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Cutting and grinding, cover to cover

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Publisher
Dennis Spaeth
847-714-0176 • dspaeth@ctemedia.com

Editorial
Alan Richter, Editor
847-714-0175 • alann@ctemedia.com
Greg Bartlett, Managing Editor
847-714-0182 • gregb@ctemedia.com
Gina Stehl, Creative Director
847-714-0178 • ginast@ctemedia.com
Conrad Hunter, Digital Media Director
773-949-2944 • conradh@ctemedia.com

Contributors
Cutting Tool Engineering regularly features writing by numerous industry experts and practitioners, such as Jeffrey Badger, Michael Deren, Keith Jennings and Christopher Tate.

Circulation
Synergy Direct Inc.
866-207-1448 • andreas@sdicirc.com

Advertising Sales
United States
Scott Beller, East
847-714-0183 • scottb@ctemedia.com
Marc Condon, Central/West
847-714-0170 • mccondon@ctemedia.com
Dave Jones, Central/West
708-442-5633 • djones@ctemedia.com
Dave Sweeney, Central
248-540-0300 • dsweeneyc@ctemedia.com

Corporate Staff
Chief Executive Officer
Dennis Spaeth
847-714-0176 • dspaeth@ctemedia.com
CFO/Director of Sales
Kenneth Spaeth
847-714-0173 • kspaeth@ctemedia.com
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One of the best parts of my job is to tour factories where metal parts are machined. In connection with the feature article I wrote for this issue about machining large parts, I traveled to Romulus, Michigan, and visited Lincoln Park Boring Co., where I met with Vice President Gary C. Yesue and President Rick Yesue. (See the article on Page 30.)

LPB’s 60,000-sq.-ft. shop is quite impressive, as well as temperature-controlled to ±1.5°F from the crane rail down. When it comes to machining enormous parts, LPB turns to its Henri Líné heavy-duty gantry Promill vertical boring machine with five-sided capability and 10’ under the spindle. The travels for the X, Y and Z axes are 480”, 204” and 120”, respectively.

“We can do longer parts,” Rick said. “We’re quoting a 600”-plus part right now.”

The company has a number of newer machine tools, such as a Fives Giddings & Lewis RT 130 horizontal boring mill with a 5.1”-dia. spindle purchased last year, but I found some of the older machines to be equally if not more eye-catching. For example, one machine that grabbed my attention was a Monarch lathe (31” diameter × 60” travel) that was built in 1942 and still functions. I just appreciate how people designed products in the past, including antique musical instruments, vintage bicycles and muscle cars from the 1960s.

The shop doesn’t produce any parts that would fit inside a shoebox. However, LPB’s equipment list includes more than just monstrous machines. “Some people notice us just for the big machines,” Rick said, “but we have a lot of other machines to fill too that are, let’s say, 4” to 5” boring mills.”

Although the definition of high-speed machining is a moving target as technological developments enable spindles to rotate faster and faster, what qualifies as a large part seems fairly static. I feel that the vast majority of metalworking professionals would agree with the definition provided by Michael Cope, product technical specialist for Indianapolis-based Hurco Cos. Inc. and a source in the article: “What I would consider large is anything I can’t load by hand.”

That is why shops that specialize in machining large parts have plenty of cranes. “We have 23 overhead cranes,” said Blake Conner, general manager of CBM Precision Parts, Bessemer City, North Carolina, and another article source. “You have to have plenty of overhead cranes if you do the bigger parts. It makes life easy.”

More likely, cranes only make life easier because, from what I’ve gathered, machining massive workpieces is anything but a stroll in the park.

Lincoln Park Boring still machines parts for in-house purposes on this 1942 Monarch lathe.

about the author

Alan Richter is editor of CTE. Contact him at 847-714-0175 or alanr@ctemedia.com.
Details are everything at Frankenstein Engine Dynamics, and flawless precision has made the Weatherford, Texas-based shop’s complex cylinder heads and engine components much sought-after in the world of motorsports. To keep pace with continuous demand, CEO Chris Frank says the shop’s Mazak Multi-Tasking Machine is like having “a built-in second and third shift.”
QUICK-CHANGE JAW SYSTEM IS AFFORDABLE: Huron Machine Products Inc.’s System 3 quick-change base jaws bolt to a chuck like a standard top jaw. The base jaw is made of 8620 steel and ground to enhance durability. The base jaws adapt to any jaw lock dimension for any power chuck, enabling end users to use their existing chucks. Jaw inserts are available in hard, soft or full-grip inserts for 6” to 40” chucks. Repeatability is 0.001” or to the chuck’s original manufacturer’s specifications. Huron Machine Products Inc.; www.huronmachine.com

FACEMILL FOR THIN-WALLED ALUMINUM AUTO PARTS: The design of the two-in-one M5F90 facemill from Sandvik Coromant Co. allows roughing and finishing in one operation. The cutter body is 25mm to 80mm in diameter and accepts brazed PCD inserts that enable high feed rates without vibration and don’t require adjustment. No scratches, burrs or breakages are produced on the machined part because of a combination of cutting angles, insert shape and edge preparation when following recommended cutting parameters. The tool can take up to a 4mm DOC. Sandvik Coromant Co.; www.sandvik.coromant.com

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Platinum Tooling Technologies Inc.; www.platinumtooling.com

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Circor International Inc.; www.circorpt.com/emtec
VIBRATION DAMPER MODULE FOR LONG-OVERHANG APPLICATIONS: Allied Machine & Engineering Corp. says the Wohlhaupter Novitech vibration-dampened intermediate module increases the productivity, surface quality and process reliability when boring while extending the life of the insert and machine spindle. The viscoelastically mounted damper module reduces vibration when boring holes 50mm to 205mm in diameter at up to 10 diameters deep. Allied Machine & Engineering Corp.; www.alliedmachine.com

STABILIZER SYSTEM ENHANCES MACHINING STABILITY: The Unilock stabilizer system from BIG KAISER Precision Tooling Inc. provides lateral support for tall parts during machining and allows for the transfer of loads down to the table or base. The modular system can be adjusted to any new part. The system attaches to the worktable and the side of the workpiece. This lateral support is important because as workpiece height increases and the workpiece moves farther away from the table, cutting forces push against the workpiece. The stabilizer helps offset them. BIG KAISER Precision Tooling Inc.; www.bigkaiser.com

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MILLING TOOLS FOR LARGE WORKPIECES: Walter USA LLC has expanded its milling program to allow the universal square system inserts of its M4000 milling line to be used in its F2010 milling tools, which use a replaceable, adjustable cartridge. Cartridges are available to convert the standard F2010 mill bodies into the following: the M4002, which has a 15° lead angle; the M4003, which has a 45° lead; and the M4132, which has a 90° shoulder mill. The M4132 is available in two insert sizes. These cartridge-based milling cutters come in diameters from 80mm to 315mm. Walter USA LLC; www.walter-tools.com/us
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Manager’s Desk

FORCEFUL SALES AND MARKETING

With the erratic world economy we compete in, many shops have to cut expenses to ensure competitiveness. Some reductions are obvious and necessary. When business is slow, activities in advertising, marketing and sales are commonly at the top of the list of cuts. However, this is actually the time to increase spending on these activities.

When times are good and you’re busy, spending on sales and marketing is easier to absorb, and expanding these functions seems logical. But that’s also when your competition is marketing, making it more challenging for your shop to stand out. In addition, when business is robust, costs associated with marketing efforts are usually at a premium.

If you’re busy and not desperate for work, it’s illogical to spend lots of money seeking business when concentrating on customer service and careful job selection makes more sense. The time to become aggressive and sell your operation like never before is when things slow down and new work is a must.

about the author
Keith Jennings is president of Tomball, Texas-based Crow Corp., a family-owned company focused on machining, metal fabrication and metal stamping. Contact him at jennings4176@yahoo.com.

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The means vary to accomplish this goal, but finding an effective technique is crucial. Some shops find success advertising in industrial directories. Others reap benefits from trade shows and trade magazine ads. Others lack funds for any of that and instead conduct marketing techniques in person and on the street, like personally delivering sales packages and following up until given an opportunity for business.

Of course, many prospects will tell you they are satisfied with their current suppliers and don’t need more. So what? Once a potential customer realizes you’re a viable company, a call could come anytime. Our company has acquired a sizable amount of business over the years only because we marketed to prospects at the same time that they had a problem with an existing supplier. When they need you, the approval process is suddenly much faster. You may find yourself with a package of prints to quote, possibly because a previous supplier couldn’t survive turbulent times. Your consistent sales and marketing efforts let potential customers know that your shop is managing the situation and continuing to machine top-quality parts, albeit with fewer people.

Advertising and marketing companies also need business and may be willing to reduce their prices when times are lean, making it easier for you to experiment and analyze the effectiveness of certain activities, such as website and social media improvements, industrial directory listings, association memberships and updated sales materials. Find new ways to promote your shop while many competitors cut back on the very activities that build awareness. As the competition plays defense, go on offense and tell the world about your shop.

In a down market, advertising, marketing and sales must continue aggressively. Let prospects know that you want their business and you just may get it.
A German machine tool manufacturer is working on a more automated version of its wear analysis system to put customers in complete control of the process.

The current version of the system, developed by Emag GmbH & Co. KG, Salach, Germany, features a removable vibration sensor attached to a machine spindle. Conducted by a service technician, the process of assessing wear starts with a dry run of the machine that includes movement along every axis, as well as spindle rotation. During the dry run, the sensor measures vibration and sends the data via cable to a wireless device that transmits the data to the technician’s computer.

Then the technician compares the measured data with the expected results. The more that the measured and expected results differ, the more wear that there is in the machine, explained Peter Strohm, Emag’s global service project manager. By examining the data, he said, an experienced technician can spot trouble with a certain axis or axes.

Emag calls this form of the system the mobile version because it requires a technician to come to the customer’s shop with the sensor, which he or she attaches to the machine and then removes and takes away after the testing cycle. As the

MODERNIZING MAINTENANCE

By William Leventon

William Leventon is a contributing writer for CTE. Contact him at 609-926-6447 or wleventon@gmail.com.

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company sees it, however, this is the system’s main downside because it means customers can’t use the system themselves.

Soon, therefore, Emag hopes to replace the mobile version with a system that features a machine learning algorithm capable of processing sensor data to determine which machine components are likely to fail due to excessive wear. In addition, the mobile sensor will be replaced by a fixed sensor in every machine. This sensor will send data to a computer via cable rather than wirelessly because a cable connection is more reliable, Strohm said.

With the machine learning algorithm evaluating the sensor data, Emag aims to eventually cut technician visits from the process.

“As we get better at this and as the algorithm works better,” Strohm said, “the process can be fully automated and the customer can have it whenever he wants by just pressing a button.”

The new technology was co-developed by data analysis company anacision GmbH, Karlsruhe, Germany. Emag has acquired a minority stake in anacision, which develops machine learning systems.

“We think machine learning will become more and more important for drawing the right conclusions from a lot of machine data,” Strohm said.
Emag also has high hopes for a new service app designed to make it easier for a customer’s maintenance staff to get in touch with Emag’s service department. When the app scans a QR code on an Emag machine, it shows the machine’s serial number and the right contact information for the customer’s country and machine type. The customer then can choose to contact Emag specialists by phone or email. For problems that are difficult to describe in words, Emag offers customers the option of initiating a live video chat, during which they can show a video of their problem to a service specialist.

Strohm said the app also helps Emag get the information it needs when a customer contacts the company for service.

“Some customers find it difficult to give us the right machine serial number,” he said. “Even though it is written on a plate on the backside of the machine, customers often call and say something like, ‘I have a problem with my blue machine in the third building.’ But we need the serial number because each machine we build is more or less unique and we have to know the exact configuration in order to give him the right advice for his problem.”

Emag’s vibration sensor attaches to a machine’s spindle housing.
SIMULATING ON-MACHINE PROBING

By Ivan Mikesic, CAMplete Solutions Inc.

Automation has become an important—almost essential—part of manufacturing. As new technologies emerge, it is increasingly practical in both cost and implementation for small and large shops alike to embrace some form of automation. Although many kinds of automation are available for manufacturing, one that is becoming popular at machine shops is on-machine probing, as well as the digital technology that drives it.

With on-machine probing, shops can perform part setup and inspection tasks using the same setup and hardware used to machine a part. When combined with a pallet system, which is a form of automation that allows parts to be loaded automatically into a machine, on-machine probing permits a machine tool to run completely unattended.

That said, just as a CNC machine requires an NC program to tell the machine how to cut a part, a machine must be told how to probe a part. There are a few ways to do this. Perhaps the most common method is to have the machine operator perform the probing cycles directly on the machine controller after a new job is loaded. However, this
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Get With the Program

requires the operator to stop the machine and manually probe each part, which does not lend itself well to automation. This approach also increases the risk of user error because the operator must manually enter data, and even simple probing cycles can be quite complicated. Fortunately, probing cycles can be included as part of an NC program. Manufacturers of on-machine probes provide a set of NC programs, which are installed on a machine’s controller. These programs can be called up as subprograms or cycles directly from an NC program, so probing is performed automatically after a part is loaded. This procedure reduces the risk of operator error and increases the runtime of a machine because it does not need to be stopped to manually probe each part.

But even with probing cycles provided on a controller, successfully creating an automated probing routine requires the right strategy and tools. To prevent an NC program from running if the stock is incorrect, the program should include probing cycles to ensure that the correct stock has been loaded onto the correct pallet. If the stock is right, the NC program needs to include probing cycles to set the datum so the program runs in the proper location.

To accomplish this task, see that probing cycles are programmed using the original CAD data so the
values in the probing cycles are accurate. In addition, each probing cycle provides a variety of options, which affect the motion of the probe between probe points. Therefore, before running a program on a machine, proper simulation is essential to protect a probe and machine tool by detecting collisions in a virtual environment and preventing them on the shop floor.

To aid this endeavor, CAMplete TruePath 2019, a post-processing and simulation suite, is adding software support for on-machine probing for select machine tools. With CAMplete TruePath, users can pick which probing cycle they would like to use and select the geometry for the cycle directly from their CAD model. The NC code then is generated and added to a project, which has already been posted by CAMplete TruePath, ensuring that the probing cycle is integrated seamlessly into the NC program. After the posted code is generated, it can be simulated on a machine tool in a virtual environment, guaranteeing that any collisions or errors in the program are caught before they are sent to the machine.

Automation in manufacturing has come a long way and will continue to advance. To take full advantage of what’s available now and what’s to come, you must have the proper tools in place and know how to use them. The right simulation software will help you progress to where you need to be, and it will grow with you as the manufacturing industry and your business evolve.

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about the author

Dr. Jeffrey Badger is an independent grinding consultant. He recently published the 4,000-page Book of Grinding. He also has upcoming courses in South Carolina, Michigan, Germany, Sweden and India. For more information, visit www.TheGrindingDoc.com.
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is temperature-induced diamond tool growth as the diamond traverses the wheel.

Dressing generates heat, some of which goes into the dresser. Let’s say that from the beginning to the end of the dress, the overall bulk temperature of a 25mm-long, single-point, steel shaft dressing tool increases 10° C. During dressing, the tool shaft will increase in length by 3µm. The equation is $25 \times 10 \times 12 \div 1,000,000 = 0.003$mm, where $0.000012$, or $12 \times 10^{-6}$, is the material’s expansion coefficient. That may not seem like much, but it might be enough to cause visible barber pole marks on a workpiece, especially because that sharp corner on the wheel digs into the workpiece.

In addition, if we consider that a half-carat, single-point diamond has a diameter of around 4mm and that diamond heats up 100° C during dressing, that’s $4 \times 100 \times 1 \div 1,000,000 = 0.0004$mm = 0.4µm, and we have to add that to the length increase.

The solution is to keep a high-pressure stream of coolant on the diamond during dressing. You also can dress the sharp edge from the wheel. This approach is cheating because it doesn’t address the root cause, but it does work pretty well.

The equation for thermal expansion can be used in lots of applications. What happens to a 300mm-dia., aluminum-hub wheel if it heats up by 5° C? It’ll grow about 0.033mm (300 × 5 × 22 ÷ 1,000,000). And perhaps it will make holding size more difficult.

What happens to a 50mm-dia., nickel alloy workpiece when it heats up during grinding by 15° C? It’ll grow about 0.010mm (50 ×
15 \times 13 \div 1,000,000). Then, after grinding and cooling to room temperature, the workpiece will be undersized by about 0.010mm. What if the 200mm-high steel column where a spindle on a machine is mounted heats up during the day by 5° C? The size variation will be 0.012mm (200 \times 5 \times 12 \div 1,000,000).

You get the idea. Keep in mind that this formula isn’t exact. Geometry has an effect, and the thermal expansion coefficient varies for different grades of steel and even with temperature itself. But the formula will put you in the ballpark to see the effect of temperature.
When it comes to machining large workpieces, Norman Besand’s definition of large is any piece that requires a crane to move. “When you start getting parts that you can’t lift, to me, those are large,” said the shop superintendent for American Machine & Gear Inc.

The Portland, Oregon, job shop has several cranes, including one with a 20-ton capacity, he said. AMG primarily serves the steel mill and paper and pulp industries and produces parts up to 12’ long x 5’ tall and gears up to 60” in diameter, as well as significantly smaller items. “It runs the whole gamut.”

Besand added that AMG also rebuilds gearboxes and recently completed one weighing about 30,000 lbs. in about six days. When customers are “under the gun” to quickly get a gearbox up and running, “we do as best we can to run around the clock.”

All in the Family

Lincoln Park Boring Co. is another manufacturer of large parts that understands the importance of timely delivery, said Gary C. Yesue, vice president of the Romulus, Michigan, job shop. This is particularly critical for some small customers, which may not have another project to work on without the parts from LPB.
To meet delivery requirements on parts that can take 400 hours or more to produce, President Rick Yesue said he and his brother, Gary, take the time to properly plan and process each job. That begins with the complex task of estimating the requirements and costs. (Rick and Gary’s sister, Nancy Yesue, is also a co-owner.)

Their father, Richard Yesue, founded LPB in 1956 in Lincoln Park, Michigan, and mainly served the automotive industry. When his children took the shop management reins in 1984, “we went from being a shop that did all sizes of parts to concentrating on larger boring mill-type parts,” Rick said.

LPB’s jig boring machines include an SIP Hydropptic 720, the shop’s most accurate machine, according to Rick. The “mother machine” has travels of 60” in the X-axis, 40” in Y and 50” in Z and can hold a tolerance of ±0.00015”.

“We make the parts for the machines that make the parts,” Rick said, noting that LPB’s parts include machine beds, columns and heads. “That’s the easiest way to put it.”

For gigantic parts, LPB has an Henri Liné heavy-duty gantry Promill vertical boring machine with five-sided capability and 10’ under the spindle. The travels for the X, Y and Z axes are 480”, 204” and 120”, respectively.

“Not only is the footprint massive for the shop’s largest machine—so is its foundation, which has 750 cu. yd. of concrete. “That was 75 trucks lined up, all pouring in one monolithic pour,” Gary said.

LPB set up a newer type of foundation when it installed a Fives Giddings & Lewis RT 130 horizontal boring mill with a 5.1”-dia. spindle last year. Rick said the shop chose a vaulted foundation. “It’s a foundation within a foundation.” After the rectangular pit is created, Unisorb isolation material is placed on the bottom and sides, and then the foundation is laid. He added that the shop’s foundations are generally 50 to 100 percent thicker than the builders’ recommendations.

To move parts for that and other large machine tools, LPB has nine

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cranes, including a couple with 60-ton lifting capacities. Rick emphasized the importance of safely handling and moving such large parts, and the company has its cranes, chains and straps inspected biannually.

Precisely Massive

Although the parts are often large, with 2-cu.-ft. ones being the smallest, tolerances are typically tight, Gary said. So the 60,000-sq.-ft. shop is temperature-controlled to ±1.5° F from the crane rail down.

“Undoubtedly, the coefficient of thermal expansion has more effect the bigger the part you do,” Rick said. “It’s really hard to get parts flat within 0.001" when your parts are 500" long.”

To further enhance precision, all workpieces are stress-relieved, Gary said. The array of materials includes cast iron, ductile iron, stainless steel, alloy steel and aluminum, as well as exotics on rare occasion.

In addition, LPB generally requires the machine tools it purchases to achieve tighter tolerances than standard models. “Most are ordered as specials to hold closer tolerances to push those machine tool builders to the max,” Gary said.

LPB specifies other customized machine features to improve part inspection and safety. For example, Gary explained that the shop’s Fives Giddings & Lewis PT-1800 table-type horizontal boring mill was ordered with a specialized operator platform that incorporates an expensive scissor lift to enable safer, more efficient part inspection.

When it comes to producing large parts, being able to inspect them properly is essential, according
to Blake Conner, general manager for CBM Precision Parts. The Bessemer City, North Carolina, job shop specializes in machining and fabricating parts that range from the size of washing machines to 400”×155”×116” and weighing about 50 tons for a variety of industries, including power generation, mining and aerospace.

“I think that’s the most important thing. Most people don’t have QC for the big parts,” he said, adding that the shop inspects parts with Faro laser trackers and ScanArm laser 3D scanning devices. “With the bigger parts, you kind of have to have the inspection equipment come to the part. If you buy a CMM big enough, it costs $5 (million) or $6 million and it’s a waste of money.”

CBM holds tolerances as tight as 0.001” on numerous parts and stress-relieves a lot of multipiece weldments before machining, Conner added.

Besand said AMG outsources multiple-piece fabrications for stress relief, such as a gear with a rolled outside ring, a hub and plates that serve as webs. “Anytime you fabricate something like that and then start cutting it without stress relieving, you really run the risk of things moving around. Anything that is just a blank hunk of steel, the machining itself will stress-relieve it, and that’s all we do.”

In Control

Because the machine tools and grinding machines that produce big parts tend to be large and therefore fairly expensive, it’s important to maintain them well.

“We pride ourselves on our quality and keeping the machines in really good shape,” said Rick at LPB. “Gary really heads up the part of keeping the machines in shape.

Hurco’s DCX42i VMC has a 4,000mm × 2,100mm table and X, Y- and Z-axis travels of 4,200mm, 2,600mm and 1,100mm, respectively.

Grand ‘Mother’

Large parts.indd   34
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Double Column for the Big Stuff

The headline reflects how Hurco Cos. Inc. promotes its biggest machine tools: the DCX series 2m and 3m vertical machining centers. The Indianapolis-based machine tool builder states that the gantry-style machines’ double-column design provides enhanced dynamic behavior and promotes thermal stability compared with other designs.

Besides dual columns, Hurco’s Michael Cope, a product technical specialist, said machine tools for producing large parts need to be rigid, offer a high level of torque in the spindle and have adequate tool magazine capacity. “Those machines are typically available in CAT 50,” he added. “Speed becomes less important, and rigidity and power become more important.”

To potentially reduce the number of setups when machining a workpiece that usually requires a crane to move, one DCX model is available with a 5-axis head. “Once you have the part leveled, planted and squared up, you want to hit as many sides as you can,” Cope said.

After Hurco introduced the initial DCX model, it added a smaller version and two larger versions.

“We’re fortunate to have good relationships with our customers,” said Marketing Manager Maggie Smith. “In many instances, a customer who wants the versatility and usability of the Hurco control will mention he needs a larger machine to make a specific part. We take these customer requests seriously. If market data supports segment growth and it is a viable option, Hurco is responsive to adding those types of machines.”

For those looking to take a horizontal approach, Hurco offers its large HM1700Ri horizontal mill and the HBMXi boring mills.

No matter what type of CNC machine is used for big parts, stress relieving before the finish pass is critical. “I learned about the importance of stress relieving early in my career when I was a machinist at a job shop,” Cope said. “It was on a lathe, but it was still a very large part. I had done some very close-tolerance work, the part looked beautiful, and everything measured just right until I unclamped it from the chuck. And then it went egg-shaped. That was the first experience I had with stress relieving, and the lesson applies to parts machined on mills as well.”

Stress relieving, Cope explained, might require roughing five sides of a part, then taking another complete roughing pass to remove more material and allow the part time to complete its movement before beginning the finishing operation. “Then you are machining it once it is relieved.”

—A. Richter
And most of our work comes to us from word-of-mouth for quality.”
He pointed out that the shop served about 150 customers last year, with the largest one representing roughly 20 percent of business.
LPB converted some of its older large machines to CNC, Rick said. The conversions enhance the machines’ functionality while enabling them to still be operated manually and cut the time for programming when creating basic part features.
Other older equipment continues to be operated manually, including a Monarch lathe with a 31” diameter × 60” travel that was built in 1942 and is used occasionally for in-house turning purposes, Gary noted.
Whether a part is produced on an older or a newer machine, it should be able to be machined efficiently. Like a large percentage of part manufacturers, LPB works with customers to improve the design of parts so they are easier to machine. Gary added that the shop also will recommend changing the workpiece material, when appropriate, without changing part functionality. For example, it might make more sense to select 4140 steel instead of cast iron to overcome a porosity issue or when a part requires flame hardening that’s more evenly distributed.
“I’m quoting a large weldment right now that’s probably 120 sq. in., and it was supposed to be A517, a more expensive grade of low-carbon steel,” Rick said. “After talking to them, we were able to reduce the cost to a more normal A36 low-carbon steel, and their engineers feel that it will still meet the specs they want in the end.”

Mindset for Big
Also similar to many other manufacturers, LPB, which has around 30 employees, finds it “extremely difficult” to find and hire people with the right skill sets. After two machinists left the company...
because of health reasons, Rick said LPB hired replacements about six months ago following a year-plus search. “It’s the same thing everybody else is fighting.”

To help bring younger skilled workers into the fold, Rick said LPB and other local shops have collaborated with Schoolcraft College. “We try to help them out with what we think they should be teaching.”

AMG, which has 28 employees, also finds it’s challenging to locate people with the needed skills and works with Clackamas Community College to help train CNC machining technicians, Besand noted.

Nonetheless, well-trained graduates and even veteran machinists may not be a good fit when part sizes leave their comfort zone. “A lot of people are really scared to work on some larger parts,” Besand said. “It’s intimidating to them at first.”

CBM’s Conner concurred that there’s a whole mindset and different approach to machining large parts compared with more conventional sizes. “We bring guys in who are used to doing small parts, and you have to have a quality control plan and really see it through,” he said. “Otherwise you have an

American Machine & Gear rebuilds a gearbox that weighs about 30,000 lbs.
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Setup is one element of large-part machining that dissuades many people from gravitating toward those applications, according to Michael Cope, product technical specialist for machine tool builder Hurco Cos. Inc., Indianapolis. “You’re going to spend a lot more time in setup and preparation than you will actually cutting the part many times. Most people, myself included, don’t like running large work because of that. When you start talking gauge blocks and clamping fixtures, everything gets bigger and more complicated.”

Specializing in large-part machining, however, can keep a shop busy.

That’s the case at LPB, but Rick emphasized that the shop isn’t content to rest on its laurels. “My dad was always talking about the next machine we were going to buy and used to say, ‘The world is always turning, and when you are standing still, you’re falling behind.’ If you don’t keep going, you don’t stay up with it. You are either falling behind or keeping up. There is no standing still.”

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Deburring drilled holes is essential to the manufacturing process. Burrs that aren’t cleaned up can cause part failure by breaking off and clogging or damaging a part or an assembly or by cutting a wire or an O-ring that’s passed through a bore. But cross-holes, where two or more holes intersect, are hard to reach and often require deburring by hand.

When cross-hole deburring, challenges are commonly encountered in applications with sloped or uneven surfaces, wide penetration angles, multiple intersecting bores, 1:1 ratio cross-bores and microscale bores. The burrs that develop in these situations frequently can’t be easily removed with standard deburring tools on a CNC machine.

"Cross-hole deburring is an issue for our customers because typically they have to take the part off the machine and remove that burr by hand, which takes a lot of time and actually can cause physical stress for a machinist to do the tedious labor of deburring,” said Lynn Bissell, sales and marketing coordinator at Heule Tool Corp., Loveland, Ohio. “Automated deburring with a tool in the CNC machine provides a solution that makes the process more efficient and gives the end product a more consistent finish from part to part.”

Complex Shapes

Drilling a hole through a flat plate of metal generates a flat, 2D circle. “So going in and deburring it on the backside is no different than deburring that same edge on the outside, because there’s no complex shapes,” said Stan Kroll, partner and general manager at J.W. Done Corp., Hayward, California.

In the case of cross-holes, when burrs occur deep inside a part, things become tricky.

But in the case of cross-holes, when burrs occur deep inside a part, things become tricky. “Whenever you have people using abrasive stones or carbide rotary burs by hand, it’s got to go in very carefully without scratching up the wall or without moving too far down the hole and scratching up any other features beyond the edge,” Kroll said. “You try to carefully and selectively follow just the edge where the burr is, and that’s not so easy to do when you can’t
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Saddle Burrs

On saddle-shaped cross-holes, many tools designed to deburr flat holes will cut high on the high spots and cut low or do nothing on the low spots, according to Bill Hargrove, national sales manager at Heule Tool. “This leaves bigger edge breaks on the high spots and smaller edge breaks on the low ones, or it may not deburr completely all the way around the hole.”

In some precision applications, the uneven size of the edge break is a concern. Heule developed its line of Cofa deburring tools to produce a consistent edge break throughout the surface of a saddle-shaped cross-hole. The carbide cutting blade is controlled by a simple spring that allows it to pass through a bore without cutting or damaging the bore’s surface. Once the blade exits to the interior of the cross-hole, it opens to interact with burrs wherever it comes into contact with metal, pivoting to follow the contour of the hole’s surface. This way, the tool can remove all burrs while creating an even-tapered corner break.

“It’s a unique tool that is simple to use,” Hargrove said. “It’s just straight through the center of the hole and straight back out through the center of the hole. It does not
need a complex program to follow the contour, because the blade does all of the work.”

**Ratio in Balance**

Another solution to the potato chip problem is J.W. Done’s Orbitool. Kroll said it was developed to remove burrs from the intersections of cross-holes of nearly or exactly the same size—sometimes called 1-1 cross-holes—such as those seen at the 90° elbow of T-pipes common in fittings and manifolds.

As the diameters of the two holes reach identical size, the potato chip shape expands until the intersection reaches halfway up the sides of both holes. This configuration is typical yet extremely difficult or even impossible for many deburring tools.

“A lot of traditional tools always had a hole ratio limitation,” Kroll said. “They could do cross-holes but only up to a certain cross-hole size in relation to the bore.”

The Orbitool looks like a traditional carbide rotary bur, which is essentially a ball-shaped milling cutter mounted on a rigid shaft.

The difference is the combination of a flexible shaft and a protective metal ring, or disc, which encircles the end of the tool. Kroll said the ring makes it physically impossible for the carbide cutting tool to touch anything but the actual edge of the holes’ intersection, thereby protecting the rest of the part from any stray damage.

“Then the most important thing about our tool is what we call a helical interpolation, which in simple terms is a thread spiral,” Kroll said. “Just as if you were programming a standard thread milling routine with the CAM cycle in a CNC machine, you program the tool to interpolate and gradually feed down the hole towards the edge, essentially tracing the ID of that hole. It’ll constantly flex and adjust and move out of the way if it encounters anything that should be protected. But during
that process, it’s going to remove the burrs from all of those edges.”

This flexibility is helpful for deburring parts with uneven or offset surfaces.

Sometimes holes exit into castings and forgings with irregular surfaces that aren’t necessarily predictable, and end users can’t program a tool to know exactly where that edge is going to be, Kroll noted. “That’s where something like the Orbitool becomes very handy because we’re not programming it to actually find the edge, and in fact we never tell the tool where the edge is located.”

**Brush Them Away**

Another method for deburring these difficult shapes on a CNC without elaborate programming is to use deburring brushes. These tools self-center and self-align to a bore so elaborate, rigid setups are not required. The brushes can handle angled cross sections, irregular surfaces and multiple cross-holes in a cylindrical bore. Contingent on the tool, it may be usable on a CNC machine, as well as off-machine with a hand drill or drill press.

“We have a few different lines for deburring cross-holes, depending on the thickness of the burrs, the base material, the size of the hole and the surface finish requirements,” said Elysha Cole, applications engineer at Brush Research Manufacturing Co. Inc., Los Angeles. “For the larger holes—4mm and up—we offer the Flex-Hone Tool, which is a flexible nylon filament rotary brush with abrasive globules on the end of each filament. The Flex-Hone moves into the bore in an oversized state. When it exits the bore to the ID, the globules pop out into the cross-hole a little bit, which allows them to get those burrs.”

Brushes are especially good at deburring nonstandard shapes and surfaces.

“Because the tool is flexible, angles

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are not such a big deal,” Cole said. “In the case where a cross-hole breaks into a bore at an angle, as long as the brush can go through the cylindrical main ID, it will deburr the sharp edges and produce a slight radius on that elliptical hole.”

In some cases, a brush may need additional maneuvering.

A brush is most effective when it moves perpendicular to the edge being deburred rather than parallel, said Rick Sawyer, general manager of Automated Deburring Solutions, a subsidiary of Weiler Abrasives Group, Cresco, Pennsylvania. “A bore that comes in at an angle to the main bore creates an oval opening. So as I rotate the brush down through it, I get the sides of the oval very well, but I don’t get the top and the bottom as well unless I also oscillate the brush back and forth.”

Abrasive brushes can be used for a range of small holes as well depending on the hole and burr. “Above an inch in bore size, I have a lot of options—for example, Bore-Rx brushes, which have nylon abrasive filaments with ceramic abrasive grains coextruded through them,” Sawyer said. “With larger brush diameters, I get a lot of filaments, which means I get a lot of cutters as every grain is actually a minicutter. But once you get below an inch, now I must start going down in the filament’s diameters, which limits the grain size it can carry.”

Sawyer said brushes ¥¼” and smaller can support fine-grain sizes of only 500 or 1,000 grit and can’t remove a heavy burr.
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“All it can do is polish,” he added. “If the burr is loose, the brush can go in there and push it out. But it can’t detach it, because it just doesn’t have enough horsepower, so to speak.”

Using coolant impacts a brush’s deburring efficiency. “If the brush is dry, such as in the case of a robotic cell, I can only bring it up to about 2,000 surface feet per minute because the abrasive grain generates heat,” Sawyer said. “Meaning at higher speeds, the nylon filament itself may start to melt or transfer onto the part. If we have coolant, the abrasive media will leave a nicer finish, and it also allows us to run the brush more aggressively by increasing rpm or having a larger depth of interference.”

Sawyer said these types of products tend to work better with water-soluble coolant rather than oil-based coolant because the former doesn’t cause buildup onto the abrasive grain.

“When I look at a burr, it’s all about root thickness,” Sawyer said. “How well attached is it? How much energy will it take to remove it? In some cases, it’s too well attached and you need a deburring tool or stone to cut it off.” When this happens, a brush is often still required to remove the secondary burr generated by the hard tool or stone.

In contrast to the cutting action of a carbide bur, a brush performs a filing action. This is akin to the way that a nail clipper cuts a nail and a file merely smooths edges. But in cases where a brush can do the job, a
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Get the most out of tried-and-true machinist vises.

By Kip Hanson

Of all the workholding methods available to machine operators, the machinist vise continues to be the most popular. It’s easy to use, flexible and readily accessible with a price tag that all but the most cash-strapped of shops find agreeable. Getting the most out of a vise, however, requires a little tender, loving care, as well as the ability to think creatively.

The TLC part is easy. Steve Kane, sales and marketing manager at Kurt Industrial Products, Minneapolis, said the first step is simply to keep vises clean.

“A lot of people make the mistake of not wiping the vise down and applying a coat of oil when they’re done using it,” he said. “Depending on what kind of coolant they’re using and its condition, this can lead to rust, especially if the vise gets placed on a shelf between jobs. They should also make sure there are no chips collecting inside. If so, blow them out with a little shop air.”

Aside from keeping a vise clean, Kane said to apply a small amount of marine grease to the screw threads once a month and then run

about the author

Kip Hanson is a contributing writer for CTE. Contact him at 520-548-7328 or kip@kahmco.net.
Every minute a CNC machining center sits idle while it's being tooled up for the next job costs companies money. A modular base plate along with a kit of precision fixturing components can get your machines back up and running; often in less than half the time it takes an operator to set up a job manually.

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the vise through its full travel to evenly disburse the grease. It’s also wise to remove scratches or dents with a fine stone. Of course, shops must adjust their maintenance routines to the types of materials being machined and the amount of use a vise gets. Shops that routinely cut cast iron and other abrasive materials, for example, should watch for wear. Machinists might want to more often clean and lubricate internal components and even periodically break down a vise to avoid damage, as long as they know how to properly reassemble the vise.

“We get frequent calls from people who wonder why there’s so much jaw lift after they’ve reassembled the vise, only to find they lost one of the internal components or failed to tighten it properly,” Kane said.

A common mistake is overtightening. Operators can damage vises when using an impact wrench to tighten them or cranking on the handle with a 3’ breaker bar. Instead, manual vises should be tightened with a torque wrench for the most consistent, accurate clamping, using forces no higher than manufacturers’ recommendations.

Beyond the Bridgeport
The second part of getting the most from a vise—thinking creatively—is a bit more challenging. The traditional pair of 6” machinist

Vise longevity and accuracy often come down to keeping it clean.

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vises often seen on machining centers get the job done, but a variety of space-saving, time-saving and more accurate options exist.

Mike Antos, product manager at Cleveland-based Jergens Inc., said vise selection frequently comes down to familiarity. “A lot of machinists and shop owners learned the trade working on a manual knee mill,” he said. “When they graduate to CNC, they use the workholding they’re most comfortable with. There’s certainly nothing wrong with this, but we feel it’s better to take a systematic approach to workholding, which starts by mounting a subplate onto the machining center table.”

Most people agree that the beauty of a subplate is its flexibility, especially when it’s equipped with a quick-change ball lock or zero-point clamping system. Again, options are available, each with its own merits and cost considerations. But all alternatives make it easy to switch among vises, fixtures, toe clamps and rotary tables in moments.

In that vein, all vises also should be equipped with some sort of quick-change jaw system. Eric Sun, founder and CEO of Orange Vise Co. LLC, Placentia, California, said ‘It’s better to take a systematic approach to workholding.’

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As 5-axis machining grows in popularity, the need for high-profile yet rigid vises able to lift workpieces into the work area is abundantly clear. Most of the available options require that part blanks be pre-machined with a dovetail shape along their bottom edge, which allows the workpiece to be gripped using a small amount of sacrificial material that is later removed.

Eric Nekich, operations, technology and inside sales manager at Hartland, Wisconsin-based Lang Technovation Co., suggested there’s a better way.

“Most people don’t stop to evaluate the cost of pre-machining both in time and lost material,” he said. “For instance, a dovetail cutting operation might take 20 minutes and use $\frac{1}{4}$" of material whereas our Makro-Grip stamping unit takes maybe five seconds of workpiece prep and only uses 3mm of material.”

The tool clamps a workpiece blank in a special fixture, which creates a series of small dimples where the dovetail would normally sit. These dimples connect with mating bumps in the Makro-Grip vise jaws. Investment in equipment is needed, but Nekich said return on investment is usually fast. He also said the product is not a be-all and end-all solution. Depending on part geometry, a dovetail might be a better option.

“I’m probably a little biased, but if the name of this company was Eric’s Precision, I would go for the Makro-Grip all day long.

For more information about Lang Technovation, call 262-446-9850 or visit www.lang-technovation.com.

his company’s vises accept CarveSmart-style jaws, as well as Orange Vise’s proprietary system.

“An increasing number of shops recognize the need for speed and flexibility in their workholding systems, and we’ve developed a number of vise styles and configurations to support that,” he said. “So aside from quick-change jaws and our own ball-style coupling system, there’s the possibility of using the top jaw as a pallet or incorporating the bottom half of the vise into a fixture. There are a lot of ways you can go, and there’s no reason to settle for the status quo.”

Feel the Power

Another convention being challenged is manual clamping. Virtually all vise manufacturers offer hydraulic or pneumatic activation systems. Which is better for a given application is debatable, but what’s not in
The Makro-Grip stamping unit produces dimples on the workpiece, which connect with mating bumps in the Makro-Grip vise jaws.

“Just because of the time and energy it saves,” he said. “I don’t need a milling machine and special cutters, the parts can be pre-stamped in the toolcrib or warehouse, and it’s easy enough that anyone can do it with a few minutes of training. It’s a very simple process, and for those operations where it works, it works really well.”

—K. Hanson

Double-station vises are a great way to increase productivity without eating up a lot of real estate.

“The question is the greater accuracy, speed and, above all, operator ergonomics these systems provide. “Consider a typical 40” machining center with five or six vises on the table, and then imagine having to
stand there loading and unloading them for eight hours a day,” Antos said. “I can pretty much guarantee the operator won’t be applying the same pressure at the end of the day as he did at the beginning. And then here comes the second shift with another operator who has his or her own idea of what ‘tight’ actually means. Yes, a torque wrench is one way around this, but it’s much more effective to simply flip a lever or push a button and activate all of the vises at once.”

Kane agreed, saying, “For us, the hydraulics end of the business is growing. Some of this is due to an increase in automation, whether it’s robotic loading and unloading or pallet changers. But we’re definitely seeing more and more shops get on board with some form of hydraulic or pneumatic activation.”

Elbow Room

There’s also real estate to consider. For the best use of available table space, consider a double-station vise. Whether called a Production Vise (Jergens), a DoubleLock or an HDL Vise (Kurt), double-station vises offer the ability to machine twice as many parts per machine cycle versus single-station counterparts, with a footprint that’s only marginally larger.

It’s for this reason that Orange Vise didn’t always offer a single-station vise.

contributors

Jergens Inc.
877-486-1454
www.jergensinc.com

Kurt Industrial Products
877-226-7823
www.kurtworkholding.com

Orange Vise Co. LLC
714-482-3952
www.orangevise.com
Orange Vise says its Twin-Delta uses a pair of dovetailed wedges to self-align top-mounted fixture plates.

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“A lot of folks buy equipment without being fully aware of how much the tooling will cost,” Sun said. “That’s nobody’s fault—it’s just the way things work in the machining industry. You never know what’s going to pop up or whether there’s enough budget available for what are admittedly more expensive dual-station vises. That’s why we recently introduced a single-station vise to address this particular need.”

Vise manufacturers continuously improve and expand their product offerings, and only by staying abreast of what’s available in the market will shops stay competitive. To those concerned they’ll end up with a hodgepodge of vise styles and brands, this is one more reason to install a quick-change modular subplate on every machining center and manual mill. Doing so makes it easy to use the best tool for the job while ensuring less downtime and greater flexibility no matter whose vises do the holding.

Pneumatic workholding is on the rise, as shown here with Kurt’s zero-point VB DockLock clamping system.
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Efficient, productive machining involves many factors. Programmers, engineers and machinists need to master multiple important areas. Becoming adept at the use of key calculations is a critical matter.

Students, apprentices and trainees receive considerable instruction on gauges, machine alignments and operation of machine tools but often get insufficient education about shop math. Smartphones, computers, CAM software and conversational controls almost have eliminated the requirement for students to learn the subject. Many people believe that technological advances minimize the obligation of craftspeople to understand and use shop math, as evidenced by the marketing of software and controls that generate information that once was calculated by machinists and toolmakers.

Given the power of today’s digital tools, reducing the instructional time spent on shop math is not warranted. There are calculations and geometric concepts that everyone associated with machining should master.
### Speed Equation

Calculating the proper cutting speed is vital whether using a million-dollar vertical machining center or 50-year-old knee mill. When milling, the cutting speed is a function of rpm and tool diameter. Learning to express the cutting speed in terms of rpm or sfm enhances technical communication by giving common terminology to everyone. Being able to work backward from rpm to sfm allows a person to propagate efficient cutting parameters across a range of tool diameters. Using rpm to define the cutting speed of a milling tool is the same as using rpm to define the speed of a car—it has no meaning by itself.

Once the cutting speed is established, the feed rate—the speed at which the tool traverses the workpiece—must be calculated. The most basic such calculation is: feed rate = rpm × the number of cutting teeth × the desired chip load, where the feed is expressed in ipm or mm/min. This is the “money” calculation because the feed rate is tied directly to the cycle time. A change in the feed usually is accompanied by a change in the cycle time, and feeding higher is almost always better for the bottom line.

Engineers and machinists should have a good understanding of chip thinning calculations and keep a reference source or calculator handy. As the DOC decreases for milling tools, there is a point at which the feed rate must increase to maintain the desired chip...
thickness. Chip thinning boosts the money calculation, so learning to manage chip thickness is a game changer.

A good example is work I did at a previous employer where a team of engineers significantly improved milling efficiency by using speed and feed calculations to determine the most effective cutting parameters. We had applied a 3/4"-dia. dovetail-style tool with four flutes and had horrible tool life as a result of the cutting speed being too high for the material. Reducing the cutting speed was not an option because that would have necessitated reducing the feed rate, hurting cycle time.

The solution was to manufacture a custom 5/8"-dia. tool. We were able to increase the spindle speed while maintaining the optimal cutting speed, or sfm, which increased the feed rate. (Remember that the feed rate equals rpm times the number of cutting teeth times the desired chip load.) We also added four cutting edges, taking the total from four to eight, thereby doubling the feed rate while maintaining the proper chip load. Cycle times were slashed by two-thirds, and tool life tripled.
everyone operating a machining center should be taught to graph using the Cartesian coordinate system, the foundation of digital manufacturing. Anyone operating a machining center, coordinate measuring machine or similar device learns to maneuver through the X, Y, Z, A and B values needed to use the machine, but it can be a difficult, costly journey.

When people don’t understand the coordinate system, machine setup can be inefficient and making adjustments based on measurements, such as CMM data, can negatively impact quality. Becoming proficient with the Cartesian system on paper before moving to a machine tool improves efficiency and lowers the cost of quality.

Basic trigonometry is a must for anyone operating or programming a machining center. Bolt circle coordinates; true position data; I, J and K values for CNC programming; and countless other pieces of necessary machining information rely on trig calculations. Some would argue that CAD, CAM and other manufacturing software minimize the need for machinists to master basic trig. However, first mastering the concepts on paper increases the power of the digital tools and creates efficiency in the CAD/CAM environment.

We no longer are heading toward a digital machining environment. We already are immersed, and the most significant advances in manufacturing will be driven by digital technology. Elements like complete digital simulation, additive manufacturing and voice-controlled human-machine interfaces have moved beyond concepts. These are fully developed technologies, and their use in machining is expanding rapidly. Successful machining necessitates mastery of key calculations.

**Math Matters**

**Coordinate System**

- Bend the stem to reach inaccessible locations, in confined areas, down in a hole, inside a cavity or in a buried feature which cannot be seen.
- Mount the ball on a wire for flexibility to go around corners in pipe and tubing, for example.
- Easily measure the width of grooves or the surfaces of spherical and toroidal features.
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**Becoming adept at the use of key calculations is a critical matter.**

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.

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**about the author**

Chris 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.
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“Our first impression was that the JetCAM interface was very user-friendly,” said I-Cherng Senior Engineer Ian Yo.

Since that purchase of JetCAM, I-Cherng has bought several more CNC punch and laser machines, including a Finn-Power SG6 and LP6. With each purchase, I-Cherng has added a post-processor to its JetCAM license, and four years ago the manufacturer obtained two additional seats of JetCAM Expert.

Less than a year ago, I-Cherng acquired an Amada FLC 4020AJ fiber laser, which was supplied with alternative programming software. Problems were encountered immediately with the software.

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with their machines,” Yo said. “However, the original software supplied with the machine did not consider the characteristics of fiber laser cutting and still appeared to use CO2 laser logic. There were many unnecessary codes in the NC programs. Also, it was not user-friendly. Staff had to spend time deleting unnecessary codes, and some programs could not cut the parts well. We could easily spend over four hours to modify the NC code in order to get it to run on the machine.”

The following month, I-Cherng contacted JetCAM to ask if a post-processor was available for the machine. The answer was yes, so the post was installed remotely and the JetCAM Expert nesting software was upgraded to version 20 across the company’s three licenses. Further tweaks were made remotely to the post-processor to accommodate I-Cherng’s requirements and machine configurations, with test parts cut using NC from both JetCAM and the originally supplied software for comparison. Yo said the resulting NC that was generated automatically from JetCAM was much shorter.

I-Cherng immediately noticed significant benefits. Programming time was reduced by 80 percent as pre-defined technology tables automatically applied cutting conditions based on material, thickness and quality settings. Tooling and profiling logic could be applied routinely to parts for both punching and laser cutting, ensuring that parts were

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Version 20 of JetCAM Expert nesting software enabled I-Cherng Refrigeration Industrial to reduce programming time by 80 percent and machine runtime by 13.2 percent.

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Brian Beauregard
CNC Machinist/Programmer
Antron Engineering & Machine
available for nesting on either type of machine. Features such as single-component automatic processing and single-component automatic nesting allowed multiple components to be imported and tooled, and complete nests of each part could be created automatically in seconds.

Additional material savings have been achieved by employing common cutting to separate components with a single cut.

“With the previous software, we had to specify each common cut manually,” Yo said. “But with JetCAM, it’s fully automatic. We’ve seen material utilization improvements of between 5 and 30 percent.”

Version 20 included two new features: Jet-Cut and Jet-Optimizer. Jet-Cut provides automatic fly cutting, or grid cutting, based on predetermined parameters. This feature locates grids of internal holes and then splits the cutting into separate, short line segments that lie on the same line or circle. The cutting head is kept down when moving, and the laser beam is switched on and off on the fly, which dramatically reduces the cutting time of grids. Rounded movement between cuts can be applied as the laser head moves to the next row, minimizing acceleration changes. Once configured, the entire process is automatic and applied with a couple of mouse clicks.

Jet-Optimizer optimizes the sequence of cutting internal holes to minimize machine movements while also avoiding travel over previously cut areas and reducing the risk of collision.

Compared with the same nests generated by the originally supplied software, machine runtime was reduced by 13.2 percent using Jet-Cut.

“Now, the full capabilities of the Amada fiber laser can be realized,” Yo said.

I-Cherng is considering future investments in more fiber lasers or punch-and-laser combination machines. The company already has decided that JetCAM will drive any selected technology.

“With the combination of the massive reduction in programming time, material savings and additional throughput on the machine,” Yo said, “we calculated our ROI on the upgrade of under four months.”

—Article by JetCAM International
People & Companies

PEOPLE

- Carpenterville, Illinois-based Acme Industrial Co., which makes key locking threaded inserts and studs, hired Andrew Kuhl as plant manager and promoted Megan Evans to order fulfillment manager.
- Watertown, Wisconsin-based Berken Solutions Inc., which manufactures conveyor systems, appointed Brett Allard project manager.
- Erie, Pennsylvania-based Eriez Manufacturing Co., which makes equipment for conveying, metal detection and magnetic lift and separation, promoted Charlie Ingram to executive vice president and chief marketing officer.
- Minneapolis-based Industrial Tool Inc., which makes robotic automation systems, workholding fixtures, turnkey systems and custom machining centers, named Patrick Hjelm CEO and president after the retirement of CEO Richard Lueck.
- Thomas R. Kurfess, a member of the board of directors at the consultancy National Center for Defense Manufacturing and Machining, Blairsville, Pennsylvania, was appointed chief manufacturing officer at Oak Ridge (Tennessee) National Laboratory.
- Salt Lake City-based SA International Inc., which develops CNC machining software, promoted Gudrun Bonte to vice president of product management.

COMPANIES

- Toolmaker Arch Global Precision LLC, Bloomfield Hills, Michigan, acquired toolmaker American Tool Service, Fort Wayne, Indiana; Fort Wayne, Indiana-based OrthoGrind LLC, which provides grading services for surgical cutting instruments; and toolmaker Competitive Carbide Inc., Mentor, Ohio.
- Toolmaker Harvey Performance Co. LLC, Rowley, Massachusetts, acquired toolmaker Micro 100 Tool Corp., Meridian, Idaho.
- Kalamazoo, Michigan-based KMC Global, which makes conveyors, systems for metal scrap reclamation and equipment for parts coating and bulk material handling, expanded its controls and automation division to serve outside markets.
- Toolmaker Mapal Frhenosa, Monterrey, Mexico, opened a factory in Santiago de Querétaro, Mexico.

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brush offers several benefits.

“Our brushes are not going to remove material from your part, change the geometry or make the bore bigger,” Cole said. “So if you have tight tolerances, for example, in aerospace applications, we can remove the burrs without removing metal.”

The beauty of using a cross-hole deburring brush, Cole said, is that it potentially can perform two functions in one step—deburring and surface finishing—saving time and space on the tool magazine.

“You might not get the right finish with a carbide cutting bur, but our tools can do both,” Cole said.

Supply Chain Benefits

The benefits of moving the deburring process to a CNC and applying specialized tools ascend the supply chain.

“With deburring tools like the Cofa, the manufacturer is able to produce parts faster and meet their production demands,” Bissell said.

“So they save money, and they also make the OEM customers that are buying the parts happy. But when you go up another level to where the parts are assembled to create products, those also can be produced faster and with higher quality.”

Ultimately, this increasing efficiency enables companies to meet consumer demand, Bissell said.

“For example, the increasing demand for air travel is creating a huge backlog in the aerospace industry as they’re trying to meet that demand,” Bissell said. “On that level, these tools are important because companies need to produce planes faster to get the project going and out the door.”

CTE
With ongoing development in composite materials, the aerospace industry faces the challenge of finding ways to improve manufacturing processes.

One collaboration is determined to advance a key goal of aerospace manufacturing: automating the inspection of composite assemblies with real-time measurement.

The National Research Council, Ottawa, Ontario, and Fives Machining Systems Inc., Hebron, Kentucky, are partnering to develop the Sentry, the next generation of in-line inspection instrumentation, suitable especially for composite applications in aerospace and other industries.

The Sentry generates a 3D map of the assembly surface. This enables the measurement of gaps and overlaps between fiber tows, the beginning and ending points of fiber tows, and ply angularity; the detection of missing tows; and the capture of any other phenomenon that manifests as a change in surface profile or dimension. The tool eliminates the need for manual inspection, saving up to 30 percent of production cycle time, the partners say.

Existing technology uses line laser triangulation (LLT), which wields the geometry of the beam to capture dimensional information. “This restricts the effectiveness of LLT to relatively simple surfaces,” said Ken Wright, chief technology officer at Fives’ metalcutting and composites unit. This approach “fails to capture a high percentage of measurements on more complex surfaces.”

In addition, he said, LLT is sensitive to the type of material being measured, because of variations in re-reflectivity of surfaces that reduce the fidelity of generated images.

A final limitation of LLT is size. “The technology requires a separate location for the sending and reception of the laser beam,” Wright said. “This limits the ability to design a compact unit that can integrate onto the fiber placement device and take real-time measurements.”

To overcome all these limitations, the Sentry uses an advanced form of interferometry, which he said has not been deployed previously in these applications.

The Sentry is mounted on the fiber placement equipment just before curing the material. As a result, the tool can take real-time measurements while the fiber is assembled into a structure. “This provides immediate status of the quality of the process and prevents the creation of scrap,” Wright said.

The NRC and Fives say these improved measurements will enable composite manufacturers to shorten their production times and reduce defects.

“We are in discussions for initial deployment right now and are demonstrating it to customers on a placement machine, which is operating in the Montreal area,” Wright said.

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