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   7. ☐ Furniture and Related Product Manufacturing
   8. ☐ Miscellaneous Manufacturing
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3b. If your company does NOT manufacture AT THIS LOCATION, specify company’s primary product or service performed. (please specify)

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   4. ☐ Energy
   5. ☐ Heavy Equipment
   6. ☐ Medical
   7. ☐ Transportation (including automotive)
   8. ☐ Other (please specify)
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Iscar Metals Inc. runs nearly 30 different cuts in a block of 4140 alloy steel using a range of tools and tool lines at a milling seminar.

Precision Tool Technologies Inc. shows its FullShop system, which monitors coolant at a machine tool sump and replenishes coolant before it runs low.

Jeffrey Badger looks at the impact that different grinding approaches have on cup wheel wear in the 101st episode of CTE’s Ask the Grinding Doc video series.

Fight COVID-19 and keep your workplace safe with these 3D-printed door handle adapters that enable hands-free entry. Emag LLC’s adapters withstand everyday industrial use. Keeping true to #InThisTogether, the company is freely sharing the designs. See this and more on CTE social media.
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PANDEMIC RESPONSE UNIFYING

When I joined Cutting Tool Engineering in 2007, I immediately noticed the lack of controversy in our coverage of the manufacturing industry — an aspect I welcomed. I’d had enough after spending nearly two decades writing about dentistry prior to joining CTE.

Right about now you might be wondering, “Dentistry? Controversial?” Yes. Just try writing about mercury in dental amalgam fillings or the fluoride in our drinking water.

CTE covers practical information about new products, technologies and machining operations, to put it succinctly. Sure, there’s usually more than one way to get a job done when it comes to metalcutting, but you don’t see machinists protesting about it, at least not in public.

Even with the current political divide in the United States, there’s been little worry that the “us versus them” fervor somehow would spill over into our coverage.

Then came COVID-19, sheltering in place, working from home, essential businesses, nonessential businesses, layoffs, furloughs and, perhaps inevitably, protests to reopen the economy. I suddenly found myself worrying that the controversy surrounding the pandemic would cast a shadow over the industry.

But that hasn’t happened, at least not yet. In fact, the opposite has occurred as evidenced from the flurry of news posted to our website in the past couple of months. Here’s a tiny sampling:

Monaghan Tooling Group rushes custom ventilator tooling project.

Bantam Tools gives milling machines to companies working on COVID-19 relief efforts.

Crafts Technology Inc. provides tooling in COVID-19 test kit production.

Boyce Technologies Inc. produces 3,000 “bridge” ventilators.

Forest City Gear Co. donates $3,100 to Rockford Rescue Mission.

In short, the industry has stepped up to help battle COVID-19. That’s an uplifting, unifying response.

COVID-19 Survey Addendum

To gauge the economic impact that the pandemic is having on the industry, CTE added four optional questions to our biennial benefits and salary survey. While you’ll have to wait until our August issue for the results of the benefits and salary portion, I want to share early results from the COVID-19 addendum.

Of the nearly 100 respondents who completed the addendum, 83% said their company remains open, and 57% have not laid off or furloughed employees. Of the companies that remain open, CTE asked, “Which of the following best describes your situation?”

- The company is considered an essential business and therefore remains fully open.
- The company is considered an essential business and therefore remains open on a limited basis.

Almost 70% responded that they remain fully open. Slightly over 30% of respondents said they are open on a limited basis.

Of the companies that remain open, CTE asked respondents to indicate how their current production compares with their workload prior to the pandemic. Their responses follow:

- 21% said their workload is about the same or up.
- 22% said their workload is down 20%.
- 21% said their workload is down 40%.
- 19% said their workload is down 60%.
- 16% said their workload is down 80%.

Overall, this isn’t great of course, but it’s a sign that the industry is weathering the pandemic.

about the author

Dennis Spaeth is CEO and publisher of CTE. Contact him at 847-714-0176 or dspaeth@ctemedia.com.
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Kwik Mark Inc.; www.kwikmark.com

ROUTERS FOR MACHINING FIBERGLASS: YG-1 Tool Co. Ltd. has introduced four solid-carbide routers for machining fiberglass and other composite materials with CNC or manual machines. The routers are suitable for roughing, finishing, edge trimming, slotting, grooving, drilling and interpolation. They are available with four distinctive cutting ends: NC, burr, mill and drill.
YG-1 Tool Co. Ltd.; www.yg1usa.com

ROBOT FOR HEAVY LOADING: Erowa Technology Inc. offers the Robot Easy 800 for loading workpieces that weigh up to 800 kg (1,764 lbs.) and measure up to 850 mm in diameter × 1,000 mm (33"×39") into a CNC machine. The robot is optimally suited for moving pallets from Erowa Technology’s modular tooling system.
Erowa Technology Inc.; www.erowa.com

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Right now, what’s providing the main push toward advanced digital technology at machining firms? Is it a sudden influx of more knowledgeable, forward-thinking leaders at these companies? No, it’s the threat that has driven millions of people from workplaces all over the world: the spread of the coronavirus.

That’s the view of Francesco D’Alessandro, branch manager at Balance Systems Corp., Wixom, Michigan. The business offers equipment that falls under the umbrella of Industry 4.0, which aims to improve data collection and interconnectivity of industrial machinery. He believes that this equipment can help machining firms cope with the consequences of the pandemic. But he also thinks there’s a good chance that the people in charge at these companies aren’t even aware of what’s possible.

“Among machine users, I think many decision-makers don’t know that today there is technology that can help them,” he said. “By making a minimal investment in this technology, they can do a variety of monitoring and maintenance operations remotely.”

Until recently, D’Alessandro said, many people in the machining industry who did know about this technology failed to embrace it due to “cultural problems” at both small shops and large manufacturing plants.

“The former are skeptical of technological novelties, which they often see merely as a cost and not as an investment,” he said. “As for the latter, their internal path for product validation can be long and have some roadblocks.”

Now, however, D’Alessandro thinks that the pandemic is forcing machining operations of all sizes to consider speedy adoption of advanced technology if they want to gain an edge over competitors or even stay in business.

As an example of this type of technology, he mentioned Balance Systems’ B-Safe spindle monitoring system, which comprises a sensor unit with a cable, along with an electronic interface. The sensor unit attaches to a machine spindle. The cable carries data from the unit to the electronic interface, which is located in a nearby electrical cabinet.

One of B-Safe’s main functions is to detect any type of collision during machining. Connected to the internet, B-Safe allows users to remotely monitor machines and receive notification in the event of a collision. Continuous machine monitoring can be done remotely via laptop or cellphone.

In addition to watching for collisions, B-Safe lets remote users keep tabs on vibration and temperature when machining.

“If the cutter or spindle is not in good condition, the vibration and temperature generated are typically higher than normal,” D’Alessandro said. If this “red flag” is observed while monitoring a machine from home, “a manager can call the plant and tell the operator to double-check the machine to make sure everything is in order.”
B-Safe also features a predictive maintenance function that estimates the remaining lifetime of a spindle based on use of a machine tool. He said plant or maintenance managers working remotely can be alerted on cellphones when spindle life reaches a certain preset threshold. After receiving an alert, a manager may call a repair company to arrange spindle service before a breakdown occurs.

Remote machine monitoring also is possible with Balance Systems’ VM25 and VM15 process control systems for grinding machines, D’Alessandro said. When connected to the internet, these systems can be checked by service engineers working from home. Unlike B-Safe, he said, these systems allow remote maintenance via the internet.

“Because of machine wear, mechanical conditions can be different after six months of operation, so the parameters of these systems may need to be adjusted a little,” D’Alessandro said. “The same thing might be necessary if a grinding wheel is changed. If that’s the case, a service engineer using our service package can connect via the internet and adjust those parameters remotely.”

He recently has seen more systems introduced by other companies that enable remote machine monitoring. He also reported knowing two major machine tool OEMs that have embedded remote monitoring technology in their machining centers.

If COVID-19 stays around much longer, more developments like these certainly will follow.

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**about the author**

William Leventon is a contributing writer for CTE. Contact him at 609-926-6447 or wleventon@gmail.com.
The challenges of high-temperature materials like titanium, plus increased pressure to reduce cycle times and costs, are forcing manufacturers in aerospace, energy, medical and other industries to seek new methods to machine these materials in the most productive ways possible.

CAM software providers continually improve their products to keep pace with the evolution of materials while adapting to innovations on the side of cutting and machine tools. The goal is to develop toolpath strategies that address the machining characteristics and challenges that these materials present, as well as to exploit developments with machine and cutting tools. Research and testing often uncover surprises.

For example, Tolland, Connecticut-based CNC Software Inc., developer of Mastercam, operates a manufacturing lab for toolpath and machining research to gain hands-on feedback on CAM developments. Personnel ranging from application engineers and product specialists to the partnership team use the lab to test new ideas under typical shop conditions. What makes the lab unique is its collaboration with industry leaders in the machine and cutting tool fields. The facility regularly cycles through equipment to accurately replicate customer environments, and cutting tool partners often use the lab to test their most recent technological advancements.

A recent project involved testing a counterintuitive roughing strategy that potentially could translate into large cycle time reductions for titanium parts. This theory was grounded in earlier lab tests. Leveraging the optimum cutting condition and constant chip load capabilities of Mastercam’s Dynamic Motion toolpaths, the lab ran a test with D2 tool steel at an 80% step-over and 200% DOC with a 9.525 mm (0.375”) dia. tool. Even at a more traditional feed rate of 1.7 m/min. (65 ipm), the material removal rate was still over 40% greater than using the high-speed machining, radial chip thinning approach that’s more common in the industry. This new “power cutting” method required higher horsepower usage and more rigid workholding, yet the MRR and...
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cycle times were far better. The lab wondered if similar results were possible in superalloys, such as titanium.

The lab often is approached by cutting tool partners to test new tools, and the team’s effort isn’t limited to our own shop. So when Arlington, Texas-based Iscar Metals Inc. offered to test a new tool at the company’s new technology center in Charlotte, North Carolina, on an Okuma MB-4000 horizontal machining center, we jumped at the chance.

Tom Raun, chief technical officer at Iscar Metals, suggested using a 9.525 mm ECKI (Ti-Turbo) series carbide endmill for the titanium test cut. This line of endmills is designed specifically for aggressive rough milling of titanium and is capable of full slot machining at depths up to two times the cutting diameter. The HMC had the horsepower and performance needed to compare a high-speed chip thinning approach with a power cutting strategy to validate any cycle time gains.

With most HSM applications, climb cuts are the norm, yet they can create extra motion as a cutter rapid back for the next pass (left). However, to address some material applications, a bidirectional option was added to Mastercam’s Dynamic Milling toolpaths, resulting in an average cycle time reduction of 15% (right).

Using Dynamic Motion, the first test cuts used typical HSM parameters: a 15% step-over at a depth of 19.05 mm (0.75") and a feed rate of 1.07 m/min. (42 ipm). A second run machined the part at an 80% step-over and the same 200% DOC but at a typical feed rate of 229 mm/min. (9 ipm). Initial results were promising but not jaw-dropping. The average difference between making fast, multiple passes and performing a large step-over with fewer passes at a slower feed rate was only about 4% improvement in cycle time. It was time to return to the drawing board.

With most HSM applications, climb cuts are the norm, yet they can create extra motion as a cutter rapid back for the next pass (left). However, to address some material applications, a bidirectional option was added to Mastercam’s Dynamic Milling toolpaths, resulting in an average cycle time reduction of 15% (right).
create extra motion as a cutter rapids back for the next pass. However, to address some material applications, a bidirectional option was added to Dynamic Motion. This allowed alternating passes of climb cutting and conventional with small exit and entry loops between each pass. At nearly full slot engagement, a conventional cutting mode could work because the cutting edge would quickly enter material and avoid any burnishing. Alternating cut motion then would eliminate extra travel and cycle time. The only question was how it would work in titanium.

Testing was the eye-opener. The bidirectional option greatly reduced extra motion and kept the tool in the cut longer. At a more traditional feed rate and with the same cut parameters, the cut was flawless. Yet the real telltale clue was the sound. The cut sounded no different in the conventional pass than it did in the climb cut. Entries and exits with material were tight and kept travel to an absolute minimum. But cycle time reduction was the real highlight.

On our 203 mm × 203 mm (8" × 8") workpiece, overall cycle time dropped by 15%. Extrapo-
lated across larger parts with more elongated machining areas characteristic of aerospace components, this innovative strategy, combined with the right tooling and machine, could save as much as 30% to 45% of total machining time.

Lab testing and outside-the-box thinking are uncovering novel approaches to difficult machining challenges. Collaboration among leading metalworking industry suppliers makes this an exciting time to help shape the future of global manufacturing.

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**about the author**

Stas Mylek is strategic partnership manager at CNC Software Inc., Tolland, Connecticut. For more information about Mastercam CAD/CAM software, call 800-228-2877 or visit www.mastercam.com.

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FULL-DIAMETER SLOTTING OF STEEL

By John Saunders

Full-diameter slotting is not the preferred method for removing large amounts of material, but sometimes part geometry makes slotting the best — or only — option. ProvenCut recipe 551 shows how to achieve a high material removal rate while maintaining a reliable cut using a light-duty machine with a 6.35 mm (0.25") endmill to slot 4140 alloy steel.

When developing this slotting recipe, we adjusted the spindle speed, feed rate and DOC with the goal of creating a dependable, productive process. We discovered that maximizing the DOC did not maximize the MRR. Rather, the recipe that achieved the best balance of removal rate and reliability was at a 6.35 mm axial DOC (A_p). The result was an MRR of 15,403.84 mm^3/min. (0.94 in.^3/min.). Our initial hypothesis that a larger axial engagement would lead to a higher MRR was wrong. Reducing the A_p from 200% to 100% allowed an increase in the feed rate that resulted in a 30% higher MRR.

Two notable differences between the 6.35 mm and 12.7 mm (0.5") axial DOCs are enhanced chip evacuation and the number of radial contact points that an endmill has with the workpiece material. A 6.35 mm axial DOC results in one contact point with the material and produces one chip at a time, whereas a 12.7 mm DOC has two contact points and produces two chips at a time.

More points of contact can help stabilize a tool when using adap-
tive-style machining strategies with thin radial engagement, also known as dynamic or high-speed machining, but additional points tack on tool pressure. Too many points of contact can increase pressure to the level of causing chatter. With a light-duty machine, reducing points of contact helps minimize the amount of rigidity required for a stable, chatter-free cut.

The 6.35 mm DOC offered superior chip evacuation when compared with the 12.7 mm DOC. This improvement minimizes re-cutting of chips and enables coolant to more easily flush chips, reducing heat buildup and lubricating the cut.

Caution must be exercised when testing slotting recipes as the length of the overall slot and changes in slot direction affect the ability of coolant to access the cut. Any changes in a coolant’s aim can lead to tool failure and breakage — often quickly. A 102 mm (4”) test slot along one axis is very different from a 508 mm (20”) slot around the profile of a part that involves x- and y-axis movement.

Consider recipe 551 for drilling and tapping machines, Bridgeport-size machines or even old vertical machining centers that may not benefit from the higher rpm common with modern machine tools. A larger machine tool with more rigidity or power may yield different results.

The setup is shown for a Tormach 1100MX CNC mill. A steel workpiece (inset) is shown after full-diameter slotting.
It’s Personal

Customize waterjet software with scripting.
By Joshua Swainston

Customization often starts with the question, “Is there an easier way to do this?” A manufacturer might need to change its clearances on a series of part files by a fraction of an inch. A prototype shop could look to integrate a robotic arm for loading material. A fabrication shop may have to guarantee the alignment of an upcoming order.

The answer frequently is, yes, there is an easier way. External programming known as scripting extends applications in a machine tool’s CAD or CAM with custom capabilities, including new commands, file filters and automation. Scripting also can be used to create stand-alone applications that broaden the possibilities for how a waterjet works as part of a shop floor. IntelliMax software from Omax Corp., Kent, Washington, enables customization through script programming.

Omax Scripting is a complete but basic programming environment, compiler and execution system built right into Omax’s IntelliMax Layout and IntelliMax Make. Scripting’s purpose is to allow third parties to easily extend software to do new things, such as write commands for Layout, modify a path in Make, create an interface for a third-party plug-in or even create applications.

Scripting

Scripts can be run by themselves in CAD software, bundled for easy distribution and installation by anyone as plug-ins or used to create stand-alone applications.

“Scripting is a way for people to externally access the code that runs inside the controller software,” said Custom Software Supervisor Jerry Thomas. “Instead of clicking a button to draw a line, you have code that does it for you. You provide start point, endpoint, bow, quality, etc., and the code will draw the entity you described. For a single line, this isn’t very useful. But as part of a script that opens multiple files, adjusts and

Changing specific dimensions in a series of parts is quick and easy using scripting (left). When piercing brittle material using a static pierce operation, a programmer must divide the tip of every lead-in approximately 0.025 mm away from the endpoint (above).
paths them, then automatically sends those files to the controller, you can significantly reduce the manual effort.”

To give some sense of what scripting can do, it’s worth noting that Omax Scripting is used in many places inside software. For instance, move lead, swap lead and sprocket commands were written using scripting and dialogues.

“Scripting is one of the go-to features when encountering an unusual problem requiring an outside-the-box solution,” said Applications Lab Supervisor Vlad Bucur. “One example is the necessity for stationary piercing brittle/laminated materials. In order to command the software to execute a stationary pierce, the programmer must divide the tip of every lead-in approximately 0.001” (0.025 mm) away from the endpoint. This can become tedious if a program has tens or hundreds of holes. The simple solution was to write a script that easily managed to execute this command for all the lead-ins on a path.”

Although Omax Scripting is more valuable if a user knows how to program or wants to learn, many demonstration scripts still could be useful. Adventurous people may want to explore these to find useful tools that otherwise might not be available in Omax’s software. Scripts can be written in different languages, including Delphi, Object Pascal, C#, Visual Basic, C++ and Java.

“We’ve had a couple of customers work on synchronizing Make and a robot,” Thomas said. “Robots tend to not use PCs, and getting the two systems to talk is a challenge, but it can be done.”

Users familiar with basic concepts of programming, such as loops, variables, conditionals and functions, and basics of Omax software should be able to dive in. Machine shops can load sample scripts provided by Omax, study the code, run

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**It’s Personal**

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**about the author**

Joshua Swainston is the content marketing writer at Omax Corp., Kent, Washington. For more information, call 800-838-0343 or visit www.omax.com.

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‘Scripting is a way for people to externally access the code that runs inside the controller software.’

It’s Personal

the scripts and modify them to suit needs. Most users don’t worry much about scripting but instead deal with plug-ins created by other people who used scripting to make custom features. If someone doesn’t program or have time to, some scripts are available in prepackaged, ready-to-install plug-in files.

To reconfigure several entities in Layout may take more than one script. By combining scripts as a single plug-in, they can be turned on and off as a whole. Plug-ins are a way to bundle multiple files into a single group to plug in to Layout and add functionality. This makes it easy for end users of a script to install it without needing in-depth knowledge of scripting or having to hand-copy a bunch of files into folders.

Ordering Custom Programs

For less adventurous customers who want several new commands for Layout, Omax offers custom scripting with endless possibilities developed by the company. “For a few customers, we have written large applications to automate significant procedures for waterjet cutting,” Thomas said. “These have

Although Omax Scripting is more valuable if a user knows how to program or wants to learn, many demonstration scripts still could be useful.
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focused on precision part alignment for cuts on manufactured parts or for alignment along the grain of a material.”

Machining can be hyperspecialized from shop to shop. What one waterjet user needs may not be what another looks to do. The most highly specialized operations typically are created in-house at Omax and then tested and fine-tuned before delivery to customers.

“We have used scripting to help users integrate a waterjet into their existing processes,” Thomas said. “If all of their machines are set up to use bar code work orders, we don’t want the waterjet to require a different process. So applications have been written to take bar code input and match it to a specific file, and sometimes we also link the material and thickness. Another example is import filters for file types that are already in use in a shop. We’ve written a few CNC G-code importers, so the same files are used for all of a customer’s equipment.”

With Great Power

Scripting comes with a lot of power. With such power comes the ability to make mistakes that can wipe out data. Some script commands allow users to erase or overwrite files or folders. Be careful when using such commands.

“Scenarios like lights-out operation depend on having the waterjet synchronize with other machines, whether a robotic arm or some other load/unload device,” Thomas said. “The more a waterjet can coexist with other machine tools and not require any special handling, the more the waterjet can become a better tool in the workflow.”

External programming known as scripting extends applications in a machine tool’s CAD or CAM with custom capabilities, including new commands, file filters and automation.

‘Scripting is one of the go-to features when encountering an unusual problem requiring an outside-the-box solution.’

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COLLETS UP CLOSE

Users should benefit from more information about these popular toolholding components.

By William Leventon

Collets are among the items most commonly found at machine shops. But people who routinely use these toolholding mainstays probably don’t have all the important facts about them. That’s because there’s a lot to know about collets — in a number of different areas. These include how collets stack up against other toolholding options and the latest in collet technology, as well as how to choose and use collets to extend their lives and get better results with machining.

Placed in a chuck, a collet forms a collar around the tool to be held. The standard ER collet is the most widely used tool-clamping option for machining applications. Commonly used to hold endmills, drills, taps and reamers, ER collets exert clamping force when tightened with a nut.

Comparing Collets
Other well-known toolholding alternatives include shrink fit and Weldon flat — also known as side lock — as well as hydraulic and milling chucks. Compared with these, the biggest advantage of ER collet systems is their versatility, said Alan Miller, engineering manager at BIG KAI-SER Precision Tooling Inc., Hoffman Estates, Illinois.

With the other options, “you’re really locked in to one size toolholder for a specific-size cutting tool,” he said. “But with collets, one holder size can hold a wide variety of cutting tool shanks. Especially for smaller shops, that versatility will make things easier.”

As an example, Miller pointed out that an ER32 collet chuck can hold tool shanks ranging from 3.175 mm (0.125”) to 19.05 mm (0.75”) in diameter with different collets. ER systems, he explained, include...
different collets for every 1 mm (0.04") increment in tool shank diameter at a minimum, so it would take at least 17 collets to cover the 3.175 mm to 19.05 mm shank diameter range.

“But the base holder remains the same,” he said, “and you just change out the collet to clamp on to different tool sizes.”

On the other hand, shrink-fit holders are sized based on tool shank diameter, said Dan Doiron, milling product manager at Emuge Corp., West Boylston, Massachusetts. This means that a shop would need a different shrink-fit holder for each tool diameter. In addition, he said, a shop using shrink-fit holders needs a heating unit to install tools in the holders, adding more cost to that option.

While shrink-fit and Weldon flat toolholders accommodate only one tool size, hydraulic and milling chucks allow the use of straight reduction collets to change tool sizes, Miller said. But he added that the presence of reduction collets in these chucks hurts their performance, resulting in increased runout and/or decreased clamping force.

Besides the versatility of the ER collet system as a whole, users get the toolholding flexibility of the individual collets in the system. This is due to the slotted ER collet design, which allows a good deal of compression and therefore can accommodate different tool shank diameters, explained Andy Moon, product man-

Held by a collet, a thread mill cuts threads (above).

ERC collets (surrounding photo) are inspected twice to check runout accuracy.
ager for milling and toolholders at Guhring Inc., Brookfield, Wisconsin. He added, however, that this flexibility is limited to a small range, which can be anywhere between 0.5 mm (0.02”) and 1 mm.

A Looser Grip

On the downside, Miller said ER collets fall short compared with other toolholding options when it comes to gripping strength. As a result, he said, ER collets are not well suited for high-torque cutting. So his company mostly recommends them for finish milling, drilling and reaming applications.

A problem with ER collets in this regard is what gives an edge in flexibility to them over competitors: their compressibility.

“When you have a larger amount of collapsibility, there is more room for runout to be introduced and quite a bit more room for instability or chatter,” Moon said. “So for high-performance applications, especially being a milling guy, I generally do whatever I can to steer people away from an ER collet chuck.”

He added, though, that many people use ER collet chucks for light milling.

But even when customers come in with relatively light milling applications, Moon said, “if we can get them to move to a hydraulic, milling or shrink-fit chuck or even a side-lock holder, they can double their tool life because the tool isn’t moving around as much in the chuck and you don’t get the chatter.”

For shops set on using ER collets, he said the best way to optimize performance is to closely match collet size with tool shank diameter.

Shops that want to use collets but don’t want the compressibility of the ER type may want to consider FPC collets sold by Emuge.

“Our collets have a minimal amount of flexibility, following ISO

The PJC straight collet is a reduction sleeve for small-diameter cutters with peripheral coolant supplies.
“H6-H9 standards,” Doiron said. “They are designed to fit one specific tool diameter.”

The company recently expanded its line of FPC collet chucks to include Slim Line models. Available in 2 mm to 14 mm sizes, the slim design and tapered shape of these models eliminate problems caused by a toolholder when trying to access work in confined areas or negotiate challenging angles.

“These are specifically designed to get into very difficult areas during five-axis machining,” Doiron said.

Other recent developments involve collet designs that depart from conventional shapes. Most traditional collets have a taper. As the toolholder nut is tightened, this taper is forced into a matching one in the toolholder. Hydraulic chucks, however, lack this taper.

Inside these chucks is “just a straight bore,” Miller said. “So you need a tightly tolerated straight cylinder to go inside these holders.”

For hydraulic chucks, BIG KAISER Precision Tooling has introduced straight reduction collets. One type, which is called Perfect Seal, seals the cutting tool shank so coolant can flow through drills at high pressure. The other, which is named Perfect Jet, lacks a seal but reduces the clearance between the collet and cutting tool to improve coolant delivery along the tool shaft.

“The idea is to keep the coolant focused down the shaft of the tool rather than fanning out,” Miller said.

**Do’s and Don’ts**

When using collets, the things that shops do — and don’t do — can make a big difference in how collets perform and how long they last. One common mistake made with collets is over-tightening the collet nut.

“People get the idea that tighter is better, but that’s not the case,” Moon said. “When you overtighten, you’re over-stressing the nut and collet, and the metal starts to yield and bend at some point.”

For best results, he recommends the use of a torque wrench for tightening. He said shops today can find
Toolholders are the critical connection between a cutting tool and a machine tool spindle. Toolholder performance dictates productive output, surface finish of a part and the life of a cutter. With the right toolholder for the application at hand, a shop maximizes benefits from high-performance cutting tools and machine tools.

Different toolholder types provide different levels of performance. Depending on the machining application, some performance factors are more important than others. For precise work, a low total indicator runout may be most important. When multiple setups are involved, quick-change capability is essential to maximize productivity. In heavy-cutting situations, tool retention force might be emphasized. And in most operations, the cost of the tooling system itself is a significant factor.

When it comes to the various toolholders and their qualities, ER collets are known for gripping strength and accuracy. Collets in the ER system, which was introduced in the early 1970s by Rego-Fix Tool Corp., Whitestown, Indiana, and later standardized as DIN 6499, supply a wide clamping range and high accuracy over an extended selection of operations.

Most shops select toolholding systems based on the parts being made and how they are manufactured. Depending on the product mix, shops generally use more than one holding system. An effective way to simplify toolholder selection and acquisition is with a family of toolholding technologies, such as those developed by Rego-Fix Tool. Its original ER clamping system — composed of an ER collet holder, a collet and a nut — is engineered for traditional machining applications while its powRgrip system is aimed at high-speed milling and drilling and other high-performance applications. The latter system consists of powRgrip toolholders with internal tapers that accept the matching tapers of powRgrip collets. Tools are inserted into and removed from the holders using a fast-acting manual or automatic hydraulic powRgrip unit.

For tougher machining operations, secuRgrip toolholders are made to fit powRgrip clamping units and prevent cutter pullout. This method utilizes a patented locking system and threaded cap, with the key element being a special collet configured to accept a threaded insert that locks into the Weldon flat on any tool with that feature. The system has a total indicator runout of 0.00254 mm (0.0001”). No tool shank modification is required, and existing powRgrip holders can be modified for use with these holders.

At the opposite end of the toolholding size spec-
Not surprisingly, overextending a tool in this manner increases the chance of failure.

Some effective practices for getting the most from collets are easy and obvious. For example, Moon recommends taking out and thoroughly cleaning a collet and collet chuck every time that a tool being held is changed out. Simply blowing off chips and any other debris with an air hose is all that’s required. He said if cleaning isn’t done regularly, debris will cause wear on the outside of a collet and the inside of a toolholder.

In addition, shop personnel should visually inspect the collet and chuck while a toolholder is out of a machine and disassembled.

“If anything looks like it’s all chewed up,” Moon said, “it’s probably best to throw it out and get a new one.”

Toolholders are the critical connection between a cutting tool and a machine tool spindle.

trum, the micRun system handles small-tool, micromachining applications, such as those found in the watchmaking and medical industries. A symmetrical design without grooves or flats minimizes vibration, and special threads keep the nut aligned with the holder for maximum rigidity and repeatability. The system provides runout of ≤3 µm (0.0001”) at 3 diameters deep, which enhances machining quality, overall productivity and tool life in high-precision applications.

No toolholding system is perfect for every machining circumstance. However, toolmakers have focused their tool development efforts to create systems that enable high productivity and cost efficiency across the wide range of manufacturing situations.

CTE
ONE-STOP PIONEER

Ty Miles Inc. specializes in high-speed broaching systems.

By Alan Richter

When it comes to broaching, Ty Miles Inc. does it all: Build and rebuild broaching machines, produce broach tools and provide production broaching services.

With its humble beginnings, the family-owned Westchester, Illinois, company didn’t always provide such an array of capabilities. President Steven M. Mueller said his grandfather Tyrus H. Miles founded the company in 1958, designing broaching machines at his home and having them built elsewhere before he eventually leased manufacturing space and hired workers to produce the machines.

One of the initial investors in the company was
Leonard J. Smith, whose family owned a screw machine shop. Previously a Ty Miles customer, Smith ended up joining the company and served as president from 1972 to 1998, when he handed the reigns to Mueller.

Mueller said he started working at the company during his winter and summer breaks while attending the University of Illinois at Urbana-Champaign and came on board full time in 1978 after graduation.

Initially, Ty Miles outsourced broach manufacturing, Mueller said. “But as time went on, it was a natural for us to get into producing tools.” The tools are made of M4, T15 and powder metal HSS and are sold uncoated unless a customer specifies a coating, in which case Ty Miles sends the customer to a coating service.

**Turn to Production**

Ty Miles added production broaching services to its offerings in the 1990s when a customer with several of the company’s machines wanted to outsource a broaching program, Mueller explained. The customer approached the company that was producing its blanks, but the blank producer didn’t want to get involved with broaching and suggested that it purchase a broaching machine from Ty Miles and create a work cell. However, Ty Miles’ customer didn’t want to purchase additional equipment.

“So I raised our hand and said, ‘We can run broached parts for you,’” Mueller said. “That’s how we got into broaching parts.”

Because it was a high-volume automotive application that required broaching about 2 million parts annually, Ty Miles needed to extend its regular operating hours from 5 a.m. to 5 p.m. to 1 a.m. to 10 p.m., Mueller added. The company ran that program for about five years using two machines.

“On one machine, we were broaching four parts at a time, doing internal splines and other forms on an aluminum yoke part from the steering column,” he said. “We also broached an external slot on the clamp yoke.”

With that production broaching experience under its belt, the company took on additional automotive parts a few years later and continues to broach parts with the machines it builds.

Ty Miles performs the majority of its production work using vertical broaching machines, with rotary broaching reserved for tasks like generating the twist on pistol barrels.
"When you are small, you can be flexible, and you just do what you have to do."

— "the most efficient broaching machinery," according to the company.

“When you are small,” Mueller said, “you can be flexible, and you just do what you have to do.”

Similar to other part manufacturers, Mueller said he is not seeing as many high-volume applications as in the past, yet Ty Miles has a number of steady jobs. “But the volumes are not where we need to extend our hours to meet those deliveries. If somebody had those types of volumes today, they would look to do it in-house with our equipment.”

He said Ty Miles performs the vast majority of its production work using vertical broaching machines, with rotary broaching reserved for generating the twist on pistol barrels, for example. In addition to automotive, the company frequently serves the firearms, medical and hardware industries. Workpiece materials include stainless steel, steel, brass and aluminum, and typical broached features are keyways, splines, flats and forms. Common part tolerances are ±0.0254 mm (±0.001”), with some as tight as ±0.0127 mm (±0.0005”).

Adding Automation

Ty Miles reports that having robotics interfaced with one of its broaching machines makes things more economical by reducing operating costs while increasing production rates. Robotic part loading and unloading can be integrated with any Ty Miles broaching machine, and Mueller said the company has incorporated a small selective compliance articulated robot arm into numerous broaching systems. This arrangement is becoming more popular as smaller robots are being manufactured that cost less than earlier models, he added.

“The robot doesn’t take a break,” Mueller said. “In the right application, you are going to see more robotics utilized.”

Nonetheless, although a
COVID-19 hit. Manufacturing will hit back.
broaching machine can run for an extended period of time without operator intervention, Mueller said he doesn’t feel that a broaching machine can run unattended during a night shift.

To enhance the versatility of a broaching machine by enabling it to perform secondary operations, Mueller said Ty Miles can add a rotary table to it. Indexing a part, for example, would enable a manufacturer to not only broach a feature but drill or tap a hole.

“We have been fairly innovative over the years by combining other secondary operations with broaching,” he added, “so that with one part handling, you can get a completed part.”

Quickening the Pace

Traditionally, broaching machines were built to run at cutting speeds of 9.1 to 18.3 m/min. (30 to 60 sfm). Mueller said Ty Miles specializes in high-speed broaching systems. “Our standard machine is typically 120 feet per minute (36.6 m/min.),” he added, noting that internal applications usually go up to only 60 sfm.

Those speeds, however, are for HSS broaches. When applying a broach with indexable carbide inserts from another cutting tool manufacturer, the company was able to run as high as 87.8 m/min. (288 sfm) during a demonstration at a trade show, Mueller said.

Because Ty Miles’ broaching machines are built to last, Mueller said it can be a challenge to sell a new machine to existing customers when an older machine still cranks out parts, even if at a reduced rate.

“We still have machines from the 1960s that are working,” he said. “Once a company has maybe two, three, four machines, you can always retool them for a different application, so they are really not in the market for a new piece of equipment. Unfortunately, there is no planned obsolescence, and that is a problem.”

To enhance machine productivity and bring it up to date, Ty Miles frequently rebuilds its machines. “Over the last several years, we are doing more remanufactured machines than new ones,” Mueller said. The rebuilding process potentially involves stripping down a machine to its base; reconditioning the ram column; replacing needed electrical, pneumatic and hydraulic components; updating the control; and building it back up, Mueller explained.

“Basically, what they get looks like a new machine when it gets done,” he said, adding that the cost of a rebuild is about 70% to 75% of the cost of a new machine, which costs from about $75,000 to $200,000 or more.

Not all rebuilt machines go back to the same end users. Mueller said Ty Miles sometimes purchases its used machines at auctions or other venues and takes old equipment as trade-ins when customers want new machines. If needed to close a deal, the company even takes a competitor’s machine and rebuilds it.

“We prefer not to because we are more familiar with our equipment,” he said.
On occasion, however, a customer just wants to sell a machine without replacing it. “I’ve had customers come back to us that aren’t utilizing the machine because maybe a product has gone away for them,” Mueller said. “They contacted me and said, ‘Your company was good to work with, and this machine was a great machine, and we would like you to have it.’ Basically, they prefer that they sell it to us and know we will rebuild it, sell it to somebody else and the machine will have a new home.”

Workforce Matters
Ty Miles employs 15 workers at its 1,700-sq.-m (18,300-sq.-ft.) facility, including toolroom machinists and design, mechanical, broach tooling, electrical and control engineers. “Most of our people have been here over 25, 30, 40 years,” Mueller said.

Because worker longevity is high, turnover is low, he noted. In addition, business has been relatively stable for the company over the past several years. As a result, Ty Miles hasn’t needed to hire anyone. However, the company occasionally may hire a temporary worker when it sees an uptick in production broaching.

This scenario helps Ty Miles avoid the challenges of finding workers with appropriate skills or training promising applicants. Although broaching is a highly consistent, precise machining operation and typically faster than milling required part features, many people consider broaching “black magic” and are sometimes hesitant to get into it, according to Mueller. “At times, there is a hand-holding process that has to take place.”

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For more information about Ty Miles, call 708-344-5480 or visit www.tymiles.com.

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DESIRE FOR DATA

Connectivity will continue to advance industrial technology.

about the author

Christopher Tate is engineering manager of advanced manufacturing engineering and machining at the Savannah, Georgia, facility of Mitsubishi Hitachi Power Systems Americas Inc., Lake Mary, Florida. Contact him at chris23tate@gmail.com.
Experts, scholars and industrial leaders agree that we have entered the Fourth Industrial Revolution, which is characterized by interconnectness of devices and the ability to collect seemingly unlimited amounts of data for analysis. “Internet of things” is jargon that has emerged since the onset of the Fourth Industrial Revolution. IoT is driving new technologies, making connections and communication between devices commonplace in industrial settings. Companies now have access to a volume and quality of data that were not available in the past. As machine tools advance, controls will be able to provide not only a stream of data but the software and apps needed to analyze the data stream.

Our society craves data, which has become an integral part of the modern economy. It is therefore easy to see why manufacturers want data from many sources, including machine tools. Six Sigma, statistical process control and other lean manufacturing concepts rely on a good flow of data to drive improvements, and advances in connectivity thanks to new technologies make it simple for businesses to get data they never had before.

Helpful Data

High-volume manufacturers often survive on lower margins, so minimizing downtime is critical to profitability. A stream of data helps in a few ways. Being connected to a machine tool allows real-time monitoring, and current software lets a person assess machine condition from anywhere. Consider a shop like ours where one worker tends to several machines. Each of our EDMs is dedicated to a specific operation. If one stopped, it would disrupt the entire machining line. Remaining connected to every machine enables us to monitor machine status from a single location. We immediately know when a machine stops, and it can be addressed right away, reducing lost time.

Machines go down for many reasons, whether because of machining processes or mechanical or electrical failures. In all cases, it is necessary to understand when, why and how frequently a machine tool is out of service so corrective actions can be implemented. Systemic issues may not be recognized without a useful data stream. Collecting, sorting and charting data from machine tools lets us see patterns and trends. Finding those allows a maintenance department to predict failures and plan maintenance instead of reacting to failures, which is the main tenet of total productive maintenance.

Aiding Engineers

Noticing trends also enables manufacturing engineers to find process failures that might not be evident otherwise. Documenting and analyzing trends provided by a good flow of data helps engineers better predict the life of critical wear items, such as cutting tools. Analyzing tool wear and quality data allows engineers to reduce variation in a process, improve quality and lower costs.

Data from machines while in operation makes it possible for manufacturing engineers to investigate machine tool condition at specific times and analyze things like power consumption of various motors and drives. Understanding how much power a machine uses gives insight into the efficiency of machining processes. Drives and motors operating near or at full power can indicate that a machine is being used at maximum capacity or that a machining process is not optimized. High power consumption also may signify imminent mechanical failure.

More advanced data solutions allow engineers to connect temperature sensors, accelerometers, strain gauges and other instruments to machine tools. These devices let engineers study the relationship between a machining process and a machine tool structure. Temperature changes in the structure of a machine tool and miniscule movements among machine tool components indicate process severity and machine rigidity.

When we can see how a machine tool reacts during a cut, it is possible for manufacturing engineers to develop methods that put less stress on a system, which improves tool life and part geometry. Machine tool builders use this same data to build more robust components and structures, improving machine tool efficiency and longevity.

Adaptive machine tool control is the most advanced form of data collection and analysis available for machine tools. Adaptive control takes data from various sensors and adjusts cutting parameters in real time to maintain ideal cutting conditions. Adaptive controls overcome chatter, maintain part size by adjusting for temperature changes and detect worn tools.

Data from machine tools already helps build better machines, develop more robust processes and eliminate inefficiencies. At present, IoT delivers cutting tools that can be adjusted via smartphones. In the future, we will see cutting tools tuned for specific machine tool brands. Connectivity will continue to increase across industry, and larger volumes of data will become available, resulting in a growing rate of technological advancement.

By Christopher Tate
Whether a railway carriage carries freight or passengers over the 225,308 km (140,000 miles) of track in the U.S. railway network, wheel sets wear out and must be re-profiled or scrapped when outside the tolerances set by the Association of American Railroads. Since 1910, Simmons Machine Tool Corp., Albany, New York, has built machine tools and measuring machines for producing and maintaining railway wheel sets. The company also manufactures automation systems.

When worn wheel sets arrive at an AAR-certified railway wheel maintenance facility, the end caps and bearings first are removed and manually inspected. The serial numbers for each wheel set component then are entered into a supervisory control and data acquisition system. A measurement machine qualifies the parameters of a worn wheel set. Based on that data, a wheel set is either re-profiled on a machining center or scrapped.

Each wheel traditionally is placed on a machining center using a forklift, a crane or another manual handling method — a slow, inconsistent process in which worker safety is a concern. When workers place hooks around a wheel to lift it, there are potential pinch points, so personnel risk suffering from repetitive motion injuries or even having hands crushed under the wheel, said Scott Mitchell, manager of turnkey projects at Simmons Machine Tool.

“All those things are there because the operator has to manually move the wheel,” he said.

When the machine builder designed its new Wheel Turning Center, a vertical CNC lathe for machining railway wheels, its goals were to maximize worker safety and boost productivity to avoid repair delays. For the WTC-60 model, Simmons automated most of the process to avoid making operators manually place the wheel on the machining center.

Simmons Machine Tool chose the ZP-6 overhead gantry with a two-axis robot to provide most of the material-handling capability for the Wheel Turning Center, a vertical CNC lathe for machining railway wheels.
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handle wheels. For the automation system, the company turned to Coventry, U.K.-based Güdel Linear Tec Ltd., which Simmons Machine Tool has worked with for about 30 years. (Güdel Inc. is in Ann Arbor, Michigan.)

Although Simmons Machine Tool historically has had success with Güdel, Mitchell said Simmons Machine Tool explores the market every five or six years to “see if Güdel is still all that we need.” Those searches include Simmons Machine Tool’s sister company that manufactures components for automation systems.

For the WTC-60, Simmons Machine Tool selected Güdel’s ZP-6 double-axis gantry robot.

“Simmons chose Güdel’s ZP-6 gantry system for this application primarily for its reliability and capability and because equipment availability is critical for our customers,” said Jason Steven Murphy, marketing specialist at Simmons.

Mitchell said the ZP-6 gantry is probably the lowest-cost option that still provides the throughput that customers need. The complete machine cell, however, stands about 4.5 m (14.8’) high. If a customer’s

Wheel sets that require machining are placed onto a conveyor and transported into a machine cell. To accomplish this task, each wheel is picked up by a vertical lift system from Güdel. The system consists of a ZP-6 overhead gantry with a two-axis robot that has specialized grippers by Simmons Machine Tool to handle the heavy wheels. The operation transfers wheels to a vertical CNC lathe.

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facility cannot accommodate that height, Simmons Machine Tool offers other automation options, such as a six-axis robot.

When designing the WTC-60, the company modified a “widely available, generic” vertical turning center by adding a special table and tooling, reinforcing the column and enhancing the guarding, he said.

Nonetheless, Mitchell said, Simmons didn’t build the base machine, and the cell didn’t supply the rigidity required for the freight side of the industry, which moves heavier loads than the transit side.

“It is not a machine we would offer across the board,” he said.

When reviewing the designs of Simmons Machine Tool’s older machines, which can last 40 years or more, the company chose to return to a moving-column design for the latest WTC-250 model.

“We found there was this love for the moving-column design,” Mitchell said.

He said that design allows the mass of the machine carrying the cutting tools, or its center of gravity, to move over the top of a wheel, increasing stiffness.

“That means you can take deeper cuts and beat the machine up more than the WTC-60,” Mitchell said.

In addition to building the vertical CNC lathe for the WTC-250, Simmons Machine Tool designed and produced special grippers to handle the heavy wheels, which use a V-shaped roller and the wheel flange as a gripping area.

“We are able to center the wheel that way because we have four different contact points,” Mitchell said.

The system transfers a wheel to the machine, which bores the center hole of the wheel. It then is placed by Güdel’s gantry on an outbound conveyor for pressing onto an axle. He estimates that about 90% of wheels require only boring of their center holes, but others with a drive system or that have disc brakes mounted to them need additional machined features, such as drilled and threaded holes. For those applications, Simmons Machine Tool offers the WTC-250 mc, which is short for machining center.

The company says access to pre- and post-machining measurement data is important to railway companies so they can extend the lives of wheels, as well as maintenance machines and automation systems.

“The more data you can provide to them, the more excited they get,” Mitchell said.

The interest in data began when sensors were added to locomotives to provide feedback about their performance.

“That culture shift has taken a few years,” Mitchell said. “But now everybody is asking the question, ‘How do I get more data on the rest of it?’”

For more information about wheel boring by Simmons Machine Tool, view a video presentation at www.ctemag.com by scanning the QR code on your smartphone or entering this URL on your web browser: cteplus.delivr.com/22urr
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**FIXTURE FLEXIBILITY AT THE SHOP**

By Ken Schnepf

Designed for completing a wide range of projects, the Uni-Vee is a single V-block fixture from Seattle-based Dunlap Tool and Die Inc. The fixture has a rectangular main body and is indexable by 180° about a vertical axis and 90° each way about a horizontal axis to provide repeatable vertical and horizontal positioning.

“The V-block can be used to machine the workpiece with an unusual amount of flexibility, and both can be moved around the shop as one unit,” said Mark Dunlap, owner and operator of Dunlap Tool and Die and inventor of the fixture.

The design specifically allows a user to quickly and accurately rotate the fixture 180°. The Uni-Vee holds one workpiece and enables users to work on multiple sides of a part in a single fixturing.

With a clamping range from 50.8 mm (2”) to 304.8 mm (12”), the standard Uni-Vee is offered with a chain and pawl clamp system that is adjustable from both ends. Once adjusted, a centrally operated mechanism clamps and locks with one motion. A single motion similarly unlocks and unclamps a workpiece and subfixture. A baseplate accessory permits easier access to the common data point feature when indexing.

“In my experience,” Dunlap said, “V-block fixturing has always presented a number of shortcomings. When the unusual combination of a current job requirement and available time/materials allowed the opportunity, I built a fixture that would address a couple of those shortcomings in the hopes of finding occasional shop use for it.”

With no protrusions on its front, back or bottom, the Uni-Vee can be installed directly into a milling vise or laid flat on a table or surface plate. This capability also lets the fixture lie down for the contouring of custom jaws, eliminating the need for a special fixture and potentially increasing the accuracy of shop-built jaws.

“The main benefit is its flexibility,” Dunlap said. “You can do so much with it. Even in the CNC programming environment, you can make it all work as one unit to make it as simple as possible. It also has replaceable, configurable and removable jaws.”

He said the fixture can be attached to an older machine to rough bores, grab them and attach them on a CNC. The Uni-Vee enables older, underutilized machines to be used economically.

“Let’s say I have an 8”-dia. (203 mm) piece of stock and it needs a 4”-dia. (102 mm) hole in it,” Dunlap said. “You don’t want to rough a big bore on a small CNC machine because it’s abusive to the expensive machine.”

The Uni-Vee’s indexing feature and clamping security offer fast setups and sufficient holding power for precise, efficient cuts.

**about the author**

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