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- Thread exotic materials
- Machine large parts
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2. Your job title (check one):
   1. □ Corporate Manager (Owner, Chairman, President, VP, GM or other corporate manager);
   2. □ Engineering Manager (Supervise Engineering Personnel);
   3. □ Engineering Department (Non-Supervisory Position);
   4. □ Production Manager (Supervise Production Personnel);
   5. □ Production Department (Non-Supervisory Position);
   6. □ Design, R&D;
   7. □ Purchasing;
   8. □ Quality Assurance, Control;
   9. □ Other (please specify)

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+

5. Which of the following market segment(s) does your company serve? (check all that apply)
   1. □ Aerospace
   2. □ Communications, Computers, Electronics
   3. □ Defense
   4. □ Energy
   5. □ Heavy Equipment
   6. □ Medical
   7. □ Transportation (including automotive)
   8. □ Other (please specify)
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CENTURY OLD INVENTION
FINALLY REALISING ITS
FULL POTENTIAL –
ANCA ENTERS THE SKIVING MARKET

Tapping into a growing market, ANCA brings a complete solution for manufacturing and sharpening skiving cutters as part of a comprehensive gear cutting tool package. The GCX Linear will set the standard for skiving cutter manufacturing.

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Industry firsts of ANCA’s new dedicated GCX Linear are:
• Design-Optimise–3D Simulation-MRR Estimation and more, full process virtualization on design station before grinding.
• In-process dressing with acoustic emission monitoring system and supervised machine learning algorithm to guarantee the dresser cleans the wheel with minimum reduction.
• To push for the last micron of profile accuracy, constant spindle temperature control has been added to control the thermal growth.

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You can use your smartphone to scan the QR code images below to instantly access the reports on ctemag.com. Or access the reports by entering the listed URLs into your web browser.

LMT Onsrud LP and RobbJack Corp. offer aluminum machining demonstrations as part of CTE’s video supplement to the July article “Give and Take.”

cpteplus.delivr.com/2fbm4

Watch a demonstration of a robotic CNC machine tending operation on a Haas VF-2SS with a Universal Robots UR5e and a Robotiq dual Hand-E.

cpteplus.delivr.com/2medd

The Grinding Doc gives a simple if not pretty solution to a nasty cylindrical grinding problem: when the side of a grinding wheel meets a flat surface.

cpteplus.delivr.com/229sz

Check out Haimer USA LLC’s new face shield to help folks return to work safely. Comfortable to wear, the adjustable visor and head cushion can be replaced easily for repeated wear, making the item sustainable and environmentally friendly. The shields are available on Amazon. See this and more on CTE social media.

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BUSINESS AS UNUSUAL

Normally, any Purchasing Managers’ Index above 50 — a sign of industry expansion — would be reason for optimism, especially after the PMI had fallen below 50 — a sign of industry contraction — in each of the five previous months.

By the time the Institute for Supply Management reported its January PMI of 50.9, however, we were well into February and the industry already was bracing for the looming pandemic despite an uptick in cutting tool consumption in January.

Indeed, cutting tool consumption reached $196.5 million in January, an increase over the previous month of 5%, according to January’s Cutting Tool Market Report, which was published in March by the United States Cutting Tool Institute and The Association for Manufacturing Technology.

Unfortunately, February’s CTMR, which was published in mid-April, followed with cutting tool consumption at $188.2 million, a 4.2% drop from January. That — coupled with the PMI dipping to 50.1 in February, then 49.1 in March and 41.5 in April — confirmed what industry professionals had suspected.

I think that USCTI President Bret Tayne perfectly captured industry sentiment in April’s CTMR news release: “The most recently released February cutting tool statistics reflect the modest slowing we began to see in the latter part of 2019. But these numbers precede the effects of the COVID-19 fallout. I suspect we have all experienced a much steeper drop over the past several weeks.”

Tayne, who is president of West Chicago, Illinois-based Everede Tool Co., added, “Buckle your seat belts!”

To be sure, cutting tool consumption inched back up to $189.8 million in March before dropping to $142.9 million in April and $136.6 million in May.

Meanwhile, after bottoming out in April at 41.5, the PMI ticked up a bit to 43.1 in May, then soared back to positive territory with 52.6 in June.

With ups and downs that dramatic, we all need to keep our seat belts fastened until this crazy pandemic roller coaster comes to a stop.

Until then, it’s business as unusual.

That is to say, usually this month is our IMTS pre-show issue. Although there is no IMTS this year, there’s still a steady stream of new cutting tools and machine technologies for CTE to write about. To that end, this issue includes dozens of product announcements and video demonstrations for readers.

Tooling and workholding products begin on Page 10, machine tools and accessories begin on Page 14, and metalworking products begin on Page 18.

You also may learn about new products and technologies featured in our special video showcase on pages 74 and 75. Each item includes a link to a video demonstration.

As for the future, I just keep telling myself that business as unusual is still business.

about the author

Dennis Spaeth is CEO and publisher of CTE. Contact him at 847-714-0176 or dspaeth@ctemedia.com.
30% Increased Flexibility

The original pinch/peel grinding machine ShapeSmart® NP50, new with quick set-up enhancements
**Product Showcase / TOOLING AND WORKHOLDING**

**SOLID-CARBIDE MICRODRILL.** The new Supreme DB133 solid-carbide microdrill with internal and external coolant capabilities from Walter USA LLC reportedly achieves precise, reliable working processes and a significantly longer tool life in steel, cast iron and nonferrous materials (ISO P, K and N workpiece groups). The use of grades WJ30EL and WJ30ER specifically for the microdrill ensures superior wear resistance.

Walter USA LLC  
https://delivr.com/29zqz

**PLUNGE MILL.** A new version of the plunge mill CrazyMill Cool P&S from Mikron Tool SA is said to be suitable for milling the deepest possible slots and pockets with a single tool and reaching more distant machining areas in a workpiece. Like its shorter predecessor, the cutter features the ability to plunge vertically into material.

Mikron Tool SA  
https://delivr.com/2cquh

**HIGH-FEED MILL.** The ENMX High-Feed Mill 4 from YG-1 Tool (USA) Co. is a new high-feed milling series developed to meet the most stringent demands of versatility, productivity and process stability for today’s applications. The unique ENMX High-Feed Mill 4 concept is said to provide the ideal choice for high-feed milling with small-diameter tools.

YG-1 Tool (USA) Co.  
https://delivr.com/2uaqu

**JET-THROUGH HYDRAULIC CHUCK LINE.** BIG KAISER Precision Tooling Inc. expanded its jet-through hydraulic chuck line to include the BCV interface and additional sizes. The HDC jet-through-type holders are said to be ideal for high-precision five-axis machining with a maximum rpm of 35,000 and a clamping range of 6.35 mm (0.25") to 12.7 mm (0.5").

BIG KAISER Precision Tooling Inc.  
https://delivr.com/2py6w

**TITANIUM DRILL BITS.** Shockwave Red Helix titanium drill bits from Milwaukee Tool include two new features: Quad Edge Tip and Enhanced Tapered Web. Quad Edge Tip reportedly delivers a longer life with a precision start and four cutting edges to stay sharper longer. Enhanced Tapered Web acts as an internal backbone strengthening the bit to reduce premature breakage.

Milwaukee Tool  
https://delivr.com/2c8gr

**HIGH-FEED MILLING CUTTERS.** Tungaloy America Inc. expanded its TungForce-Feed line of small-diameter high-feed milling cutters to include diameter options of 20 mm and 25 mm. The cutter diameters join the existing range of 8 mm to 16 mm. The addition reportedly enhances the application range in exotic materials for cutting depths of 0.5 mm or less.

Tungaloy America Inc.  
https://delivr.com/2nret
Economical High Feed Milling

The versatile Pramet ISSN11 milling cutters are suitable for high feed copy milling, helical interpolation, ramping and face milling in die & mold and general machining industries.

SNGX11 inserts offer a strong cutting edge with eight indexes, cutting up to .067" in depth for price-per-edge efficiency.

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- MM geometry for smoother cut

SNGX11 M Inserts
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Features 4xD right-hand cutter geometry

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MRO TOOLS. Dormer Pramet unveiled a selection of cutting tools and accessories aimed at maintenance, repair and overhaul professionals that features brands like Precision Twist Drill, Union Butterfield and Dormer. Dormer Pramet’s experts have identified drills, taps, dies, reamers, endmills and rotary burrs that deliver reliable, cost-effective results for applications in a wide range of operating conditions and various materials.
Dormer Pramet
https://delivr.com/2x3un

CHUCK SWITCHING SYSTEM. SMW-Autoblok Corp. offers the CCS chuck changing system, which is said to provide excellent repeatability that is guaranteed within 10 µm (0.0004”). A standard adapter system supplies automatic push-off and easy mounting for all types of traditional or custom workholding, including two-jaw chucks, three-jaw chucks, collet chucks, mandrels and manual fixtures.
SMW-Autoblok Corp.
https://delivr.com/249hu

AUTOMATION PLATFORM. With the new ctrlX Automation platform, Bosch Rexroth Corp. reportedly removes the traditional boundaries among machine control systems, information technology and the internet of things. Thanks to a Linux real-time operating system, open standards, application programming technology, web-based engineering and a comprehensive IoT connection, ctrlX Automation is said to reduce engineering time and effort by 30% to 50%.
Bosch Rexroth Corp.
https://delivr.com/24r2a

DURATOMIC TM GRADE INSERTS. Seco Tools LLC rolled out three insert grades for stainless steel turning that feature the company’s latest Duratomic generation and its used-edge detection technology. The new grades — TM1501, TM2501 and TM3501 — secure operations and improve productivity in materials ranging from austenitic stainless steel to high-alloyed, superduplex stainless steels.
Seco Tools LLC
https://delivr.com/2ap7n

SMALL INTERNAL GROOVING TOOL. Kyocera Precision Tools Inc. released additions to the SIGC small internal grooving series. The SIGC toolholder’s proprietary clamping system and the use of double coolant holes are said to provide excellent chip evacuation while making small grooves inside a workpiece. The SIGC series includes a unique Excellent Bar steel shank and carbide shank toolholder styles.
Kyocera Precision Tools Inc.
https://delivr.com/2ej8q

COATED CARTRIDGE ROLLS. Shur-Kut coated cartridge rolls from Superior Abrasives LLC feature a specially wrapped design that produces new layers for fresh cutting action throughout tool life as surface layers wear away. The rolls are said to be ideal for shaping, porting, finishing or polishing hard-to-reach areas.
Superior Abrasives LLC
https://delivr.com/25frp
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Get the whitepaper: unist.com/mqlturn
VERTICAL MACHINING CENTER. The OKK VB53a vertical machining center from Methods Machine Tools Inc. is said to be ideally suited for die and mold machining. The high-speed OKK VB53a reportedly minimizes vibration and maximizes accuracy, resulting in superior surface finishes for high-end die and mold applications and precision parts. Methods Machine Tools Inc. https://delivr.com/2zf98

PINCH/PEEL GRINDING MACHINE. Rollomatic Inc.’s ShapeSmart NP50 is a five-axis precision cylindrical pinch/peel grinding machine with an integrated three-axis robot loader and a grinding diameter range from 0.025 mm (0.001”) to 25 mm (1”). The ShapeSmart NP50 is suitable for cutting tool blank preparation, as well as punch and mold applications requiring complex geometry and high length-to-diameter ratios. Rollomatic Inc. https://delivr.com/2ac68

LINEAR TRANSLATION STAGE. Nanopositioning solutions specialist Physik Instrumente LP introduced a high-precision linear translation stage family for high-vacuum and ultrahigh-vacuum applications. The L-509 vacuum stage series is offered for three vacuum levels: 10-6 hPa, 10-7 hPa and 10-9 hPa. Physik Instrumente LP https://delivr.com/26gpt

LASER CUTTING SYSTEM. The LT360 all-in-one 3D laser cutting system from BLM Group USA Corp. features a fiber laser cutting head mounted on a six-axis robot working in tandem with a part handling robot to produce the most complex geometries in any 3D piece within a single process, helping eliminate secondary cutting, drilling, punching, milling and deburring. BLM Group USA Corp. https://delivr.com/23shq

INDUCTIVE COUPLER SYSTEMS. With contactless inductive coupler systems, SMW-Electronics offers technology to transmit energy and data contact-free between stationary and moving components via an air gap. The product range includes standard couplers, as well as couplers for complex customer-specific designs. SMW-Electronics https://delivr.com/2nk3t

LASER ALIGNMENT MODULES. Flat Pack Laser alignment modules are a new addition to the alignment series of laser diode modules from BEA Lasers. The module package includes a laser diode, its housing, a mounting base and a separate power supply. The FPL is a low-profile (20 mm or 0.8” high) flat pack mounting for size-constrained applications. BEA Lasers https://delivr.com/2b3ds
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SLANT BED LATHE. The 127 mm (5") CNC Slant Bed Lathe from Palmgren is a turning center designed for production, short runs, one-offs and prototyping. Said to be an economical solution for machining small parts, the lathe’s small size and footprint make it an excellent option for machine shops needing a second operation machine or an additional chuck.

Palmgren
https://delivr.com/2xujr

TOOL CLEANING AND LASER MARKING MODULES. To further increase efficiency of the manufacture and final inspection of cutting tools, Walter Helicheck Plus and Helicheck Pro machines from United Grinding North America Inc. feature new modules for tool cleaning and laser marking.

United Grinding North America Inc.
https://delivr.com/2sdnx

SWISS-STYLE LATHE. The M532 VIII is the newest version of the Citizen Cincom M series turret-style Swiss turning center from Marubeni Citizen-Cincom Inc. This 32 mm (1.26") capacity machine (with the capability to increase to 38 mm or 1.5") has a new design that helps improve productivity and operating convenience.

Marubeni Citizen-Cincom Inc.
https://delivr.com/2pqp5

SINGLE-PHASE MOTOR. Single Phase Power Solutions LLC offers the Belle Single-Phase Motor, a 75-hp single-phase electric motor to power industrial equipment like pumps, conveyors, grain dryers and many other types of industrial and commercial machinery. The motor uses Written-Pole technology that is compatible with readily available single-phase utility services.

Single Phase Power Solutions LLC
https://delivr.com/2msd8

CABLE REEL. The e-spool flex cable reel from igus Inc. guides cables and hoses for the transmission of energy, media and data without interruption. The e-spool flex increases safety at manual workstations and operating panels. For quick installation of the cable reel, developers opted for a worm guide. The cable is inserted in a few simple steps.

igus Inc.
https://delivr.com/2hy7h

CNC RETROFIT PACKAGE. To breathe life into old CNC mills or turn a mill into a CNC as a cost-effective alternative, Servo Products Co. introduced the Orion CNC Retrofit package for knee mills and lathes. The CNC Retrofit kits — 1000 M (Milling) and 1000 T (Turning) — are said to provide upgrades while saving money versus purchasing a new machining center.

Servo Products Co.
https://delivr.com/2fky9
Whoever wants to shape the future will need forward-looking rotary tools – and intelligent solutions for their production, processing and maintenance. VOLLMER supports you: with innovative sharpening and eroding machines to suit virtually every requirement. With economical automation options and strong services. For the highest possible flexibility, efficiency and quality of results.

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CAD/CAM SOFTWARE SUITE. The hyperMill 2020.2 CAD/CAM software suite from Open Mind Technologies USA Inc. offers enhanced features for efficient 3D and five-axis machining, such as the hyperMill Automation Center Advanced option. New features include the addition of plunge milling cycles to the 3D and five-axis strategies for machining cutting edges.

Open Mind Technologies USA Inc.
https://delivr.com/2bqwj

CYLINDRICAL GRINDING SOFTWARE. New software from NUM Corp. provides the means to add noncircular grinding capabilities to products without adding significant development time and costs for manufacturers of CNC cylindrical grinding machines. Noncircular grinding is used in a wide variety of automated manufacturing applications, such as the production of camshafts, crankshafts, cams and eccentric shafts.

NUM Corp.
https://delivr.com/2dhz7

PIEZOELECTRIC FORCE SENSOR. Kistler Instrument Corp. offers a new sensor to measure very small forces. The 9323AAA is a highly sensitive crystal that guarantees extremely precise measuring results, making the sensor ideal for use in challenging industrial environments.

Kistler Instrument Corp.
https://delivr.com/2jtws

CNC SIMULATION TRAINING. Fanuc America Corp.’s Machining Simulation for Workforce Development provides training for control operation and part programming in a virtual environment. Via a digital twin, a new five-axis machining simulation allows users to learn how to set up and operate three common advanced five-axis milling machines: mixed type, tool type and table type.

Fanuc America Corp.
https://delivr.com/2ht5j

CLEANER AND DEGREASER. Madison Chemical Co. Inc. offers JFC Gold, a liquid alkaline detergent said to be ideal for cleaning and degreasing floors, equipment, machinery and more. JFC Gold features a lemon-lime scent and is safe on ferrous, stainless, aluminum and zinc alloys, as well as most painted surfaces, when used as directed.

Madison Chemical Co. Inc.
https://delivr.com/2r9dw

CAD/CAM SOFTWARE. Hypertherm Inc. released ProNest 2021, a major version update of advanced CAD/CAM nesting software for automated cutting. This release contains new features, such as a redesigned 2D CAD package and a CAD editor preference for users to set a default CAD program for edits to parts in the ProNest part list.

Hypertherm Inc.
https://delivr.com/2txk9
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PRESSURE-SENSING FLOWMETERS. New pressure-sensing digital flowmeters from Exair Corp. provide a way for plant personnel to monitor flow and pressure throughout a compressed air system. A pressure sensor is mounted between two flow-sensing probes, and the display can be configured to show air pressure or air flow.

Exair Corp. https://delivr.com/2nabu

AUTOMATED HANDLING SYSTEM. The HS flex heavy handling system from Hermle USA Inc. is designed to be adaptable to five-axis Performance-Line machining centers (C 400 and C 650), as well as High-Performance-Line models (C 32 and C 42). This also marks the first time that the C 650 is available with automation capabilities.

Hermle USA Inc. https://delivr.com/2derv

AUTONOMOUS BIN PICKING KIT. The ActiNav autonomous bin picking kit from Universal Robots USA Inc. allows manufacturers with limited or no bin picking deployment expertise to quickly achieve high machine uptime and accurate part placement with few operator interventions. ActiNav combines real-time autonomous motion control, collaborative robotics and vision and sensor systems in one easy-to-use, fast-to-deploy and cost-effective kit.

Universal Robots USA Inc. https://delivr.com/2yjbq

ROLLER CONVEYOR TECHNOLOGY. The Edge Roller Technology (ERT 250) conveyor from Dorner Manufacturing Corp. uses rollers to smoothly move pallet conveyors with no friction, a byproduct often seen with belt-driven platforms. An open design eliminates concerns of small parts or screws dropping into rollers and causing conveyor damage or jams.

Dorner Manufacturing Corp. https://delivr.com/256cu

AUTOMATED MILLING STRATEGIES. Smirt 2021 production software by Hexagon Manufacturing Intelligence features NC functionality for machining planar surfaces and pockets. Long-standing easy-to-use drag-and-drop capabilities are complemented in the 2021 release by two automated strategies geared toward high-speed cutting of 2D surfaces on stamping die castings.

Hexagon Manufacturing Intelligence https://delivr.com/2n7pg

CAD/CAM SOFTWARE. With the release of Mastercam 2021, CNC Software Inc.’s CAD/CAM software reportedly increases machining productivity and reduces overall production costs with faster, more flexible multiaxis improvements; enhancements in turning and turning-related applications; and advances in speed and safety.

CNC Software Inc. https://delivr.com/275hz
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MACHINE AXIS CHECKUP

By William Leventon

Proper functioning of machine tools with rotary axes depends partly on axis parallelism and the positional accuracy of the center of rotation. Early detection of problems in these areas can significantly reduce scrap and rework.

So shops should welcome a new tool designed to make machine axis checks faster and easier. Developed by Marposs Corp. in Auburn Hills, Michigan, AxiCheck analyzes measurement data collected with a probe to identify rotational problems that may impact workpieces. The goal is to reduce the number of rejected parts.

Created mainly for five-axis machines with fixed heads and rotary tables or trunnions, the AxiCheck package includes software, a calibration artifact and, if necessary, a Marposs touch probe. But the probe often should not be needed because the vast majority of machines sold today come with one, said Probing Products Manager Sharad Mundra.

“Since you’ve already got a probe,” he said, “you can use it as an inspection or a verification tool.

AxiCheck software analyzes probe data to spot axis-related problems that can affect machine performance and workpiece quality.
With the NEW YG HF4 Mill, You Save 3 Big Ways:

1. Maximum performance value-packed bundle!

2. BUY 30 ENMX INSERTS, get a FREE high feed end mill

3. BUY 40 ENMX INSERTS, get a FREE high feed shell mill

Maximum performance and savings are all part of the package.

With its unique design, featuring a positive geometry for reduced cutting forces and reinforced corner geometry for process security, the small-diameter YG HF4 Mill makes a perfect match for narrow and long reach applications. The exclusive insert thickness adds a multitude of advantages, such as improved clamping, additional strength and the ability to offer four true corners. The result: higher productivity and unparalleled value.

The new YG HF4 Mill meets and exceeds the demands in today's and tomorrow's applications in mold steels, die steels, alloys and cast, while easily navigating the process security demands in the tight corners in your machining process. And did we mention longer tool life? The YG HF4 Mill lasts up to 230% longer in carbon steel alone.

For more information or to find a distributor, call 800-765-8660 or visit yg1usa.com.

Limited time only offer. Valid in the U.S. only through participating authorized YG-1 distributors.
to see if your axes and machine rotation point are good.”

AxiCheck takes measurements to determine reference values on the artifact, a unit with one or two spheres that is held in place on a machine table with a magnetic base. The artifact serves as a reference point while the probe moves around and measurements are taken.

AxiCheck software uses instructional items called macros to direct the movement of the probe and machine during the measurement process. When an AxiCheck user presses a button to start the process of establishing a machine’s center of rotation, a macro sets the machine in motion so the artifact with the single sphere can be measured in different locations. The measurement data is fed to a computer, which performs a volumetric analysis that identifies the machine’s pivot point.

In addition to checking the center of rotation, AxiCheck measures the parallelism of the machine axes to see if they are pointing in the right direction. The system can detect inaccuracies in the positioning of linear axes in real time using the artifact with two spheres set a predetermined distance apart. Like the single-sphere artifact used to check the center of rotation, this artifact is mounted on the machine and then rotated to different positions where measurements are taken.

The graphical data produced by AxiCheck can be displayed on the screen of a Windows-based computer. If a measurement is out of tolerance, the system also can send warning and alarm messages to alert a user.

Mundra said in most cases, AxiCheck would be used after a machine crash.

“Brand-new machines come pre-aligned, and you get a center of rotation,” he said. “But when a crash occurs in the user’s shop, that may change the pivot point. So you need to establish a new one.”

Mundra said the conventional
way of doing this is to call in a maintenance person, who may take a day or two to find a new pivot point — time that the machine will be down.

With the AxiCheck system, on the other hand, and a probe already in the machine, “you just press the cycle-start button,” he said, “and in 30 minutes or less you will get the center point.”

In addition to checking a machine after a crash, AxiCheck can be used during regularly scheduled preventive maintenance. Mundra said this is a good idea because gear wear may change a machine pivot point every few months.

Besides its role with five-axis machines, the system can be used to check the linear axes of three-axis machines. But AxiCheck is not for machines with rotating heads. He said these present a much more complicated measurement and analysis problem than machines with rotating tables or trunnions. However, he added that Marposs is working on software for head-rotating machines.

For now, though, at least owners of fixed-head machines have a new option for fast axis checkups.  

about the author

William Leventon is a contributing writer for CTE. Contact him at 609-926-6447 or wleventon@gmail.com.
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making the leap to five-axis machining can be intimidating. Luckily, five-axis machine tool builders and controller manufacturers have developed tools to make the leap a bit easier. One of those tools that has been around for quite some time is tool center point control.

Before we dive into what tool center point control is and why it’s important for five-axis machining, let’s consider how we would set up a three-axis job. We would set our tool lengths on the controller, set our work offset and run the program. Simple, right?

Now consider a five-axis job. We would set our tool lengths on the controller, set our work offset and run the program just like we did on our three-axis machine, correct? Not so fast. When setting up a five-axis machine, there’s a lot to be mindful of. Depending on the kinematic configuration of a machine, the introduction of rotary motion can affect tool length offsets, work offsets or both.

That’s where tool center point control comes into play. It and tilted work plane commands use kinematic data on a machine’s controller to ensure that work offsets and tool lengths are effective at any angle. In other words, these commands account for the kinematic configuration of a machine so users don’t have to.

For trunnion-style machines, you used to have to program from the intersection of the tilt and rotary axes to maintain a stationary work offset as a part rotated. Alternatively, if a post-processor supported it, you could enter the location of your work offset relative to the intersection of the tilt and rotary axes so the post-processor could perform the compensation. For tilting spindle-style machines, you used to have to tell the post-processor the gauge length for each tool so the post-processor could account for the difference in effective tool length as the spindle tilted.

In both cases, it was the responsibility of the programmer and/or post-processor to perform the compensation, and the posted program could run only on the machine that it was posted for. Additionally, if the gauge length of a tool changed or the work offset was in a slightly different position from the information provided to the post-processor, the program would have to be reposted to capture the change.

With tool center point control and tilted work plane commands, you can set a work offset exactly like you would for a three-axis job and let the machine take care of the kinematics for you. This is great news because it allows simpler programming in CAM and much quicker setup times at the machine, especially if yours is equipped with a probe and tool setter. You can use the probe to pick up your work offset and use the tool setter to set your tool lengths before letting the machine and controller handle the rest. If you add probing routines and tool measurement directly into...
your program, the work offsets and tool lengths will update automatically, which is ideal for automation.

So how can you make sure you’re using tool center point control and tilted work plane commands? First, you have to confirm that your machine supports these functions. Then you need a post-processor set up to output the required codes and toolpath coordinates. If your machine has both of these options and your post-processor doesn’t support them, you’re not making the most of the machine. A post-processor that supports these functions is key to successful five-axis machining.

CAMplete Solutions Inc. of Kitchener, Ontario, understands this, so the company has worked with machine partners to develop post-processors that support the advanced five-axis features of machines, including tool center point control and tilted work plane commands. Along with post-processing, CAMplete Solutions provides machine simulation so you can see exactly how your program would run on your machine in a safe, virtual environment. This is important because even with tool center point control and tilted work plane commands, it’s difficult to visualize how a five-axis program would run on a machine.

If you’re thinking of making the leap to five-axis machining, make sure that you take full advantage of tool center point control and tilted work plane commands. Ask your post-processor developer if its post-processors support these functions on your machine and if it includes full simulation for your machine as part of the package.

---

**about the author**

Ivan Mikesic is technical support manager at CAMplete Solutions Inc., Kitchener, Ontario. For more information, call 519-725-2557 or visit www.camplete.com.

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<table>
<thead>
<tr>
<th>Number of Machine Tools</th>
<th>0</th>
<th>50</th>
<th>100</th>
</tr>
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<tr>
<td>5</td>
<td>(\text{X})</td>
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<td>(\text{X})</td>
</tr>
</tbody>
</table>

Weekly Machining Hours

| 80 | \(\text{X}\) |

Estimated Reduction in Machining Time

Reduce machining time by as much as 15-25% or more

| 25% (typical reported savings) | \(\text{X}\) |

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Hourly Cutter Cost $ (average cutter cost/cutter life hours e.g. \(\$100/1\) hour)

<table>
<thead>
<tr>
<th>Number of Machine Tools</th>
<th>0</th>
<th>50</th>
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<td>5</td>
<td>(\text{X})</td>
<td>(\text{X})</td>
<td>(\text{X})</td>
</tr>
</tbody>
</table>

Weekly Machining Hours

| 80 | \(\text{X}\) |

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TOOLING FOR A COVID-19 WORLD

By John Saunders

The emergence of COVID-19 has forced businesses, including manufacturers, into uncharted territory in terms of health and safety. As companies reopen, they grapple with how to implement viable operating procedures while minimizing the risk of infection for employees and customers.

For the economy to regain its footing while the virus is still at large, a combination of health and safety controls must be in place. In addition to supplying personal protective equipment for employees, businesses are implementing what the Occupational Safety and Health Administration calls engineering controls — items that physically alter a work environment to reduce the risk of infection.

Sneeze guards commonly hover above salad bars and buffets but are becoming a prolific, crucial part of retail existence — or for any industry with face-to-face interactions, for that matter. With demand growing for physical barriers, manufacturers are rising to meet it.

The call came in. Retail businesses and medical offices needed sneeze guards as soon as possible. Material was — and continues to be — scarce, so we used the polycarbonate drops that our client had on hand. Within hours, we had worked up a speeds-and-feeds recipe to machine the drops. As is so often the case with job shop work, we wanted to push the machine and cutting tool as hard as we could to minimize cycle time, just not at the risk of ruining tools or material.

That’s where a maximum 40,000 rpm spindle and a 3 mm (0.118”) dia. tool came in. With the Datron neo Series 2’s built-in vacuum

**about the author**


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workholding, we were able to hit cycle-start once to complete two machined parts.

Polycarbonate isn’t difficult to machine. However, there are tricks to maximize the speed and the quality of the finish. We used a carbide four-in-one cutter by Datron Dynamics Inc. of Milford, New Hampshire, for both operations. The first operation roughed out the perimeter shape and the middle slot that perpendicularly accepts the upright sneeze shield panel. The slotting operation was run at 36,000 rpm and 0.2 mm (0.008") feed per tooth in 3 mm axial step-downs, resulting in 32 AUGUST 2020
in a blistering 7,112 mm (280") per minute feed rate.

The finishing operation smoothed out the edges and ensured a burr-free finish. The finishing pass was run at 0.13 mm (0.005") feed per tooth at the same 36,000 rpm at a full 9.52 mm (0.37") axial DOC and 0.13 mm radial DOC.

Plastic is a poor conductor of heat, so managing heat is key to successful speeds and feeds. The single-flute endmill provided ample clearance to minimize heat from re-cutting chips, and the machine’s air blast feature further aided chip evacuation.

Besides being functional, the bases needed to be free of sharp edges and burrs for safety. Contouring the profiles of bases provided the added benefit of a finished, professional aesthetic, which was a win-win scenario for the end customer.
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The pandemic and social unrest seem to grab all the headlines, but manufacturing is an essential industry that continues to generate wealth for a sizable portion of the population and is worthy of news coverage. However, compared with Cutting Tool Engineering’s biennial Benefits and Salary Survey from 2018, which showed an uptick in pay and benefits for all metalworking professionals on average over the previous two years, 2020’s survey paints a less rosy picture.

Across the board for all positions, salaries are either down a bit or, at least for programmers, about the same as two years earlier based on the national average. Similar to the previous 10 surveys, corporate managers make the most money. Nonetheless, their earnings saw a decline compared with 2018.

Regular CTE readers may notice that the presentation of the national average of salaries by position is different from previous surveys. CTE normally creates a web-based survey instrument using SurveyMonkey and then emails the link to subscribers who have access to companywide salary information. This year, in addition to the usual method, CTE utilized a paid data collection option whereby SurveyMonkey conducted surveys using its own survey panels that targeted the manufacturing industry. To ensure that the difference in respondents by company types did not significantly impact salary results, CTE weighted 2020’s sample to match the company type proportions from 2018’s survey. When comparing average salaries across the unweighted and weighted samples, no meaningful differences were found.

The national average presentation below breaks out companywide results from 103 subscribers, 236 results collected by the survey service and the combined results. However, to provide a more apples-to-apples comparison for salaries by region, company size and company type, as well as benefits provided, the graphs on pages 38 to 45 contain only the results gathered from subscribers. (See Page 46 for a better understanding of how subscriber results compare with results from the survey service for those 19 graphs.)

For nonweighted results, average salary was...
calculated according to the arithmetic mean. For instance, if four respondents indicated that their CNC machinists earn average annual salaries of $46,000, $59,000, $53,000 and $51,000, the mean would equal $52,250; (46,000 + 59,000 + 53,000 + 51,000) ÷ 4 = 52,250.

Benefit percentages were calculated by dividing the total number of positive results for a specific benefit by the total number of respondents. For example, if 55 respondents indicated that their project engineers receive a company-paid health plan, the percentage receiving that benefit would be 53% (55 ÷ 103 = 0.534).

As is typical, not all regions and company types followed the national average’s pay reduction. For example, while manual machinists in the East and South regions are experiencing lower levels of compensation than two years ago, those working in the same position in the Midwest, Mountain and West regions have seen an increase. Likewise, corporate managers at general manufacturers and suppliers of metalworking products have increased salaries while those at other types of manufacturing companies make less.

Most positions at companies with 20 or more employees see pay cuts, but eight positions at companies with one to 19 employees make more money: 7.5% more for CNC machinists, 10.6% more for programmers, 9.1% more for tool and die makers, 8.4% more for tool/manufacturing engineers, 11.6% more for design engineers, 6.3% more for project engineers, 11.6% more for shop supervisors and 6.2% more for engineering supervisors.

When it comes to benefits, nearly all positions receive fewer health, dental, retirement and company vehicle benefits, with the exception of corporate managers. Except for a dental plan (down 7%) and a retirement plan, which remains about the same, 1.2% more corporate managers receive a health plan and 14% more receive a company vehicle compared with 2018.

Nonetheless, eight out of 11 positions see increases in profit sharing and receive more job training.

Chart Key

<table>
<thead>
<tr>
<th>MM</th>
<th>Manual Machinist</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNC</td>
<td>CNC Machinist</td>
</tr>
<tr>
<td>P</td>
<td>Programmer</td>
</tr>
<tr>
<td>TD</td>
<td>Tool and Die Maker</td>
</tr>
<tr>
<td>TME</td>
<td>Tool/Manufacturing Engineer</td>
</tr>
<tr>
<td>DE</td>
<td>Design Engineer</td>
</tr>
<tr>
<td>PE</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>SS</td>
<td>Shop Supervisor</td>
</tr>
<tr>
<td>ES</td>
<td>Engineering Supervisor</td>
</tr>
<tr>
<td>PM</td>
<td>Plant Manager</td>
</tr>
<tr>
<td>CM</td>
<td>Corporate Manager</td>
</tr>
</tbody>
</table>
Salaries by Region

EAST (ME, NH, VT, NY, PA, DE, MA, RI, CT, NJ, MD, WV)

- $20,000
- $40,000
- $60,000
- $80,000
- $100,000
- $120,000

- $31,577
- $49,644
- $60,917
- $73,249
- $85,000
- $97,417
- $109,333
- $119,107

MIDWEST (OH, IL, MI, WI, IA, MN, OK, KS, NE)

- $20,000
- $40,000
- $60,000
- $80,000
- $100,000
- $120,000

- $43,152
- $52,314
- $63,500
- $58,500
- $66,923
- $70,104
- $89,647
- $61,125
- $101,700
- $106,750

MOUNTAIN (MT, ID, WY, CO, NM, AZ, UT, ND, SD)

- $20,000
- $40,000
- $60,000
- $80,000
- $100,000
- $120,000

- $58,333
- $63,750
- $64,500
- $50,500
- $70,000
- $71,250
- $50,000
- $75,100
- $83,750

SOUTH (TX, AR, LA, MS, AL, FL, TN, KY, VA, NC, SC, GA)

- $20,000
- $40,000
- $60,000
- $80,000
- $100,000
- $120,000

- $42,778
- $47,708
- $53,958
- $54,000
- $60,750
- $67,273
- $70,385
- $90,000
- $116,250

WEST (WA, OR, CA, NV, HI, AK)

- $20,000
- $40,000
- $60,000
- $80,000
- $100,000
- $120,000

- $40,833
- $46,250
- $42,500
- $60,000
- $80,000
- $70,000
- $85,000
- $90,000
- $85,833
- $105,000
- $116,250

Once again, corporate managers in the East make the most money, receiving $119,107 on average. However, that’s down $27,632, or 18.8%, from 2018.

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Salaries by Company Size

1-19 EMPLOYEES

Manual machinists earn at least $40,000 a year on average at all types of manufacturing companies except tool, mold and die shops. Manual machinists at those shops receive $36,500.

20-99 EMPLOYEES

100+ EMPLOYEES

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A Tale of Two Respondents

As mentioned in the main article, CTE used a paid data collection option from SurveyMonkey, which collects results from its own survey panels, to gather additional results for the 2020 Benefits and Salary Survey. What’s notable about the national results from subscribers is that those results are higher on average for all positions than the results gathered from the survey service.

Some results are similar, such as those for corporate managers, with a 5.2% difference. Others, such as engineering supervisors, with a 16.1% variation, are significantly higher for subscribers.

Although results from survey service respondents for benefits are not included in the graphs presented on pages 44 and 45, responses show that subscribers offer more job training to all positions than survey service respondents do, as well as more health plan benefits (except for tool and die makers and engineering supervisors) and more profit sharing (except for engineering supervisors). In addition, subscribers responded that five positions receive a higher percentage for a retirement plan than survey service respondents give, though the percentage for manual machinists was about the same.

In contrast, survey service respondents offer more dental benefits to eight positions compared with subscriber respondents, and all positions except engineering supervisors (down 10.1%) and plant managers (about the same percentage) receive the perk of a company vehicle at a higher percentage.

The survey revealed one other significant difference between the two groups of respondents. When asked about layoffs and facility closings as a result of the pandemic, 24% of subscribers furloughed workers while roughly half of survey service respondents did. In addition, 97% of subscribers reported that facilities remain open while the other group was at 72%.

— Alan Richter

About the author

Alan Richter is editor-at-large of CTE. Contact him at alanr@ctemedia.com.
Salaries and benefits stagnated before the pandemic, which made matters worse.

By Alan Richter

Along with many other industries, the pandemic slammed U.S. manufacturing, which wasn’t in top shape before the coronavirus hit.

“Probably since late in the fourth quarter of 2018 through most of 2019, there was a stagnation in salary and compensation, which often occurs when orders are on the trailing side of the business cycle,” said Patrick W. McGibbon, chief knowledge officer of The Association for Manufacturing Technology in McLean, Virginia. “Orders were down in 2019 compared with 2018, which was a fantastic year.”

He said although manufacturers often had difficulty hiring workers with required skills prior to the pandemic, the challenge hasn’t subsided now that tens of millions of workers are unemployed and seeking jobs. People out of work might be interested in manufacturing, but they would need certain skills, particularly for production. As a result, many companies are juggling workforces to maintain the workers they
have until orders improve.

“I’ve heard a number of members talking about how during the pandemic, they are furloughing people one week,” McGibbon said. “And the next week, the people that were furloughed come in and those working are put on furlough just to help stretch out people employed at some level and the whole team from being able to survive it.”

Those types of actions help manufacturers be as productive as they were before the pandemic without hiring new workers. The National Association of Manufacturers reported in its second quarter outlook survey that full-time employment over the next 12 months was expected to decrease by at least 1.3 million from February to April.

The survey stated that despite workforce concerns no longer holding the top spot, respondents continued to expect long-term struggles with identifying promising candidates, especially as more Americans retire. Indeed, 50.5% of manufacturing leaders anticipated that difficulties in attracting and retaining employees would continue to be a challenge over the next 12 to 18 months, assuming that COVID-19 abated.

Automation will remain significant in boosting productivity of existing workers.

“Automation makes every skilled worker that much more valuable,” McGibbon said. “The more automation that you can latch a skilled person to, the more productive that person is going to be. Those people are scarce. And because they are scarce, if you can get them in a position to leverage automation, their salaries will reflect that as well.”

For those still employed in manufacturing, the expected growth rate for employee wages over the next 12 months was up 0.5%, the lowest figure for the survey since second quarter 2009. The survey noted that the crisis led 22.2% of manufacturers to cut pay for some workers.

To help attract and retain workers, McGibbon said manufacturers should increase digitalization, or the digital thread that connects various elements of a production environment. He said virtual reality and artificial intelligence will be integral to shop floors and enable work to be performed remotely.

“Where the rubber meets the road on the production floor,” he said, “they will be integrated be-
As a result of the pandemic, 76.9% of survey respondents planned to reevaluate what work could be done remotely.

As shown by the results of Cutting Tool Engineering's 2020 Benefits and Salary Survey, nearly all positions received fewer health, dental, retirement and company vehicle benefits.

McGibbon concurred that as manufacturers try to recover and restore employment levels and salary packages to pre-pandemic status, worker benefits would be targeted. “Benefits may either stall or have some type of hiatus to permit businesses to get back into a healthy and strategic position,” he said.

The rising cost to provide benefits is part of the picture. For instance, the survey reported that the expected growth rate for health insurance costs over the next 12 months would be up 5.7%. Although this was the lowest increase since the question was added to the survey in third quarter 2014, 53.6% of respondents expected costs to rise by 5% or more, and 19% saw costs rising by 10% or more.

In addition, 49.6% of respondents named rising health care and insurance costs as a primary business challenge during the second quarter. This figure was second to overcoming the challenge of a weaker domestic market and product sales, which 83.1% of respondents indicated.
A cloudy economic future contains a silver lining for manufacturers.

By Dennis Spaeth

Although the pandemic continues to cloud the worldwide economic future, results from Cutting Tool Engineering’s 2020 Benefits and Salary Survey reveal a silver lining for manufacturers: Nearly 80% of respondents said their companies were considered essential businesses and remained open during lockdowns in spring.

Of the 277 respondents who completed the COVID-19 addendum to CTE’s biennial salary survey, 219 said their companies remained open for business. Among the companies that remained open, 68% were fully open while the rest were open on a limited basis.

Asked how current production compared with the workload prior to the pandemic, almost half reported a 40% to 80% drop while a fifth said business was down 20%. A quarter of respondents said business was about the same.

Unfortunately, 46% of respondents said the pandemic had triggered layoffs or furloughs at their companies.

Beyond the overall results, analyzing the data according to certain demographics reveals a tougher time for tool, mold and die shops, as well as for businesses with fewer than 20 employees or for those located in the West.

Broken out by company size, company type and region, the following results highlight the most significant differences from CTE’s nationwide data.

Company Size

■ Among companies that employ up to 19 people, 73% remained open in May while nearly 60% reported...
a drop in business between 40% and 80%.

Among companies that employ 20 to 99 people, 61% said they were fully open.

Among companies with 100 or more employees, over 53% said the pandemic had triggered layoffs or furloughs.

**Company Type**

Among machine shops, 90% remained open in May and just over a third had laid off or furloughed employees.

Among metalworking suppliers, nearly 88% remained open in May. Of those, 94% said they were fully open. Just 31% reported layoffs or furloughs.

Among general manufacturers, 73% remained open in May, but more than 54% said they had to lay off or furlough employees.

Analyzing the data according to certain demographics reveals a tougher time for tool, mold and die shops, as well as for businesses with fewer than 20 employees or for those located in the West.
COVID-19 Survey Report

Among tool, mold and die shops, 59% remained open in May and 69% said they had to lay off or furlough employees.

Company Location

Among companies in the Midwest, 85% said they remained open in May.

Among companies in the West, 66% remained open in May. Of those, 62% were fully open. Nearly 58% of these companies had undergone layoffs or furloughs.

Among companies in the East, 75% remained open in May, but nearly 52% said the pandemic triggered layoffs or furloughs.

Among companies in the Mountain region, 36% said they had to lay off or furlough employees.

Among companies in the South, 41% reported layoffs or furloughs.

Further analysis of pandemic-related responses by two types of survey data collectors also reveals significant differences from the overall results.

CTE normally would use only one type of data collection via SurveyMonkey — a web-based survey service — because participation in the biennial salary survey usually is limited to industry professionals who subscribe to CTE’s print and digital media. This year, in an effort to collect as many respondents as possible despite the limitations presented by COVID-19, CTE utilized a paid data collection option whereby SurveyMonkey targeted its own survey panels of manufacturing professionals.

The following results highlight the most substantial differences from CTE’s nationwide data when broken out by data collection type.

More than 97% of companies surveyed from among CTE’s subscribers reported they remained open in May compared with 72% of companies reached via SurveyMonkey.

Among CTE subscriber companies that remained open, 78% said they were fully open compared with 64% of such companies reached via SurveyMonkey.

Some 76% of CTE subscribers had not laid off or furloughed employees due to the pandemic. Among companies reached via SurveyMonkey, 54% reported layoffs or furloughs.

about the author

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Technology for automated data collection and analysis isn’t new and sounds like something that would have broad appeal in a machining industry bombarded by talk of the industrial internet of things and Industry 4.0. Thus far, however, many shops have taken a pass on the tech. This may be a costly mistake judging by the advertised capabilities of the latest data collection and analysis products. Product developers say they can improve machining operations, boost productivity and provide timely notification of problems, among other things that would be welcome at any shop.

One such product is FASData software from Fanuc America Corp. in Rochester Hills, Michigan. Working with Fanuc CNCs, FASData allows users to collect and analyze shop floor data. Key process and maintenance information can be viewed on a simple dashboard. Displayed data includes machine status (up or down), alarm information, cycle time and part count. Collected data can be stored for later analysis or passed along in real time to other software programs.

FASData is installed on a single computer — for example, a desktop or a small-business server — connected to a shop’s network. Data is viewed on webpages shown by a variety of displaying devices, including PC screens, phones and tablets.

**DATA MINING**

Shops can strike process improvement gold with tools that gather and analyze machining information.

By William Leventon
Solutions adapted to the unpredictable
In many cases, complicated analytics isn’t required to produce valuable information, said CNC Engineering Manager Paul Webster of Fanuc America. “Probably 80% of the issues in shops are relatively straightforward, (like) you had an alarm on your machine for 10 minutes before somebody realized it,” he said. “(An alarm) is a simple thing for software like this to pick up. The same with production data. Maybe the feed rate override is turned down to 50% because an operator doesn’t want to run it at 100%. There are hundreds of examples of data that a simple dashboard, simple analytics, simple reporting can pull out to identify maintenance problems or slowdowns in your production process.”

Grinder Networking
Similar to FASData is Redax software, which is used to network grinding machines to send and receive data. Developed by Melbourne, Australia-based Anca...
Pty Ltd., Redax allows users to view, analyze, manage and generate reports on production and maintenance data from all machines at a shop. (Anca Inc. is in Wixom, Michigan.) Data is accessible anytime, even when machines are shut down, using any web browser on a desktop computer, mobile phone or tablet, as well as a monitor on a shop floor. Shop personnel also can receive email or text message notifications when machines are down so immediate action can be taken.

On a screen, Redax users see at a glance how all their grinding machines are operating. Displayed data includes machine availability, uptime and time spent in setup. Redax also collects information that lets users calculate overall equipment effectiveness, a common measurement of how well a manufacturing operation is performing compared with its full potential.

By showing which machines at a shop are most productive, Redax makes it possible for shops to identify their best operators.

“Then they can get those operators to train the others so they can have best practices on their whole site,” said Global Marketing Manager Lucas Hale of Anca.

Redax comes in on-site and cloud versions. The on-premises package consists of an Intel minicomputer with a Redax 2.0 server pre-installed for plug-and-play connectivity to a shop’s network.

Hale said some machine shops had a hard time installing the first version of Redax, which was strictly software.

“Small and medium-size shops typically don’t have in-house IT or...
the skill sets needed to set up a server and install the software, and they struggled to find someone locally who could do it cost-effectively for them,” he said. “So now we provide a turnkey solution that they just plug in to a socket to connect to their network.”

Those who opt for the other version of Redax install software that allows them to connect all their machines to the cloud. This makes their machine and production data available anytime and anywhere. “If you’re outside of your business network,” Hale said, “you can still pull out your phone and check what’s happening on your machines.”

To receive preventive maintenance advice, users of the cloud version also could let Anca’s service engineers access machine data. But because an insufficient number of shops have opted for the cloud version thus far, he said this service hasn’t been launched fully.

Although it offers more capabilities, the cloud version of Redax has been less popular than the on-premises option. The reason is concern about data security, Hale said, despite the fact that Anca’s cloud provider employs sophisticated security measures.

“Opening up their networks to the outside world is something a lot of companies aren’t comfortable well” for relatively small sites. “But once you get big, you need to set up a hard-wired network, and that tends to be a challenge for a lot of companies,” Hale said. “They don’t have people with those skills, so it can be very expensive for them to install a network.”

Getting machines connected and communicating on a network is the biggest problem for many users of Fanuc America’s data collection products, Webster reports. Compli-

FASData allows machine users to view snapshots of operations on any PC or tablet, as well as on monitors on a shop floor.

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FANUC

Current Utilization

33%

Current Status

Total Machines Powered On Running Down Idle

6 6 2 1 3

Top Down/Idle

MACHINE

MINUTES

Lathe 49h 15m

Router 49h 15m

Grinder 14h 06m

Mill 14h 06m

21TA

GRINDER

LASER CUTTER

LATHE

MILL

ROUTER

SW100 PARAMETER ENABLE SWITCH OFF

FANUC FASData

FANUC FASData allows machine users to view snapshots of operations on any PC or tablet, as well as on monitors on a shop floor.

Not Connecting

A major obstacle to using either form of Redax is the sorry state of networking at many shops. “To set this up, you need connectivity to all your machines,” Hale said. “But often, there is no hard-wired network (at a shop). Or if there is, it’s in very poor condition.”

Anca offers a plug-and-play USB Wi-Fi adapter that allows machines to be hooked up wirelessly. He said this arrangement works “pretty

Data Developments

A new product that simplifies equipment networking and communication is the Fanuc Field system. Currently being used by early
adopters in Japan but not yet in North America, Field is an edge computing system that allows users to connect machines of different generations and from manufacturers other than Fanuc. The system is compatible with OPC Unified Architecture and MTConnect, both of which are widely accepted standards for industrial machine-to-machine communication.

An open platform, Field also lets users connect devices, such as robots, programmable logic controllers and sensors from different suppliers, to networks. In addition, the system can link to common in-plant programs like those for enterprise resource planning, supply chain management and manufacturing execution.

“Field takes care of data collection and allows other applications to do analytics,” Webster said, adding that the system can download and install applications written by other vendors, including some machine-learning apps. “The amount of data it collects is quite large, and applications could be written to leverage all that data.”

While Redax was developed specifically for users of Anca’s tool and cutter grinders, the software allows the machines to connect to other equipment at a plant, Hale said. Anca is involved in the ongoing effort to develop umati, which is short for universal machine tool interface, a companion specification for OPC UA. The purpose of umati is to permit easy, secure connections of machine tools and related equipment.

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to user IT systems to facilitate transmission of machine- and production-related data. Last year, Anca took part in an umati demonstration involving about 60 companies that shared machine information.

In addition to efforts to standardize data to enable sharing information, he sees a good deal of work being done in the area of data gathering for predictive maintenance. This involves collecting information from machines — vibration, temperature, electrical signals, power draw, etc. — and identifying problems as machines fall out of tolerance, as well as informing users of what to do to solve the problems.

“That will allow more autonomous manufacturing so companies can reduce the number of people on-site,” Hale said. “This works well in the COVID environment and will also work well once economies get up and running again. Everyone was pushing in that direction because of labor shortages, and I expect that to come back very strongly on the other side of this crisis.”

Automated Part Checks

Automated data collection and analysis also can be employed to assess the quality of machined parts. At a plant in South Carolina, an artificial intelligence system developed by the North American research and development team of Charlotte, North Carolina-based Bosch Rexroth Corp. is gathering and analyzing data to spot bad automotive components made by 38 CNC machines. The machines drill two different holes in each part. After a machine drills a hole in one side of a part, a tower holding the workpieces rotates and a second hole is drilled in the other side of the component. In the process, chips that are sent flying during cutting operations can end up in the already drilled cavities and produce undesired part vibration.

The goal of the R&D team was to eliminate the need for humans to manually check each part for chips in cavities.

“It’s a tedious and time-consuming operation,” said Lead Innovation Strategist Matteo Dariol of Bosch Rexroth.

The system created by him and his colleagues includes Bosch sensors mounted on a drill to capture vibration data, which is collected by an edge device near the machines and eventually travels to an Amazon Web Services cloud platform for analysis.

To create an AI neural network capable of evaluating the parts, the Bosch Rexroth team had to extract certain information from the vibration signal produced during drilling. The team also needed “labels” created...
By operators clicking on Amazon Dash buttons to signal whether each drilled part was good. By matching labels and vibration information produced at different times during machining, the team was able to teach the neural network which vibration data indicated a bad part (one with a chip in the cavity) and a good part (one with no chip in the cavity), as well as the type of tool used in the machining operation.

Downloaded to the edge device, the neural network can evaluate parts almost instantaneously as they’re machined, Dariol said. The system has been running for more than two years and has become more accurate over time thanks to continuous data collection.

“Now we produce 1% or less false positives and false negatives,” he said. “So our customers are really trusting the results they are getting from our system.”

Bosch Rexroth’s analytics system (above) can determine quickly and accurately whether a part is good, eliminating the need for manual inspection.

On a screen, Redax users (left) can see at a glance how all their grinding machines are operating.

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Bosch Rexroth

NEW
SO EXOTIC

Picking the threading process for difficult-to-machine materials can be hard.

By Larry Adams

Exotic metals are more popular than ever as industrial designers and manufacturers take advantage of the properties exhibited by these materials, such as high strength-to-weight ratios, excellent corrosion and oxidation resistance, and strength and hardness retention at high temperatures. But properties that help make great finished components also may make machining parts a challenge throughout production, including threading.

Manufacturers usually have two main threading methods from which to choose: tapping and thread milling. Tapping is traditionally the go-to method for cutting threads into standard metal parts but can be challenging with these hard,
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heat-resistant, expensive materials. Thread milling costs more and has requirements for equipment and software but is much more flexible and multifunctional and produces pristine finishes. Tapping is fast but might gall a surface, tear a thread or — worst case — break a tap inside a part. In that scenario, a beautiful part is likely expensive scrap.

The Bottom Line
When considering which process to use, threading experts point to the potential for monetary loss — both in terms of raw material and value-added processing — as the No. 1 factor.

“Threading is typically one of the last processes performed on a part,” said Marlon Blandon, product manager of thread milling for Emuge Corp. in West Boylston, Massachusetts. “By the time you do the threading, many machines have engaged that expensive part, and the overall cost is much higher.”

While any cutting tool can break from wear and tear after enduring heat resistance, tensile strength, ductility, hardness and other factors, taps often cannot be fixed. The major diameter of a tap is almost exactly that of the inner diameter of the milled hole that the tap is grooving.

With thread milling, the major diameter of a tool is much smaller than the inner diameter. If that tool breaks, it can be removed and replaced by another tool to finish grooving threads.

“If the tap breaks,” Blandon said, “you’re left with a piece of high-speed steel inserted very tightly into a $5,000 engine casing or turbine, bone screws in medical parts or another expensive part that is now basically scrap.”

A tap might break for a number of reasons, but it often comes back to the properties of exotic materials. Exotic metals are alloys composed of a blend of metals to cre-
ate a more functional material with specific physical properties. For instance, some exotics stiffen from heat, making them literally and figuratively harder to machine, he said. Emuge recently released ZGF-S-Cut solid-carbide thread mills that feature multiple teeth, a helical flute form and a multilayer TiAlN T46 coating that can thread-mill a variety of exotic materials.

Examples of exotic metals are titanium, stainless steels and hardened nickel-alloy steels. Well-known brand names include Inconel, an austenitic nickel-chrome mix, and Hastelloy, a nickel-molybdenum recipe. Both are noted for hardness and durability, resistance to rust and corrosion, and the ability to withstand heat and remain stable over a wide range of temperatures.

Nickel alloys are “incredibly good at absorbing heat,” said Drew Strauchen, executive vice president of South Beloit, Illinois-based North American Tool Corp., a division of GWS Tool Group in Tavares, Florida. “In an aircraft engine housing, heat builds up, and you don’t want the heat getting out to the wing or electrical wiring. So you house it with an exotic metal, such as Inconel 718, and it absorbs the heat. This metal has wonderful attributes for the component but terrible attributes if you want the cutting tool to last.”

Mark Ford, director of global product management for threading tools at YG-1 Tool (USA) Co. in Vernon Hills, Illinois, said heat and points of contact on a tap quickly could wear out the tool. Taps traditionally are made of various grades of high-speed steel with a physical vapor deposition coating or surface treatment, and they work well with a range of materials up to about 50 HRC. Thread mills typically are made of carbide and can mill material up to 60 HRC.

“So tapping, the tool is fully engaged at once, and that generates

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**about the author**

Larry Adams is a freelance writer who has written extensively about manufacturing. Contact him at AdamsEditorialServices@gmail.com.
a lot of heat that gets put back into the tool,” he said. “Temperatures above the oxidation point will begin to oxidize the coating, and then it gets down to (cutting with) the bare metal.”

Carbide is the material of choice for thread mill makers. While harder, carbide is not impervious to the crystalline structure of martensitic steel or other properties of superalloys. But carbide can withstand things better.

“In addition, through CNC programming and the smaller major diameter of the cutting tools, users can select how much material that (they) want to remove per pass and adjust spindle speed to achieve the best thread quality,” Ford said.

Computer-Driven

Tapping is a much simpler procedure that can be done quickly on a variety of machines. Thread milling exotic materials, however, requires at least a three-axis CNC machine

These thread mills feature a helical flute design and are manufactured from premium micrograin carbide for increased life and improved thread quality.
capable of helical interpolation, which means that the machining center can move with simultaneous motion in three axes, Ford said. He said in the past, programming this action might have been a challenge, but most modern CNC equipment is easily capable of helical interpolation, and most tooling suppliers offer software and applications to help customers. YG-1 Tool (USA) recently released a thread milling program generator, YG-1 TM Xpert, which generates G code required for thread milling and displays relevant images and data.

In addition, Strauchen said exotic solid-carbide thread mills today are made with a left-handed helix and left-handed cut, which permit an operator to run from the top of a hole to the bottom and climb-mill threads. “This will create a right-hand thread in the part,” he said.

Compared with tapping, thread milling also can be more precise. “We are talking microns of precision,” Blandon said.

Although taps can be used in exotics, Ford said taps might not be the better choice for several reasons, such as precision and potential scrap cost. Like the other companies interviewed, YG-1 Tool (USA) produces taps and thread mills, including those for exotic metals. He said the choice ultimately comes down to what a customer wants and needs.

“The preferred method for producing threads is tapping,” he said. “While a large majority of all threads are done using a tap, you can be far more precise with a thread mill than you can with a tap. And for many applications, that precision is critical.”

Controlling Chips
Ford said thread milling also

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So Exotic

These tools are available in two-times-diameter lengths and have coolant-fed options starting at 6.35 mm (0.25") dia. One tool easily makes screw thread insert threads for through-holes and blind holes.

These tools are available in two-times-diameter lengths and have coolant-fed options starting at 6.35 mm (0.25") dia. One tool easily makes screw thread insert threads for through-holes and blind holes.

achieves a better thread quality than tapping thanks to chip control.

For instance, blind-hole tapping exotic materials is a “major issue in particular because in most cases taps make long, stringy chips that love to wrap around taps and potentially lead to breakage and scrap,” he said. “It is one of the most difficult application issues to overcome with a tap because it is so limited in what can be changed. With a thread mill, you don’t have that problem, because it is designed to move in and out of the cut very fast. And you don’t have any issues with chips, because they are very small and manageable and they flush out of the hole very easy.”

Still, deep-hole threading can be problematic, creating excess tool pressure, heat buildup and tool deflection. Unlike tapping, in which forces are distributed 360° around the circumference of a tap, thread milling doesn’t have the same engagement.

“The radial load is a fraction of a tapping operation,” Strauchen said.

North American Tool offers a line of taps and thread mills. The thread mills for exotic alloys, much like...
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Emuge’s ZGF line, are designed with only three teeth.

“So there is less stress on the tool than (with) a conventional thread mill with six or eight or 10 teeth engaged in the material at the same time,” Strauchen said.

As for tool deflection, Blandon said thread mills experience radial side pressure during cutting and that cutting forces are not balanced. Tools and workpieces should be clamped securely into chucks, shrink-fit toolholders and other devices, he said.

For toolholding requirements, he said the general rule is “the better the toolholder and the lower the runout, the better the tool performance.”

Emuge offers the FPC line of toolholder solutions, including chucks that feature “mechanical clamping via worm gear that provides superior clamping force and concentricity,” Blandon said.

While both methods have advantages, when it comes to exotic materials, thread milling may be the better choice. A thread mill can perform many functions. Depending on the product, a mill can drill a hole, chamfer it and machine the thread. A single tool could be used in thread milling to make a wide range of hole sizes, interior and exterior threads and right-handed and left-handed threads. Thread milling also allows users to closely and consistently control pitch diameter and achieve tight tolerances. And thread milling provides a good finish to a thread, which is always an issue with tapping, particularly with difficult-to-machine exotic materials.

Solid-carbide thread mills (far left) are especially useful for threading blind holes.

North American Tool’s pipe tap thread mill (left) produces threaded pipes that are used in many applications to deliver gases or liquids, often under pressure.

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BIG PARTS, BIG QUESTIONS

How is machining large parts different from machining small ones?

By Christopher Tate

Power generation components are enormous compared with the automotive and aerospace parts that I worked with before coming to Mitsubishi Hitachi Power Systems Americas Inc. The machines shown to me during my interview there were much larger than anything I had used. I had seen photographs on the internet of big machines, but photos mask the true scale of the components and the machines used to make them.

It is easy to be intimidated by the size of power generation manufacturing. Several questions entered my mind as I realized what I faced: How do I hold these parts? Do they act differently from small parts? How do I estimate cycle times? What cutting tools do I use? The answers that came surprised me.

Ask and Receive

Most of our turning is done on vertical turret lathes. Unlike smaller turning centers, large machines typically do not have self-centering chucks. Most of the time, we use chuck jaws mounted to a machine table, which creates the same type of setup as a four-jaw chuck on a small toolroom lathe. Each jaw moves independently, allowing a machinist to accurately align a part before machining. Part geometry occasionally does not lend itself to jaw use, in which case we clamp the part in place with threaded studs and strap clamps, much like using a faceplate on a manual lathe. (Only old-timers remember using a faceplate with clamps.)

Holding parts on a large horizontal boring machine is no different from holding parts on a small machining center. When we can justify the expense, we make dedicated fixtures that mount on a table and provide clamping and locating elements for a part. In other situations, it is not feasible to make a fixture, so a part is mounted directly on a machine table and clamped with T-nuts, threaded studs and strap clamps like those found with a knee mill in a toolroom.

Gas turbine rotors can weigh 64 metric tons (70 tons) when fully assembled. The largest lathe at Mitsubishi Hitachi Power Systems Americas is rated at 200 metric tons (220 tons).

Much like with workholding, cutting tools and toolholders used on large machines are not different from those used on small machines. Our horizontal boring machines all have CAT 50 spindles, and milling toolholders use ER-style collet chucks, hydraulic chucks and...
some shrink-fit holders. Many cutting tools surprisingly are small relative to the size of parts; most of our tools are 25 mm (1”) or less in diameter. However, 500 mm (20”) boring heads, 100 mm (4”) drills and 75 mm (3”) taps are not uncommon with horizontal boring machines.

Much like with milling, turning tools used on big lathes are small.

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relative to part size. All lathes at Mitsubishi Hitachi Power Systems Americas utilize Capto C8 toolholders with various types of inserts in common shapes and sizes. With many of our parts, chatter can be a problem because lathe tools frequently have long extensions. Capto tools provide the option to use vibration damping tools, and the Capto interface gives support in multiple planes. Both features help eliminate chatter. Capto also supplies an exceptionally repeatable connection, so we do not need to remeasure tools each time they are changed.

Big parts probably have big tolerances, right? Not really. On the loose side, we are allowed ±0.15 mm (0.006"), which may sound like a lot until considering that some parts can be 3.7 m (12’) tall with features 3 m (9.8’) apart. On the tight side, we hold some 850 mm (33.5”) shaft diameters to +0/-0.01 mm (+0/-0.0004”), which can be difficult for small parts. To achieve these tolerances, we spend large sums of money on calibration to ensure that machines are repeatable and accurate.

Small parts are subjected to distortion from clamping, stress relieving and aggressive machining. Big parts are worse. They are subjected to the same issues but have an added challenge: weight. Large parts can distort under their own weight, causing problems like bowed shafts or out-of-round rings. Some machining processes start with a “slow roll” in which we allow a sizable shaft to rotate for an entire shift to remove a bow before we machine. In some cases, like with a ring that has a thin section relative to the diameter, we must perform stress-relieving heat-treat operations before taking a part to a machine. This prevents movement during machining operations that require big ovens. Our largest oven is 10 m (33’) deep and 4 m (13’) tall — almost spacious enough for a semi-trailer.

Estimating cycle times is similar to estimating for small parts. To

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**about the author**

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calculate cutting times, we use our CAM software the same way that a user would for small parts, but that is where similarities end. Small parts are loaded by hand, and handling times are only a few seconds. Our handling times for big parts are measured in hours. It can take two hours to flip a large cylinder and three to four hours to move a gas turbine rotor from one end of the shop to the other. It is necessary to account for all material handling or else cycle time and lead time estimates can be wrong by multiple shifts.

All in all, machining large parts on large machines is not very different from machining small parts as long as the few distinct differences are recognized. The primary difference is simply size.

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GRINDING AND ERODING. Do you want to grind carbide tools and erode PCD tools with high productivity? The new VHybrid 360 from Vollmer of America Corp. combines the strengths of an innovative grinding machine and a proven, powerful erosion machine. The VHybrid 360 allows users to switch between the two functions in no time. A range of automation options are available.
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CHANGING TOOLS. The L20XII ATC by Marubeni Citizen-Cincom Inc. provides an environment in which tool setting for machining several types of workpieces can be completed in a single setup. This unique, compactly designed automatic toolchanger with a b-axis can be mounted on the gang tool post of the Cincom L20XII to enable use of front machining b-axis tools – 12 ATC tools and one built-in tool.
Marubeni Citizen-Cincom Inc.; www.marucit.com

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**DRILLING.** The A Brand ADO-TRS from OSG USA Inc. is a high-feed, three-flute carbide coolant-through drill. Patented geometry permits stable chip ejection even with less chip pocket space, which is inherent in three-flute drills. The result is up to three times faster speed than two-flute drills and up to three times longer tool life. The video illustrates the advantages and shows the tool in action. OSG USA Inc.; www.osgtool.com

**FACEMILLING.** Tungaloy America Inc’s new TungEight-Mill facemilling cutter is for extremely light cutting with low power consumption. The tool is suitable for low-rigidity and low-horsepower machines with a BT30 connection. TungEight-Mill incorporates single-sided positive inserts with eight economical cutting edges for heavy roughing to mirror finishing of various material faces. Tungaloy America Inc.; www.tungaloy.com

**SKIVING.** With its GCX Linear machine, Anca CNC Machines brings a complete solution for manufacturing and sharpening skiving cutters as part of a comprehensive gear cutting tool package. Adapted from the company’s CNC grinder platform, the GCX Linear adds tailored features to finish all operations for skiving cutters and shaper cutters in a single setup. Anca CNC Machines; https://machinesanca.com

**MILLING ALUMINUM.** Kyocera Precision Tools Inc. has released a milling line for high-speed aluminum applications. The MEAS series is engineered with unique grooved insert pockets for added stability when machining at high speeds. Utilize simultaneous three-axis machining with a maximum ramping angle of up to 20°. MEAS allows a broad range of applications, from facing, shouldering, slotting and profiling to pocketing, ramping and plunging. Kyocera Precision Tools Inc.; www.kyoceraprecision tools.com

**WORKHOLDING.** Is it possible to change heavy workholding in one minute? The answer is absolutely with the centroteX S from Hainbuch America Corp. The changeover system features ergonomic handling, resists contamination and provides a short return on investment. No rigidity is lost compared with clamping devices bolted directly on machines. View a real-time demonstration changing from a chuck to an ID mandrel. Hainbuch America Corp.; www.hainbuchamerica.com
Consistently drilling a deep hole in heat-resistant stainless steel can be challenging enough. But when a workpiece is spun-cast, complexity increases because the center has a void of varying shape and size that’s created during the purification process.

“It’s the shape of a lightning bolt is the best way I can describe it,” said Tim Geyer about the spun-cast reducer that MetalTek International machines for the petrochemical industry.

The Waukesha, Wisconsin-based company is a one-stop shop for engineered products, said Geyer, senior process engineer for the machine shop and supervisor of the toolroom and programming. In addition to providing machining services, MetalTek International produces workpieces using centrifugal, sand, investment and continuous casting processes. When the company centrifugally casts a workpiece, liquid metal is poured into a die, which is spun at a specific rpm.

“It creates the Gs that force the pure metal alloys to form around the die,” he said, “and all the impurities end up inside the casting.”

The void created during casting measures about 6.35 mm to 25.4 mm (0.25” to 1”) wide and 152.4 mm to 177.8 mm (6” to 7”) deep, Geyer said. The drilled hole measures 74.93 mm (2.95”) in diameter and 203.2 mm (8”) deep.

MetalTek International does have a heat treatment facility, as well as a full chemistry laboratory. But because the part operates in a hot environment that heat-treats the part, he said the stainless steel reducer isn’t heat-treated. The part receives an initial heat treatment to anneal it, but the treatment does not increase hardness. The clean outer metal of the part has a hardness of 190 HB while the void is somewhat softer but more abrasive because of the scale that ends up there as a result of the casting process.

The company originally produced the hole with an indexable-insert drill that accepted inserts with four cutting edges, but each insert needed to be indexed two or three times to make one hole during actual production operations, Geyer said. In addition to the time that indexing consumed, the part was machined on a Warner & Swasey automatic chucker machine from Tungaloy America Inc.

**END USER**

**SOLUTION PROVIDER**

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the late 1960s, which moved only in one axis and didn’t have a recall function to put the head back into its previous position after a tool was extracted from a bore. This limitation meant that the machine didn’t know where it left off and therefore increased cycle time to air-cut the length drilled previously.

“Because of the abusive work that we do,” he said, “the older machines tend to provide us better results than newer machines.”

While attending a Tungaloy America Inc. seminar, Geyer became interested in the TungSix-Drill from the Arlington Heights, Illinois-based toolmaker because of the double-sided insert design with six cutting edges, which improves insert strength. Furthermore, the pocket geometry varied between the drill’s central and peripheral pocket. He also was attracted by the shape of the coolant channels, which he said delivered coolant more effectively to the face of the insert where it’s needed.

Kedar Bhagath, chief technical officer of Tungaloy America, explained that one side of the double-sided insert is for the peripheral pocket and the other is for the central pocket, which allows the chip-breaker to be optimized for the two pockets to produce the best chips. Because the cutting speed at the central pocket approaches zero toward the center axis, the chip formation is different from the chips produced by the peripheral insert.

“The most important point is that the insert corner angle in the central pocket has an obtuse angle design, which strengthens the insert and avoids insert fracture,” he said.

Bhagath said the drill’s two coolant channels are twisted with the flute shape to allow a larger chip gullet area. In addition, at the end of the channel is a slot that directs coolant toward the insert and pushes chips through the flute and out of the hole.

Geyer conducted a test to determine how the TungSix-Drill compared with the drill that MetalTek International used, as well as a drill from another cutting tool manufacturer. That third tool from a different toolmaker performed better than the original drill but had to run at about 27 m/min. (90 sfm). In comparison, the TungSix-Drill ran at a cutting speed of 52 m/min. (170 sfm) during the test. Results showed that the original drill was able to run at a cutting speed of 30 m/min. (100 sfm), a feed rate of 25 mm/min. (1 ipm), a spindle speed of 129 rpm and an operation time of 463 seconds per hole. In contrast, the TungSix-Drill ran at a feed rate of 51 mm/min. (2 ipm), a spindle speed of 220 rpm and an operation time of 273 seconds per
hole while producing 24 holes.
The drill cost analysis indicated that the original drill had a $14.28 cost per drilled hole and a $13.26 machine cost per hole for a $27.54 total cost per hole. The TungSix-Drill, on the other hand, had a 45-cent drill cost per hole and a $7.80 machine cost per hole for an $8.25 total cost per hole. For the 1,000-part job, MetalTek International reduced costs by about 70% through switching to Tungaloy America’s drill.

“The total life of the job saved us about 340 hours,” Geyer said.

He described the part as a semi-recurring job.

After the hole is drilled, the company performs a semifinishing pass and a finishing pass with carbide boring bars.

In addition to cost savings, the reliability of the drilling operation with the TungSix-Drill enhanced MetalTek International’s confidence that new employees could correctly perform the process, especially those on the second and third shifts, Geyer said.

“Being able to use this drill,” he said, “knowing that the inserts weren’t going to explode in the middle of the cut and knowing how many cuts we are going to get out of the insert really helped us feel comfortable that these less experienced operators running these parts will be successful in making quality parts throughout the night.”

**correction**

In July’s issue, the article “Give and take” by Alan Richter incorrectly stated that the more flutes a tool has, the higher the helix angle is, which reduces the pull on a part. Mitchell Parker, process improvement specialist for LMT Onsrud LP, actually had said the pull increases. CTE regrets the error.
The next-generation Sapphire industrial 3D metal printer can print up to 1 m (3.3') in height. Available in the fourth quarter of this year, the laser powder bed fusion additive manufacturing system by Velo3D Inc. of Campbell, California, includes a 315 mm (12.4") dia. build plate, dual 1-kW lasers and in situ optical calibration. The 1-m-tall machine targets a variety of industries, such as aerospace and energy.

“I think there’s a lot of different applications where the geometries that customers are looking for at the end of the day can be very difficult to machine,” said Zach Murphree, vice president of technical partnerships. “And a lot of that has to do with access limitations. So if you think about parts that are manifolds or shrouded impellers or pieces that have kind of internal flow paths, these are generally difficult to get to with a machining tool — or they can be depending on the geometry. And that’s one of the places where we see the technology, 3D metal specifically, being very, very useful.”

For example, he said a 12.7 mm (0.5") dia. gundrilled hole that is 762 mm (30") long and needs to maintain a certain tolerance dimensionally in terms of straightness and where it is in relation to the other surfaces of a part can be challenging to machine. Or perhaps a part requires machining as separate components before being assembled.

With the Sapphire, Murphree said much complexity can be incorporated into a part from the beginning. Costs, lead times and cycle times may be reduced because fewer steps are demanded to produce parts.

“You can be a really good machine shop and add this to your toolkit without needing to create a center of excellence and hire people who went to school only for additive manufacturing,” he said. “There is calibration and metrology built in to the machine, so the operator can hit a button on the screen and the machine can calibrate itself. It can measure how healthy its optical components are and how accurately the lasers are pointing at different places on the plate, how much is building, how accurate the lasers are relative to each other and do this all without requiring a field service engineer. And so the system that we built is really completely focused on being a production technology that can live on a shop floor next to a five-axis mill and kind of have the same mode of operation.”

For more information about Velo3D, call 408-610-3915 or visit www.velo3d.com.

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