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3a. What is the primary end product manufactured (or service performed) at this location?

   331 ☐ Primary Metal Manufacturing
   332 ☐ Fabricated Metal Product Manufacturing
   333 ☐ Machinery Manufacturing
   334 ☐ Computer/Electronic Product Manufacturing
   335 ☐ Electrical Equip/Appliance & Component Manufacturing
   336 ☐ Transportation Equipment Manufacturing
   337 ☐ Furniture and Related Product Manufacturing
   339 ☐ Miscellaneous Manufacturing
   423 ☐ Wholesale/Trade/Durable Goods
   999 ☐ Other Manufacturing NEC

3b. If your company does NOT manufacture AT THIS LOCATION, specify company’s primary product or service performed. (please specify)

4. Number of employees at your company.
   A ☐ 1-9  B ☐ 10-19  C ☐ 20-49  D ☐ 50-99  E ☐ 100-249  F ☐ 250-499  G ☐ 500+

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   3. ☐ Defense
   4. ☐ Energy
   5. ☐ Heavy Equipment
   6. ☐ Medical
   7. ☐ Transportation (including automotive)
   8. ☐ Other (please specify)
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Seco Tools LLC and CTE conclude a four-part series about optimized roughing. Watch the full series online.

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Alpha Workholding Solutions LLC demonstrates its electro-permanent magnetic workholders.

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The Grinding Doc urges shops to carefully determine where to start rapid in-feed if they want to reduce cycle time for a cylindrical OD plunge grinding operation.

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Congratulations to Eriez Manufacturing Co. as it expands its Erie, Pennsylvania, plant. The 10,591-sq.-m (114,000-sq.-ft.) facility will grow to 14,121 sq. m (152,000 sq. ft.) this year with areas dedicated to specialized repair, testing, demonstrations and R&D. Eriez Manufacturing has called Erie home for 78 years. See this and more on CTE social media.

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After a bit of a hiatus, I received a new book about metalworking, “Essential Guide to Metals and Manufacturing,” by Krishan Katyal. The author is a mechanical engineer who has worked for four decades designing and manufacturing machine tools, consumer appliances, diesel-electric locomotives and heavy concrete construction products for Chicago-area companies.

The 324-page book is intended for people new to the manufacturing industry who want to learn and grow in the metal manufacturing business. Katyal hopes that the covered subjects will help readers develop greater understanding of metals and manufacturing methods, as well as help them contribute to and improve the companies they work for or own.

The 18 chapters in the book, which is published by Xlibris LLC, Bloomington, Indiana, provide basic overviews of topics, beginning with the making of iron and steel. Some subjects typically are not found in the pages of Cutting Tool Engineering, such as welding methods, plastics and shaping of materials, but there is plenty of information about CNC machine tools and metalcutting.

Each chapter starts with a list of the topics covered and then describes each subject. Within or at the end of many topic sections is a list of equipment suppliers’ websites that readers can visit to gather additional information. In addition, the author includes “glimpses” from websites that highlight equipment specifications and product line overviews.

Katyal also includes brief summaries of various articles from trade magazines, including a number from CTE. He noted he was a CTE subscriber until 2009, and a couple of the referenced CTE articles were published even before I began working for the magazine in 2000. However, one summarized CTE article that I remember working on was “Turning the Big Stuff” by Bill Kennedy from June 2004. Several other CTE articles are listed in the references section.

Possibly my favorite sections of the book are the author’s cutting tool, equipment and process sketches that appear at the end of nearly all chapters. Drawn in pencil, many of the 50 sketches even include erasure marks, which enhance rather than distract from the detailed images and information.

Although I read the book from front to back, readers just as easily can browse chapters in a random order and adequately absorb the material. With its host of definitions and process explanations, the book can serve as a handy reference source.

One criticism is that the book would have benefited from having a professional copy editor go over it at least once before sending it to the printer to minimize the style variations that appear in the text. For example, I found it a bit distracting when a few words in a sentence, a random URL or even a period at the end of a sentence would be underlined for no apparent emphasis.

**METALWORKING BOOK GUIDES WAY**

**about the author**

Alan Richter is editor of CTE. Contact him at 847-714-0175 or alanr@ctemedia.com.
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Inserts for Efficient Back Draft Milling: Dapra Corp.’s SBD series inserts help operators finish back draft jobs faster and with enhanced accuracy and fewer insert changes. A positive-rake cutting wiper allows large step-downs and high feed rates. The inserts are coated with AlTiN-based TS for general-purpose machining or AlCrN-based HM for cutting hardened steel, high-temperature alloys and 300 series and PH stainless steel.

Dapra Corp.; www.dapra.com

CNC Sensor Monitoring System for Numerous Applications: Caron Engineering Inc. has increased the versatility of the Diect-IT system so it can communicate with multiple sensors: vibration, strain, high-precision power and analog. The last option allows connecting any sensor with a 0 to ±10 VDC analog signal and 4 to 20 mA current signals.

Caron Engineering Inc.; www.caroneng.com
TOOL FOR SMALL INTERNAL GROOVING APPLICATIONS: Kyocera Precision Tools Inc. offers the SIGC small internal grooving tool. The tool body has a clamping system that firmly holds an insert for high-precision machining. Double coolant holes enhance wear resistance while the optimized flute shape efficiently evacuates chips. With a minimum bore diameter of 8 mm (0.315”), the tool is suitable for small internal grooving. Kyocera Precision Tools Inc.; www.kyoceraprecisiontools.com

VISION SYSTEM HAS A MICROFORM SCANNING PROBE: MiScan from Mitutoyo America Corp. is a multiple-sensor microscopic-form measurement system that combines a coordinate measuring machine and a vision measurement system. The MPP-Nano probe can use styluses as small as 125 µm (0.005”) in diameter to measure microscopic workpieces. The SP25M scanning probe also is supported to allow measurement of small to large workpieces. Mitutoyo America Corp.; www.mitutoyo.com

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DUST AND FUME COLLECTOR CONNECTS INTO METALCUTTING SYSTEMS: The Gold series X-Flo package dust and fume collector from Camfil Air Pollution Control integrates with CNC laser and plasma cutting systems. The compact collectors are prewired and ship fully assembled, which enables users to plug them directly into the cutting line.

Camfil Air Pollution Control; www.camfilapc.com

DRILL IS MADE OF NEW PROPRIETARY CARBIDE GRADE: Guhring Inc.’s RT 100 XF drill is coated with nano-Firex, which receives a pre- and post-treatment process to smooth the coating. A negative chamfer along the side of the cutting edge protects the corner. The drills are available in diameters from 3 mm to 20 mm (0.118” to 0.787”) and produce holes five and seven diameters deep.

Guhring Inc.; www.guhring.com

ADAPTIVE-SHAPE GRIPPER MAXIMIZES FLEXIBILITY: The DHEF adaptive-shape gripper from Festo Corp. automatically grips mixed objects with multiple shapes, unaligned objects and numerous objects at once. The gripper gently forms around an object and models the gripping mechanics of a chameleon’s tongue. The lizard’s tongue darts out at prey and then pulls it in while the outside edges wrap around the target, securely holding it.

Festo Corp.; www.festo.us

INSERT FOR HIGH-FEED MILLING: Dormer Pramet’s double-sided SNGX11 insert can achieve a DOC up to 1.78 mm (0.07”). The square, eight-edge insert is suitable for copy milling, helical interpolation, ramping, progressive plunging and facemilling. The insert is available in two geometries: M for machining steel, hardened steel and cast iron and MM for machining stainless steel, soft steel and superalloys.

Dormer Pramet; www.dormerpramet.com
A pair of spindle-related advancements may be good news for part manufacturers looking to go beyond what’s possible in conventional machining.

For end users interested in equipping themselves for Industry 4.0, PCI Scemm, St.-Étienne, France, has introduced the e-Spindle, an electro-spindle that uses sensors to monitor cutting processes and actuators to adjust parameters. PCI Scemm developed e-Spindle technology in collaboration with France’s Cetim, the Technical Centre for Mechanical Industry, and France’s Arts et Métiers ParisTech engineering and research graduate school. (PCI Scemm is a partner of Absolute Machine Tools Inc., Lorain, Ohio.)

Vibration sensors inside the e-Spindle allow spindle condition monitoring during machining. Analysis of vibration picked up by the sensors helps users identify problems, such as bearing wear and coolant inside the spindle, said Max Paulet, PCI Scemm’s business development manager for North America.

He said vibration analysis also can determine whether a machining process is reliable. Before a process begins, the acceptable vibration pattern for each cutting tool that will be applied is entered into the machine control. If the vibration pattern for one of the tools goes outside its tolerance limits during machining, the control automatically recognizes the anomaly, which sets off an alarm, notifies an operator or stops the machine.

“The aim is to give machining lines some independence so they can recognize that something is going wrong with the process and not machine bad parts,” Paulet said.

In addition to monitoring vibration and other key process variables in real time, the e-Spindle uses actuation devices to supply up to 5 kVA to tools without physical connections, such as cables, he said. During a machining process, this power can be employed to move the
Machine Technology

cutting edge of a tool. Power from the e-Spindle also can generate vibration. This capability may be helpful for applications that involve drilling through difficult-to-cut materials. In these cases, Paulet explained, power is transmitted to the toolholder, causing the drill to vibrate, which breaks up chips and thereby speeds up the process. “We’ve almost doubled the speed just by generating vibration to break those chips,” he said. Analysis of data from torque sensors inside the spindle shows whether the drilling process is optimal, Paulet said. If it’s not, the machine automatically can adjust the spindle vibration level to keep the drill moving through the material at the highest possible speed.

Another recent spindle advancement, which is called twin-spin-}


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about the author
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independence, PCI Scemm’s twin-spindle machines have two fully independent carriages.

“It’s more like having two machines in one,” Paulet said.

With two independent spindles, programming one of the machining zones for a new job doesn’t require the other zone to be reprogrammed.

“You can leave that spindle programmed as it was with a specific cycle and save all the adjustments you’ve made to make good-quality parts,” Paulet said.

He said the benefits of having two spindles that operate independently of each other are apparent to manufacturers of powertrain components. Finishing operations for these components require high spindle accuracy, which he said is hard to achieve for long with conventional twin-spindle machines because any adjustments that are made affect both spindles. With two independent spindles, on the other hand, once adjustments are made to one spindle to achieve the desired accuracy, they won’t be affected by subsequent adjustments to the other spindle.

“This helps people get a reliable process for an extended period of time,” Paulet said.
Properly machining a part requires knowing the correct speeds and feed rates for a cutting tool and workpiece material — a skill that can take years to master. What if a resource existed that could make it possible for anyone to run a CNC machine and successfully cut a range of materials, from plastic and stainless steel to titanium? What if the same resource could help seasoned machinists learn how to optimize a new cutting tool or material?

More than a decade ago, I bought a benchtop CNC mill to develop a product. To improve the odds of my business succeeding, I needed to learn the basics of machining. But all the essentials, such as cutting tools and CAD/CAM software, were foreign topics to me. So I soaked up every resource I could find in the pre-Youtube era and fell in love with machining.

Countless aids since have emerged that shorten the learning curve for manufacturing entrepreneurs: affordable CAD/CAM software; YouTube channels dedicated to CNC machining, including my company’s own, NYC CNC; online and hands-on training classes; and the resurgence of manufacturing through reshoring and insourcing. Yet I have continued to see people struggle with speeds and feeds whether they are new to machining, working with a new material or trying to optimize a new cutting tool.

The machining world needed a modern solution for determining correct speeds and feeds — a solution that accounted for high-speed CAM toolpath strategies, current CNC machine capabilities and user-friendly, intelligent interfaces. The idea for ProvenCut was born. It would offer proven speeds and feeds backed by video tutorials and comprehensive machining and tool information.

Since launching ProvenCut last year, user response has been exceptional, with feedback ranging from “You saved me hours of testing a new tool for stainless steel” to “ProvenCut is like watching high-definition TV after spending your whole life reading plain text.”

Each ProvenCut recipe includes:
- Comprehensive cutting data, ranging from coolant and gauge length to horsepower.
- Video footage of the cut, allowing users to watch and listen as if standing next to a skilled machinist.
- Photographs of the cutting tool, the chips made during the cut and the machine setup.
- Links to purchase tools, toolholders and raw material.
- A link to automatically open the cutting tool and CAM operation in Fusion 360 software from Autodesk Inc.

ProvenCut recipes can be filtered by almost any machining criteria. Examples include the machine tool brand; gauge length; number of flutes on a tool; coolant type, such as flood, through the spindle, dry or near dry; machine horsepower; toolholder style; and tool type. The filter options are unparalleled in the speeds-and-feeds world when compared with resources like tool manufacturers’ starting recommendations, PDF guides and calculators.

Dimensional units may be switched from imperial to metric with
a master toggle, or a simple mouse hover over any dimension will display the alternate unit. Recipes can be starred as favorites, and users can add cutting tools to their tool libraries to filter recipe results by cutting tools that they already own.

Recipes are created at Saunders Machine Works LLC, which operates over a dozen CNC machines that range from a FANUC Robodrill to a Haas UMC-750. Our experience running NYC CNC, a CNC YouTube channel with more than 300,000 subscribers, meant we knew how to film machines and had a great audience to help kick-start ProvenCut. ProvenCut also has worked with select partners to make recipes with machines, such as the popular Da- tron neo and high-end DMG Mori machines.

ProvenCut continually is expanding its CNC machines, recipes and materials, as well as adding different CNC machines, including lathes and turning centers, as we reduce barriers and allow anyone to succeed with CNC machining.

about the author

SUCCESSFULLY SLOTTING WITH ALUMINUM

By John Saunders

Presented here is ProvenCut recipe 440 for machining a deep slot in 6061-T6 aluminum. ProvenCut recipes, which use real-world, unbiased testing to enable successful cutting, have been developed at our machine shop since last year.

With 63.5 mm (2.5") of the 9.5 mm-dia. (0.375") endmill from Helical Solutions LLC sticking out from the collet holder face, or 6.7 times the tool diameter, determining this recipe was sure to be tricky — and a recipe that ultimately deviated significantly from the toolmaker’s recommended speeds and feeds. Even Helical Solutions’ software for calculating speeds and feeds, Machining Advisor Pro, suggested running the machine at its maximum spindle speed.

While carbide cutting tools frequently can exceed a cutting speed of 304.8 m/min. (1,000 sfm) when machining a nonferrous material, a recipe that includes a long gauge length and stick-out would not support such a high speed. Although speed and feed calculators often recommend starting points, that software is unable to account for all cutting conditions. As this example illustrates, the initial recommendations were unsatisfactory.

The task required milling a deep slot in which chatter would lead...
SUCCESSFULLY SLOTTING WITH ALUMINUM

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Wayne Taylor –Master Fluter

CUT COSTS. NOT QUALITY.

This endmill sticks out from the collet holder face at 6.7 times the tool diameter.

to an unacceptable surface finish, re-cutting of chips and likely a scrapped part. Machinists commonly do not have the time, material or machine setup to start testing a new recipe; their goal is to machine a part as quickly as possible while having confidence in the process. Machinists do not want suggestions but solutions — things that work on the first try. For this recipe, surface speed was reduced to 61 m/min. (200 sfm) at a feed rate of 0.0381 mm (0.0015”) per tooth and 233.7 mm/min. (9.2 ipm) to provide a stable, reliable cut that was free of chatter.

This is how ProvenCut offers substantial value to any machine shop owner, machinist or CAM programmer. With ProvenCut, there are no formulas working behind the scenes to calculate theoretical recipes, no surprise factors — like extreme stick-out — to invalidate calculations and no guesswork. ProvenCut helps shops produce good parts without trial and error.

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CTE
There’s a perception in some quarters that turning hasn’t changed much in the past century. But people who think that are not up on current metal-cutting events. Makers of turning tools and equipment lately have been unveiling significant developments. These manufacturers say turning personnel who embrace the advances can reap many benefits, including shorter cycle times, finer surface finishes, improved chip control, longer tool life and fewer tool changes.

By William Leventon
It could be said that one of these developments takes turning in a new direction. With conventional turning, feeding is done toward the chuck in the z-axis. But with PrimeTurning from Sandvik Coromant Co., Fair Lawn, New Jersey, multidirectional turning is possible with one tool. PrimeTurning users even can feed a tool back and forth while it stays in the cut. The result is faster machining, especially when roughing while taking multiple passes.

Sandvik Coromant’s CoroTurn Prime inserts are key to PrimeTurning. They come
in two designs: A-type for light roughing, finishing and profiling and B-type for roughing. When machining with both designs, a small lead angle relative to the feed direction is supposed to speed up the cutting process and improve surface quality.

Consider the Advantages
Sandvik Coromant reports that the combination of the PrimeTurning method and CoroTurn Prime tools can increase productivity by 50% or more compared with conventional turning. In addition, the entire cutting edge of CoroTurn Prime inserts can be used. “They allow you to put wear all the way around the edge of the insert so you can get better tool life,” said John Winter, Eastern U.S. product manager.

Since the inserts are suitable for a number of operations, they also reduce tool changes. Another advantage is their impact on chip control. “A lot of people will say back turning with a tool isn’t new, but you have never been able to get chip control when doing that,” Winter said. “So we have designed (insert) geometries that give us chip control in both directions.”

New chipbreaker, toolholder and coolant delivery designs also are aimed at improving chip control. Thanks to all these developments, he said, PrimeTurning users are effectively controlling chips when machining low-carbon steel, which presents a major challenge for conventional turning. He cited an application in which a customer employed PrimeTurning for better chip control when machining low-carbon steel and furthermore experienced

“...greatly improved surface quality and smoothness, while minimizing cutting forces, noise and vibrations.”

William Leventon is a contributing writer for CTE. Contact him at 609-926-6447 or wleventon@gmail.com.
300% improvement in tool life and 25% reduced cycle time.

“I’ve seen 200% cycle time improvements” in other PrimeTurning applications, Winter said, “but sometimes the gains may be more on the tool life side than on the productivity side.”

On the downside, existing turning programs no longer work for shops that switch to multidirectional turning. Sandvik Coromant offers a code generator to help users create the programs needed for PrimeTurning and produces ISO code that users can cut and paste into current programs. In addition, he said, Sandvik Coromant machining specialists help new PrimeTurning users develop the best programs for their parts.

The company also provides online help for shops trying to determine whether PrimeTurning suits their applications. Well-supported parts generally are good candidates, Winter said, pointing out that the process can exert a lot of tool pressure on a part.

“So if it’s not supported well,” he said, “you can get deflection and vibration.”

Another consideration is that PrimeTurning typically benefits large-volume manufacturers more than those with small part runs. Winter stressed, however, that the process can substantially improve low-volume machining too.

“High volume is definitely the...
place where you can see the biggest gains,” he said. “But we’ve also had onesie twosie (applications) running Inconel and were able to make gains there. It depends on the commitment of the customer.”

Turning on a Roll
Another recent advance that can boost turning productivity is rollFeed turning, jointly developed by cutting tool manufacturer Vandurit GmbH, Leverkusen, Germany, and machine tool builder Emag GmbH & Co. KG, Salach, Germany. (Subsidiary Emag LLC is in Farmington Hills, Michigan.) The patent pending process is available on Emag’s vertical turning machines and suitable for any horizontal turning machine, said Philipp Ruckwied, manager of cutting technology. With rollFeed turning, a specially shaped insert swivels on a b-axis while moving on the x- and z-axes.

“Normally, you turn with x and z,” he said. “But with this b-axis movement, you can roll the curved cutting edge so that the contact point is moving along the edge.”

Since the contact point moves during machining, each point along the cutting edge heats up for only a few seconds, Ruckwied said, adding that the entire cutting edge is used during the process. These two factors combine to significantly reduce insert wear. For hard turning operations that use rollFeed, he said tool life can be up to five times longer than with conventional hard turning.

The rollFeed process requires a special unit for b-axis movement, as well as a special tool body and special inserts. Because the method involves an additional axis, the process also requires special programming. Emag worked with CAD/CAM software developer Open Mind Technologies AG, Wessling, Germany, to create software for rollFeed based on Open Mind Technologies’ hyper-Mill CAM product.
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Featuring an unusually large cutting-edge radius for turning, the rollFeed process — with its swiveling insert — is designed to improve surface finishes. For applications that don’t require high surface quality, though, the big cutting-edge radius allows the system to run faster, Ruckwied said. He noted that shops that switch to rollFeed turning can get finer surface finishes with the same feed rate they used before or the same surface quality with a feed rate three to five times higher than before.

A Different Angle

Like PrimeTurning and rollFeed, a third development puts more movement into the turning process. With conventional turning, a tool with a fixed approach, or lead, angle is applied to create a workpiece contour. However, Mamer, Luxembourg-based Ceratizit SA introduced a tool system that offers 360 degrees of freedom in the angle at which the insert interacts with the component. (Subsidiary Ceratizit USA Inc. is in Warren, Michigan.) Called High Dynamic Turning, this system is capable of machining almost all workpiece contours, with 40% higher feed rates in some cases, said Paul Höckberg, product manager for cutting tools. He said HDT also allows feed rates to be adjusted during a process and offers excellent chip control.

Ceratizit’s FreeTurn tools are designed for HDT and feature a slim shank that allows quick, easy adjustment of the insert angle during the cutting process or between operations.

“The ability to adjust the angle opens the door to endless possibilities for a wide range of turning operations and applications,” Höckberg said.

A single FreeTurn tool can be used for all traditional turning...
operations, including contour, face and longitudinal turning. He said turning with just one tool eliminates the need for tool changes and saves substantial money on tool types.

Consider a gear shaft with multiple diameters and angles that normally would require a broad range of tools to machine. With HDT, however, the ability to rapidly change the approach angle during the cut or between cuts makes it possible to machine the entire component with a single tool, Höckberg said.

“It is even possible to have different radii on a single insert,” he said, “allowing one tool to handle both roughing and finishing operations.”

With conventional turning, generated forces are directed more or less perpendicular to the tool. During HDT, by contrast, the main cutting force is directed through the tool and into the spindle.

“This reduces vibration and allows for an optimal force distribution,” Höckberg said.

HDT-ready machines must have an integrated mill spindle with a y-axis and a control system for positioning on that axis. Software requirements include five-axis simultaneous function and y-level cutting radius compensation. He said Ceratizit is working closely with an assortment of software partners to develop products that help users quickly and efficiently program machines for HDT and FreeTurn tools.

So far, a couple of software developers have come up with “adequate” offerings, Höckberg said, but “you can’t just click ‘High Dynamic Turning’ and have the software spit out the programming in an optimized way. Solutions like that are not available at the moment.”

Comparing HDT with PrimeTurning and rollFeed, he said the other systems don’t offer 360 degrees of rotational freedom.

In addition, HDT “offers way more flexibility,” Höckberg said. “Our system is so flexible that our tooling can be used in PrimeTurning operations, as well as a wide range of diverse additional operations.”

“The intricate EDM electrodes required to produce our audio speaker grills take 7+ days of machining and 30+ hours of EDM burning. We needed a graphite we can trust to withstand this demanding application. We switched to Mersen’s DS4 ultra-fine EDM graphite a few years ago and it’s been the best performing graphite we’ve used. With the DS4 material we have also seen significant savings per electrode.”

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Need to have your newest bowling trophy engraved? If so, don’t call Wisconsin Engraving Co./Unitex. Although Vice President Pete Kambouris said the New Berlin-based company receives plenty of requests for retail-type engraving, “That’s not what we do.” Instead, the job shop’s craftsmen are dedicated to detailed engraving for molds and dies.

Founded in 1922 as Badger Engraving Co. by German immigrants, Wisconsin Engraving employs 28 workers at its 1,951-sq.-m (21,000-sq.-ft.) facility.

For engraving, the company developed the CAD-Grave process, which satisfies the requirements for the most complex shapes and contours and is suitable for mold surfaces that are not easily accessible by conventional methods, such as engraving close to a vertical wall.

Turn to the Burn
The company’s EDM department, which includes nine sinker EDMs, serves as an extension of the engraving department, Kambouris said, adding that he considers “engraving department” an overly broad term. “We’ve started calling it our micromachining department because of the level of detail we cut.”

The sinker EDMs perform a variety of functions, such as burning cavity IDs, logos and ribs for customers that perform plastic injection molding, he added. Other tasks include threading when a customer forgets to tap a hole in a block of
hardened steel and assisting tool, mold and die shops by burning cores and cavities.

Because its projects have little need for wire EDMing, Kambouris said Wisconsin Engraving outsources that work to local shops when the occasion arises.

In addition, Wisconsin Engraving receives overflow work from moldmakers. “They don’t have time to push it through their shops,” Kambouris said. “Not being dedicated moldmakers, we don’t compete with our customers. This enables us to take in a project, and there is no worry from our customer that we’re going to go after their customer, because we are only doing a small portion.”

Offering a variety of services, such as engraving, texturing, polishing and sinker EDMing, enables Wisconsin Engraving to be a one-stop shop for customers — a good selling point, according to Kambouris. “Timelines have become condensed. Before, toolmakers would quote a project for 16 weeks, and there was time. I’ll quote a project to my customers now and say, ‘Two weeks,’ and they’ll call back and say, ‘Three days.’ I’ll say, ‘How about four days?’ It’s very tight.”

When acquiring a sinker EDM, Kambouris said Wisconsin Engraving always looks for good-quality used equipment to save money while still satisfying the shop’s requirements. The average age of an EDM in the shop is 10 years.

“We have to look at the value of the equipment versus the product that we are putting in there,” he said. “If I had my way, everything would be
brand new, but that's not the case. We find that even an EDM that's 10, 12, 13 years old does the same thing for us that a new one would do.”

Electrode Production
On the other hand, the company always buys new CNC metalcutting machine tools, Kambouris noted, with its latest purchases being Haas machines, including a five-axis one with 3+2 machining capability. Previously, Wisconsin Engraving favored Sharnoa machines. The shop still has three, but “two are having some surgery done on them. The problem is that after they closed shop in the U.S., there were no parts or service. If we are down a few weeks, in a few weeks I can cut a lot of electrodes.”

The five-axis machine helps reduce the number of electrodes needed when a mold detail requires a lot of undercuts, for example, he said. “If we can do the majority of the work on the five-axis, it will become more efficient for our workflow internally and help us with deliveries and pricing.”

The process for machining an electrode starts with a customer...
providing artwork or a CAD file, Kambouris explained. Wisconsin Engraving reviews the CAD file and “cleans it up” if needed. From there, the shop determines the depth of features and sends the file to a machine. The electrode is mounted on a fixture using the System 3R Macro holder system, which Kambouris said enhances stability, and then the tool steel or aluminum workpiece is burned. The company avoids EDM-ing carbide, he noted, because its hardness causes electrodes to wear quickly, requiring numerous electrodes to complete the job.

In addition, carbide jobs are challenging to quote or at least challenging for a customer to stomach the quote. “If I have it sitting in the EDM tank for 10 hours, and I have to use 100 electrodes to burn that detail, it’s expensive,” Kambouris said. “Sometimes they don’t pick that up, but most of our customers are highly educated about this stuff and understand.”

The vast majority of the electrodes are made of graphite. Wisconsin Engraving occasionally machines and burns using copper electrodes but tries to avoid it, Kambouris said. The graphite grade is an important consideration, with higher-quality grades being denser, easier to machine and able to produce finer workpiece details without chipping than lower-quality ones.

“Where it is applicable, we will always go with the highest grade we can,” he said. “We go mid to high on almost everything.”

Sometimes a customer supplies the graphite material and Wisconsin Engraving recommends a grade based on a project’s requirements, Kambouris said. However, that doesn’t guarantee that a customer will follow the recommendation and avoid sending a lower-quality grade to try to save money. “But now I’m struggling to cut

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about the author
Alan Richter is editor of CTE. Contact him at 847-714-0175 or alanr@ctemedia.com.
it,” Kambouris will tell the customer when that’s the case. “My price is going to change, so you are going to lose money. We try to educate the customer.”

In addition to producing electrodes, including ones for other shops, Wisconsin Engraving uses its CNC machines for contract manufacturing on a limited basis, with volumes ranging from one-offs to double digits. “There is a lot of competition in that,” he said. “We got into it just to help fill some of the lulls.”

An Alternative Approach

Kambouris said hard milling continues to be an alternative to sinker EDMing, and Wisconsin Engraving has milled hardened workpieces as well. If the surface that’s being hard-milled does not require a texture, hard milling is suitable and the shop can polish the surface to the specified finish. But because hard milling workhardens a workpiece, workhardening can cause problems when texturing, such as when acid etching the surface, he added.

However, sinker EDMing creates a thin white layer, about 0.127 mm (0.005”), on the surface that was vaporized, Kambouris said. Because acid can’t penetrate the white layer during etching, it must be removed via bench work.

Due to electrode wear during EDMing, roughing and finishing electrodes are needed. Kambouris explained that the shop might begin roughing with a slightly oversized electrode to perform most of the burning and then switch to a more detailed electrode to sharpen the corners and “iron everything out.”

The required number of roughers and finishers depends on the application. If a customer requests a large number of roughers and finishers, say 20 of each, Kambouris said he will ask to see the CAD data and inquire about the workpiece material. With that information, he’ll discuss it with others at the shop. If they suggest that fewer roughers and finishers will do, Kambouris will tell the customer that if Wisconsin Engraving does the job in-house, the desired results may be achieved with as few as two of each.

“We can take the money and run, but we hope for repeat business,” he said. “You build a relationship, and they trust you.”

On the Move

The company’s current location is its third. It has expanded the

**Quality Wire EDM launches tooling-on-demand program**

To enable its customers, many of which are spring manufacturers and stamping houses, to keep production tooling up and running, Quality Wire EDM Inc. developed QW Elite, a tooling-on-demand program. According to Jeffrey Andrade, plant manager and technical sales – quality for the Bristol, Connecticut, job shop and contract manufacturer, the program is unique to the manufacturing industry.

In addition to wire EDMing, the company provides other machining services, such as sinker EDMing, CNC milling, grinding, waterjetting, stamping and laser marking and engraving.

A manufacturer begins by enrolling in the program and selecting a set of details that will be put under contract with Quality Wire EDM. The company recommends starting with the most important and mission-critical wear items. Next, Quality Wire EDM procures the materials specified and begins production. A customer’s one-off web store will be located at Quality Wire EDM’s website. The store includes part photos and all corresponding information about every detail under contract, as well as a “buy now” button.

QW Elite orders receive next-day shipping at no additional charge. To assist in supply chain continuity and maintain traceability, customers can have individual login accounts for every buyer, along with the ability to attach purchase order numbers and notes. Orders also ship with mill, heat-treat and conformance certificates at no extra expense.

The program enables participants to leverage their supply chains by no longer forcing their experienced employees to work on tooling maintenance and repair and reduces unscheduled overtime when a machine unexpectedly goes offline, according to the company.

Program participants pay an annual subscription fee based on the quantity of parts stored at Quality Wire EDM, Andrade said.

For more information, call 860-583-9867 or visit www.qwmfg.com/elite.
building three times, and no more land is available for additional expansion, Kambouris said. However, to add equipment and better serve customers, he feels that Wisconsin Engraving needs nearly twice the square footage it has. As a result, for about a year the company has been looking to move to another facility, either an existing building or a site to build one. That would enable the shop to add machine tools and possibly an automated work cell while replacing a couple of EDMs.

In the event of a move, Wisconsin Engraving probably wouldn’t dispose of too much equipment regardless of its vintage, according to Kambouris. “We have been one not to throw out any of the old technology. We are all over the board in technology because by having all that available to us, we can do almost any project our customer brings us.”

He added that if the shop hits a roadblock when using technology, it can circle back and achieve the desired task with old technology. “And that gives us a competitive edge.”

That old technology includes pantographs that are used every day and older than he is, Kambouris said. A pantograph is for copying a drawing or plan on a different scale by a system of hinged, jointed rods.

The array of machines, tools and other equipment enables Wisconsin Engraving to continue creating specialized, highly detailed work that often skews toward the artistic side of industrial production, according to Kambouris. “We are a tool and die shop, and I like to joke and say, ‘With an art degree.’”

For more information about Wisconsin Engraving, call 262-786-4521 or visit www.wi-engraving.com.
EDM PRODUCT SPECS

Presented here are specifications for a selection of EDM products.

Mitsubishi EA12S Advance Sinker EDM
X, y and z travels: 398.8 mm × 299.7 mm × 299.7 mm
(15.7"×11.8"×11.8")
Dielectric fluid level: 78.7 mm ~ 398.8 mm (3.1" ~ 15.7")
Internal work tank: 399.2 mm × 698.5 mm × 449.6 mm
(15.7"×27.5"×17.7")
Maximum electrode weight: 49.9 kg (110 lbs.)
Maximum workpiece weight: 997.9 kg (2,200 lbs.)
Table size: 701 mm × 500.4 mm (27.6"×19.7")
Platen to table distance: 200.7 mm (7.9") minimum, 500.4 mm
(19.7") maximum
Machine weight: 3,499.9 kg (7,716 lbs.)
C-axis rpm range: 1 to 30
Machine unit dimensions: 1,724.7 mm × 2,131.1 mm × 2,405.4
mm (67.9"×83.9"×94.7")
MC Machinery Systems Inc.; www.mcmachinery.com

Cut C 350 Wire EDM
X, y and z travels: 355.35 mm × 240.79 mm × 240.79 mm
(13.99"×9.48"×9.48")
U/V travels: ±44.96 mm (±1.77")
Maximum workpiece weight: 400 kg (882 lbs.)
Maximum workpiece dimensions: 819.91 mm × 679.96 mm × 244.86 mm
(32.28"×26.77"×9.64")
Wire diameter: 0.152 mm to 0.305 mm (0.006" to 0.012")
Maximum cutting speed: 18,064.48 sq. mm/hr. (28 sq. in./hr.)
Control interface: AC Cut HMI 2 – touch screen
Control central processing unit: Core i5
Control storage: 40 GB
Network capable: yes
GF Machining Solutions LLC; www.gfms.com/us

EDNC21 Sinker EDM
X- and y-axis travels (twin head): 2,000 mm × 1,700 mm
(78.7"×66.9")
Optional x- and y-axis travels (single head): 2,600 mm × 1,500
mm (102.4"×59.1")
Z-axis travel: 800 mm (31.5")
Z-axis jump speed (standard z-axis): 5,000 mm/min. (196.9 ipm)
Optional z-axis jump speed (HS-Rib): 20,000 mm/min. (787.4 ipm)
Rapid traverse (x/y): 3,000 mm/min. (118.1 ipm)
Maximum workpiece weight: 10,000 kg (22,046 lbs.)
Worktable size: 2,800 mm × 1,600 mm (110.2"×63")
Table surface height: 1,650 mm (65")
Makino Inc.; www.makino.com
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**Mitsubishi MV4800-S Advance Type M800 Wire EDM**

- X, y and z travels: 800 mm × 600 mm × 510 mm
  (31.5”×23.6”×20.1”)
- UV travels: ±100 mm (±3.9”)
- Maximum workpiece weight: 3,000 kg (6,613.9 lbs.)
- Maximum workpiece dimensions: 1,250 mm × 1,020 mm × 505 mm (49.2”×40.2”×19.9”)
- Table dimensions with back rail: 1,080 mm × 870 mm
  (42.5”×34.3”)
- Wire diameter: 0.152 mm to 0.305 mm (0.006” to 0.012”)
- Minimum start hole diameter: 0.5 mm (0.02”)
- Control: Mitsubishi M8000
- Hard disk size: 80 GB
- Filters/type: four/paper

MC Machinery Systems Inc.; www.mcmachinery.com

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**Ellor DS4 Ultrafine-Grain Graphite**

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Mersen; www.mersen.us

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Just as CNC machine tools have become more multifunctional over time, so has the equipment needed to measure the parts produced on them. As a result, some shops can use a single device, fixture and routine to inspect workpieces rather than the traditional process in which parts are moved from a coordinate measuring machine to a profilometer to an optical comparator or a vision system.

This capability hasn’t been achieved with a super-CMM but through efforts by various metrology equipment providers to combine as many measurement technologies as possible into existing equipment. A CMM might be equipped with optical scanning capabilities, for example, or a vision inspection machine with touch probes. This type of metrology equipment reduces manufacturing costs, increases throughput and eliminates errors.

One such provider is Carl Zeiss Industrial L.S. Starrett. The L.S. Starrett Co. said its AV350 CNC vision system’s Metlogix software makes multifunctional metrology fast and easy, with features such as automated edge pick, DXF import and probe management.

MULTIFUNCTIONAL METROLOGY

Multisensor measurement systems can increase throughput while eliminating errors.

By Kip Hanson
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**Multifunctional Metrology**

Metrology LLC, Maple Grove, Minnesota, where David Wick, leader of product management, pointed out numerous benefits of the multisensor approach to metrology.

“At Zeiss, we have several coordinate measurement machine lines that we call multisensor capable,” he said. “This means the customer can take their choice of a tactile probe sensor for measuring holes or slots, a laser line scan sensor for capturing a workpiece contour, a noncontact optical sensor for measuring soft materials that would be deformed if you touched them, a surface roughness sensor for checking surface finishes or any combination of the above.”

All these options are plug-and-play compatible with the Prismo CMM and other brands by Carl Zeiss Industrial Metrology, Wick said, and all use common measurement software, making adoption easier than one might expect given the range of functions. Nor is there a need to decide in advance which capabilities may be required when purchasing one of these machines — provided it’s multisensor capable. Most are, so adding a laser scanning head or roughness gauge after the fact is no big deal.

“A customer can buy a system today, come back next year and say, ‘We picked up a job machining cylinder heads and need a way to measure flatness,’” he said. “Or maybe they need to add noncontact measurement for the gaskets that go with those heads, or perhaps they’re looking to improve their inspection throughput.”

Multisensor CMMs provide less obvious benefits as well. By equipping one with a laser line scanner, for instance, a user could generate a 3D model of the cylinder head just described and then use it to develop an inspection routine or even reverse-engineer the part.

“I’m hesitant to say you can measure every part all of the time on one of these machines,” Wick said, “but we have a lot of examples where customers have done exactly that. Just being able to perform roughness measurement on the machine you use for dimensional measurement saves customers floor space and money because they don’t have to buy a dedicated roughness tester. For this and a variety of other

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**about the author**

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reasons, we have many, many customers adopting this technology.”

Seeing Clearly
Vision-based multisensor metrology systems share similar capabilities, said Mark Arenal, general manager of Starrett Kinematic Engineering Inc., Laguna Hills, California, a division of The L.S. Starrett Co., Athol, Massachusetts.

“Our systems are primarily optical, video-based measuring systems built on a precision, three-axis coordinate positioning platform,” he said. “And over the years, we’ve added capability to these products, such that virtually all of them now have the option of adding a touch probe, a probe changing rack and, in some cases, a laser.”

L.S. Starrett’s AV450 and AV350 CNC vision systems are examples of this capability, Arenal said. Each can be equipped with a variety of task-specific measurement tools or retrofitted as new inspection requirements arise. Additionally, a single part program can utilize as many of these tools as necessary to measure a workpiece, such as automatically swapping a camera for a touch probe or a touch probe for a laser scanner until the job is completed.

“Each machine has a probe library, and you simply pick whichever one is most appropriate for the part you’re measuring,” he said, adding that the company offers laser probes, touch probes and a variety of optics. “You might use one lens...
Multifunctional Metrology

that zooms in to 250 times or higher magnification for very small features or one with a large field of view that will capture some or all of the part in one shot. Our software also makes it possible to stitch different images together."

Although it’s hard to find any negatives about these systems, Arenal said, like all high-tech equipment, training is required. An operator must be knowledgeable about each of the disparate measurement functions, as well as have a good handle on metrology practices overall. In the case of optical measurement, understanding how lighting, edge detection, magnification and field of view affect inspection results takes a little practice.

That said, he pointed out that L.S. Starrett’s multisensor equipment is a “walk-up” measurement solution. “They’re suitable for a wide variety of users and applications,” Arenal said. “The system could be used to execute a very complex measurement routine by a highly trained quality technician, a product designer for reverse engineering a product or a machinist on the shop floor that wants to take a quick measurement of an angle or diameter. Yes, some knowledge is needed to operate one — it’s not as easy as using a caliper, say. But once someone learns the basics, it’s not too far off of that.”

Swiss Army Knife
Tobias M. Weber agreed. He is product manager of the Optiv line of multisensor metrology equipment at Hexagon’s Manufacturing Intelligence division, North Kingstown, Rhode Island. He said a few days of intensive training is required to use the company’s metrology hardware and software to their fullest potential, especially for creating optimized part programs. But for more basic tasks, a highly intuitive interface minimizes the need for training.
“One of the main strengths of our multisensor CMM solutions is their flexibility along the entire metrology workflow of our customers, making them a kind of metrological Swiss knife,” he said. “On the other hand, we tend to focus more and more on delivering complete solutions for specific applications in the electronics, medical, aero-engine or automotive segments. These include semiconductors, stamped and bent metal parts, turbine blades and small gears — generally, any sort of high-precision small part is especially suitable for measurement on this type of equipment.”

Like multifunctional CNC machine tools, multisensor metrology equipment is not inexpensive. Yet it’s important to look at the big picture.

“It is usually less expensive to purchase a combination of features within a single system than investing in the equivalent individual pieces of equipment,” Weber said. “Further, part handling is much more efficient when a single system is used to complete all measurements, especially when palletized measuring or automated loading is involved.”

Let’s Take This Inside

Someday, some or all of these technologies might be common on CNC machine tools, not unlike certain in-process probing systems. Such capabilities allow operators to know whether a part being machined is within tolerance, ultimately eliminating the need for post-machining inspection.

Manuel Müller, product marketing manager of the sensors product line at Hexagon Manufacturing Intelligence, said that day is near.

“Hexagon offers multiple solutions for measurements directly in the machine tool,” he said. “For example, the machine tool measurement business unit offers traditional 3D probes or tool setting devices in combination with sophisticated software solutions to enable in-machine measurements and are simple enough for users without any programming knowledge. And Hexagon recently launched some groundbreaking measurement solutions for in-machine measurements.”

These include an ultrasonic probe for directly measuring thickness in a machine. This can be used to replace manual external processes and save significant time.

Müller said Hexagon also has introduced “the first complete solution for capturing laser scanning data in the machine tool,” which allows users to quickly capture data over the entire part surface rather than as separate points.

“Users could, for example, use in-machine tool setters to check the quality and dimensions of the cutting tools before production, determine the alignment and coordinates of the workpiece with a 3D probe, use a laser scanner to inspect the workpiece once complete and then use our software to generate color-coded quality reports,” he said. “Having all of these devices resident in the machine tool serves to maximize part quality, reduce inspection costs and increase the output of the machine tool.”

‘I’m hesitant to say you can measure every part all of the time on one of these machines, but we have a lot of examples where customers have done exactly that.’

**Contributors**

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www.zeiss.com/metrology

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Automation enables part manufacturers to boost efficiency, but limitations remain.

By Christopher Tate

Manufacturers have been steadily advancing automation for decades. These advances have resulted in robots that tend machines and even paint and weld, CNC machine tools that run unattended and integrated work cells that have replaced entire teams of technicians. More than ever, companies seek ways to improve efficiency through automation.

Automotive manufacturers traditionally have been the primary drivers of automation in manufacturing. Tasks like painting and
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frame welding once required a person to commit to hundreds or thousands of hours of training before mastery. Supporting production called for hundreds of people to master these skills. Automation, such as robots, has been developed to perform these tasks so accurately and consistently that only a few people now are needed to monitor production during frame fabrication and painting.

Transfer lines found at high-volume machine shops like those that build engines can have several machines performing various machining operations where parts and tools move from machine to machine with no machinist present in a cell. There often is just one person who tends a cell by loading parts, changing cutting tools and monitoring machine tool condition. For the most advanced cells, a person is involved only occasionally, and they operate unattended much of the time.

**Time to Mastery**

Automated processes reduce the time needed to gain proficiency. Machining is a good example. Mastering the machining trade takes substantial mental aptitude and years of training and practice. Even early automation like turrett lathes required many hours of training to master. But the CNC machines frequently found today at manufacturing facilities allow technicians with little experience to succeed with minimal training.

Automation also improves part quality. Human intervention is a significant cause of defects in machining processes. The high level of repeatability that can be achieved through automation mitigates the risks that arise when people interact with machines and processes.

Robots used for loading and unloading pallets or moving parts in dangerous areas greatly enhance worker safety. Earlier in my career, I worked for a Japanese automotive manufacturer that adhered to the Toyota Production System.
At that time, the TPS philosophy discouraged the use of automation, but we exclusively used robots and other automation in the confined space of a heat treatment cell where parts were hot, wet and slippery. Manual operation of these heat treatment workstations was dangerous, so it was out of the question to expect people to work in them.

For many years, automating machine tools usually meant adding a bar feeder, pallet changer, large-volume toolchanger, robotic loader or combination of these. However, automation is changing. Machinists now can adjust a cutting tool with a smartphone. It is hard to imagine what will be available in the future with gains from the industrial internet of things, artificial intelligence and exponential increases in computing power.

It's not difficult to understand why automation is desirable or why the demand for more advanced technology is increasing, but automation can come with drawbacks.

Diminution or elimination of human involvement — the primary
As we continue to improve our technology and machines, we should not forget that automation is ineffective without skilled craftspeople.

Mechanized Marvel

purpose of automating — is not always desirable. Humans are very good at some activities that robots and automation are not. Humans can learn faster and adapt quicker and are capable of independent thought, which is usually a desired quality. It’s not ironic that AI and machine learning are focal points at research institutions.

Rigid Robots

Robots, along with other types of automation, are not flexible. Even the technologies capable of being moved throughout a plant must be configured for each job. Robots require specific tools called end effectors, which allow them to interact with the work. If you move a robot to a new job, you’ll likely need a different end effector, along with a new program. If you move a person to a new job, he or she may be effective immediately — no end effectors or programs are needed.

In addition, automation cannot adapt quickly to variation like a person can. A good example is at Boeing Co. where engineers had been developing robots to drill holes and install rivets that hold the skin of an aircraft in place. The company abandoned the project after six years of development and millions of dollars in investment because humans have the ability to react instantly to small anomalies and variations, but robots do not. A robot with the most advanced processors, optics and controls cannot adjust to variation like a human can.

As we continue to improve our technology and machines, we should not forget that automation is ineffective without skilled craftspeople. Even state-of-the-art CNC machines, robots and digital devices must be programmed by someone who knows how to perform the work. It is imperative that we begin to emphasize the need for skilled trades, along with cutting-edge technologies. Otherwise, technological advances will be diminished by a lack of experience.
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Five ways to maintain machine performance and tool life.

By Alan Miller

Machine maintenance is critical to metalcutting. Because of their manual nature, certain tasks can be hard and time-consuming, taking up valuable spindle time. These efforts are necessary, however, to ensure consistent performance of machinery and tooling.

Left to work for extended periods without attention, spindles and other machine components may pass on problems to parts and cutting tools. I often see how frustratedly difficult these issues are to diagnose.

The best plan is to schedule routine maintenance and testing, especially when applying premium tools. What many people first think is tool trouble frequently can be resolved with cleaning, more vigilant monitoring of machinery or both. The following suggestions are for maintenance and monitoring.

Verify Taper Accuracy

The spindle is a key link in the machining chain. Whether it’s an errant chip, fluid buildup or heating wear, part quality and machining efficiency can be hurt. Visual checks are not enough, and neither is an occasional wipe-down. This is where a taper gauge comes in handy. By applying a blue layout dye, inserting it into the spindle and removing it, inconsistencies that cause poor contact of the spindle taper with toolholders are revealed. This information enables targeted cleaning and repair.

Test Static Accuracy

Another way to confirm spindle performance or ensure that bearings are holding up is to inspect the accuracy of spindle movement. Any runout in a spindle will be amplified as it extends through the tool and into the part. Similarly, if z-axis movement is not parallel, users will see the resulting imperfections on parts. I recommend using a test bar that’s inserted...
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into the spindle and a touch probe to measure movement. Simply spinning the spindle slowly or moving it along the z-axis while the probe is on the bar will reveal any issues.

**Align Automatic Toolchangers**
Essentially an entry-level form of automation, ATCs are a popular way to improve setup and changeover efficiency. As with any other machine component, accuracy matters. Misalignment between the spindle and ATC gripper can damage the spindle taper, and clamping a misaligned holder may increase runout and shorten tool life. ATC alignment tools can help realign the center point between the spindle and gripper. They also could realign the gripper with tool magazine pockets.

**Level Worktables**
A small imperfection in a spindle taper can interfere with a cut, and the same can be said for a table. Just like adjusting a tool while it’s in a spindle is tricky, adjusting a table while verifying that it is level is easier said than done. Leveling systems with two-axis simultaneous detection and extreme optical precision that send a remote signal to a device outside the machine have been developed to simplify this process.

**Test Retention Force**
The retention force of a machine tool spindle is critical to imparting fine surface finishes and achieving acceptable tool life, but the pulling force produced by the clamping device of machine tools can deteriorate due to degradation of disc springs or wear of amplifier components. Testing retention is most easily and accurately performed with a tool clamp measuring device that accepts a holder and pull stud, which is inserted into a spindle and then provides a reading.

Performing these five maintenance steps can go a long way toward ensuring that capital investments continue to pay off, tool life is extended and parts are done right the first time. Don’t let what is preventable cost you money.

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**about the author**
Alan Miller is engineering manager and product manager at BIG KAISER Precision Tooling Inc., Hoffman Estates, Illinois. For more information, call 888-866-5776 or visit www.bigkaiser.com.

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CUTTING TOOL ENGINEERING

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Twin City EDM and Manufacturing Inc. has been machining parts since 1959 for various industries, including defense, aerospace, aircraft and veterinary. However, the company’s main focus is medical devices and components, noted Steve Lindell, vice president of the Fridley, Minnesota, shop.

“Completing difficult jobs has become our forte, especially in the medical industry,” he said. “It’s always rewarding to look back at the evolution of the company and how far we have come.”

In addition to wire and sinker EDMing, as well as microhole popping, Twin City EDM offers five-axis and other CNC milling, laser marking and laser welding services, Lindell added.

“Because we have all the different processes,” he said, “we can do just about anything.”

Lindell’s father, Robert, started the company with a Charmilles sinker EDM and was one of the first to bring this technology to the Minneapolis area.

“My father is 83 and still active with the business,” Lindell said. “We still have that sinker, and he still runs it.”

However, Twin City EDM is now a fully stocked Mitsubishi EDM facility, with 12 sinker EDMs and 13 wire EDMs. According to Lindell, EDM operators in the area are familiar with Mitsubishi EDMs. “It’s tough finding an EDM operator, but the ones who come through our doors know Mitsubishi machines over any other competitor. That is part of the reason we chose Mitsubishi.”

Over the past few years, the

The automation cell pairs two Mitsubishi MV1200 wire EDMs with a FANUC six-axis robot for part handling.
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company began to secure a number of large production orders, with some jobs having part volumes of up to 10,000 or even 20,000 parts, Lindell said. “Each year it just gets to be more production-type stuff.”

To better serve customers, Twin City EDM determined that integrating a robot into wire EDM processes would be ideal for large production orders and the best investment would be a dual-wire EDM automation cell to pair two Mitsubishi MV1200 wire EDMs with a FANUC six-axis robot for part handling.

Although plenty of different machine tools lend themselves to some form of automation — Lindell said Twin City EDM has two robots for its sinker EDM side and automation for the milling machines that produce electrodes for those EDMs — it’s rare to find a wire EDM with automation. That’s mainly because wire EDMing often creates a slug, or leftover piece from the raw material, that needs to be manually removed from the part.

Twin City EDM purchased the new wire EDMs from Elk Grove Village, Illinois-based MC Machinery Systems Inc., a subsidiary of Mitsubishi Corp., and enlisted the services of Minneapolis-based Industrial Tool Inc., an automation robotics integrator for machine tools. ITI was able to do most of the legwork at its own facility, thus eliminating any shop disruption for Twin City EDM.

“Industrial Tool was instrumental in helping us,” Lindell said.

“Like any new automation initiative, it takes time and collaboration to refine the process,” said Steve Brown, regional manager for MC Machinery. “From the original discussions to full implementation, it was a yearlong process.”

“After the automated cell implementation, MC Machinery’s wire
EDM application support team came in to optimize the setup,” Lindell said. “They made a huge impact by taking out all the inefficiencies in the process. When taking a production part from a manual setup to full robot automation, the small inefficiencies in the process make huge differences in the total time.”

He added that the cut times were initially about 30% slower than originally quoted, but improvements were made to bring the times to within about 5% of what Twin City EDM had anticipated. Those improvements included switching to a wire that cuts faster, positioning the upper and lower heads closer to the workpiece, enhancing flushing and generally fine-tuning the technology.

To overcome the slug issue, Twin City EDM produces relatively small, coreless parts in the cell. “We remove all the material with the wire, so there is no slug,” Lindell said.

In addition to loading and unloading parts, the robot must rotate a part 90° or 45° as part of the “burn and turn” production scenario, Lindell said. “In the past, we would have to go in there and manually rotate for each view.”

As a result of implementing the cell in early 2019, Twin City EDM already has seen faster turnaround times. For example, the company worked on a job that previously required four wire EDMs to complete the needed volume of parts. With the automated EDM cell, the company was able to complete the same workflow and volume with two machines.

“It was a good time to make that transition and see if we could make a go of it,” Lindell said, “and it worked out.”

‘When taking a production part from a manual setup to full robot automation, the small inefficiencies in the process make huge differences in the total time.’

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CARBON SHOWS SUPERHARD POTENTIAL

By Ken Schnepf

Researchers have identified 43 previously unknown forms of carbon that they think are stable and superhard. Theoretically, these superhard materials can slice, drill and polish other materials and potentially could create scratch-resistant coatings to protect expensive equipment from damage.

“Diamonds are right now the hardest material that is commercially available, but they are very expensive,” said Eva Zurek, professor and chemist at the University at Buffalo and one of the researchers. “I have colleagues who do high-pressure experiments in the lab, squeezing materials between diamonds, and they complain about how expensive it is when the diamonds break.”

She devised the study and co-led it with Stefano Curtarolo, professor of mechanical engineering and materials science at Duke University. Published in the journal npj Computational Materials, the research combines computational predictions of crystal structures with machine learning to hunt for novel materials. The work is theoretical research, meaning that scientists have predicted the new carbon structures but have not yet created them.

“We would like to find something harder than a diamond,” said Zurek, who has worked in the field of materials prediction for a decade. “If you could find other materials that are hard, potentially you could make them cheaper. They might also have useful properties that diamonds don’t have. Maybe they will interact differently with heat or electricity, for example.”

In addition to diamond, boron carbide is a superhard material used to cut, polish, drill and grind, as well as for coatings, she said. Several of the theoretical materials are predicted to be nearly as hard as or slightly harder than diamond. Each new variety consists of carbon atoms arranged in a distinct pattern in a crystal lattice.

Zurek said the new superhard materials may have excellent properties and might have technological applications, such as wear- and corrosion-resistant coatings; long-lasting seals for extreme conditions; high-speed dry machining; drills for energy-efficient mining of hard, tough rock formations; and tools for cutting, polishing and grinding. These novel materials may find further importance in defense applications, such as coatings for body armor and tanks.

First, a way must be found to synthesize some of the predicted superhard phases, she said. One method is via high-pressure synthesis. Cold-compressed graphite is an example of how new forms of carbon, some of which are superhard, can be made under pressure and quenched to atmospheric conditions.

“I am currently collaborating with Russell Hemley, who led one of the first groups to make cold-compressed graphite,” Zurek said. “Hemley also has developed a technique to make diamond via chemical vapor deposition.”

about the author
Ken Schnepf is a freelance writer based in the Chicago area. He can be reached at kjsgbp1@aol.com.
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