-format machine featuring a digital galvo marking head with a third optical axis. Incorporating this technology allows the machine to mark in a continuous 20" × 20" marking field without any moving stages or moving any parts. »

The advantage of this system over a traditional X-Y gantry-style machine is that it seamlessly marks a larger field. This means decreased cycle times and easier tiling and marking of large graphics. With traditional X-Y systems, operators must mark a section, mechanically move the head or material, and then mark again. This process must be repeated until the machine has marked across the entire area. Not only does this make it more difficult for the operator to program the software, but it also makes it more complicated. The operator may also be unable to meet cycle time requirements because of the slow speed of the mechanical motion. The XD can process the entire area without having to tile mark. This speeds up the process, eliminates gaps in the final image and eases programming.

Laser Marking Technologies LLC | 866-799-0199
lasermarktech.com

EDM Drilling Machine Features 38" Y Axis

Current EDM's EdmDrill RT3038 is a high-capacity machine designed for complex drilling of large and heavy parts common to the aerospace, automotive, power generation and cutting tool industries.

The EDM's table strokes measure 30" in the X axis and 38" in the Y axis. The longer Y axis enables the use of large rotary tables that can be installed either horizontally or vertically to drill both flat and tall parts. The standard five-axis configuration uses the Nikken 5AX201 tilt/rotary table, which is installed at the front of the machine to ease part loading and unloading.

Current EDM Inc. | 650-966-9676 | currentedm.com

Turn-Mill Features Ergonomic Design

Index's G420 turn-mill features two identical 3,500-rpm spindles with 315-mm (400-mm optional) chucks as well as a five-axis milling spindle. The machine's stability and dynamic response make it a good choice for working with difficult-to-machine materials such as those used in aerospace, and machining large, complex parts in a single setup, the company says.

The main and counter spindles each accommodate barstock ranging to 102 mm in diameter and can chuck parts ranging to 315 mm in diameter (400 mm optional). The large work area provides space for parts as long as 1,600 mm and incorporates an ergonomic design to optimize operator accessibility. An optional workpiece handling system can be incorporated for loading, unloading and transferring parts weighing up to 20 kg and measuring 120 mm in diameter.

The milling spindle offers 26 kW of power, 150 Nm of torque and 12,000 rpm with an HSK-T63 interface. A Capto C6 option provides 27.5 kW, 100 Nm and 18,000 rpm. Optimized Y⁄B quill kinematics enable highly productive simultaneous five-axis milling operations to tackle complex geometries, the company says.

Designed as a modular system, the G420 can accommodate up to three tool carriers, each equipped with a Y axis. Turret steady rests are available to ensure maximum stability when machining long parts or shafts.

Ergonomics and flexibility were major considerations when designing the G420, Index says. The goal was to make all relevant components easily accessible to operating and maintenance personnel. A chip conveyor can be mounted to either side of the machine to make optimum use of available floorspace. Automation such as conveyor belts and robot handling units can be integrated to provide additional enhancements to productivity.

Index Corp. | 317-770-6300
index-usa.com; indextraub.com

Five-Axis Machining Center Features Versatile CNC

Hurco's double-column BX40Ui five-axis machining center is equipped with a trunnion table mounted along the Y axis for performance and flexibility. The ladder structure and double-column design lend rigidity and support to the head casting. The 18,000-rpm motorized spindle and oversize linear guide rollers are said to make the BX40Ui well-suited for a range of applications.

The integrated Hurco control powered by WinMax control software and UltiMotion supports multiple programming methods: conversational programming for five-sided machining without a CAM system; NC programming for simultaneous five-axis machining; and Hurco-specific NC/Conversational Merge designed to optimize programming efficiency. The newest control feature, 3D Import, enables the automatic creation of Transform Planes for easier five-sided conversational programming that eliminates data-entry requirements.

| Hurco Companies Inc. | 800-634-2416 | hurco.com

Gundrill Provides Six Spindles for Productive Camshaft Processing

The DeHoff 1024C, available from Kays Engineering, is a six-spindle gundrilling machine designed for high-volume production of automotive camshafts. The machine is designed to gundrill a hole down the centerline of the camshaft to reduce weight. This enables a Tier 1 automotive supplier to produce lighter camshafts in large volumes for use in newer high-efficiency engines.

The 1024C has a gundrilling diameter capacity of 1" (25.4 mm) and a slide travel of 24" (610 mm). It features six gundrilling spindles on a single machine base and uses adjustable tailstocks and hydraulic workpiece clamping. The camshafts are automatically loaded and unloaded using a lift-and-carry material handling system.

The machine features steel box ways and hand-scraped mating components (instead of linear guideways and milled surfaces). These components are said to provide superior vibration damping, extended tool life and improved surface finish, the company says.

Kays Engineering Inc./DeHoff/Eldorado
660-886-9929 | kays-dehoff.com

Scanner Improves Field of View for Micromachining Lasers

Aerotech's AGV-SPO single-pivot-point galvanometer scanner provides a larger field of view and reduced spot distortion for laser micromachining applications. The optical design effectively controls the beam entrance pupil to be coincident for the X and Y scanner motion, increasing the effective numerical aperture of the scanner system. It thus enables a larger field of view for a given focal length and reduces spot distortion over the entire working area. These advantages allow the AGV-SPO to process larger parts faster with greater consistency, the company says.

The galvanometer is available with a selection of optical coatings and focusing optics to support a variety of commonly used laser wavelengths and focal lengths. Customized optics and optical mounting features are also available, upon request. The AGV-SPO can be configured with active cooling features such as air-cooled mirrors and/or water-cooled motors to preserve working-plane accuracy in the presence of thermal disturbances caused by the laser and aggressive motion profiles.

With Aerotech's motion and Position Synchronized Output (PSO) capabilities, contouring functions such as Acceleration Limiting can be used to automatically reduce speeds in tight corners or small radii, minimizing overshoot. The laser can be triggered based on the position feedback of the mirrors with PSO to ensure consistent spot overlap as the scanner changes speed. The company's Infinite Field of View (IFOV) function combines servo and scanner motion to extend the marking capability of the scanner across the entire travel range of the servo stages, eliminating stitching errors that can occur in a traditional move-expose-repeat process.

Aerotech Inc. | 412-963-7470 | aerotech.com

12-kW Fiber Laser Increases Machine's Productivity

Bystronic has introduced the ByStar Fiber with a stronger 12-kW fiber laser enabling use of the BeamShaper option, which is designed to ensure consistent cutting quality on varied materials up to 1.125" in thickness. With the stronger laser, the machine's cutting speeds increase by as much as 20% when laser cutting with nitrogen, compared to the previously available 10-kW laser source, thereby increasing productivity with sheet metal ranging from 0.125" to 1.125".

A slimmer design for the new cutting head decreases the possibility of contact with cut features while operating. With fewer components, the new design also decreases maintenance and operating costs because the integrated technology is better protected from contamination. Optimal cooling features promote consistent cutting performance during long operations at high power.

The BeamShaper function is said to improve cutting quality with steel sheet metal as thick as 1.125". This option can be selected with the purchase of a new ByStar Fiber or retrofitted at a later date. BeamShaper enables adjustment of the laser beam profile to cut greater sheet thicknesses and variable sheet metal qualities.

Bystronic Inc. | 800-247-3332 | bystronicusa.com

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Metalworking Index Advances

Production leads Index growth.

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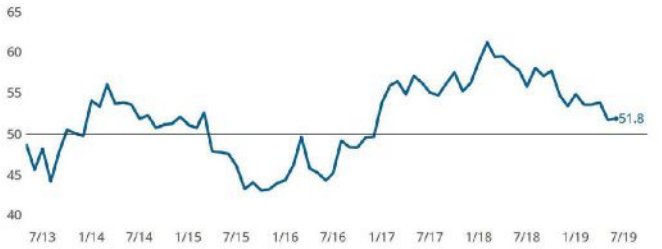
Michael has performed economic analysis, modeling and forecasting work for nearly 20 years. Gardner Intelligence is a division of Gardner Business Media, publisher of this magazine.

The Gardner Business Index (GBI): Metalworking registered 51.8 in June, signaling marginally greater business activity compared to the previous month. Index readings above 50 indicate expanding activity while values below 50 indicate contracting activity. The Index is calculated as an average of its components. The Index was supported by expanding activity in production, supplier deliveries and employment. The new orders reading registered slightly below the average of the components. The Index was pulled down by the ongoing contraction in exports and backlogs.

Data collected in June extended many of the trends observed in the data over the last six to 12 months. Supplier deliveries have continued to closely track with production activity readings. This comes after supplier deliveries expanded far faster than any other component during the second half of 2018, as manufacturers rushed to fill new orders. Similar readings for both the supplier deliveries and production components in 2019 suggest that manufacturers have astutely moderated their inventory levels, thereby preventing a glut of inventory.

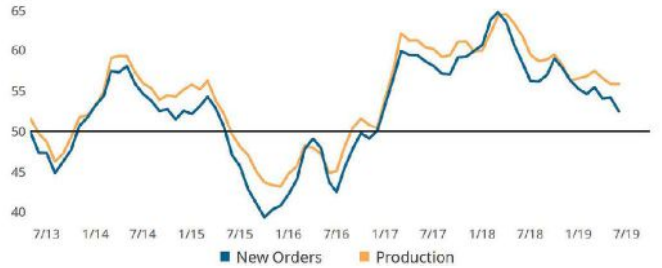
Exports registered their fastest rate of contraction since August 2016. A June increase in production activity coupled with a simultaneous slowdown in new orders growth contributed to another month of contracting backlogs.

METALWORKING BUSINESS INDEX



The Metalworking Index was supported by production, supplier deliveries and employment. New orders activity fell slightly below the average reading of the six components that constitute the total index.

METALWORKING — NEW ORDERS & PRODUCTION



The gap between production and new orders activity has widened since the beginning of 2019. This gap has been made possible as shops have drawn down their inventory of backlog orders.

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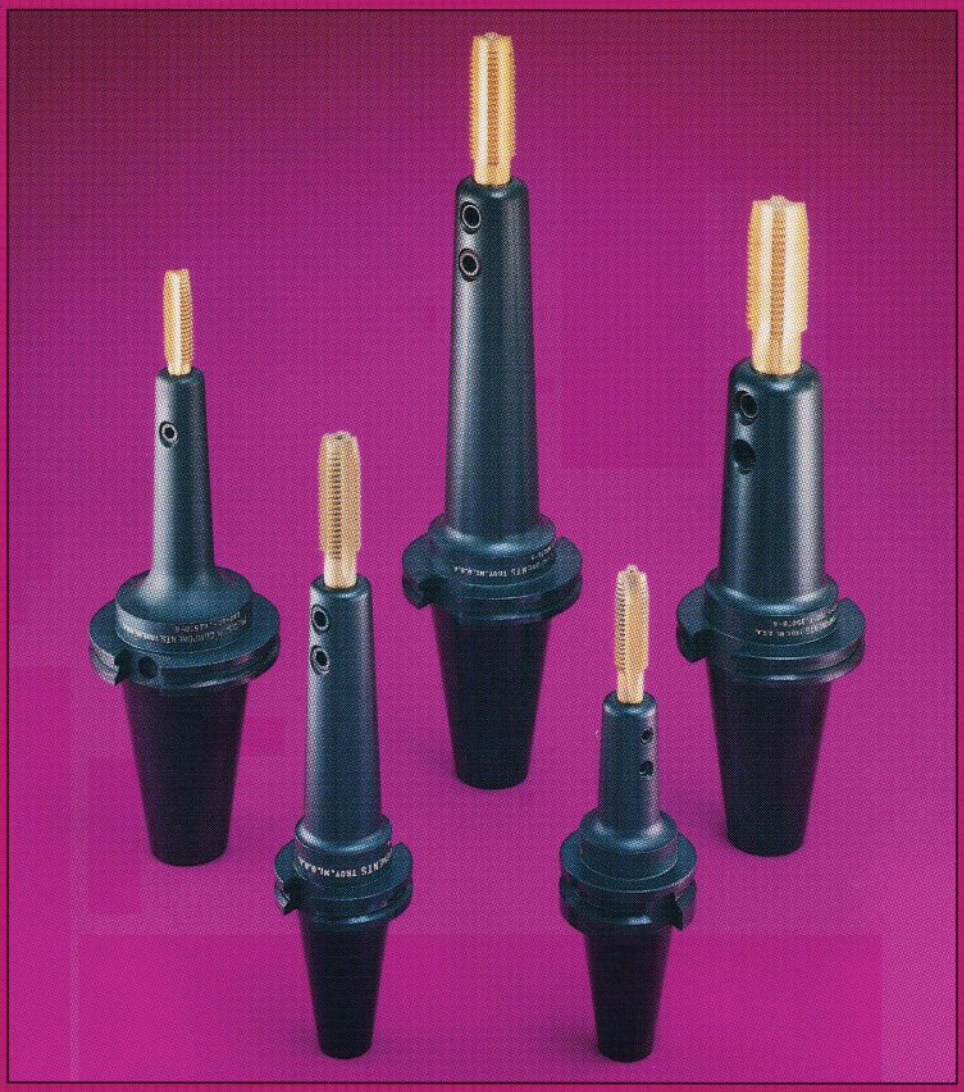

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