CUTTING TOOL ENGINEERING

May 2020 | Vol. 72 | Issue 5
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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    C ❑ 20-49    E ❑ 100-249    G ❑ 500+
   B ❑ 10-19    D ❑ 50-99    F ❑ 250-499

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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Equipped with a new sub-spindle option, Okuma’s GENOS L3000 Lathe puts full, finished-part machining at your fingertips! And, when coupled with the machine’s milling and y-axis functionality, making simple or complex finished parts just got a whole lot easier.

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ProvenCut uses a standard four-flute carbide endmill to machine 8620 alloy steel hardened to 55 HRC.

Applications Engineer Robin Cave explains how the 3D simulation feature on Mazak Corp.’s Mazatrol Smooth CNC makes machining setups quicker and safer.

In the 100th episode of CTE’s Ask the Grinding Doc video series, Jeffrey Badger discusses his least favorite subject: chatter.

Help us thank companies, such as Star SU LLC, Dapra Corp., Allied Machine & Engineering Corp., The L.S. Starrett Co. and Monaghan Tooling Group, for their contributions to making personal protective equipment for health care workers and ventilators to combat COVID-19. #InThisTogether. See this and more on CTE social media.
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- Tooling Design Engineers

EQUIPMENT AS A SERVICE


“Instead of buying a machine and fully financing it or paying cash, you can pay as you use it,” he said in an interview with CTE.

This model provides financial flexibility to part manufacturers.

With equipment as a service, Immerman said machine tool builders no longer will sell “a piece of iron” but an industrial internet of things-enabled piece of equipment that is also a service. By being IIoT-empowered, a machine can send data to a machine builder or distributor to provide a host of services, such as developing a custom preventive maintenance plan based on customer usage of a machine, allowing remote machine monitoring and revealing whether a machine is operating at optimal capacity.

“MachineMetrics can tell you that the average customer is using their equipment about 25% of the time,” he said.

As a result, manufacturers buy equipment that wouldn’t be needed if equipment utilization was more optimized.

“That’s just a fact,” Immerman said. “As all manufacturers start having data and realizing these facts, builders are not going to sell them these iron things anymore at some random rate. They are going to enable other use cases and wrap these models around the sale of machines.”

He said MachineMetrics is a subscription-based service in which customers purchase a platform for providing services around that platform, which can connect every machine on a shop floor.

Although the metalworking sector has been slow to offer the equipment as a service model, Immerman said the adoption rate for this kind of technology can be quick.

“The type of data that we collect from the equipment is so deep that we can enable this service so fast,” he said.

Immerman said the first use case gaining traction is remote machine monitoring, which reduces the time required to have a machine making chips again. Remote machine monitoring also lowers service costs for machine builders by helping lessen on-site service visits by 10% to 20% and provides a better experience for customers, which are then more likely to invest in additional machines.

“The ability to remotely diagnose and resolve problems without having to go on-site is a win-win for the machine builder or distributor and customer,” Immerman said.

He said other gains that a machine builder could derive from having data fed directly from production equipment include improved equipment design and identification of optimal changeover sequences.

The path to this new model starts with data and data transformation.

“It’s the foundation of all these future business models,” Immerman said.

about the author
Alan Richter is editor at large of CTE. Contact him at 847-714-0175 or alanr@ctemedia.com.
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SUGARCOATING IT

The following was written in response to Alan Richter’s Lead Angle column in the March issue about the amount of coating for a drill.

I’m a longtime reader of CTE. I was hired into the business by Frank Hofbauer, the late founder and president of the old Mohawk Tools Inc., Montpelier, Ohio, in 1967 as a draftsman. Frank came up with the subland drill for drilling and chamfering shells and bombs for World War II, along with many other innovative cutting tools. I learned the craft from the best. During my apprenticeship, I was taught every operation to produce a cutting tool and every engineering function to design the correct features so the tool would function properly for the application and material to be cut. I could not wait to get my copy of CTE to find out what was new to our business and what the competition was up to. It served as part of my training. In time, I became head of design and engineering and Mohawk’s cutting tool expert. Enough about me.

I take my hat off to Mr. Paul Friedli to still have an interest in our business at his age of 91. I’m sure he has won the title as oldest reader, and congratulations. I would be curious to know how long he has been reading CTE. I have been reading CTE since 1967. I had collected all of the copies until about 10 years ago.

From an engineering standpoint, I will disagree with Mr. Friedli about only coating for two diameters of flute length. The cost of the coating material is insignificant compared with the labor cost to mask off the tool for only two diameters of coating length. Yes, he is correct about the point taking most of the abuse from heat generated at the chip interface along the cutting lip. Flank and crater wear generation are dependent on many different factors. Axial rake (helix), clearance (lip relief), speed and feed are just a few that must be correct for the material and hardness being cut. If you are drilling three diameters of depth or less, then the coating on the margins and flute face becomes less important.

However, drilling deeper than three diameters of depth is considered deep-hole drilling, and most operators do not retract the drill to extract chips. Chip congestion in the flutes is the leading cause of drill failure. A tapered web general-purpose drill is not appropriate for deep-hole drilling, but parallel web parabolic flute-form drills are better suited for deep-hole drilling. If the drill has a coating on the margins and flute face for the entire length, then it gives self-lubricating and wear resistance properties so the chips can flow easier up the flutes, carrying heat away from the point where it is created. Heat is any cutting tool’s worst enemy. Coatings are only an enhancement and not a substitute for proper design and application for the material and hardness being cut.

Drills are the most abused cutting tool and remove more material than all of the others in the magazine. Keep up the great work that you do.

Lynn Fifer
Metalworking Product Review

REAME**R ENABLES 70% HIGHER FEED RATES:** Monaghan Tooling Group has introduced the modular Top Speed Ring reamer. The diameter range is from 50.6 mm to 225 mm (1.99” to 8.86”). Solid, straight or left-hand flute designs ensure stoutness throughout service life. Holders come standard with internal coolant and are made with either cylindrical shanks or module connections for runout compensation. Monaghan Tooling Group; www.monaghantooling.com

BUFFING WHEELS REQUIRE MINIMAL BUFFING COMPOUND: The fixed abrasive buff, or FAB, buffing wheels from Norton | Saint-Gobain Abrasives are tear-resistant, waterproof and durable. The wheels have silicon-carbide abrasives, which are uniformly dispersed and applied to both sides of the cloth to enhance buffing performance consistency. Norton | Saint-Gobain Abrasives; www.nortonabrasives.com

LASER MACHINE SIMPLIFIES MICROTOOL PRODUCTION: United Grinding North America Inc. offers the Laser Line Ultra from Ewag AG for machining microtools. The machine uses an eight-axis configuration and picosecond lasers to produce complex microscale geometries. The Laser Line Ultra is suitable for producing drills with diameter-to-length ratios up to 1-20. The force-free process eliminates waste from tool breakage. United Grinding North America Inc.; www.grinding.com

DOT PEEN MARKER FOR RANGE OF MATERIALS: Rocklin Manufacturing Co. offers the FlyMarker mini Station tabletop dot peen marking unit from German manufacturer Markator Manfred Börries GmbH. The battery-operated unit’s 120 mm × 100 mm (4.72” × 3.94”) marking window and adjustable force settings deliver permanent marks on materials that range from plastics to steel hardened to 63 HRC. Rocklin Manufacturing Co.; www.rocklinmfg.com
**Microgrinder Targeted at Medical Device Industry:** Glebar Co. offers the CAM.3 microgrinding machine, which is suitable for medical applications, such as guidewires with flats, multiple tapers, hexagon shapes and other complex geometries. The machine accurately grinds lengths from 0.127 mm to 9.525 mm (0.005” to 0.375”) in diameter. The 406.4 mm (16”) grinding wheel is mounted on a servospindle with ABEC 7 spindle bearings.

Glebar Co.; www.glebar.com

**Flap Discs Allow Aggressive Grinding:** Weldcote Metals Inc.’s Korner right-angle zirconia and ceramic flap discs are designed so the abrasive material wraps over the edge. This allows a user to grind aggressively into corners and other tight spaces. The lightweight flap discs have a poly-cotton backing for enhanced flexibility and a compressed shape to extend product life.

Weldcote Metals Inc.; www.weldcotemetal.com

**Laser Tube Cutting System Has 3D Tilt Cutting Head:** BLM Group USA Corp. offers the LT8.20 laser tube cutting system, which allows users to choose their preferred laser source, loader/unloader style and positioning of peripheral equipment to maximize floor space. The machine can handle cutting diameters up to 241.3 mm (9.5”). It performs angular cuts in round, square, triangular, I-beam and other shapes.

BLM Group USA Corp.; www.blmgroup.com

**Compensating Collet Chuck Has Compact OD:** MicroCentric Corp.’s quick-change compensating collet chuck is for applications in which shafts are machined between centers. It has a pullback design with a floating collet seat and incorporates a mounting in the ID of the chuck body for centers or other types of locators. The collet can compensate up to 1.5 mm (0.06”).

MicroCentric Corp.; www.microcentric.com
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With many job shops shying away from robots because of integration and programming difficulties, a machine tool builder has introduced a couple of products to offer an easier path to automation. One offering from Okuma America Corp., Charlotte, North Carolina, is Armroid, a robot that is built into an Okuma America machine and can work inside it.

"Many companies build small kit- ted robots," said Product Specialists Manager Wade Anderson. "The difference here is having something built by the machine tool OEM that comes married up with the machine and ready to run."

The Okuma America-built Armroid is mounted inside a machine tool over the spindle. The result is a smaller footprint than those of conventional robot-machine combinations. Also, Armroid doesn’t require any robotic integration or guarding.

An Armroid-equipped machine looks like a lathe with an attached storage cabinet.

"It’s not till you open the door and look inside that you realize, ‘Oh, my gosh, there’s a robot in there,’” Anderson said.

Creating a robot operating program normally requires special programming language skills that shop personnel may lack. Therefore, Armroid features a robot operation system that needs only interactive inputs of numbers.

"To me," Anderson said, "the coolest thing about the Armroid is the programming aspect of it."

A key feature is a conversational human-machine interface that helps users through the process of providing the necessary programming.
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Operators enter information, such as workpiece dimensions and where the robot’s gripper should grab the workpiece. Armroid then uses artificial intelligence and the machine’s collision avoidance software to learn how to maneuver safely inside the machine. This allows Armroid to generate motion paths for collision-free machine loading and unloading using a configurable cabinet that contains racks for raw materials and finished parts.

When not loading or unloading a machine, Armroid can perform other tasks. For example, it can drop its end effector into a drawer in the machine and pick up a high-pressure coolant nozzle. Following a toolpath with this nozzle, Armroid

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

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can deliver coolant to wash troublesome chips out of the machine.

Unlike Armroid, Okuma America’s other new automation robot, Standroid, is made by a third-party supplier and located in an enclosure outside a machine. Standroid equipment comes in a compact automated cell package that includes everything needed to build and implement an automation package without the assistance of system integrators, according to Okuma America.

Although it loads and unloads a machine from the outside like a conventional robot, Standroid uses the same AI programming technology as Armroid to teach itself how to move around in a machine environment without collisions. So far, Anderson said, Standroid has been used with mills, mainly handling bigger, heavier parts than those handled by Armroid, which typically is used with lathes.

While automation has been used at high-volume shops for years, most shops have considered it ill-suited for their typical high-mix, low-volume work, he said.

“They think, ‘We do small batches, and we’re constantly changing over, so we can’t automate that,’” Anderson said.

He said in addition to easier integration and programming, Armroid and Standroid offer the flexibility that shops need to successfully automate machining operations. The robots also can make it easier for shops to adjust to whatever circumstances the future may bring.

“If your work is going to be changing and what you do may look a lot different three years from now than it does today,” Anderson said, “you’ve got an automation system that can be adapted as your work evolves.”

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about the author

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

THE CHUCK STOPS HERE

By Brandt Taylor

Setting a z datum to do chucker work on a lathe is a frequent task for many shops. This activity involves using some sort of work stop to get repeatable parts and ensure that they are clamped squarely in the jaws. Let’s look at chuck jaws that speed up this process.

In the past, there have been two methods for setting a z datum. One is to attach a work stop to a chuck. An example is a tripod arrangement that works with hard jaws and attaches to a chuck face with magnets. That’s simple enough, but it doesn’t work on a four-jaw chuck. Each Jaw may have to be changed, consuming more time and money.

The other method is the old standby of machining soft jaws, which always work. But machining them costs time and money. Soft jaws are machined to fit a specific clamping diameter and z dimension. It’s possible to accommodate a few different part geometries with one set of jaws, but shops end up investing in a library of machined soft jaws. As it grows, so does the investment. When the job changes, the jaws may have to be changed.

What’s been needed is a work stop that is accurate, versatile, quick and easy to use, plus it shouldn’t interfere with cutting tools. To fill the void, I developed Stop Jaws, hard jaws with removable hard work stops.

Each Stop Jaw has an array of slot pairs that accept work stops and allow different z settings. Thirteen different z positions can be accommodated. Here’s a photograph of a Stop Jaw, using a boring bar to machine the internal features of a bearing retainer part.

Using a Stop Jaw, a boring bar travels through a bearing retainer part to machine its internal features.

About the Author

Brandt Taylor is owner of Berlin, Massachusetts-based Taylor Engineering, a machine shop and manufacturer of lathe chuck jaws. He can be reached at 978-838-2979. For more information about the chuck jaws, visit www.stopjaws.com.
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are standard. A threaded hole in the jaw accepts a threaded stop retainer, which positively locks the stop in the jaw. The stop can face in or out. Note that the work stop protrudes a small distance from the clamping face to allow cutting tools to pass by the stop without interference. (See the photograph at the bottom of the page.) Without the stops, Stop Jaws perform like other hard jaws, such as for doing bar work. Installing a work stop enables users to perform chucker work.

In operation, a work stop is inserted into a slot pair, and the retainer is inserted into the hole in the top of the jaw and threaded down with a hex key. Go from bar work to a second operation or from one z

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It's important to recognize that Stop Jaws don't do the work of pie jaws or any soft jaws in which a part requires a large angular contact area.

A work stop can be used on the outside of a Stop Jaw to clamp a part on an inside surface. For example, with a cylinder clamped on its ID, its entire OD can be machined.

With a work stop used on the inside of a Stop Jaw and a part clamped on an OD, machining through a part is no problem. If a part is clamped on its OD and the diameter being clamped is less than the length being clamped, using only one work stop on one jaw does the job.

Stop Jaws are available for three-, four- and six-jaw chucks 152.4 mm to 381 mm (6" to 15") in diameter.
Dear Doc: We grind hardened steel with plated CBN wheels. When a wheel reaches the end of its life, sometimes only half of it is worn while the other half appears untouched. Is our supplier selling wheels to us that aren’t round?

The Doc replies: Probably not. You’re likely mounting the wheels eccentrically, and they die before being broken in fully.

On all grinding wheels, the bore diameter is larger than the spindle shaft diameter. When mounted, there is play between the shaft and bore, which causes runout. If you dress a wheel, this runout isn’t a problem. Dressing knocks off the high points, creating a wheel shape concentric to the axis of rotation.

But plated wheels aren’t dressed. Therefore, the high point on a freshly mounted eccentric wheel bangs against a workpiece. Gradually, more and more of the wheel circumference acts on the workpiece until the entire wheel circumference is being used. (See the figure.)

I’ve had customers argue that they have “perfect tolerances” and, accordingly, no runout. Don’t buy it. All wheels and shafts are required to have some play. An H6 tolerance on a 37.5 mm (1.48”) bore is +0/-16 µm (0.0006”). When a wheel is mounted poorly, that’s at least 16 µm of runout. Add to that the out-of-tolerance state of a beat-up shaft, and runout can increase quickly.

This situation is unavoidable because you always have some runout after mounting. If runout is excessive, a wheel may bang for a long time before wearing away enough so the entire circumference of the wheel is in the grinding zone. You might reach the end of life for the portion of the wheel circumference that’s in the action before the other portion even gets a chance to grind. For large-grit wheels, this scenario is unlikely as there’s a lot of radial wear during their lifetimes. For small-grit wheels, there is less wear, and using only half a wheel is a bigger risk.

What’s the solution? Get a piece of wood, a rubber mallet and a dial gauge. Then, mount the gauge on the machined metal rim that is on most plated wheels. Next, mark the runout high point and tap the mallet, with the wood acting as a cushion, to tap away the runout.

It usually takes me 30 taps before the runout is reasonable, but you might achieve this with significantly fewer taps.

It’s tough to say how much runout is acceptable. I’ve seen people get it as low as 2 to 3 µm (0.00008” to 0.00012”), and I’ve seen people tap like mad for 30 minutes only to get it to 15 µm (0.00059”). It depends on your tolerances, the age of a machine, the condition of a shaft and how talented you are. Regardless, lower is better.

This philosophy is also true with rotary diamond dressing tools. Actually, it’s even more important in that case because those tools can be on grinding wheels for years and can take months to finally wear away for full-circumference contact.

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On Oct. 10, 1933, the eighth meeting of the General Conference on Weights and Measures, also known as CGPM, considered the necessity of substituting “international electric units” with “absolute electric units.”

On Oct. 21, 1948, the ninth CGPM meeting abolished absolute electric units and adopted the ampere as the unit of electric current. The CGPM’s definition was, “The ampere is that constant current, which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2×10⁻⁷ newton per meter of length.”

The unit of electric current is named after André-Marie Ampère (1775-1836), a French mathematician, physicist, chemist and philosopher. He is best known for work in electromagnetism.

In 1848, Lord Kelvin, aka William Thomson, in his paper “On an Absolute Thermometer Scale,” calculated that absolute zero was equivalent to -273° C (-459.4° F) on air
thermometers. His value of -273 was derived from 0.00366, which was the accepted expansion coefficient of gas per degree Celsius relative to the ice point. The inverse of -0.00366 is \(-1 + 0.00366 = -273.22\)° C. This value is very close to the true value of -273.15° C.

On Oct. 16, 1967, the 13th CGPM meeting decided that:

- The unit of thermodynamic temperature would be denoted by the name kelvin and the symbol K.
- The same name and symbol would be used to express a temperature interval.
- A temperature interval also could be expressed in degrees Celsius.

Instead of degrees, temperatures on the Kelvin scale are called kelvins. Absolute zero, or 0 K, is the coldest temperature theoretically possible, but it cannot be reached by artificial or natural means. At absolute zero, all molecular motion does not cease, yet it lacks sufficient energy for transference to other systems. Therefore, it is correct to say molecular energy is minimal at 0 K.

The following are some interesting facts:
- Helium melts at 0.95 K (-272.2° C or -458° F).
- The average temperature of the universe is approximately 2.73 K (-270.4° C or -454.8° F).
- The mean surface temperature on Earth is 287 K (13.9° C or 56.9° F).
- The surface temperature of the sun is 5,778 K (5,504.9° C or 9,940.7° F).

Lord Kelvin (1824-1907) was an Irish Scottish mathematician and physicist. His contributions to science included the absolute temperature scale, the dynamic theory of heat, the mathematical analysis of electricity and magnetism, ideas for the electromagnetic theory of light and fundamental work in hydrodynamics.
Rivets aren’t sexy like jet engines and flight control systems, but that doesn’t make rivets less important to the well-being of an aircraft. For example, a Boeing 747 has nearly 1.5 million such fasteners, all of which contribute to structural integrity. Some newer planes, such as the Boeing 787 Dreamliner, require far fewer rivets and screws due to enhanced use of lightweight composite materials. Nonetheless, each fastener must be held firmly in place for an aircraft to be deemed flightworthy. Even a spacecraft, which is expected to endure the extreme speeds and temperatures of interplanetary travel, is fastened together with rivets not all that different from those found on a fishing boat or recreational vehicle.

Give a Hand

A large percentage of these fasteners still are installed manually.
Some of the most critical parts found in an airplane are also the smallest and most abundant. The most common method of countersinking in aerospace applications is with a spring-loaded microstop.
The Solo tool has a retractable, spring-loaded blade to countersink or counterbore the back of a hole.
Several methodologies exist, but the most prevalent is the use of a power drill and spring-loaded microstop, also known as a microcage,” said Linn Win, senior business development manager at OSG USA Inc., Irving, Texas. “The cutting tool itself is typically a piloted 100° or 130° countersink with a threaded shank that screws into the microstop. You set it to the desired depth, place the tool’s pilot into a pre-drilled hole, engage the drill motor and then push down to produce the countersink.”

He described a few methods that are more productive. One is to use a semi-automated drilling unit, which can drill and countersink in a single-shot operation. Also, robotic and fully automated systems not only accurately countersink a hole but install a rivet, commonly known as drill and fill.

Whatever the method, a backing bar or similar type of support — usually placed on the inside of an aircraft — often is needed to keep aircraft skin from deflecting during drilling. In other instances, two or more sections of material may need to be disassembled, cleaned, deburred and then reassembled before rivet installation. Compared with chamfering a hole in a machined part, countersinking fasteners on an aircraft fuselage is complex work.

These operations are made even more complex by the fact that aircraft-makers use a wide range of
‘Countersinking tools must often be customized to the fastener and its unique application.’

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“The requirements vary greatly based on the size of the plane, the load and stress of a mating section and the manufacturer,” Win said. “Cutting tool manufacturers must therefore deal with a broad range of materials and thicknesses, hole sizes, countersink shapes and depths, as well as different methods of fastener installation and hole prep, making it difficult to standardize cutting tools. Because of this variability, countersinking tools must often be customized to the fastener and its unique application.”
It’s niche work to be sure. But due to the large volume of aircraft being made, never mind the number of countersunk holes in each one, there’s no shortage of high-quality custom and off-the-shelf cutting tools. One example of the latter comes from Heule Tool Corp., Loveland, Ohio. Technical Sales Engineer Matt Baumet said the company’s Comp combination countersinking and holemaking tools automatically compensate for the uneven surfaces found on many aircraft parts.

“The surfaces on these parts can vary by a quarter inch (6.35 mm) or more in height, so you need a tool that can float up and down while remaining perfectly perpendicular,” he said. “Our Comp tools are used on the doors for the 737, for instance, each of which has around 800 fasteners. But we also see a lot of demand from turbine manufacturers who need to chamfer both sides of a hole. For this, our Defa tools are a popular option, or the Solo, which has a retractable, spring-loaded blade. One of our largest customers uses these in an automated machine to put 100° countersinks on engine fairings.”

Automation is increasingly prevalent in aircraft manufacturing, Baumet said. System providers continue to develop ways to streamline the holemaking process, using robots and tracked “crawlers” to reduce the need for humans in what has long been the most labor-intensive step of fuselage production.

“You have companies like Boeing and Airbus employing 40,000 workers with air guns to deburr and chamfer and countersink millions upon millions of holes each year,” he said. “So it’s only logical that they want to automate this wherever possible, not only to reduce costs but,
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Choose Wisely

Automated or not, the array of materials found in aircraft challenge cutting tool and aircraft manufacturers alike. A diamond-tipped countersink that does a splendid job on composites may self-destruct upon striking a titanium underlayment while HSS tools commonly used in manual applications can provide shorter tool life in either of those materials.

The most general-purpose of all cutting tool materials is tungsten carbide, which is suitable for machining aluminum, titanium and even composites, especially when coated with TiN or diamondlike carbon. Even here, though, fuselage machining is typically performed in less than optimal machining conditions that tend to compromise tool life and productivity.

“A lot of aircraft manufacturers might use mist coolant or, more
often, no coolant at all,” Baumet said. “And as anyone who uses cutting tools knows, that’s not ideal. With thinner materials like wing skins, this isn’t such a big deal, but it can be challenging with the structural components or when you get into titanium. Here’s where a good tool coating can make a big difference.”

**Maximum Flow**
Gary Rozema, vice president of sales at Amamco Tool & Supply Co. Inc., Duncan, South Carolina, said PCD is the preferred choice for countersinking composite components. That’s because PCD tools generally hold their sharp ground cutting edges longer than tools made of other materials thanks to PCD’s molecular structure and its ability to withstand heat in the cutting zone. Therefore, PCD tools cut cleaner and with less delamination, which are important considerations when cutting any composite.

Tool geometry is also a factor when prepping a rivet hole. He said
some fasteners — Hi-Loks, for example — call for a slight radius at the transition point where a drill meets a countersink. This creates a relief that reduces stress on a fastener, hopefully eliminating the possibility of its head popping off in flight.

“This is less of a concern on composite structures as these provide a little more give than with a metal-on-metal connection,” Rozema said. “In either instance, however, the radius also helps assure that the head will sit perfectly flush with the fuselage surface, something that’s crucial to its laminar flow.”

Dan Thurnau, applications engineer for Amamco Tool & Supply, works with aerospace customers around Wichita, Kansas. He agrees with Win that most cutting tools used to make fastener holes are specials.

“Easily 90% of our stuff is application-specific, which is why it’s so important to develop relationships with the engineers at these companies,” Thurnau said. “That way, we can understand their specifications and what they’re trying to accomplish. We also have the ability to test these solutions in our own lab if the customer so desires, using their material and fasteners. This allows us to fine-tune the tool geometry and coatings and develop the best possible solution for their requirements.”
A fine balance exists between hardness and toughness in carbide inserts.

By Aaron Eller

At first blush, hardness and toughness may seem like interchangeable concepts, but they exist at opposite ends of a continuum that defines indexable insert and solid cutting tool performance, particularly when it comes to carbide inserts. Hard inserts offer greater wear resistance for enhanced performance and tool life in hot cutting environments than somewhat softer inserts do, yet tough inserts can withstand impacts and stressors to achieve high feed rates and DOCs. For any given application, there is an optimal balance of hardness and toughness — and toolmakers have worked diligently to establish metallurgical principles and provide a range of tools that can meet the diverse needs of part manufacturers.

Hardness represents wear resistance, which translates to the ability of a tool to withstand heat during metalcutting. The Rockwell A scale measures the hardness of tungsten carbide, though some specifications translate HRA values to the more familiar HRC scale used to measure the hardness of steel and other alloys. The temperature resistance that correlates with hardness plays a huge role in cutting tool behavior and selection.

In the cutting zone, temperatures can rise above 760° C (1,400° F). Hard carbide withstands and dissipates those high temperature levels and therefore handles the high heat generated in continuous cutting. High hardness levels can make metal brittle, however, which explains why heat-resistant carbide tools tend to chip in situations that produce large amounts of pressure or vibration.
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**Juggling Act**

**Tough Enough?**

At the other end of the continuum, toughness represents pressure and impact resistance, which correlate with the ability of a tool to withstand high feed rates, heavy DOCs and the repetitive impacts associated with interrupted cutting. But in exchange for durability, tough carbide becomes vulnerable to heat, making tough carbide less than ideal for high-speed, continuous cutting.

Both attributes tie directly to the primary elements that make up carbide: tungsten, carbon and cobalt. Tungsten promotes hardness and toughness while carbon boosts hardness, and the combination of the two yields tungsten-carbide molecules. Meanwhile, cobalt, which has a lower melting point than tungsten and carbon, contributes to toughness and intensifies the performance characteristics of other elements. In tungsten carbide, cobalt serves as a binder, essentially glue that holds carbide grains together.

Grain size also can determine the level of hardness and toughness. Hard carbide grades have smaller grains, and tough grades have larger ones. Hard grades need less cobalt binding to hold their grains together, which promotes better heat resistance for longer tool life during continuous cutting than with softer grades. Tough grades include more cobalt binding, which...
gives carbide grains better adherence to help a tool handle pressure and vibration with less heat resistance. Midway between hard and tough, cutting tools made of general-purpose carbide grades can deal with slightly interrupted cuts and offer considerable but not extreme wear resistance.

**No Magic Grade**

The current state of metallurgy means that no magic alloy offers extreme hardness and extreme toughness. Cutting tool performance improvements often focus on two areas: the addition of superalloys or other enhanced materials to cobalt binding and the production and deposition of enhanced coatings to increase wear resistance.
Material development also sparks cutting tool innovation. Workpieces can have powder metals, carbon-fiber-reinforced plastics and stacked and layered materials with fiber directionality that varies from batch to batch. When industries create materials to reduce surface-against-surface wear in medical implants or produce lightweight options for aerospace manufacturing, for instance, cutting tool manufacturers must respond with products that optimize the machining of these new materials. In some cases, existing tools effectively cut these materials. In other cases, the development of new tool technology is required.

Shops that experiment with cutting tools only to experience shorter-than-expected tool life can examine tool behavior to help find and correct the causes of failure. For example, inserts that develop large craters in continuous cutting applications show a lack of wear resistance and indicate the need for a harder substrate or a wear-resistant coating.

Conversely, if a hard grade fractures in a continuous cut, wear analysis should show the need for a tougher tool instead. In these instances of tool fracture or breakage, shops also should evaluate toolholder condition, along with machine tool stability and part setup.

Seco Tools has increased the application range of wear-resistant TH1000 and TH1500 turning insert grades with additional positive and negative geometries, chipbreakers and nose radius sizes.
With increased focus on hard-part turning, shops must decide as well whether to machine before or after a material reaches its hardened state, plus they have to select cutting tools that match the hardness of their workpiece materials. In a “green” state, many materials test at half the hardness they demonstrate after hardening, with obvious effects on tool selection, life and behavior.

Additionally, casehardened and through-hardened materials present two very different hardness scenarios. Casehardening creates a hard surface with potentially softer material underneath it while through hardening produces a uniformly hardened workpiece. In these cases, DOC plays a vital role in tool selection because it determines whether a task requires an insert that can cut harder or softer material.

Cutting tool manufacturers strive to help customers succeed with innovative tools and thorough support for informed tool selection. Successful toolmakers will continue to develop grades, geometries and coatings that effectively handle new workpiece materials and to add performance options for existing materials. Shops that want to ensure they make the right choices between hardness and toughness can benefit from toolmaker expertise to optimize the productivity of their cutting applications.

**about the author**

Aaron Eller is product manager of ISO turning/advanced materials for Seco Tools LLC, Troy, Michigan. For more information about the company’s cutting tools, call 248-528-5200 or visit www.secotools.com.
Making the Grade

A variety of attributes determine the grade of tungsten carbide.

By Alan Richter

Selecting a tungsten-carbide grade for an application is similar to putting together a jigsaw puzzle. “You can’t just look at one attribute and determine the quality is going to be good based on that,” said Rich Deptola, quality and continuous improvement director for TechMet Carbides Inc. “There are quite a few things that fit together that give you a full picture of the grade.”

Founded more than 20 years ago, the Hickory, North Carolina-based company provides tungsten-carbide technology and products to fabricators and OEMs.

Those puzzle pieces include the size of the tungsten-carbide grains, the percentage of binder content, the quantity of lesser alloying elements — or refractory carbides — in the mix and the level of wear resistance.

Against the Grain

The classifications for grain size at TechMet include nanograin, ultrafine, submicron, fine, medium, coarse and extra coarse, Deptola noted. A nanograin measures around 0.2 µm (0.000008”) while an extra-coarse grain is larger than 6 µm (0.000236”). Between those two are ultrafine at 0.2 µm to 0.5 µm (0.000002”), submicron at 0.5 µm to 0.8 µm (0.000031”), fine at 0.8 µm to 1.3 µm (0.000051”), medium at 1.3 µm to 2.5 µm (0.000098”) and coarse at 2.5 µm to 6 µm.

“The technologies that have been developed have been pushing the boundaries of smaller and smaller grain sizes over the years,” Deptola said. As a result, nanograin carbide, which provides a higher level of hardness compared with grades with larger grains, is easier to manufacture than in the past. To minimize grain growth during the sintering process, he added that refractory carbides, such as vanadium carbide and chromium carbide, are added.

Carbide hardness is measured in the HRA scale. At TechMet, the hardness of grades ranges from 81.5 to 94 HRA. At the high end is a grade made with ultrafine grain. Although some grades have a variety of grain sizes, such as ones for producing mining bits, Deptola said grain size is typically uniform in cutting tools. “The goal is to have a nice, homogenous microstructure.”

Held Tight

A binder is also added to the mix to hold the grains together. For cutting tools, cobalt is essentially always used as the binding material, but nickel is one option for suitable applications, such as a wear part in an aggressive environment, Deptola said. “That might see a lot of chemical attack on the part itself, so it would have a nickel binder instead of cobalt.”

The amount of cobalt in TechMet’s grades ranges from 3% to 25%. According to Deptola, the low end of that range is found in tools for cutting wood and composite materials while grades for parts that experience a lot of impact, such as cold heading dies, have the highest amount.

“As you increase the cobalt, you increase the toughness,” he said. “In other words, it’s more resistant to breaking.”

When selecting a grade for cut-
ting tools, Deptola said TechMet’s most popular grade is TMK-320, which has submicron grains, 10% cobalt and a hardness of 91.9 HRA. “That’s the industry workhorse, and that’s typically what people will try first unless they are doing something application-specific.”

For example, TMK-3012 is an effective grade when machining heat-resistant superalloys, he added. That ultrafine-grain grade has 12% cobalt and a hardness of 92.6 HRA. “We’ve had good success in titanium and in Inconel with that,” Deptola said.

Another of the company’s many grades is TMK-22D, which is specifically formulated for being coated with diamond, Deptola noted. The fine-grain grade has 6% cobalt and a hardness of 92.5 HRA.

He emphasized that TechMet continues to focus on customer service, developing high-quality grades and delivering value to customers. “Part of this value comes in the form of lab analysis both dimensionally and metallurgically. We offer this service free to our customers.”

For more information about TechMet, call 877-872-0044 or visit www.techmet-carbide.com.

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To enhance micromachining capabilities, low-speed machines can use spindle speeders.

By Larry Adams

Microscale parts and features present many challenges when machining, not least of which are the high spindle speeds required to reach acceptable cutting speeds and cut rather than rub workpieces or break tools. A lot of shops have robust, accurate equipment that has served them well through the years but lacks adequate spindle speed.

Many machines are built for torque, not speed. A solution might be a specialized micromachine or a premium machine with a high-speed spindle, but a spindle speeder is another option.

Spindle speeders amplify speeds for many jobs that need small-diameter tools, often less than 6 mm (0.24”). Speeders multiply spindle speeds by several times while maintaining the torque of a machine.

“The biggest problem with (using) small tools is that the shop can’t run them fast enough,” said Steve Bryan, owner of Bryan Machine Service Inc., Huntington, Indiana. “Spindle speeders can take an older machine and increase that up to 15,000 to 40,000 rpm. The older machines have a new life.”

Spindle speeders are suitable for myriad shank types, including small tapers that are lightweight and precisely produced for balance and reduced total indicator runout.

Because higher-end spindle speeders are compatible with automatic tool changers, it is easy to do multiple setups on one machine. For example, in addition to producing and selling its line of VRT spindle speeders, Bryan Machine Service operates a machine shop. Sitting amid a variety of higher-tech equipment are two 50-taper, 7,000-rpm machines. One job required machining runners on a large plate, as well as microfeatures.

“With the spindle speeder,” Bryan said, “we can put on a ¼” (3.18 mm) or a ⅛”-dia. (1.59 mm) tool on that great big machine and run it at 30,000 rpm.”

Need for Speed

Faster spindle speeds can help impart fine surface finishes and reduce burrs, chatter marks and other cosmetic blemishes. Carbide cutting tools also require higher spindle speeds for best results.

The trick is to run at the right surface feet per minute, which also can be expressed in surface meters per minute. Essentially, the faster a spindle turns or the larger the diameter of a tool is, the higher the sfm is based on the formula in which sfm equals (rpm times tool diameter) divided by 3.82. For instance, a 0.5”-dia. (12.7 mm) endmill running at 1,146 rpm achieves a cutting speed of 150 sfm (45.72 m/min.) while a 0.05” (1.27 mm) tool must run at 11,459 rpm to cut at 150 sfm, and a 0.005” (0.127 mm) tool needs an 114,592-rpm spindle speed to reach 150 sfm.

But those numbers are just the start. Different materials cut best at specific speeds, and each tool supplier suggests cutting...
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speeds for its tools. “When machining material like aluminum, the tool manufacturers might recommend a surface speed as high as 350 sfm (106.68 m/min.), and if you wanted to run a 1 mm (0.039”) carbide drill, you would need 35,000 rpm to reach that surface speed recommendation,” said Mark Johnson, manager of OMG North America, Post Falls, Idaho.

The company offers the MO series of spindle speeders, including the MO10.HS for micromachining applications with a maximum output speed of 35,000 rpm.

Meeting Challenges

If a machine can’t deliver the spindle speed to meet the required cutting speed, mechanical or cosmetic issues may occur, such as chatter marks.

Even something as common as clogged flutes is problematic, said John Young, president of Eltool Corp., a Mansfield, Ohio-based supplier of spindle speeders, right-angle spindle heads and live tooling. “People who run aluminum at lower rpm just weld the whole chunk of aluminum right onto the cutter,” he said. “That is why it is so critical to get the surface feed up, so the tool doesn’t stay in the material long enough to weld itself onto the part.”

Larry Adams is a freelance writer who has written extensively about manufacturing. Contact him at AdamsEditorialServices@gmail.com.
High speeds are key but challenging to achieve. A machine running at or near its maximum rpm can have balance and runout issues, generate friction-caused thermal expansion that burns out bearings and gears and potentially distort tools during operation.

Spindle speeder suppliers, however, have developed methods to overcome many of these problems. For example, when Bryan made his spindle speeder turbine system, one of his must-haves was a short distance between a spindle and workpiece.

“The further you get away from the machine spindle,” he said, “the more vibration you get.”

Eltool’s speeders are powered by high-pressure coolant as opposed to running a machine tool with a spinning spindle that has additional components installed, such as a torque arm.

“In our case,” Young said, “we don’t need a torque arm. We don’t need the spindle on. We just need the coolant on to run through our ball piston motor, creating very high rpm with very little reciprocating weight for very smooth, vibration-free machining.”

Having good concentricity is important when running at high spindle speeds, Johnson said.

“Anytime you add another element between the cutting tool and the machine spindle, there’s the possibility to have a greater amount of runout,” he said. “The spindle speeders that we produce have a high accuracy between the machine spindle taper and the output spindle of the speeder. The maximum runout allowance is just 1 µm, or 0.000039”. Often the resulting runout is significantly less.”

**Speeder Types**

Spindle speeders and high-speed attachments come in various types and styles, as well as power.

VRT spindle speeders have a built-in regulator that adjusts pressure to provide the right amount of power.
sources. Mechanical speeders are driven by a machine spindle and increase its speed as a fixed ratio. Electric, air turbine and coolant-driven attachments are powered by their respective sources of energy.

The mechanical type utilizes a planetary gearbox to drive the speeder and convert every spindle rotation into a higher speed. Electric models typically employ 350W, DC brushless motors to generate up to 80,000 rpm. Other kinds use compressed air or high-pressure coolant to drive a spindle. They all have benefits and best uses.

Mechanical spindle speeders include those made by OMG North America.

These tried-and-true devices are built with high-quality bearings and gears, so they have a “very positive drive-through gearing and a very rugged construction,” Johnson said.

The highest-speed models feature two planetary gears with ratios of 1:8 for high transmission and high power ratings. The speeders are available with shanks for all machine spindles and have the option of through-tool coolant to be supplied through a machine spindle. A spindle is supported by a set of pre-loaded ball bearings with oblique contact that ensure strength and rotation precision of less than 0.01 mm (0.0004”).

Bryan Machine Service’s VRT high-speed spindles have variable-speed adjustment and utilize air turbines, which do the actual turning instead of the machine spindle. The spindles feature an adjustable built-in regulator to maintain spindle speed as the cutting load varies.

“As the cut gets heavier,” Bryan said, “then it supplies itself with more air to adjust to the load.” Operators adjust spring tension internally on the regulator via a button on the side of the spindle.

The unit also features an autocoupler that originally was designed for a Haas vertical machining center. The coupler is adaptable to most CNC machines, including lathes and grinders. When not in use, it is closed on each side to seal it from debris. An air wash feature blows away coolant before it can enter the spindle during the coupling.

“The power has not changed,” Young said. “We just generated more speed by shifting into fourth gear.” The speeders also can be adapted to lathes and are available in-line or as right-angle heads.

Eltool’s Titespot spindle speeders are powered by a positive displacement ball piston motor. Coupled to a high-pressure coolant system, this results in machining center spindle speeds of as much as 45,000 rpm.

Titespot speeders, which are available in common taper sizes, operate at 13.8 to 137.9 bar (200 to 2,000 psi) depending on the load. The standard speeder delivers 900 rpm per 3.8 liters (1 gal) of coolant flow. With a 37.9-lpm (10-gpm) coolant delivery system, this equates to 9,000 rpm. But with the addition of a modular 1-5 planetary gearbox, spindle speed increases to 4,500 rpm per 3.8 liters of coolant flow. So the same 37.9-lpm system now delivers 45,000 rpm.

“People who run aluminum at lower rpm just weld the whole chunk of aluminum right onto the cutter.” Bryan said. “After thousands of cycles, it gets to be a problem eventually. This helps solve that problem.”
Have you recently tried to hire a machinist, a welder, an electrician or any other type of craftsperson? If so, you likely believe that it is harder than ever. Metalworking professionals are in a difficult situation, and it does not take a Nobel Prize-winning economist to recognize that this is a classic Keynesian problem of supply and demand.

Multiple media outlets and government sources would have us believe that these circumstances are a result of record-low unemployment and older workers leaving the market. However, positive economic conditions — depending on how the coronavirus continues to play out in the months ahead — and retiring baby boomers simply have exacerbated a situation that has existed for a long time. The industry just is not creating an adequate number of personnel to support the need.

Demand for craftsmen and craftspeople is high. Countless openings for toolmakers, machinists and every other type of craft are listed on job boards. Talk to any manufacturing operations leader, and he or she will confirm the demand. Listen to news reports, and you will hear small-business owners discuss limiting business expansion because they do not have access to enough skilled labor. The problem threatens the economy and industrial machine that made the United States the wealthiest country in the world.

Finding Solutions

So how do manufacturers fix the problem?

First, they need to strengthen vocational education programs beginning in high school. Industry-led training and vocational programs are the solution to the shortage of workers.
Business leaders must commit resources to support vocational education in communities and encourage government representatives to appropriate funding.

Crafting Craftspeople

schools. Having high-quality equipment and well-developed classrooms that represent real-life manufacturing is important, and industry should push government leaders to adequately fund the programs. Also, business leaders must commit resources to support vocational education in communities and encourage government representatives to appropriate funding.

Money for high school vocational programs is valuable, but it does no good to have well-funded but poorly attended programs. Schools and businesses must start to promote the benefits of an effective vocational education and well-developed skills. Students should visit advanced manufacturing facilities, talk to employees and be given an opportunity to experience industrial elements like machining, automation, pneumatics, hydraulics and electronics. Essentially, students need to be allowed to play and experiment with these areas in an educational setting to help develop interest.

High schools currently are not capable of supplying enough skilled workers to the market, so manufacturers rely primarily on programs found at community colleges and postsecondary vocational schools to prepare young people for entry into a skilled trade. As a result, leaders need to aggressively fund these programs. Classrooms must have the same advanced equipment as manufacturing facilities, and lessons should present actual scenarios experienced in factories. Accomplishing these objectives requires an assertive approach to funding and a commitment from business to support the programs.

Promoting and strengthening vocational programs is a shared responsibility. Government is unable to improve the situation alone; vocational programs will flourish only when industry takes the lead. I have heard some business leaders deride local vocational programs about poorly equipped classrooms, low attendance and inadequate curricula. These are the same leaders who do not participate in program development opportunities and never provide feedback to people who determine funding. Vocational programs work when industry provides guidance to educators.

Foundation of Success

To foster important, long-term relationships, communication and guidance between leaders of industry and education are the foundation of success. For a vocational program to succeed, students and instructors must be able to experience actual manufacturing environments.

Apprenticeships are the most traditional way for young people to gain work-related knowledge outside a classroom, but too few of these programs are offered to supply the number of needed workers. Industry must become more aggressive and creative in approaching training programs. The best
vocational programs will not create craftspeople prepared to add value unless industry provides opportunities for students to learn.

Apprenticeships, co-op programs and internships developed with vocational schools are the most effective, efficient ways to train future employees. At Mitsubishi Hitachi Power Systems Americas Inc., we have been extremely successful with our internship program. We work with local vocational schools to recruit welding and machining students as interns.

While completing academic requirements, interns are assigned to work with our most skilled craftspeople. Interns study theory and get the opportunity to apply what they learn. Benefits are numerous. Students are paid to experience a real production environment. They learn company methods and culture without the pressures of production. When they become full-time employees — we have a 100% retention rate — they are often more productive than people new to our culture and methods. We pay the tuition, and interns frequently receive academic credit for time spent at our shop. Interns are also our best recruiters because they connect us to other students and craftspeople who fit well with our culture.

Industry-led training and vocational programs are the only viable solution to the shortage of personnel. The business sector must provide guidance and leadership to people in education and government to build strong vocational programs. Industry, not the educational system, needs to be on the front lines generating interest and drawing young people into trades. Manufacturers should work with educators to create effective curricula and should open shops to students so they can get real-life training. To succeed, we in industry must lead students, educators and government representatives through our direct involvement.

Christopher Tate is engineering manager of advanced manufacturing engineering and machining at the Savannah, Georgia, facility of Mitsubishi Hitachi Power Systems Americas Inc., Lake Mary, Florida. Contact him at chris23tate@gmail.com.
Using buckets, barrels and hoses to manually replenish coolant in machine tools doesn’t cut it in this tight labor market or when a parts manufacturer wants to perform lights-out machining. That was the case for Precision Tool Technologies Inc., said Jim Goerges, president of the Brainerd, Minnesota, company.

“Like most companies, we were part of that 5-gal. (19-liter) bucket brigade,” he said. “It was always a pain in the butt.”

Goerges started PTT in 1993 with four products and now has about 6,000. The company does some job shop work but focuses primarily on the prescription eyewear industry.

“We don’t make lenses or frames,” he said. “We help the wholesale optical laboratories edge the lens to insert the lens into the frame and to put the prescription into the eyeglass lenses.”

That manual approach, Goerges said, meant that coolant wasn’t replenished on a timely basis. Or workers would forget to do it, and a machine would run out of coolant, smoke, break tools and potentially crash. He also reasoned that his...
qualified labor was distracted from more important tasks when tending to coolant replenishment.

An additional problem was over-filling a machine with coolant. “That happened all the time,” Goerges said, “where you bring coolant to the machine, you forget how much was in there or the sight glass wasn’t working because there was too much sediment in the tanks, and — lo and behold — you flood the machine.”

When the company decided to acquire machines that could produce parts in one setup or two at the most, automation was required for unattended machining because PTT didn’t want to add workers for the second and third shifts, he said. He calls unattended production “168 manufacturing” due to 168 equaling seven days a week times 24 hours a day.

Goerges tried with no luck to purchase a shopwide system that automatically would deliver mixed coolant with unique top-off concentrations. It seemed that there was no commercially available option, so he built one. The system needed to monitor all the machine sumps and accurately provide customized coolant percentages and de-foamers to machines.

“I didn’t appreciate at the time how difficult it really was,” he said. “How do you create this thing so it is predictable, accurate and repeatable?”

Goerges began by bringing a hose with a pressurized spigot to a machine. “The machinist just needs to turn it on and turn it off,” he said. “It sounds simple — problem fixed. But the machinists are multitasking, get interrupted and flood the floor. That didn’t work.”

Another concept was similar to an air gun in which a lever activated coolant flow and releasing the lever stopped the flow.

“Problem solved, right?”

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Goerges said. “No, they put a rubber band around it because their thumb or hand hurt when they pulled the lever. So that wasn’t a good way.”

Adding to the challenge was the coolant foaming that occurred, especially when PTT performed high-speed machining at spindle speeds up to 80,000 rpm. He explained that excessive foam can shut down a machine or deplete it of coolant by causing a leak.

Starting nearly seven years ago, PTT engineered an operation that uses a state-of-the-art control system with motor-commanded pumps and flow meters, Goerges said. The system consists of a centralized pumping station, a controller, distribution manifolds and a sensor that drops into a machine tool sump to monitor the coolant level and temperature. PTT’s in-house system is connected to 14 machines. However, the modular system is scalable up to 120 machines and can deliver as much as 21,804 L (5,760 gal.) of coolant a day.

He ran the initial beta unit for 4.5 years to vet the process. The goal was to run about 50,000 hours around the clock without realizing any failures, such as mechanical or electrical ones.

With its smart sensors, the system is Industry 4.0-compatible, he said.

“I can take a glance of the reports that come off this coolant system,” Goerges said, “and in 10 to 15 seconds I can access how productive we were for the last night, last week or last two weeks.”

In addition, human-machine interface visualization easily allows employees to see the bigger picture of what CNC machines are producing.

After making sure the system offered the required longevity, PTT decided to market the product to other manufacturers as the FullShop automated coolant delivery system. The company recently installed a system at a nearby location of another manufacturer, and prospects regularly visit these facilities to see the equipment operate, Goerges said.

He said PTT’s product development for the prescription eyewear industry has enabled the company to have the mentality of an OEM.

“We are now an OEM for automated coolant delivery with this machine,” Goerges said. “I know we are truly helping other shops with their profitability with this equipment and welcome people to reach out to review the ROI, which has proved to be very real.”
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To predict, detect and react to problems with machining processes within milliseconds, Sandvik Coromant Co., Fair Lawn, New Jersey, developed CoroPlus ProcessControl. At the same time, the monitoring system can collect data to correct and improve inefficiencies in a process.

“The main functionality is it automates data collection and analysis,” said Jeff Rizzie, director of digital machining. “It gathers the data directly from the machine tool and basically makes a decision on whether your machining process is stable or needs to be adjusted.”

A collision detection function determines when a machine has a collision and then quickly shuts down the machine. The function is not application-dependent. If a crash occurs, traditionally a machinist hits the stop button. But by the time that is performed manually, the damage is done, he said.

A tool guard function works similarly but in more finite terms. Rizzie said it looks for broken or missing tools and detects tool force overload to decide when a worn tool needs replacement. The function uses a combination of machine data, such as power and drive data, and data from a vibration sensor mounted on a spindle nose or turret.

“What we’re looking for are patterns or anomalies,” he said. “Like any kind of data analytics, we’re looking for those patterns that will tell us if everything is running properly or if there is a possible tool breakage situation.”

Data logging records profiles of tool behavior during machining, said Niels Bredick, senior solutions specialist of process control. Analyzing tools can extend their lifetimes. Using individualized sensor profiles and comparing them helps to better understand a problem with a process. Data can be used to replace a tool before something bad occurs, potentially saving thousands of dollars.

“Our equipment can be applied to any type of machine tool or robotic- or machine-type movement,” he said.

Bredick said the system increases tool life and reduces cycle times and scrap.

“What ProcessControl does is very, very powerful and provides tremendous value,” Rizzie said. “The real interesting part of ProcessControl is not what it does today but what it does in the future. What can we do with that data?”

The performance data the application gathers provides insight into how machines function as planned versus as optimized. He said the long-term objective is to build a knowledge base for engineers.

“You’re taking data, using it, collecting it and analyzing it for future use,” Rizzie said. “It can be used to find flaws in the process of using a tool as well. You can find areas of early chatter before you ever feel it.”

The size of the company, batches or components doesn’t matter, Bredick said. The customizable system can diminish damages, reduce downtime costs, provide process security and boost productivity.

For more information about Sandvik Coromant, call 201-794-5000 or visit www.sandvik.coromant.com.
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