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Metrology Matters It's Not a 'Necessary Evil'

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Columns & Departments

- 4** Chasing Threads
- 6** About Your Business
- 8** PM Business Index
- 44** Products
- 47** Ad Index
- 48** Last Word

Additive Insights

- 10** Induction Systems Specialist Applies AM to 3D Print Copper Coils

Tech Briefs

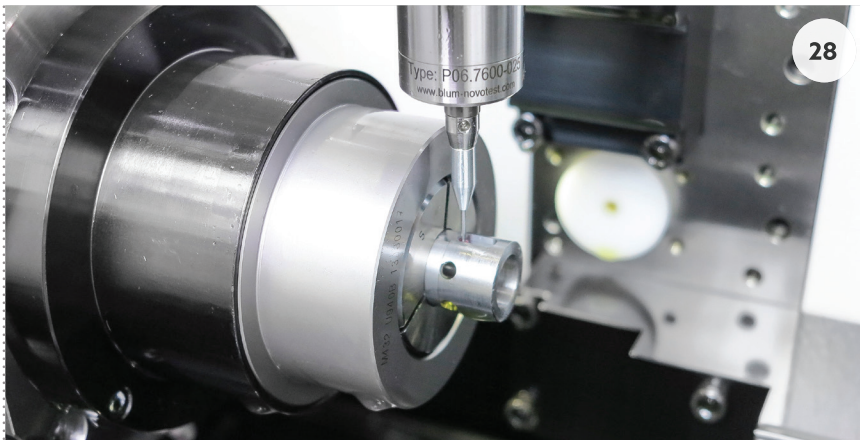
- 16** Compact Rotary Transfer Technology New to the U.S. Market
- 18** Can AI Automate Automation?

Parts Cleaning

- 32** Optimizing Parts Cleaning With Sintered Stainless Steel Membrane Technology
- 34** Joint Project Proves Suitability of Snow Jet Cleaning Technology

ABOUT THE COVER:

Don't look at inspection equipment as a necessary evil. As the article on page 28 suggests, embrace new industrial metrology technology as shown at IMTS 2026 to increase your manufacturing operation's profitability.



Features

- 22** **Unleaded Steel Leads the Way in Machinability Test**
Even in conditions better suited to leaded 12L14 steel, a domestically produced non-leaded 1215 steel showed stronger results in turning and drilling, with comparable results in grooving.
Contributed by Evan Doran
- 28** **Metrology Matters**
Don't look at inspection equipment as a necessary evil. Embrace new industrial metrology technology as shown at IMTS 2026 to increase your manufacturing operation's profitability.
By Derek Korn, Editor-in-Chief



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PRODUCTS ASSOCIATION

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- 38** Tool Geometry: A Key Principle of Reliable Automated Production
- 40** A Conversation with Federated Insurance: Why Mental Health Matters in the Workplace
- 43** Craftsman Cribsheet No. 151: G-Code Macro Programming Flow Operators by Controller

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A Few IMTS Pre-Show Booth Highlights

Writing for the event's "Show Daily" newspaper enables me to find out what new technology will be at the show and how it will be presented.

➔ I and other editors for Gardner Business Media brands help write the articles that appear in the five free editions of the IMTS Show Daily newspaper available at the event. In short, these highlight exhibitors' new technology and interesting ways they'll be presenting it at the show. For IMTS 2026, I contributed 20 such articles, which I'm pretty sure is a record for me.

So, I figured I'd share some insight about what I've learned about a handful of those exhibitors which are geared toward my *Production Machining* audience. One I highlight in the Tech Brief article on page 18 about Turkish machine tool builder Kestech, which aims to make inroads here in the States with cost-effective vertical-trunnion rotary transfer machine platforms such as its Multivexa. Another is Caron Engineering's "shop floor on the show floor" mentioned in my "Metrology Matters" feature on page 28.

Here are a few more from those 20 articles:

ALLIED MACHINE AND ENGINEERING — This company is featuring a "boring automation demo" worth checking out. Automatic diameter adjustments for Allied's AutoBore boring tool are based off of part measurements taken by a Blum-Novotest touch probe. The probe then sends a message via a radio controller connected to the machine, which in turn sends that signal to the tool. At that point, the AutoBore adjusts itself based off the measurement data prior to making the next cutting pass. Attendees can participate in a demo in which they can type in the adjustment they want to see, and the AutoBore adjusts automatically.

EDGE TECHNOLOGIES — Why not automate bar-feeder automation? It makes sense to use a robot to load heavy material into bar feeders used to automatically advance bar stock into turning centers. Edge Technologies has partnered with KUKA to display an FMB SL110 short loader with a KUKA robot to demonstrate autonomous material handling.

HORN USA — Live machining demos are a hallmark of IMTS. For the first time at the show, Horn USA features a 38-mm Nomura DS NN-38JXB Swiss-type CNC lathe to help demonstrate the variety of precision cutting tools the company offers. Here, we're talking turning, micro milling, grooving, contouring, chamfering and broaching tools followed by polishing passes using its monocrystalline diamond (MCD) tools — all to create giveaway whisky bottle toppers.

INDEX CORP. — The Traub MS12-4 machine concept merges multispindle production with sliding headstock operation. Featuring four main spindles, four tool turrets, two or four counter spindles and up to four Flex-WT flexible tool carriers, the Traub MS12-4 offers an alternative to multiple Swiss-type machines for manufacturers of small parts in high volumes.

MARUBENI CITIZEN-CINCOM — At IMTS 2024, Marubeni Citizen-Cincom unveiled its tooling and accessory workshop for the first time at the show. In addition to seeing MCC-designed and manufactured ancillary equipment running on machines in the booth, the workshop enables attendees to learn more about those specifically engineered accessories that can boost machining efficiency and capabilities for Cincom and Miyano machine models. It was so successful that the company has incorporated it again into the booth and centered it in the middle as a walk-around counter.

ZOLLER INC. — Making its world premiere at IMTS 2026, the Zoller MicBox fully automates indexable insert handling on milling tools, including tool identification, insert indexing, rotating, flipping, replacement and fastening-screw changes. With optional AI-supported WearCheck, the system evaluates each cutting edge and determines whether an insert should remain in use, be indexed or replaced.

Be sure to pick up free copies of the Show Daily when you're at the show to see other such happenings at the event. Looking forward to it as always. **PM**

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Reflections From the Shop, 25 Years After 9/11

➔ Sept. 11, 2001 — I arrive at the plant even earlier than usual. I have two important customer meetings and plan to check out a little sooner than normal; I'm joining my friend Brian Tollakson after work at Milwaukee's Miller Park to see my beloved Brewers take on the St. Louis Cardinals.

My plans have changed in recent weeks. I was supposed to travel to Washington D.C. today, but switched my schedule to accommodate two VIP visits to the plant.

Mick Anderson, president of Loves Park, Illinois-based metal stamper Modern Metal Products, shows up right on time for a meeting and tour. Unbeknownst to either of us, the flight path of an airliner that lifted off from Boston's Logan Airport an hour before is about to change history.

We tour the plant. He's looking for a new phosphate finisher for the automotive seating components he manufactures. I'm aggressively trying to fill our shop with new customers. It's a perfect match.

Passing 16 automated plating and finishing lines, I describe each in detail. We walk through our specialty plating department where a seasoned crew expertly processes small batch, unique orders by hand. Down the west stairs we descend into the second largest industrial pre-treatment operation in the world. He's impressed.

Past the metal storage locker that houses our precious metals, we travel back up the stairs to the main floor. I'm quickly reminded that the tour through our 250,000-square-foot plant takes a while.

We approach the back of the warehouse where I depress the button to call the elevator that will take us up to our employee training room. As the door opens, I'm approached by our maintenance manager.

"A plane just crashed into the World Trade Center in New York City," he tells us.

My response will give me chills every time I think of it for the rest of my life. It's just six syllables. "Osama bin Laden," I say, recalling a July 1998 *Reader's Digest* article entitled "This Man Wants You Dead." That article has haunted me ever since reading it and when I hear the news about the World Trade Center I just know he's behind it.

We complete the tour. Mick departs and I settle into my office to check my go-to news sources. My wife calls. She's at home with our 19-month-old son watching the carnage unfold in real time on cable news. By now a second plane has struck the South Tower at 2 World Trade Center and yet another has slammed nose first into the Pentagon.

The unfathomable news continues streaming in and it occurs to me that, but for the important meeting I just finished and the one scheduled for 1:00 p.m. this afternoon, I would have been in Washington D.C. I'll learn later that my friend and fellow trade association member Jaimie Malizewski, president of Milwaukee's Reliable Plating Works, traveled there for the same meetings I was to attend, and saw the plane hit the Pentagon from his seat on the commercial plane ferrying him to D.C. Likely, I would have been on the same flight.

But I'm here for my big meetings. One down and one to go. The next one is scheduled for 1:00 p.m., but with everything going on, there's no way Todd Teske is showing up. He's got more important things to worry about as the world melts down.

My evening opens up, too. Late in the morning, baseball commissioner and fellow Milwaukeean Bud Selig announces that all Major League Baseball games are cancelled. I'm relieved. No longer in a baseball mood, what I want more than anything is to go home and hug my family.

It's 12:58 p.m. and I'm standing in the front office, pondering the day's events and attempting unsuccessfully to make any sense of what's happening.

The front door opens and in walks Todd Teske.

"I didn't think in a million years you were showing up today!" I say.

It's a good meeting on a dreadful day. Todd walks back out the door he entered an hour before.

I'm spent. After two high-stakes business meetings, watching the country I love attacked by evil forces, I'm emotionally drained.

I cut out a bit early. When I arrive home, I sit in shocked silence for hours, flipping news channels. The video of people screaming as they run down the streets of New York City, away from the collapsing towers, rolls again and again.

Exhausted, at 10:00 p.m. I retire for some much-needed sleep. It doesn't come. **PM**



CONTRIBUTOR:

MATT KIRCHNER is the host of the TechEd podcast and president of ATS/LAB Midwest.

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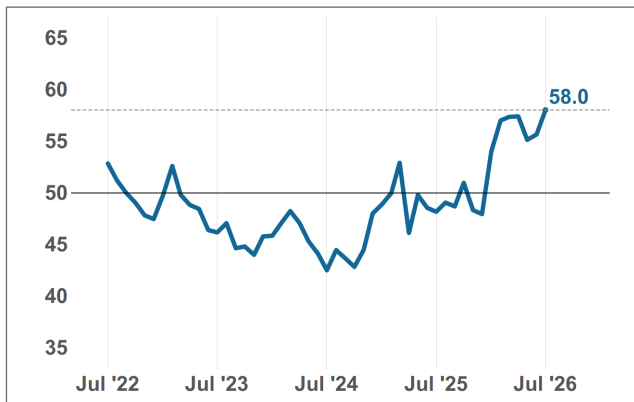
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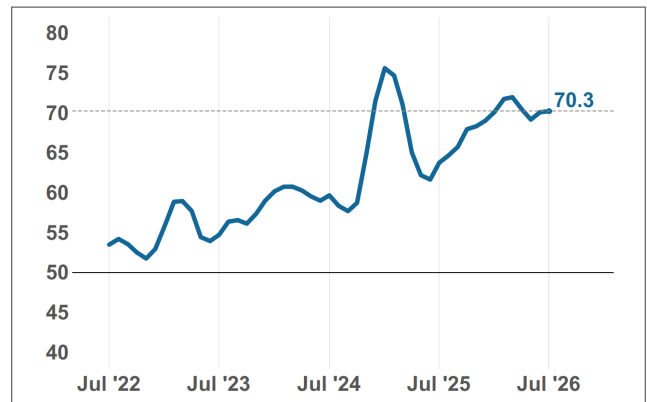
Precision Machining Index Surges in July for Seventh Month of Expansion

PRECISION MACHINING BUSINESS INDEX



The Gardner Business Index (GBI): Precision Machining is an indicator of the current state of precision machining activity based on survey responses regarding new orders, production, backlog, employment, exports and supplier deliveries. Over 50 is expansion, and under 50 is contraction.

FUTURE BUSINESS INDEX



The GBI Future Business Index is an indicator of the future state of the precision machining market from industry respondents regarding their opinion of future business conditions for the next 12 months. Over 50 is expansion, and under 50 is contraction.

GBI COMPONENTS SCORECARD

	Change vs	
	Month Ago	Year Ago
Supplier Deliveries	▼	▲
New Orders	▲	▲
Production	▲	▲
Employment	▲	▲
Backlog	▼	▲
Exports	▲	▲

The GBI Components Scorecard reports the monthly change rate of primary composites market factors contributing to the overall monthly index reading.

READING THE SCORECARD:

Color indicates where a component value falls relative to 50 for the current month. Green indicates expansion; red indicates contraction.

Shade indicates a value's distance from 50; the darker the shade, the further from 50.

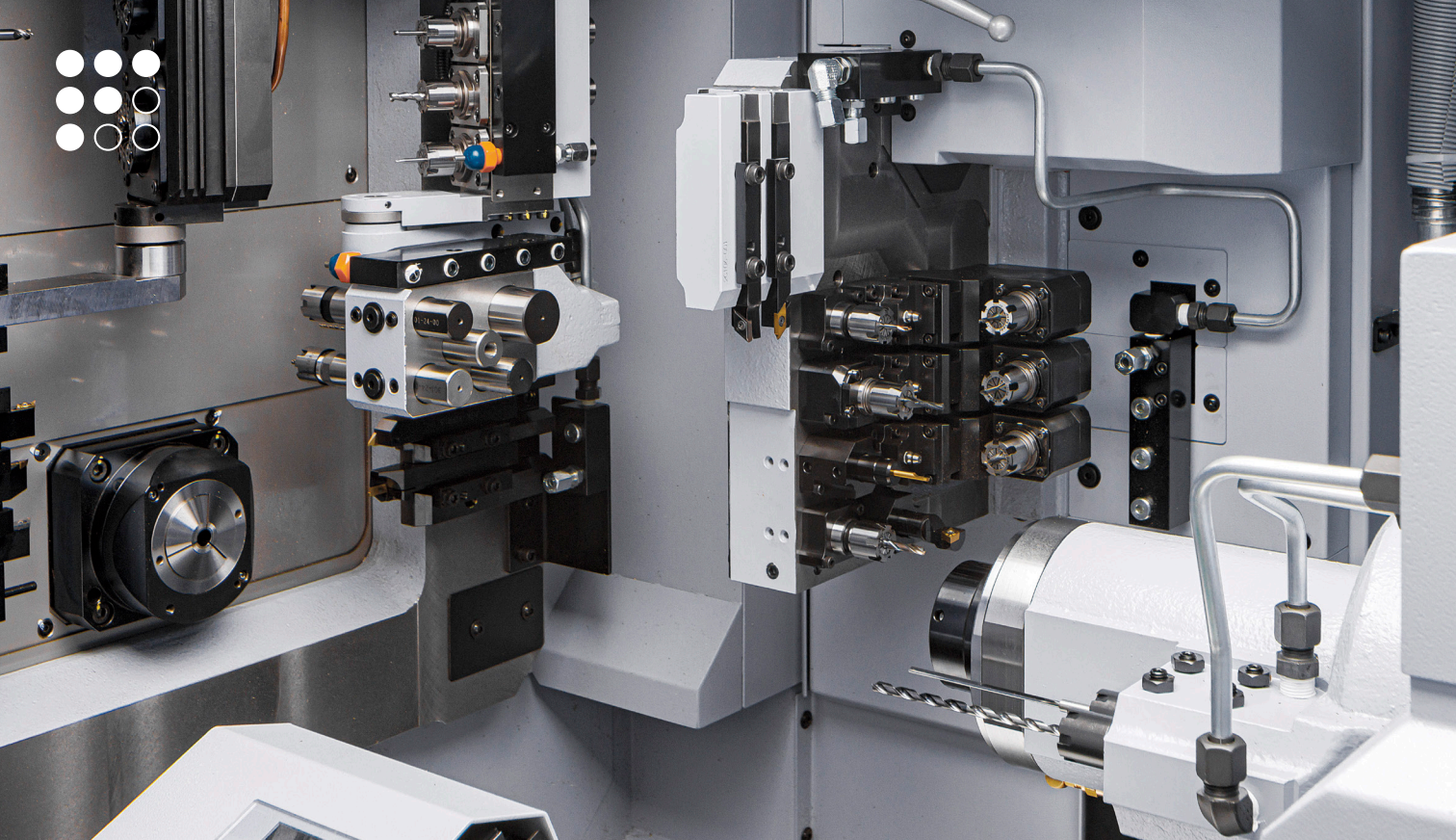
Direction indicates a value's change versus the previous time period. Pointing up is always better.



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INDEX

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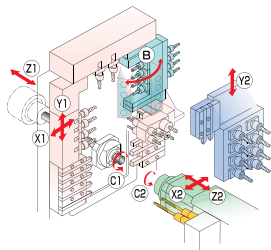


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STEPHANIE HENDRIXSON
EDITOR-IN-CHIEF
Additive Manufacturing Media

Induction Systems Specialist Applies AM to 3D Print Copper Coils

Tucker Induction's additive journey began with a desktop extrusion 3D printer, and has led to laser powder bed fusion of complex copper coils for induction heating applications.

➡ “We failed a lot to get to where we are right now,” says Josh Tucker, head of purchasing at Tucker Induction Systems, a Michigan-based manufacturer of induction coils and related equipment. But where the company is now — at the point of manufacturing many of these complex copper coils additively — has made the failures worthwhile.

When I first visited its Shelby Township facility back in 2022, Tucker Induction Systems was just beginning on its additive journey. As a Project DIAMOnD participant, the company had received a free Markforged desktop 3D printer and was beginning to find success making tooling, prototypes and some functional parts using this machine.

But the Holy Grail that seemed all but out of reach at the time was to be able to print copper coils, the components that are central to any induction heating system. Technology for 3D printing with copper was just gaining traction, and there was no obvious solution for how to work with the material.

Now, three years later, Tucker Induction has overcome that hurdle and is in ongoing production with 3D printed copper induction coils using laser powder bed fusion (LPBF).

Challenges with Manufacturing Induction Coils

Induction coils apply heat in a specific pattern and are matched to the part they are meant to process; they can



↑ **Tucker Induction manufactures complex induction heating coils like this one. In the past, coils were always assembled from various copper parts — but now, the company can 3D print the most complex.** Source: Tucker Induction Systems

be as simple as a single spiral or as complex as the application requires.

“Everything is placed for a specific reason,” Tucker says of coil designs.

Copper is the chosen material for most induction coils because of its electrical and thermal conductivity, which makes for efficient heating of both the coil and the workpiece. But to prevent overheating, most coils are constructed from tubing to enable pressurized water cooling throughout.



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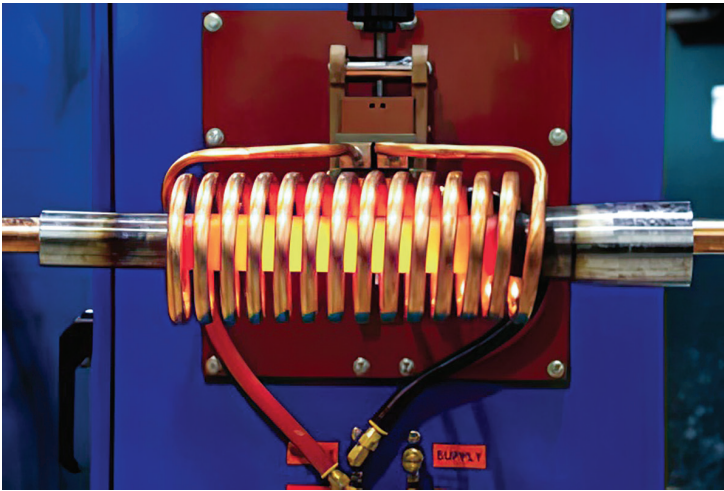
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↑ Another advantage of 3D printing is that multiple coils or components can be made at the same time, often while the machine runs unattended over nights or weekends. Source: Tucker Induction Systems

Conventionally, coils are produced through a combination of machining, bending and brazing. Even a simple two-spiral coil can be as many as 15 parts and require multiple brazed joints. These brazes are the primary points of failure for these tools. And because most turns and joints occur in the head, 90% of induction coil failures happen in their most complex regions.

“3D printing gets us past the braze joints — the weakness,” Tucker says. “We can avoid those joints and make the whole thing stronger.”

The Journey to 3D Printing with Copper

But getting to the point of a one-piece copper coil construction was a process. Tucker had been watching 3D printing technologies closely waiting for just the right machine, when he met with Nikon SLM Solutions at a trade show. Tucker Induction Systems ultimately partnered with the company, and spent several years developing the coil application with parts being printed in Germany.

“We challenged SLM right out of the gate,” Tucker says, recounting the complex coil head that was chosen as the first prototype.

→ Josh Tucker (foreground) and Micah Black facilitated the adoption of laser powder bed fusion (LPBF) for the production of copper coils at Tucker Induction. The machine offers a build volume of roughly 12 x 12 x 13", large enough to print most of the induction coil heads that the company makes.

Source: Additive Manufacturing Media

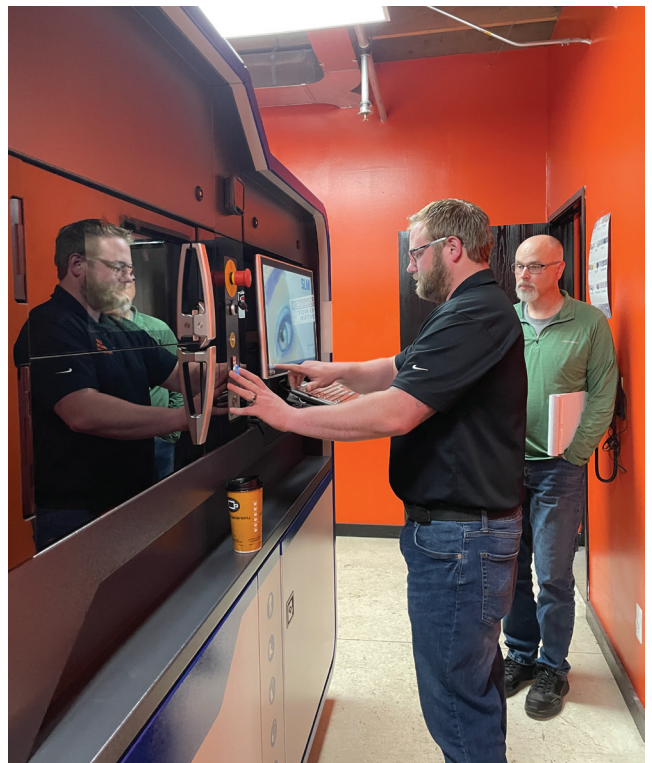
“We picked the most difficult thing to start with,” adds Micah Black, chief engineer. “At first they said ‘no.’”

But Tucker Induction turned to its experience with desktop 3D printing. After proving that its Markforged printer could successfully produce the geometry in polymer, the company persuaded Nikon SLM Solutions to attempt it. With some tweaks and compromises, the copper coil was successfully 3D printed — and set Tucker Induction Systems off on a new journey.

Other early successes included a coil provided to a particularly enthusiastic customer that helped with testing. The client evaluated the coil’s induction, pressure, flow and dimensional accuracy, and then ran the part in its induction process to provide feedback. The 3D printed coil not only proved viable in the process, but the customer also noticed significantly improved coil lifespan, most likely as a result of eliminating the brazed joints as well as the

material — the copper alloy used in the LPBF process has greater rigidity than that used for conventional coils.

In 2023, Tucker Induction Systems took delivery of its first in-house metal 3D printer, the Production series SLM 280, and began additively manufacturing many of its copper coils at its Michigan facility.





← Tucker Induction Systems' Nikon SLM Solutions Production Series SLM 280 is housed inside its own room within the facility. The system is equipped with internal powder handling and other safety features to reduce operator contact with the material.

Source: Additive Manufacturing Media

implement 3D printing. Chief among them was rethinking the design of induction coils to make better use of the technology.

A significant portion of the company's work is actually repairing damaged induction coils, not making new ones. One

Adapting to Additive Manufacturing

Despite promising early successes, there were some lessons learned as Tucker Induction Systems began to

challenge in implementing 3D printing was therefore not developing totally new coils, but producing replacement additive coils to suit an existing application. →

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“For a coil that’s already running, you can’t change what the outside looks like,” Black says. That means 3D printing these coils is a compromise between maintaining the geometry needed for the induction process and leveraging what LPBF can do.

“We bend the rules — a lot,” Tucker admits, but the strategy has been largely successful.

The water-cooling channels common throughout induction coils are the primary challenge. Tucker Induction learned early on that a self-supporting geometry would be needed, which ruled out round channels. Instead, the company designs channels with rectangular, triangular or diamond-shaped cross-sections for its 3D printed coils. The change from traditional round channels can impact the flow of the coil, so many designs are commonly 3D printed on the Markforged machine first for functional testing before moving into copper.

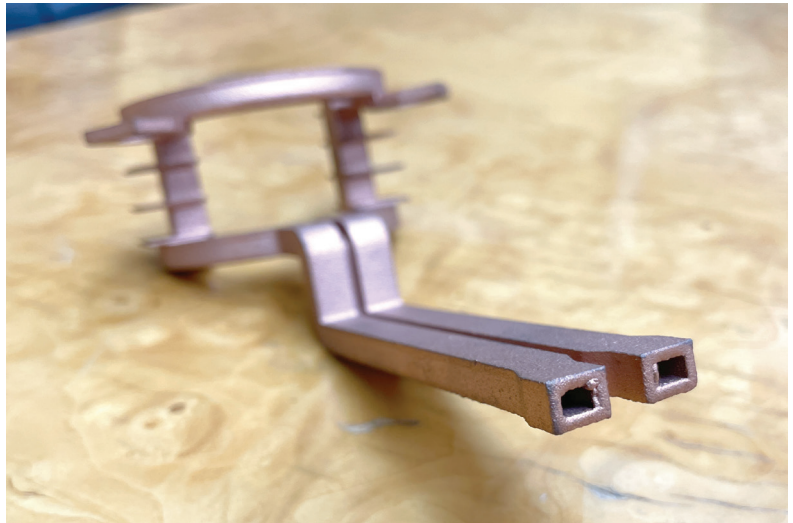
For new coils, additive manufacturing is always a consideration but tends to make the most sense for the most complex coils, where the process streamlines what would otherwise be a multistep, complex process.

But even 3D printed coils still require finishing and joining to the base plate, just like conventional ones. “There is still a fair amount of craftsmanship and finesse work involved,” Tucker says.

Benefits from 3D Printing

Since adopting metal 3D printing in copper, Tucker Induction Systems has realized numerous advantages from this technology, including:

- **ELIMINATING BRAZING.** A coil head that is 3D printed complete avoids the joining step that can result in weak points, improving performance as well as streamlining production.
- **ASSEMBLY CONSOLIDATION.** Another result of 3D printing coils in one piece is that production becomes simpler, by eliminating multiple fabrication steps for a diverse set of parts.
- **LABOR REDUCTION.** Starting with a 3D printed head, the most complex part of a coil, makes the rest of the workflow easier. Employees can focus on joining the head to the rest of the assembly, skipping over the more difficult steps.
- **STRONGER MATERIAL.** The powder material used in laser powder bed fusion is a copper alloy, rather than



↑ A side view of the single-shot induction coil shown above. While traditionally coils are manufactured using round copper pipe, Tucker Induction Systems uses cross-section geometries that are more reliable to 3D print without supports. Source: Additive Manufacturing Media

Tucker’s usual Cu110 or Cu101. “It turns out it’s a bit stronger and more rigid, but it machines the same as regular copper,” Tucker says. Customers get an improvement in coil strength without any trade-offs in manufacturing.

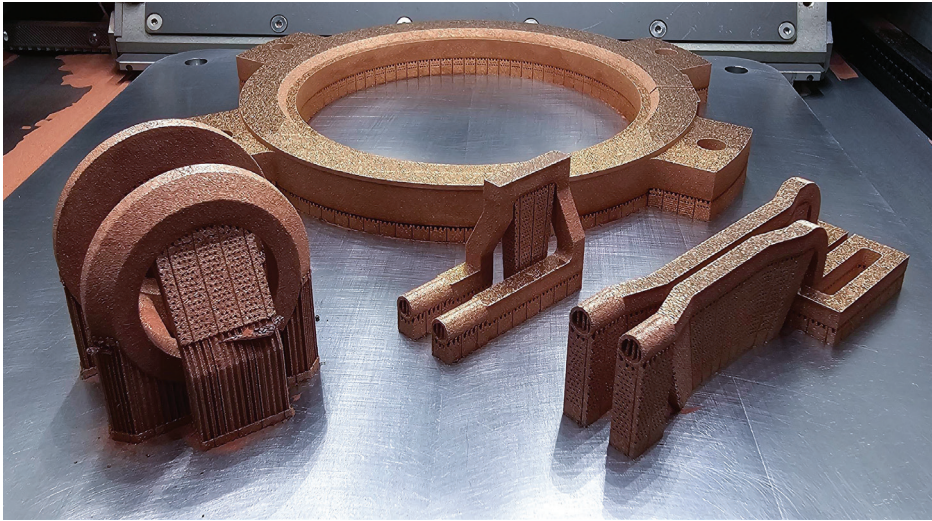
- **AUTOMATION.** The printer today runs nearly 24/7, often overnight or over weekends. The schedule increases productivity and throughput for coils, and also frees up capacity so that Tucker Induction’s skilled employees can work on something else while a coil head prints.

On the final point, both Tucker and Black note that there was workforce fear regarding the additive technology in the initial stages.

“It was a job security threat at first,” Black says, with employees worried that the 3D printer would supersede their own hands-on skills. “But then people started to see that this helps us stay on pace, maybe even get ahead.”

The 3D printer can replace much of the tricky fabrication of complex coil geometries, but even 3D printed coils will still require finish machining, joining to the rest of the assembly and other steps to be performed by skilled technicians. Over time, the workforce has come to see how 3D printing can save time and energy by letting them “out-source” some of the more difficult steps in production.

“Now we’re at the point where the guys in back almost assume that the coil head will be 3D printed,” Tucker says.



copper for its coils. Some parts will always be simple enough not to require this technology, but for those that can benefit, the time and labor reductions are significant. Both Tucker and Black are optimistic about what the future could hold as the company's use of the technology expands.

"So far we've been able to do everything we set out to do," Black says. But the company sees more potential for metal 3D printing on the horizon, now that the capability is here.

"The opportunities and capabilities are darn near endless," Tucker says. **PM**

↑ Another advantage of 3D printing is that multiple coils or components can be made at the same time, often while the machine runs unattended over nights or weekends.

Source: Tucker Induction Systems

Tucker Induction Systems has already made impressive strides in the adoption and implementation of 3D printed

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➔ Automation used to be reserved for the highest volume applications at the largest manufacturing facilities. But as technology has developed, automation has become more accessible to smaller manufacturers and high-mix applications. “There have truly been advancements in hardware and software that are making automation more accessible, reliable and affordable,” says Brendan Sterne, chief product officer at automation supplier Vention. The company provides a platform for designing, ordering, programming and operating automation systems for a range of applications, including manufacturing. Recently, Vention has created a number of releases aimed at making automation more accessible from design to operation, including AI features it says can “automate automation.”

Design

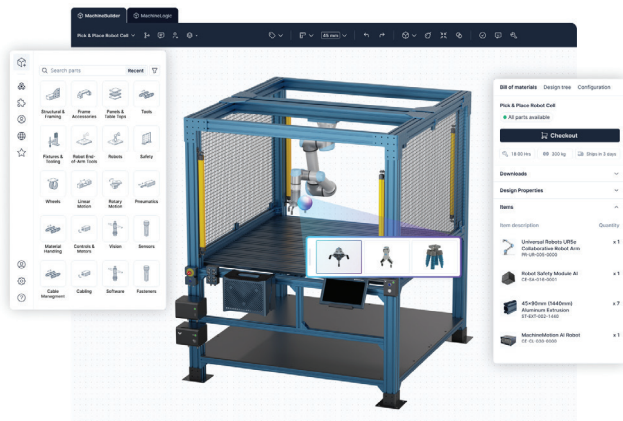
Users begin the process in a browser using Vention’s new Projects feature. It provides a centralized workflow for

defining the requirements and scope of automation projects to facilitate collaboration, including what Vention says is the industry’s largest library of machine specifications.

With the scope of the project set, users then move to MachineBuilder to assemble the cell. The quote is updated automatically as components are added and removed, and it automatically notifies users when a component they’ve chosen isn’t compatible with another component in the cell. MachineBuilder also features a new AI-based Design Assistant, which can automatically fill in connection points with connector parts (such as gussets) and aids in building subassemblies (for example, when a user adds a conveyor to a cell, the Design Assistant automatically adds the other components in the subassembly, such as legs, motors and sensors). The

↑ Vention is developing technology designed to make automation easier to implement and use, including its AI Operator bin-picking system.

Source (all images): Vention



↑ Users can design automation cells in a browser using Vention's MachineBuilder. Its new Design Assistant uses AI to automatically fill in connection points, add components to subassemblies and designs enclosures.

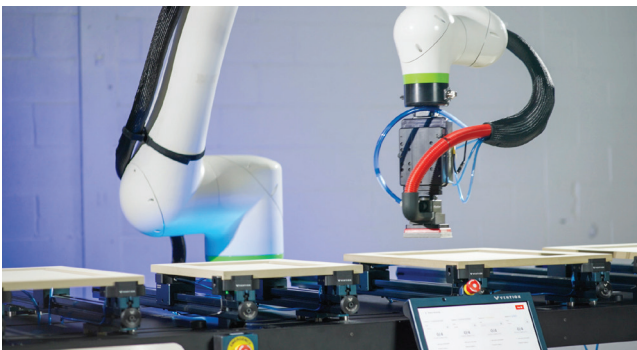
Design Assistant also helps users design enclosures with only border specifications.

Once the cell is built, users can now check that the design will function as intended before moving on to programming the system. "People design physical machines all the time, but it's easy to get it wrong physically," Sterne notes. Simulation Checker is a true physics simulation that shows where components in a design interfere so they can be resolved before programming.

Operation

AI Operator is a Vention product designed to bring AI models to the shop floor, enabling robots to perform bin picking or other tasks where parts are presented in what

↓ The company offers pre-engineered automation systems as well, including its new Rapid Series system for sanding. In addition to sanding, the system works with metal finishing processes, such as polishing.



↑ Vention's AI Operator uses its MachineMotion AI controller, NVIDIA's Isaac AI platform and a camera mounted on the robot's wrist to automate bin-picking and other tasks that require picking parts presented in an unstructured manner.

Sterne refers to as an "unstructured manner." Powered by the company's plug-and-play MachineMotion AI controller, it uses NVIDIA's Isaac AI platform and a camera mounted on the robot's wrist for perception, depth calculation, gripping and path planning, adjusting the robot in real time to avoid collisions. Sterne says all that's needed to program the system is a CAD file of the part to be picked, making it well-suited to high-mix, low-volume manufacturing.

For users that run their automation systems unattended, Vention's new RemoteView provides a 24/7 video feed of the cell. "Even though the lights are off, eyes are still on the cell," Sterne says. RemoteView also logs a seven-day recording history of the system, including status updates and alerts so users can spot problems, trace them to the root cause and solve them. This system can also be paired with Vention's RemoteSupport, which uses a one-way camera on the system controller to connect with Vention's support team for troubleshooting, reducing downtime.

The company offers turnkey solutions as well, including a "Click and Customize" machine tending application builder featuring new bases with either high-precision drawers or an angled part presenter. Vention has also recently released a new variant of its pre-engineered Rapid Series systems for sanding, which Sterne says is compatible with polishing and other metal finishing processes. **PM**

| Vention • vention.io

ABOUT THE AUTHOR:

Julia Hider is executive editor for *Modern Machine Shop*.

Compact Rotary Transfer Technology New to the U.S. Market

➔ The Eastern European manufacturing market is aware of Kestech, but it's quite possible those in the United States are not. Kestech is a Turkish machine tool builder specializing in multistation, rotary transfer machines offering models in which the trunnion holding the workpieces is oriented vertically and the machining stations approach each of them horizontally. One advantage of this is floorspace savings as compared to rotary transfer models in which workpieces circle horizontally on a large-diameter rotary table that are positioned in front of machining stations for processing.

But in addition to that, Greg Sandler, co-founder of Dynamic Machine, Detroit-area CNC equipment dealer and importer of Kestech machines to the U.S. market, highlights two other distinctive advantages for models such as Kestech's Multivexa compact rotary transfer machine.

The first is compensating chucks for forgings. Forged workpieces present a persistent and well-known

↓ **The Kestech Multivexa compact rotary transfer machine featuring vertical trunnion will be on display at IMTS in booth 339430 in the South Building.** Source (all photos): Kestech





challenge in transfer machine production: parting lines. The flash line from the forging die — even after trimming — leaves dimensional variation at the parting plane. On a rigid, non-compensating chuck or fixture, the part might seat unevenly, rocking on the parting line. This introduces runout and positional errors at the first machining station, and those errors compound through subsequent stations possibly causing increased scrap and rework. Without potentially costly pre-machining, it'd be difficult to achieve tight concentricity and perpendicularity tolerances.

Conversely, Kestech's self-compensating chuck design actively accommodates parting line variation and irregular raw material surfaces. The chuck jaw geometry with floating mechanism self-centers on the functional datum of the part rather than the raw forging surface. Parting line flash is effectively "absorbed" by the compensation, preventing it from tilting or mis-seating the part. As a result, first-hit concentricity is significantly improved without requiring a dedicated rough-turning or pre-machining station. This is said to be particularly valuable for CV joint housings, differential carriers, hub flanges, steering knuckles and other high-volume automotive forgings.

The second is integrated turning spindle capability. This is said to be one of the most technically significant differentiators Kestech offers. It relates to the inherent problem with interpolation.

On many machining centers and some rotary transfer machines, interpolation is accomplished through a generating head. This can work well for loose-tolerance parts, but has limitations. For example, interpolated bores and OD features are only as round as the interpolation accuracy — they are technically polygonal at the micro level. And, any servo mismatch, backlash or thermal growth between the two interpolating axes directly affects roundness

and concentricity. Plus, when a turned or bored feature must be critically concentric to an already-machined feature such as a bearing seat that must run true to a gear bore, interpolation might not reliably achieve the required runout tolerance.

Kestech offers the ability to install a true rotating work-piece spindle at one or more stations. With this capability, runout and concentricity of the turned feature relative



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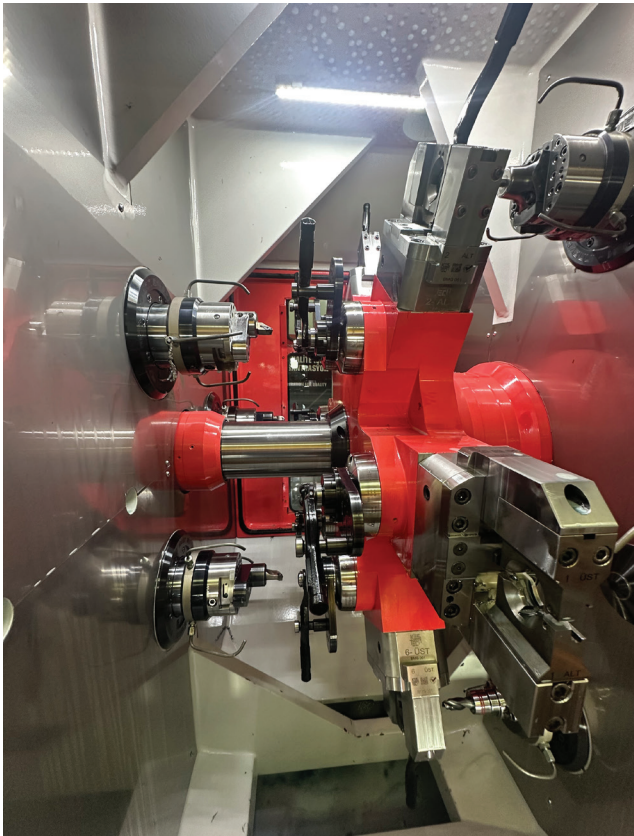
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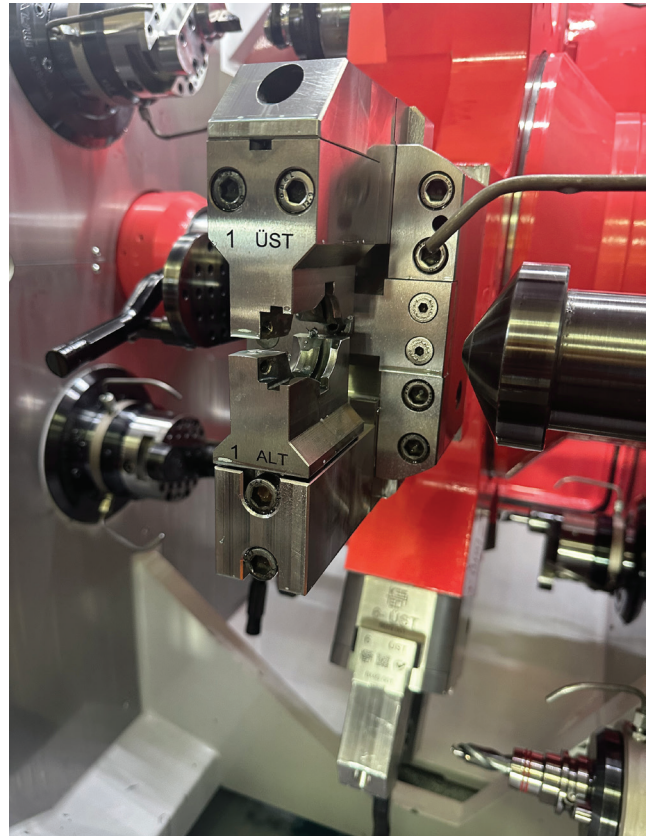


↑ A vertically orientated workpiece trunnion with machining stations approaching each workpiece horizontally saves valuable floor space.

to the datum used to chuck the part are governed by the spindle bearing quality and setup, which is fundamentally more accurate than interpolation for critical tolerances. Therefore, features such as bearing journals, seal running surfaces, outer diameters and precision bores can be generated to tolerances that rival dedicated CNC lathes. This is critical when, for example, a transmission shaft bore must run concentric to a gear OD that was machined in a prior station. This might be achievable through interpolation in prototype or low-volume work, but becomes more challenging in high-volume production.

A true rotating workpiece spindle also eliminates the need to remove the part from the transfer machine and send it to a lathe for that operation, preserving datum consistency and avoiding re-fixturing variation. It can be combined with live tooling at other stations on the same machine, giving significant process flexibility, too.

Other advantages Sandler cites include flexibility and reconfigurability. Station tooling can often be reconfigured



↑ Station tooling can often be reconfigured for new part families using new combinations of tools for drilling, tapping, milling, reaming and turning.

for new part families using new combinations of tools for drilling, tapping, milling, reaming and turning. This makes it suitable for both mid- or high-volume production because changeover times are reasonable.

In addition, automation is possible when using bar feeders and/or robot load/unload capability. Machines can be fitted with Mitsubishi six-axis robotic arms and Cognex vision system for machine operator safety such that protective physical cages are not necessary. Similarly, turnkey solutions can be developed using conveyors, vision systems and marking stations in-machine gaging and statistical process control (SPC) feedback.

Finally, Sandler points to overall affordability. He says that because Kestech is located in an EU and Turkish free trade and tax efficiency zone, the company can offer its rotary transfer machines for a lower cost than European-built models. **PM**

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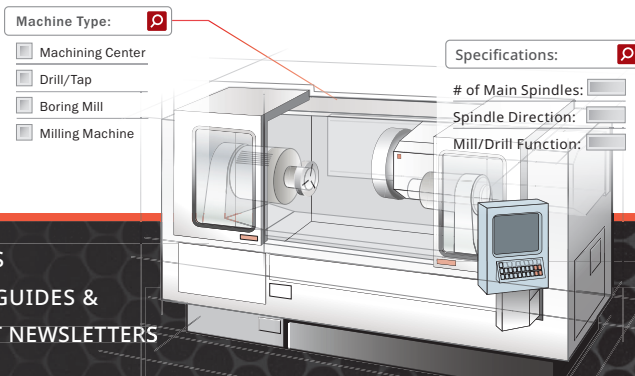
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UNLEADED STEEL LEADS THE WAY IN Machinability Test

Even in conditions better suited to leaded 12L14 steel, a domestically produced non-leaded 1215 steel showed stronger results in turning and drilling, with comparable results in grooving.

➔ Has non-leaded steel formulation improved enough to make it more machinable than leaded steel? The dearth of leaded steel providers in the U.S. makes this a vital question for domestic manufacturing and was the driving impetus behind Nucor's recent machining test of its NuCut 1215 steel, which took place in partnership with Tajmac-USA, Horn USA, Eastern Oil and Dr. Julius Schoop, associate professor in manufacturing systems engineering at the University of Kentucky. Even with cutting parameters better optimized to 12L14 leaded steel, they found Nucor's material to be more machinable than several 12L14 and 1215 alternatives in turning, form tool grooving and drilling, and developed several recommendations to further improve performance.

New Studies Around an Old Issue

Nucor's last material machinability study took place in 2018 on a CNC lathe and focused only on turning. While these results promised comparable performance between Nucor's materials and leaded steel, they only applied to one type of operation and did not represent the cam-driven multispindle machines Derek Nordby, a Nucor district technical services manager, says most of its customers typically use.

With Republic Steel's closure, and therefore the loss of the last 12L14 producer in North America, Nucor hoped to challenge longtime wisdom around the ease of machining of 12L14 compared to 1215 non-leaded steels. At its heyday, 12L14 was celebrated, as the lead acts as



← **Leaded 12L14 steel production requires virgin material, while 1215 steel production can make more use of scrap and recycled material. Nucor notes that this makes U.S.-made 1215 more sustainable and hardens the U.S. steel supply chain.** Source (all photos): *MMS*

a lubricant during cutting, enabling more aggressive cutting parameters and smoother surface finish compared to non-leaded steel. Going into the new study,

Nordby said newer cutting fluids mitigate this advantage, enabling non-leaded 1215 steels to achieve similar performance to 12L14 steels.

This depends on the 1215 formulation, Nordby notes, adding that Nucor has leveraged its vertical integration to improve the consistency of its material's chemical composition and production processes from heat to heat. Even the little variations between two materials that fall within

ASTM's standards for 1215 steel can lead to drastically different performance, so comparing the NuCut 1215 to other 1215 steels would also be important.

Building a Test

Nucor wanted an external partner to help facilitate its case study, and Nordby reached out to Schoop after hearing him speak about materials at an event hosted by the Precision Machined Products Association (PMPA). Schoop suggested Tajmac-USA, another PMPA member, host the test and recommended using tooling from PMPA member Horn USA.

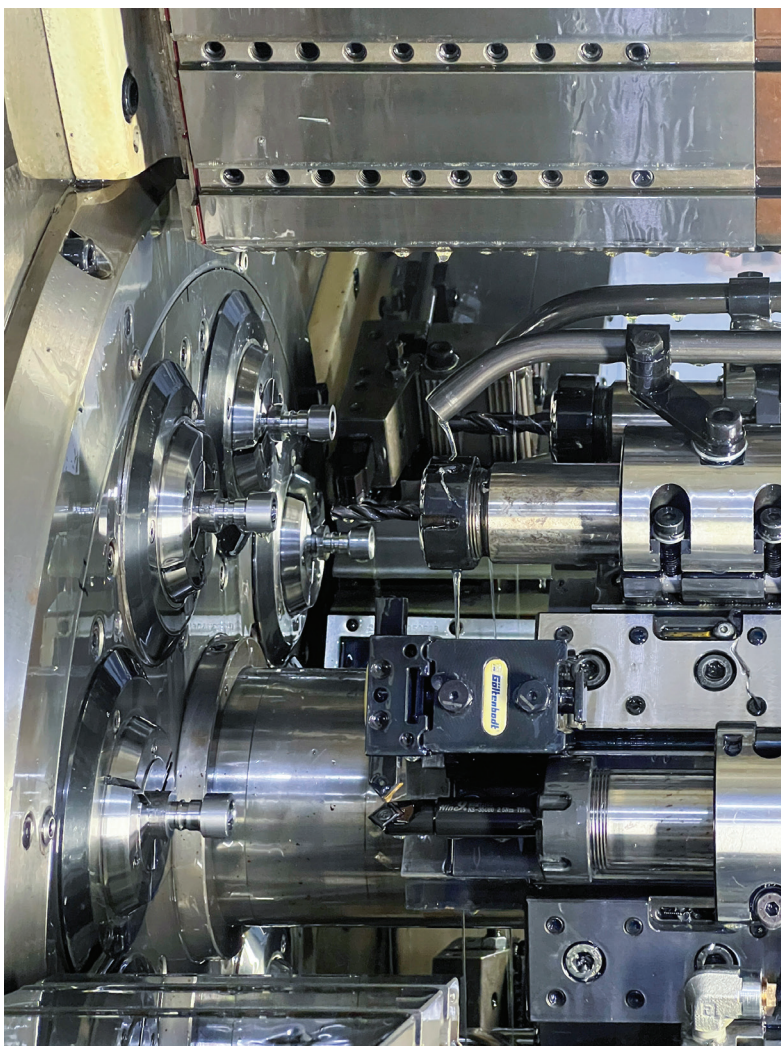
Together, the team developed the machinability test to be as consistent as possible while addressing a wide range of common user applications. The test part has several different diameters and angles with realistic surface finish requirements, as well as features that required drilling

and grooving. Horn supplied a mid-range TH35 grade on a turning tool, a cut off tool, two profiling tools and two drills. Tajmac-USA used one of its Mori-Say 832 S/AC cam-driven multispindle lathes to conduct the tests at a spindle speed of 2,600 rpm, lower than the machine's maximum spindle speed of 3,000 rpm, to more accurately represent their users' expected average spindle speed.

Average cycle times came out to about five seconds per part, and the team settled on running the tests for four hours with each material for a total of around 3,000 parts per test. While they did not expect this test to wear out any of the tools, initial preparatory work suggested that tests to this length would build up enough information to illustrate meaningful differences in how tools performed in each material over time. To prevent stopping and starting the machines too often, Schoop and the Tajmac-USA team measured tool wear with a Dino-Lite AM7915MZTL digital microscope halfway through the trial and at its



← **Tajmac-USA used one of its Mori-Say 832 S/AC cam-driven multi-spindle lathes to conduct the tests. Spindle speeds of 2,600 rpm were used (the machine's maximum spindle speed is 3,000 rpm) to more accurately represent their users' expected average spindle speed.**



end. They also used micrometers and a Mitutoyo SJ-220 Surftest surface roughness tester to collect workpiece dimensions and surface roughness at intervals of around 500 parts.

While the test was designed to address performance across single point OD turning, form tool grooving, drilling, facing and parting from 0.75-inch round bar stock, Schoop paid special attention to steady-state shearing in turning, chip formation in grooving and chip evacuation in large-diameter (11.5 mm) drilling. To get an idea of NuCut 1215's performance, this was a blind test with bars of NuCut 1215, bars of two different non-leaded 1215 materials, and bars of two different 12L14 materials.



Consistent Results

As expected, the tools all held to dimensional tolerances of ± 0.005 inch

↑ Rather than only studying turning, the team designed the test part to require multiple common operations, including grooving and drilling. This helped the team benchmark real-world type scenarios rather than isolated metrics.

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↑ On the whole, Schoop ranked NuCut 1215's performance best between the five tested materials.

throughout the testing, though surface finish showed notable differences between the steels. On the whole, Schoop ranked NuCut 1215's performance (which he defines as a combination of relative tool wear, surface finish and chip form) best between the five tested materials, with top performance in turning and drilling and a second-ranking in grooving performance.

In the turning tests, NuCut showed the smoothest overall surface finish, and all three 1215 varieties showed less wear than one of the 12L14 steels. Schoop says that while all five varieties stayed below the 125- μ m Ra surface finish limit of the test, the difference between NuCut 1215 and the worst-performing 12L14 steel was about 70% on average. Both 12L14 materials showed feed marks on the surface of the parts during inspection, while the 1215 materials showed a



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↑ Dr. Julius Schoop (right) and the team at Tajmac-USA carried out the materials testing. While they knew how many materials of each type were present, they were not informed which material was which, preventing bias from seeping into the results.

smoother surface with deposits of built-up edge (BUE), which Schoop says indicates the material better resists side flow and strain-hardens more aggressively than leaded materials. That said, the 12L14 steels produced the smallest chips, with NuCut 1215 producing smaller chips than the other tested 1215 steels.

The tools used in the form tool grooving test did not include chipbreakers, which Schoop admits disadvantaged the 1215 materials. One 1215 material failed surface finish tests after less than 1,000 parts, and in general, the non-leaded materials exhibited higher surface roughness and caused increased tool wear. Of them, NuCut 1215 performed the best, and one of the 12L14 materials did cause more wear and show more roughness at 3,000 parts. Schoop detected microscratches in the parts created with non-leaded grades and theorizes that this stemmed from BUE caused by grooving without a chipbreaker. This is consistent with the longer, helical chips the tools produced from the material, he says.

Both 12L14 materials started off well in the drilling tests, but showed runaway surface finish degradation after about 1,500 parts, with one material failing surface finish requirements by the 2,000-part sample and the other failing at 3,000 parts. Until that time, they had shown smoother surface finish than the non-leaded steels — though of these, NuCut 1215 showed the smoothest surface finish. Schoop notes that NuCut 1215 also formed the smallest (and therefore most desirable) conical chips of any of the tested materials.

These results occurred with testing parameters better suited to 12L14, Schoop notes,

and cutting parameter, coating and lubrication optimization could eliminate BUE and achieve better surface finish at even less wear. He recommends cutting speeds between 300 and 600 sfm, saying that higher speeds improve surface finish and chip control, while also recommending that NuCut 1215 users should keep feed rates along the same lines as 12L14 feed rates to reduce the risk of instability or BUE. As non-leaded 1215 produced longer chips during turning or grooving, he also recommends chip breaker geometries for proper chip segmentation and evacuation. **PM**

| Eastern Oil Co. • easternoil.com

| Horn USA • horn-group.com

| Nucor • nucor.com

| Tajmac-USA • tajmac-usa.com

ABOUT THE AUTHOR:

Evan Doran is senior associate editor of *Modern Machine Shop*.

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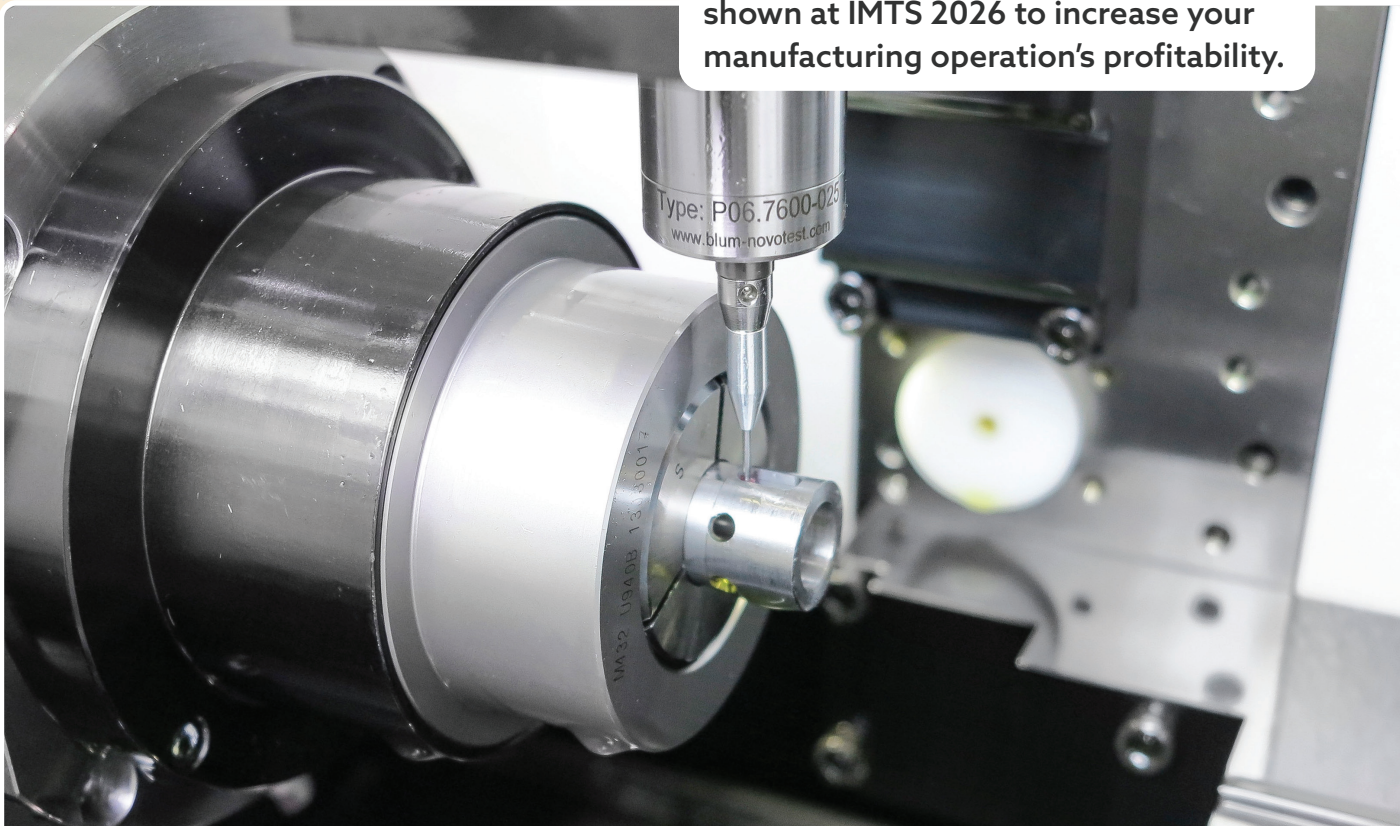
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Metrology Matters

Don't look at inspection equipment as a necessary evil. Embrace new industrial metrology technology as shown at IMTS 2026 to increase your manufacturing operation's profitability.



↑ This on-machine probe scans the complete contour of this component's slot at a rate of 2 meters per minute to ensure 2-micron slot parallelism on a quick coupling component manufactured by Karlheinz Lehmann GmbH in Oberwolfach, Germany.

Source: Blum-Novotest

➔ Coordinate measuring machines (CMMs), vision systems, hand gages — heck, even a machine shop's entire quality assurance department — don't make product. But they do ensure product quality. And new ideas on display at IMTS 2026 can provide a means to speed and simplify the collection of said data while applying that data to improve machining processes. This is especially important for shops implementing lights-out operations as part inspection can become a bottleneck.

Here are a few recent real-world examples of new measurement technology being applied for you to consider examining at IMTS, as well as a description of one demonstration there presenting a connected "shop floor" on the show floor.



The Flexible CMM Advantage

Rather than mere tolerance confirmation, advanced quality assurance technologies have become a strategic business advantage for EWT/3DCNC Inc., a contract machine shop in Rockford, Illinois. As a result of attending IMTS 2024, the shop added a Zeiss Contura bridge CMM with a touch probe and a Zeiss O-Inspect multisensor vision measuring machine with a touch probe, a camera and a white light scanner.

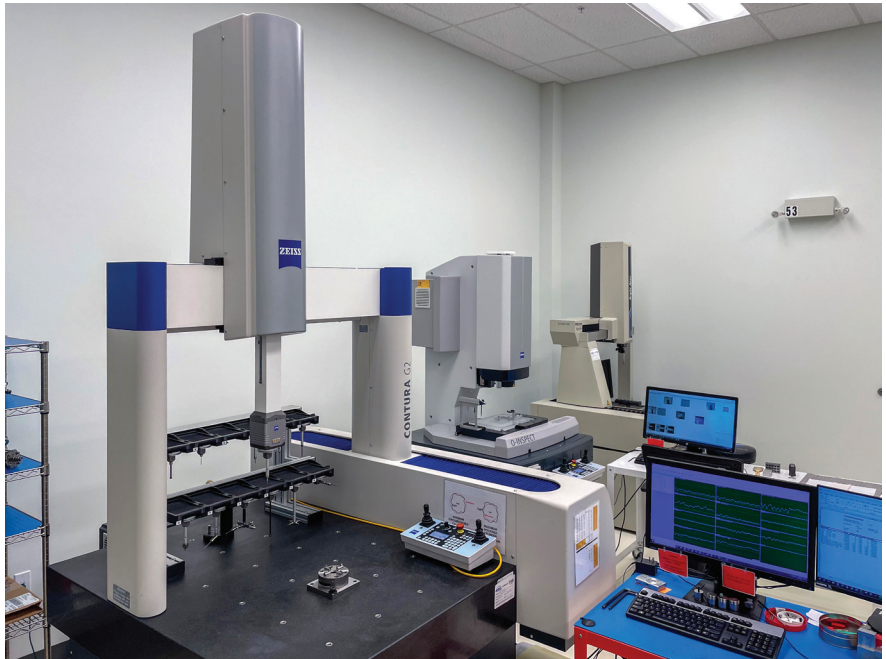
Flex-Cell Precision Inc. in Lancaster, Pennsylvania, has also benefited from new CMM as well as workholding technology. It has essentially standardized on Erowa zero-point workholding systems, many topped with proprietary part clamping devices its team designed, for its automated five-axis machining cells. But it also uses that workholding system on its Zeiss CMM for fast, repeatable installation and positioning. Inspection programs have been created that enable operators who might not be CMM experts to call up the appropriate inspection program and run it themselves.

Vision Systems as Form of Automation

Latrobe, Pennsylvania's Xcelicut Precision Machining, is a specialist in high-volume, precision-turned components. Recently, the shop has added a VisionLab-150 3D automated gaging system from General Inspection LLC. This investment specifically targets the optimization of the first-part inspection process, enabling rapid production transitions without sacrificing tight tolerance requirements. It is said to provide a comprehensive metrology solution that replaces time-consuming manual measurements with a high-speed, automated 3D scan for parts Xcelicut manufactures.

The technology brings several key advantages to the Xcelicut production floor. These include:

- **RAPID FIRST-PART APPROVAL.** The system significantly reduces the time required for first-article inspections, ensuring that CNC Swiss-type and multi-spindle lathes begin production runs faster.



↑ Erowa's zero-point pallet systems often combined with Flex Cell's proprietary part clamping devices are used on machine tools as well as this Zeiss CMM for fast, repeatable installation and positioning. Inspection programs have been created that enable operators who might not be CMM experts to call up the appropriate inspection program and run it themselves. Source: Modern Machine Shop

- **3D FORM MEASUREMENT.** By capturing complete 3D data, the system ensures that complex geometries, tapers and GD&T features are verified with a level of detail that traditional 2D optical systems cannot match.
- **MEASUREMENT CONSISTENCY.** Automation removes operator variability from the inspection process, providing repeatable, data-backed quality assurance for every production batch.
- **SCALABILITY FOR HIGH VOLUME.** The efficiency gained in the inspection lab directly supports Xcelicut's mission to deliver high-volume components with reliable lead times and competitive pricing.

Measuring Parts on Machine Tools (Even Swiss-Types)

An increasing number of shops are using on-machine touch probes to speed setups or perform in-process measurement of machined features for process control. They are more commonly found on vertical or horizontal machining centers, but are also being used on multitasking Swiss-type lathes despite limited space in the workzone to accommodate such a device.



Karlheinz Lehmann GmbH in Oberwolfach, Germany, machines precision, rotationally symmetrical parts using multiple CNC lathes and milling machines. An example is a complex, steel quick coupling for compressed air input for Parker Hannifin GmbH. This was a challenging project given the parallelism tolerance of 2 microns required for the part's four slots.

A Blum-Novotest TC76-Digilog scanning touch probe used on a Marubeni Citizen-Cincom M32 Swiss-type lathe is key to ensuring slot parallelism. It scans across the slot surface at a measuring speed of 2 meters per minute, generating an extremely large number of values (50,000 per second) in a fraction of the time of analog, touch-trigger data acquisition.

At the start of a production run for this coupling application, a reference part is clamped in the machine, the complete contour of the corresponding slot is scanned, and the master profile is recorded and saved in the evaluation software. Each machined part is measured and compared against the recorded profile. Any of the parts that exceed the tolerance are discarded. Using on-machine measurement in this way enables Karlheinz Lehmann GmbH to perform 100% inspection, while also detecting machining error trends at an early stage via the probe's evaluation software.

↓ **Xcelicut Precision Machining uses this VisionLab-150 3D automated gaging system from General Inspection LLC, to optimize the first-part inspection process, enabling rapid production transitions.** Source: Xcelicut Precision Machining



Wireless Transfer of Measurement Data

Some time ago, Hastreiter Industries in Marshfield, Wisconsin, recognized that its in-process inspection methods were not as efficient as they could be. In fact, these inadequacies caused its quality department to become a bottleneck. After researching many options for improving inspection accuracy and consistency, the shop implemented a wireless measurement data communication system. This system eliminated Hastreiter Industries' reliance on sometimes inaccurate paper records, increased the amount and quality of inspection data collected and served as a means to automatically record inspection processes. The new equipment also saved the shop time by speeding part measurement.

Prior to integrating the wireless inspection system, called Mitutoyo U-Wave, the shop's inspection records were handwritten, which led to misinterpretations and errors that negatively impacted data gathering. Also, the shop's existing mechanical mics and calipers were dated and wearing out. Therefore, the company's apprentices and interns had difficulty accurately recording dimensions, the shop says.

As a result, it decided to investigate a wireless system. Management first evaluated a traditional radio-based system. While that worked with most of its applications,

the radio system was limited to only 10 channels. Given the shop planned to add Bluetooth wireless gaging to CNC benches at more than 10 locations throughout the shop, 10 channels would be insufficient to overcome interference issues. As an alternative to a radio-based system, Mitutoyo suggested its U-Wave Bluetooth system and set up an onsite test.

The shop says the wireless Bluetooth packs required no computer plug-ins and worked seamlessly with its High QA QMS. This enabled the shop to produce easily accessible digital records for first-piece inspection, in-process inspection and final inspection. Plus, it has eliminated paper records and increased the amount and quality of inspection data collected. The new measurement process enables operators to immediately determine if a dimension is out of



for real-time cutting optimization, adaptive feed control and tool breakage detection; AutoComp closed-loop dimensional feedback with automatic CNC offset compensation; ToolConnect RFID and barcode-based tool data management and transfer; and DTect-IT advanced sensor analysis for machine health, vibration monitoring and predictive process intelligence. **PM**

| Blum-Novotest • blum-novotest.com
| Caron Engineering • caroneng.com
| General Inspection • geninsp.com
| Mitutoyo America Corp. America.Corp.mitutoyo.com
| Zeiss Industrial Quality Solutions
zeiss.com/metrology

↑ In Caron Engineering's IMTS booth, an automated, live cutting cell featuring CNC machines, automation, tooling data, measurement systems and process intelligence are shown working together continuously in real time.

Source: Caron Engineering

tolerance, leading to a reduction in scrap and nonconformance, and makes it easier for less experienced operators to record data accurately.

Also, the new inspection equipment enables the quality department to determine which machinist measured what part by setting up inspection routines in High QA for each person. This production data is not typically available to a quality department, as most low-volume, high-mix shops are not able to access in-process inspection records, according to the shop.

A Connected 'Shop Floor' on the Show Floor

At IMTS, Caron Engineering demonstrates how connected automation and real-time process control technologies help solve machining challenges in a fully integrated, live production environment in its booth. There, an automated, live cutting cell featuring CNC machines, automation, tooling data, measurement systems and process intelligence are shown working together continuously in real time to demonstrate how to improve machining stability, eliminate manual processes and increase operational reliability.

At the center of the demonstration is MiConnect Technology, the company's low-code manufacturing automation platform designed to simplify communication and orchestration across machines, robots, sensors, gaging systems and software platforms.

The live demonstrations also feature Caron Engineering's TMAC Tool Monitoring Adaptive Control

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➔ Across plating job shops, fastener manufacturers and contract coaters, parts cleaning continues to be a hidden bottleneck in overall line performance. As oils become more complex, throughput expectations rise and maintenance staffs shrink, many plants are struggling to keep aqueous cleaning baths at peak efficiency. The result: higher chemical usage, more frequent bath dumps, elevated waste treatment costs and quality issues tied to poor cleaning or oil saturation.

↓ **The AquaEase Infinity advanced sintered stainless-steel membrane filtration system minimizes operator workload, reduces chemical waste and ensures consistent quality in high-demand finishing environments.** Source: Hubbard-Hall Inc.

Membrane filtration has long been positioned as a solution, but past attempts using polymeric or ceramic membranes often failed in real finishing environments. These membranes could not reliably handle high pH, elevated temperatures, tramp oils or the heavy soils that define metal finishing. Many finishers came away believing that “membranes don't work” for cleaners.

But the technology has changed. Modern sintered stainless steel membranes are far more robust, chemically compatible and thermally stable than earlier systems — and when integrated correctly, they extend cleaner life dramatically without stripping active ingredients. The AquaEase Infinity system builds on that foundation with new design upgrades that make membrane filtration easier to operate, more durable and hands-off.

For shops fighting rising labor costs, limited maintenance bandwidth and increasing quality demands, this approach offers a reliable way to stabilize cleaning operations and reduce cost.

Improving stability, uptime and ease of use

The AquaEase Infinity system focuses on one core goal: maximize cleaning consistency while minimizing operator involvement. The system features several mechanical and operational upgrades:

Automated oil decant and full tank cleanout. Instead of relying on manual draining or periodic operator attention, the system removes oil continuously and automatically. A dedicated auto-drain function also allows for rapid, full cleanout of the process tank.

Improved handling of split-out lubricants. The upgraded system includes an improved skimming capability that automatically removes any lubes that separate from the cleaner. This prevents oil saturation, protects the membrane and helps maintain downstream cleaning performance.

Solids filtration on both incoming and process flows. The new design includes substantially improved solids filtration on both the incoming cleaner and the process tank recirculation loop. By removing fine particulates before



they reach the membrane surface, the system maintains stable flux, reduces cleaning frequency and protects long-term membrane performance.

Automated flow reversal to reduce fouling. By cycling flow periodically, the system helps shear off early stage fouling and reduces the buildup that typically forces membranes into premature cleaning. This extends run time, keeps performance steady and reduces operator workload.

Easier access for operators. The processing tank and filtration components are now easier to access for inspection and routine maintenance. While the control panel itself is more modern, the most meaningful improvements in “hands-off” operation come from automation of oil removal and enhanced solids management.

Upgraded clean-in-place (CIP) with reusable cleaning solution. The new CIP system includes a closed-loop cleaning mode. Operators can connect an auxiliary tote containing membrane cleaning solution, which the system heats and circulates through the membrane. Once complete, the cleaning solution returns to the tote where it can be reused, reducing both labor and chemical cost. This design minimizes downtime and simplifies membrane maintenance in the field.

A practical approach to cleaner stability

The redesigned AquaEase Infinity system processes up to 800 gallons per day. Because a bath only needs to be turned over approximately six times during the period when an unfiltered cleaner would normally reach end of life, the system easily stays ahead of contamination loading.

As finishing operations push for higher throughput, lower waste and improved quality with fewer maintenance resources, upgrading parts cleaning technology becomes essential. The AquaEase Infinity system delivers a more robust, easier-to-operate membrane filtration solution built specifically for the demands of metal finishing.

With automated oil removal, upgraded solids filtration, flow-reversal to reduce blinding and a closed-loop CIP system, it offers predictable performance with minimal operator involvement. Combined with reduced chemical use, fewer dumps, improved uptime and fewer rejects, the system provides a compelling economic and operational case for shops seeking to modernize their cleaning process.

Manufacturers interested in cleaner stability, waste reduction or improved productivity can contact Hubbard-Hall for system demos, technical evaluations or pilot trials. 💧

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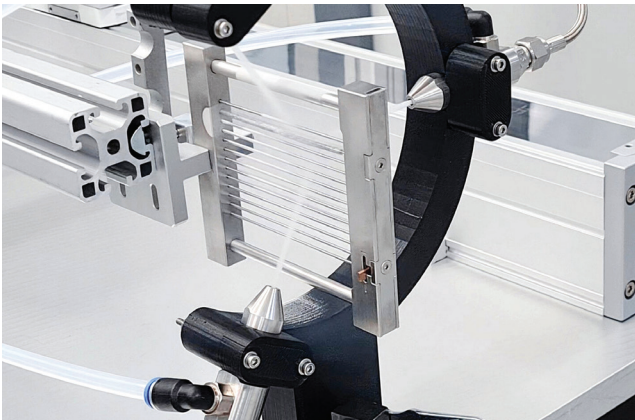


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Joint Project Proves Suitability of Snow Jet Cleaning Technology

A joint project investigated the material compatibility of the QuattroClean snow jet cleaning technology on product surfaces typically found in the medical and pharmaceutical sectors.

➔ The surface cleanliness required for medical and pharmaceutical products is generally achieved during manufacture using liquid-based cleaning processes that consume large amounts of energy and water. In order to effectively reduce resource consumption, a joint project funded by Invest BW and involving industrial partners Fraunhofer Institute for Manufacturing



↑ To effectively reduce resource consumption in the cleaning of medical and pharmaceutical products, the material compatibility and cytotoxicity of the QuattroClean snow jet cleaning technology was successfully investigated in a joint project. Source: Bentley InnoMed

Education and Automation IPA and the Natural and Medical Sciences Institute at the University of Tübingen investigated the material compatibility of ACP Systems' dry CO₂ QuattroClean snow jet cleaning technology on product surfaces typically found in the medical and pharmaceutical sectors.

The results of the tests, which included in-vitro cytotoxicity tests as well as volatile organic compound (VOC) and semi-volatile organic compound (SVOC) analyses, prove the suitability of the process for a range of applications. To lower approval hurdles, a validation for life science applications was carried out in parallel.

Focus on surface changes and cytotoxicity

In the manufacture of medical and pharmaceutical products, a cleaning process is considered suitable if contamination is reliably removed and a product-specific level of cleanliness is consistently achieved. At the same time, the surface of the product being cleaned may not be altered or damaged. Traditional liquid-based cleaning processes meet these requirements for a broad range of materials used for products in the life science industry.

The primary aim of this study was to prove that the mechanical forces of snow crystals from the QuattroClean system do not alter, impair or damage the surface. It was also important to establish whether the thermal stress and/or chemical properties of carbon dioxide (CO₂) affect the surfaces or the biocompatibility of the containers, for example by releasing cytotoxic material.

Basic validation under worst-case conditions

For the basic validation of the process by Fraunhofer IPA, the surfaces of the test specimens were first examined microscopically (light and/or scanning electron microscope) in their initial state. The subsequent cleaning process was carried out under worst-case conditions (that is, the middle section and edges of the test specimens were continuously irradiated with CO₂ snow at a high pressure of 12 bar for 10 seconds).

Surface analysis and biocompatibility

The ensuing surface analysis by light and scanning electron microscope showed no alterations such as structural changes, damage, changes in roughness or flaking on the surfaces. It was found that slightly protruding burrs on edges were partially removed.

No cracks formed in glass vials due to the cleaning process and no propagation of existing cracks was observed. With the aid of a fluorescent penetrant, it was also possible to demonstrate that the snow crystals did not cause any additional stress in the glass. Likewise, the abrupt exposure to cold and the subsequent warming of the vials to ambient temperature did not lead to the formation of any microcracks.

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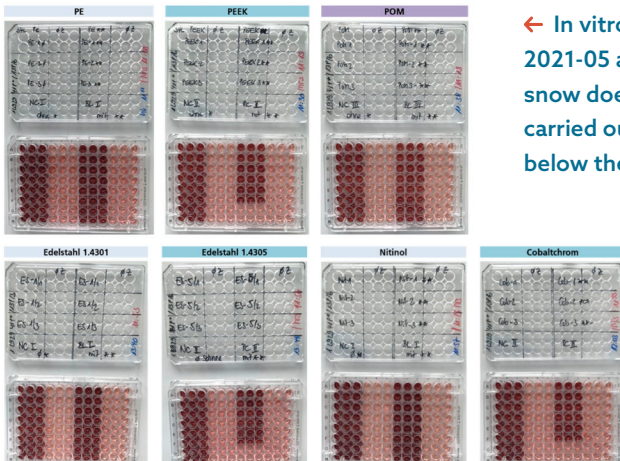


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← In vitro cytotoxicity tests in accordance with DIN EN ISO 10993-12: 2021-05 and DIN EN ISO 10993-12: 2021-08, it was confirmed that the CO₂ snow does not impair cell vitality in any way. The VOC and SVOC analyses carried out in compliance with ISO 16017-1 yielded Tenax values within or below the measurement limits. Source: Fraunhofer IPA

Resource-saving cleaning process suitable for life science applications

Extensive testing has proven the suitability of the QuattroClean snow jet technology as a resource-saving cleaning process for a wide range of applications in the medical and pharmaceutical industries. This is a dry cleaning process for full-surface and partial cleaning tasks, which uses liquid, recycled CO₂ as a cleaning medium. The CO₂ is guided through a wear-free, two-substance ring nozzle and expands on exiting to form fine snow crystals. These are bundled by a separate jacket jet of compressed air and accelerated to supersonic speed.

When the jet of snow and compressed air focuses on the surface to be cleaned, a combination of thermal, mechanical, solvent and sublimation effects occur, which is the basis of the cleaning action. With regard to residual particulate contamination, cleanliness levels in the sub-micrometer range can be reproducibly achieved.

Compatibility with stainless steels

NMI tested the material compatibility of QuattroClean snow jet cleaning with stainless steel 1.4301 and 1.4305 in greater detail. In these tests, the surfaces were examined by photoelectron spectroscopy before and after cleaning with the CO₂ snow jet. The comparisons and analyses showed that the process does not cause any material changes when used to clean the two types of stainless steel and can thus be classified as compatible with these materials.



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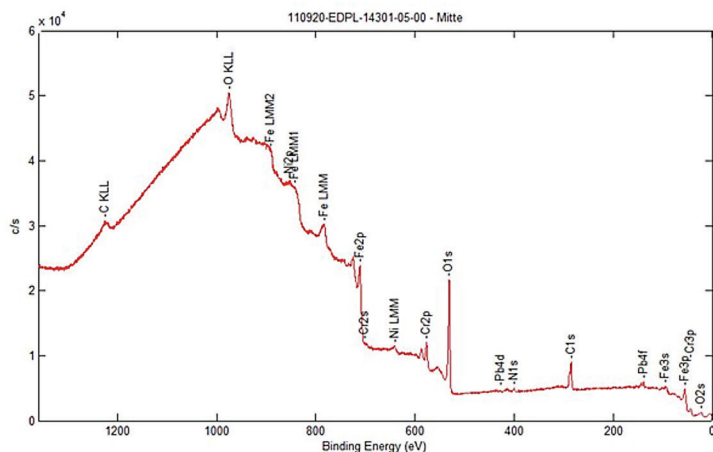


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← Left are the photoelectron spectroscopic analyses conducted at NMI. In this case, the HRXPS spectrum of stainless steel 1.4301 demonstrate that the CO₂ snow jet does not cause any material changes. Source: NMI

the crystalline CO₂ sublimates completely during the process, the cleaned residue-free surfaces are dry, thereby eliminating the need for costly and energy-intensive rinsing and drying steps.

Customizable, cleanroom-compatible and integrable into production lines

To ensure that the cleaning solution is optimally adapted to the respective component requirements and geometries, as well as the production situation, ACP Systems offers a range of modular solutions and individually planned systems, including cleanroom-compatible versions for high-purity applications. These include a media preparation unit for liquid CO₂, which ensures a cleanliness of 99.995%; the compressed air quality is 1.2.1. The process is tailored and validated according to customer and application requirements through trials in the manufacturer's cleanroom-based technical center. 💧

As far as filmic contamination is concerned, the cleaning result is comparable to that of other high-precision processes such as wet chemical and plasma cleaning.

The removed contaminants are then extracted in the compact cleaning cell, thus preventing re-contamination of the products and contamination of the surroundings. Since

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Tool Geometry: A Key Principle of Reliable Automated Production

Traditional production machining strategies were built around operator oversight. Automation demands a different mindset.



Automation is no longer optional in production machining. Labor constraints, margin pressure and customer demand have pushed shops toward bar feeders, gantry loaders, pallet systems and lights-out strategies. Yet many Swiss-type and multit spindle operations still struggle to achieve long, uninterrupted runtimes. Machines alarm out overnight, chips wrap around tools and a single insert failure can shut down an entire process. The key is changing our thinking. In automated production, success is not defined by the shortest cycle time. It is defined by getting the most in-tolerance parts off the machine over a 24-hour period.

Cycle Time vs. Throughput

Production machining has traditionally rewarded speed. Faster cycles mean more parts per shift, and that logic worked when operators were always present to manage chips and tool wear. Automation changes the equation.

Consider a Swiss-type lathe running aggressively during the day. Operator cleans chips every five parts. Changes inserts every hour. The cycle time is fast, but overnight, stringy chips prevent you from running more than five parts. No parts are produced until someone arrives to intervene.

Now compare that to a slightly slower process using a geometry designed to break chips consistently across changing conditions. The cycle time is longer but the machine runs all night. Instead of just five parts, you get 150 parts. For a part running three-minute cycle time at approximately 95% production, you gained a total of 50% more parts in that 24-hour period. That is an extra eight-hour shift. In automated production, throughput overtime always beats cycle time.

The 168-Hour Opportunity

Most shops still plan production around an eight-hour day, five days a week, which works out to about 2,000 hours per year. But machines, bar feeders and automation systems do not have to stop when the shift ends.

In reality, production equipment is available 168 hours per week, or 8,760 hours per year. When planning is limited to a 40-hour schedule, theoretical utilization is capped at 22.8%, before tool changes, scrap or downtime are considered. Even efficient operations rarely exceed 25% of their true available capacity. Automation exists to reclaim those hours. Tool geometry determines whether it succeeds.

Chip Control Is Non-Negotiable

Why does tool geometry matter more in automation? Tool geometry directly affects chip formation, cutting forces, heat generation and wear behavior. When geometry is wrong, problems escalate quickly and unattended production stops. Chip control is the first requirement for successful automated production. In Swiss machining, long chips can wrap tools or pack into sub-spindle areas. Chip behavior is driven by geometry. Rake angle, chip-breaker design and edge preparation determine whether chips break cleanly or form continuous strings. A geometry optimized for chip control may not deliver the fastest cycle time, but it will keep the machine running. If chips are not controlled, automation fails regardless of how advanced the machine may be.

Predictable Tool Life Beats Maximum Tool Life

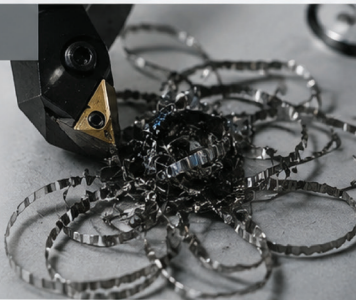
In automated production, long tool life is less important than predictable tool life. During an unattended run we cannot tolerate sudden edge failure. One broken insert can shut down the entire system. A tool that fails unpredictably is far worse than one that wears out gradually and can be changed on schedule. Tool geometry strongly influences how tools wear. Stable, robust geometries and proper coatings reduce cutting-force spikes and distribute heat more evenly, minimizing the risk of chipping or catastrophic failure.



Optimized tool geometry promotes controlled chip formation, predictable wear and longer unattended runtimes.

POOR GEOMETRY

- ✗ Long, tangled chips
- ✗ Increased risk of chip wrapping
- ✗ Poor surface finish
- ✗ More wear and unexpected downtime



OPTIMIZED GEOMETRY

- ✓ Short, controlled chips
- ✓ Consistent chip evacuation
- ✓ Better surface finish
- ✓ Predictable tool life and longer uptime



Lightly Attended vs. Fully Unattended Production

Many shops operate in a lightly attended mode, where regular operator intervention is required. They must clear chips, make offsets, retrieve parts and change tools as needed. This approach works well when operators can be present and attentive. Fully unattended machining is different. When operators can be away for hours not minutes. The longer a machine can run without operator intervention the better. First, the operator is freed up to run more machines. Also, the operator is freed to accomplish human tasks only they can do, such as planning the schedule or programming another job. Allowing our team to achieve their highest and best use. The longer a job can run unattended, the more production time it can achieve during periods when no operators are present or staffing is limited.

Maximum Unattended Runtime Is the Real KPI

The most meaningful performance metric in automated production machining is maximum unattended runtime. How long can our machines run without operator intervention? A process that runs fast but stops after six hours will always lose to one that runs slightly slower for 30

hours without interruption. Tool geometry directly impacts unattended runtime by controlling chips, stabilizing cutting forces and ensuring predictable wear. When geometry is selected with automation in mind, machines stay cutting. Uptime is what turns automation into profit.

Optimize for the Clock, Not the Cycle Time

Traditional production machining strategies were built around operator oversight. Automation demands a different mindset. Processes must work consistently without judgment or adjustment. That involves eliminating variation. Tool geometry is one of the key principles of reliable automated production. Shops that recognize this stop chasing the fastest cycle time and start maximizing output across all available hours. In machining, the winners aren't the shops making parts with the fastest cycle times — it is the shops with the most parts at the end of a 24-hour period. **P**

David Wynn, MBA is the Director of Technical Services and Industry Affairs with over 20 years of experience in the areas of manufacturing, quality, ownership, IT and economics. Email: dwynn@pmpa.org — Website: pmpa.org.

A Conversation with Federated Insurance: Why Mental Health Matters in the Workplace

An emotionally healthy workforce contributes to a business' success.



Mental health may not be the first thing that comes to mind when you think about filling an order or completing a run of parts. However, employees who feel supported, engaged and valued are better prepared to contribute to the success of the business.

In addition to insurance for the manufacturing industry, PMPA partner, Federated Insurance has an interest in work environments and frequently shares risk management resources. I recently spoke with Jack West of Federated

Insurance about mental health in the workplace and the steps employers can take to support their employees.

Carli: Why should employers be concerned about mental health in the workplace?

Jack: Employees spend more than one-third of their waking lives working, so the workplace can have a significant effect on their mental well-being.

An active, engaged and

satisfied workforce supports the employees, while also helping the business succeed.

C: How can company culture influence employee well-being?

J: Culture starts at the top. Employers can create a more positive environment by encouraging constructive interactions, problem-solving and respectful communication.

It is also important to hire employees who will contribute to that culture. During an interview, employers can ask questions that help reveal how a candidate approaches teamwork, workplace relationships and difficult situations.

Employees don't usually leave jobs. They leave bad bosses or a toxic work environment, so it matters how they are treated. Everyday interactions that show employees they are valued can create a chain reaction that encourages people to give their best.

C: What workplace factors can negatively affect mental health?

J: Concerns about job performance or job security, increased job demands, an unsafe work environment and poor work-life separation can all contribute to declining mental health.

C: What signs could indicate an employee is struggling?

J: Leaders should know their employees well enough to recognize when something seems different. Possible warning signs may include:

- Unusual behavior or extreme mood changes
- Decreased productivity
- Increased absenteeism
- Withdrawal from work or social activities

These changes do not automatically mean an employee is experiencing a mental health crisis, but they should not simply be dismissed.

C: How can employers prepare for more serious situations?

J: Expectations for workplace conduct should be communicated consistently and reinforced through training. Employees should also understand how to report concerning behavior to a supervisor or human resources representative.

Organizations including OSHA, the National Safety Council and the FBI provide resources related to workplace violence and prevention training. Federated Insurance also offers training resources through its risk management and employment-practices programs.

A successful workplace depends on its people. Paying attention, communicating expectations and creating a culture where employees feel valued can make a meaningful difference for employees and the business. **P**

This article is in partnership with Federated Insurance and is for general information only and should not be considered legal or other expert advice. Qualified counsel should be sought regarding questions specific to your circumstances.

Carli Kistler-Miller, MBA has over 25 years of experience with operations, event planning, marketing, communications and writing. Email: cmiller@pmpa.org — Website: pmpa.org.



MASTERY PROGRAM CHICAGO 2026

Members and Non-Members are welcome.

PMPA's Mastery Program is a one-of-a-kind learning experience designed to help precision machining professionals better understand the full manufacturing supply chain. Attendees will gain practical system knowledge to bring back to the shop and help with problem-solving.

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- 1 centerless grinding company
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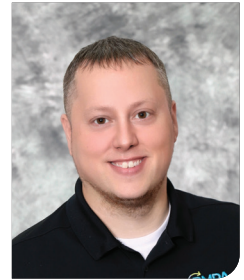
PMPA's Management Update Committee is currently laying the groundwork for the 2027 Management Update Conference. The committee is evaluating potential host properties for the fall 2027 event, with additional details to be shared as planning finalizes.

Past Events



Speaking Of Precision Podcast

- Talking Business Part 15 with John Detterbeck
- Speaking of ITAR with Tracy Nichols
- Speaking of Cox Manufacturing with Bill Cox
- Speaking of Getting the Lead Out
- Speaking of Brass Drops
- Speaking of What Makes a Shop Easy to Do Business With
- Speaking of All Things IT with Alec Martinak
- Speaking of The Cloud with Michael Vay



ListServe Communities Topics

Have a specific question or challenge? PMPA's ListServes — Technical, Quality, HR, IT and Corporate — let you tap into the right community of peers who've been there, solved that! Here are the top conversations in the Listserve Community last month:

- **Corporate: Vivek Shah Legal Complaint**
Members looking to organize a response and representation to Privacy Act concerns
- **HR: Machinists - Categories: Member**
looking for solutions for employee skill classifications
- **Technical: Material change and thread**
roll is flaking and not preforming: Member looking for clarity on running 2024 T351
- **Technical: Rusted/Discolored stainless**
steel: Members conversation on rusting stainless on delivery
- **Technical: Hard Chrome Source: Members**
sharing information on hard chrome services

Interested in Membership?
Email Harry Centa at
hcenta@mpa.org



CRAFTSMAN CRIBSHEET

G-code Macro Programming Flow Operators by Controller

By David Wynn, Director of Technical Services & Industry Affairs, PMPA

Category	Operator/ Keyword	Meaning	FANUC Macro B	Haas	Okuma	Mitsubishi
IF	IF []	Conditional IF [#100 GT10] GOTO100	Supported	Supported	Supported	Supported
Then	Then	IF-THEN- ELSE-ENDIF	Not Supported	Not Supported	Not Supported	Supported (Newer Controls)
GOTO	GOTO	GOTO N500 Goes to N line 500	Supported	Supported	Supported	Supported
While	While []	WHILE [#1 LE 10] DO1	Supported	Supported	Supported	Supported
Do	DO1	After the DO1 Code would follow	Supported	Supported	Supported	Supported
End	End (followed by loop Number)	END1 would end the DO1 statement above	Supported	Supported	Supported	Supported
N	N	Establishes line numbers	Supported	Supported	Supported	Supported

Notes: Exact availability can vary by software version and options. Check your manual for exact syntax and availability.

The workaround: Typically uses a format of IF [#100 EQ 1] THEN #101=5. Instead use a GOTO statement then put assignment on that line. IF [#100 EQ 1] GOTO N100. Put assignment on N100 #101=5. 

Port Mills Expand Options for Hydraulic Port Machining

Scientific Cutting Tools Inc. (SCT) introduces a line of solid-carbide port mills for machining SAE J1926 ORB and AS5202 hydraulic port profiles. The line is designed to provide a flexible option for hydraulic port machining.

Designed for circular interpolation from a pre-drilled hole, SCT port mills are engineered to machine key port features, including the seal surface, counterbore and chamfers. The line provides a flexible alternative to traditional plunge-style or reamer-style porting tools, especially in applications where access, spindle speed or production volume are limiting factors.

Each port mill is designed to cover a range of port sizes, helping reduce the number of tools required while giving programmers and machinists more flexibility. The line includes tools for both SAE J1926 ORB and AS5202 port profiles, with uncoated options and Versa (AlCrN) coated options available.

SCT provides application-specific tooling for demanding industries such as hydraulics, aerospace, defense, medical, energy and advanced manufacturing. By combining standard tooling availability custom and modified tools, SCT says it is helping customers simplify complex machining applications while improving access, repeatability and total cost per part.



SCIENTIFIC CUTTING TOOLS INC.
sct-usa.com • Booth 432414

Fine Boring Tools Feature Streamlined Operation

Big Daishowa's EWR series of fine boring tools are designed to provide improved usability, readability and operation. Built on the EWN and EWE platforms, the EWR series features a simplified design with only essential onboard electronics. All advanced functions — including energy management, data processing and visual feedback — are managed through a high-resolution, full-color external reader.

The reader connects to the EWR boring head via a magnet and displays readout in any orientation. The reader communicates using near-field communication (NFC), promoting stable and reliable data transmission. Operators can easily switch between inch and metric modes depending on application

requirements. The system offers 1- μ m diameter resolution and a rechargeable battery that can support up to 250 adjustments.

| Big Daishowa Inc.
bigdaishowa.com
Booth 431610



Machining Solutions Showcase Range of Precision Grinding, Machining Technology



United Machining Solutions' equipment and technology showcase features 17 CNC machines from Mägerle, Blohm, Studer, Walter, Agie Charmilles, Charmilles, Mikron Mill and Step Tec, as well as several automation offerings.

Mägerle, Blohm, Studer and Walter all have their latest

grinding innovations on display. Studer debuts the S23 universal cylindrical grinding machine for the first time, along with the S131r, S41 and S33. Walter showcases the Helitronic Vision Laser and the Automated Tool Production (ATP) automation cell, as well as the Helicheck Nano, Helitronic Micro and the Power Diamond 400. Blohm and Mägerle showcase the MC5 and the MFP 30 surface and profile grinding machines, respectively.

| United Machining • ums.swiss/en/ • Booth 236802

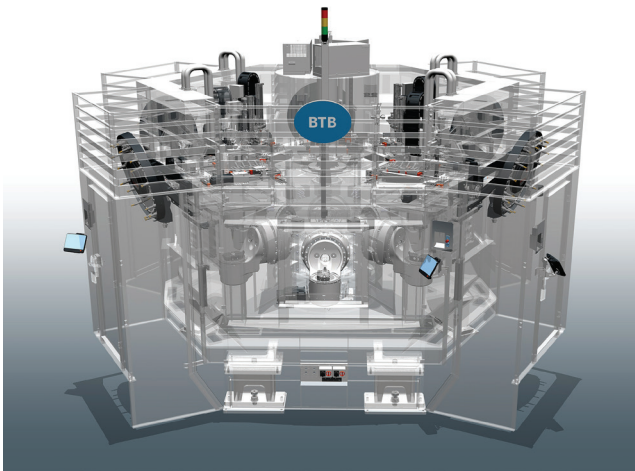


Transfer Machines Support Versatile Production

BTB Transfer showcases a range of three- and five-spindle transfer machines available in two models: the M04, with three spindles and four stations (three machining stations and one loading/unloading station), and the M06, with five spindles and six stations (five machining stations and one loading/unloading station).

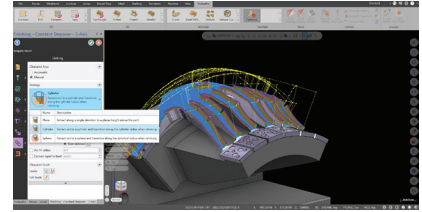
The concept of both machines is to combine the productivity of a transfer machine with the versatility of a machining center.

| BTB USA Corp. • btb.it/en • Booth 339178



Toolpathing Software Streamlines Complex Part Programming

Mastercam's EverPath Technology is an advanced toolpathing solution designed to transform how manufacturers approach complex part programming.



Adaptive algorithms within EverPath Technology analyze part geometry and automatically generate optimized tool paths for high-speed, multi-axis machining. This approach reduces the need for manual programming adjustments while maintaining precision and surface finish quality. The result, according to the company, is faster programming, shorter cycle times and improved consistency across parts.

Key features include automated toolpath optimization, real-time collision awareness and seamless integration within the Mastercam environment. Programmers can quickly iterate and validate strategies with confidence, minimizing errors and reducing machine downtime.

| Mastercam • mastercam.com • Booth 133222

Modular Drilling Inserts, Turning Geometry Expand Capabilities for Steel, Cast Iron and General Machining



Kennametal showcases the KenTip FS HP modular drilling insert and the Widia -MU geometry turning insert, both designed to improve productivity and versatility in metalworking operations.

The KenTip FS HP insert is the latest addition to Kennametal's KenTip FS modular drilling family, which already includes the HPG and GTP inserts. The HP geometry is designed with the KCPK15A multilayer coating for wear resistance and improved tool life in steel and cast iron applications.

Key features of the KenTip FS HP include:

- HP geometry designed to enable high productivity
- A clamping system that allows for quick insert changes to reduce machine downtime
- Two-margin lands designed to promote tool stability,

surface finish and hole straightness

The Widia -MU geometry is a universal turning insert engineered for finishing to semi-roughing applications. Its chip-breaker design is intended to promote high-process reliability through chip shape control and optimized edge stability. The inserts are said to be well-suited for streamlining inventory and increasing shop-floor productivity.

The -MU geometry inserts are designed to:

- Withstand higher cutting forces for deeper cuts and higher feed rates
- Handle light depths of cut without sacrificing chip formation
- Reduce cutting forces through a chip groove profile engineered for a smoother cut
- Provide balanced edge strength and low cutting forces through a reinforced nose and open geometry for stable and efficient machining

The inserts are available in CNMG, DNMG, TNMG, WNMG, VNMG and SNMG styles. Widia Victory grades include WP05CT, WP15CT, WP25CT, WM15CT, WM25CT, WK05CT, WK20CT, WU10PT and WU25PT.

| Kennametal Inc. • kennametal.com • Booth 431800

Toolholding Systems Provide Swiss-Precision Accuracy, Repeatability

Rego-Fix Tool Corp. showcases its toolholding solutions for manufacturers seeking enhanced precision, repeatability and reliability in their machining processes. The company features its original ER collet and PowRgrip toolholding system, and the booth also features an Ed Carpenter Racing vehicle on display.



Rego-Fix toolholding systems provide Swiss-precision machining for all manufacturing sectors, including motorsports, aerospace, automotive and medical, through engineered solutions that promote accuracy, rigidity and repeatability in high-pressure environments that demand tight tolerances.

Developed in Tenniken, Switzerland by Rego-Fix, the original ER collet is engineered for precision, versatility and reliability across a wide range of machining applications. Rego-Fix ER collets provide high clamping force and concentricity for extending tool life while maintaining consistent part accuracy.

The Rego-Fix PowRgrip toolholding system uses a taper-to-taper, press-fit collet holding design that creates a vibration-damping gap to interrupt the strength and severity of vibration waves. Toolsetting can be accomplished in no more than 10 seconds without heat or hydraulics as used in other tool clamping systems. The PowRgrip technology allows tools to be used immediately after the loading cycle concludes.

| Rego-Fix USA • regousa.com • Booth 431822

Indexable Insert Handler Automates Milling Tool Preparation

Zoller Inc.'s Micbox is designed to automate indexable insert handling on milling tools. From RFID-supported tool identification to mounting, indexing, rotating, flipping and exchanging inserts, the system also automatically replaces fastening screws after a predefined service life. According to Zoller, every aspect of the insert preparation process is performed with maximum precision and reliability.

An optional AI-supported measuring function, Zoller Wearncheck, takes automation a step further by automatically

inspecting and evaluating the condition of every cutting edge before any action is taken. The system can detect wear, classify the condition of individual cutting edges and intelligently determine whether an insert should remain in use, be indexed to the next cutting edge, rotated or completely replaced. This is designed to ensure that only inserts that have reached their wear limit are serviced, maximizing insert utilization, reducing tooling costs and providing a fully autonomous and optimized tool preparation process without additional cycle time or operator intervention.



The Micbox is a compact unit well-suited for manufacturing environments of all sizes. It brings the potential of 24/7 automated indexable insert exchange to milling companies at almost any stage in their automation journey, joining the wider portfolio of Zoller automation solutions that help manufacturers build smart factories for greater efficiency.

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Page

Allied Machine & Engineering	13
Atlas Bronze	2
Blackstone-Ney	33
BTB USA Corporation	46
Cleaning Technologies Group	33
CONTRAX	Inside Front Cover
Davenport Machine	3
Ecoclean Inc.	36
Gardner Intelligence	27
Hubbard-Hall	37
INDEX Corporation	5
KYOCERA Precision Tools, Inc.	19
LANG Technik USA	25
Marubeni Citizen-Cincom Inc.	Back Cover
NSK America Corp.	15
Platinum Tooling Technologies, Inc.	31
QualiChem, Inc.	24
Schutte U.S.A.	7
Schwanog LLC	11
Solvents Company	35
Star CNC Machine Tool Corp.	9
Techspex	21
Top Shops Conference	Inside Back Cover
WIDIA Products Group	Front Cover

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The Information Gap

➔ A shop owner gets a call from his aluminum supplier in late April. Pricing is moving again, the supplier says, pointing to some mix of tariff uncertainty, supply conditions and general market instability. But the bottom line is clear: If the shop needs material for near-term work, it may want to move sooner than later.

The timing isn't ideal. The shop — 35 employees and focused primarily on aerospace and defense work — has three active quotes out with 90-day delivery windows. The owner recently deferred on a multitasking machine purchase, because one of their defense customers had gone silent on a follow-on program that would have helped justify more capacity.

So the owner holds off on the material purchase, too.

Given what he knows in that moment, that is not an irrational decision. It may even be a disciplined one. The pricing movement had been visible for weeks to anyone watching the right market sources. But by the time that signal reached the shop, it had already become a decision.

This is the information gap.

When Signals Arrive Too Late

Most shop owners and general managers spend more time hunting for information than acting on it. Aluminum pricing can be tracked via commodity indices. Customer intentions have to be sorted out through emails, delayed POs and phone calls that can be misinterpreted. Policy changes trickle down through agency reports that nobody has time to read, while technology signals come through vendors and trade press that work on distinct schedules. Each source requires a different effort and none of them talk to each other.

I think about this each year when we review data from our Top Shops benchmarking program. The highest-performing shops are not merely the ones with the newest machines. They tend to have better systems around the decisions that sometimes expose weaker operations: quoting, scheduling, training, inspection, technology investment and customer communication. They know more about their capacity, costs and constraints.

A shop that can see earlier can decide earlier. It can connect market signals to its own work to quote more intelligently, protect its margins more deliberately and avoid treating every supplier call, market event or customer delay as an isolated event.

Depth, Velocity and the Need for Daily Intelligence

A job shop quoting aerospace work may need to think about material pricing, CMMC requirements, customer inventory behavior, defense spending, global events, labor availability, inspection capacity and financing costs — all in the same week. None of those signals fit neatly in one editorial category. They do not operate on a fixed planning cycle. And none becomes easier to manage once it manifests as a problem on the shop floor.

Modern Machine Shop and *Production Machining* have always been built for depth. Our responsibility is to contextualize technologies and practices in a way that helps machining professionals understand what works and why. The same is true across Gardner Business Media's other brands. Each exists because manufacturing is too technical to be covered well from a distance.

But depth and velocity serve different purposes. A deeply reported article can show how one shop solved an inspection problem, why a particular automation strategy worked or what determines whether a technology succeeds after a purchase order is signed. Daily intelligence should help a leader understand what is moving right now, why it matters and what deserves attention before it becomes urgent.

Better information can't eliminate risk, but it can narrow the amount of time a leader spends reacting to risk after it has reached his front door.

That is the gap our new Manufacturing Connected platform is built to address. Manufacturing Connected relaunched this summer as a daily intelligence platform built on the editorial foundation of Gardner's brands and structured around the decisions manufacturing leaders actually face. It connects signals across technology, supply chain, finance and policy so owners, GMs and operations leaders understand what changed, why it matters and what to watch next.

Access the new Manufacturing Connected platform at mfgconnected.com. **PM**



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