

CUTTING TOOL ENGINEERING

March 2026 | Vol. 78 | Issue 2

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Also in this issue

- PCD tooling missteps drain cycle time
- High-performance taps balance speed and life
- Sawing mistakes that cost time downstream

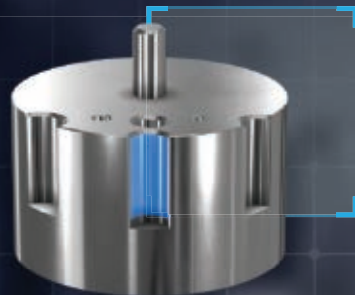
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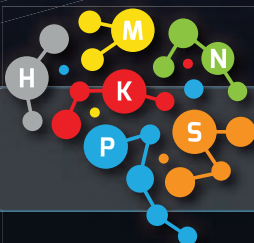
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Rego-Fix Tool

To reduce the cost of parts and simultaneously increase production speed, Ed Carpenter Racing acquired a 5-axis CNC milling machine with a maximum spindle speed of 24,000 rpm. **To learn more, read *Speed Needs Precision* on page 20.**

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EDITORIAL CREDIBILITY MATTERS

The line between editorial and advertising has never been under more pressure — and history shows what happens when it disappears.

This is not a new problem, but it is a recurring one.

In 1999, the *Los Angeles Times* faced an ethics crisis after it was revealed the paper had entered a profit-sharing arrangement tied to coverage of the Staples Center. Once revenue became structurally connected to coverage, readers — and even newsroom staff — questioned whether independence was still possible. While the episode didn't destroy the paper's brand, it remains a textbook example of how credibility erodes when transparency gives way to financial incentive.

The digital era didn't eliminate this risk — it reshaped it. In 2013, *The Atlantic* published sponsored content from the Church of Scientology that closely resembled the magazine's editorial articles in tone, layout and placement. Although labeled as sponsored, readers reacted strongly. The issue wasn't simply disclosure; it was that the content occupied editorial space and borrowed institutional authority. The magazine quickly pulled the piece, acknowledged the mistake, and reinforced its standards, preventing long-term damage. Still, the incident became a defining case study in the dangers of native advertising that looks too much like journalism.

In B2B media, the consequences can be even more serious. In 2009, Elsevier acknowledged publishing sponsored medical content in journals designed to resemble peer-reviewed publications. Although the company moved to strengthen disclosure and limit branding use, the episode contributed to lasting skepticism toward industry-funded, academic-looking materials — influencing how researchers and librarians evaluate credibility today.

Influencer marketing has created similar challenges. In 2015, Lord & Taylor paid influencers to post photos wearing a specific dress without disclosing compensation or free products. The Federal Trade Commission later

brought a complaint, resulting in a settlement that reinforced a clear rule: any compensated endorsement — whether from a celebrity, influencer or creator — must be disclosed clearly and conspicuously.

Across all of these examples, the takeaway is consistent: perceived independence matters. Legally. Reputationally. Practically. Transparency has to be designed into both content and distribution.

For independent trade magazines, the answer isn't rejecting advertising or partnerships. It's understanding that independence cannot simply be claimed — it has to be engineered. Readers can tolerate advertising. What they won't tolerate is uncertainty about what has been vetted, what has been paid for, and what reflects editorial judgment.

That puts real responsibility on publishers to:

- make editorial and promotional formats clearly distinct,
- avoid revenue structures tied directly to coverage outcomes,
- use plain language — not euphemisms — for paid content, and
- protect editorial authority, even when it costs in the short term.



Scan to take the survey

Manufacturing professionals understand how this industry works. You know when information is designed to inform — and when it's designed to persuade.

So we're asking for your help. Please take a short, five-minute survey to share how you view editorial independence, technical guidance, and how *Cutting Tool Engineering* should evolve — in print, digital, audio, or new formats still to come. **CTE**



about the author

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



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Metalworking Product Review



SOLID CARBIDE ENDMILLS WITHOUT NECK RELIEF.

Endmills from ISCAR's new EC-H5M-CF line are available without neck relief and feature a wide variety of new corner radii for diameters of 10 mm and up. Designed primarily for machining stainless steel and carbon steel, the new endmill line complements the company's existing EC-H5M-CF/NE series, making it suitable for a broader range of applications, according to the company.



TOOLING COMBINES MULTIPLE MACHINING OPERATIONS.

The COMBI compact tool from Heule Precision Tools can be configured to drill, chamfer, countersink and, in certain configurations, spotface. The tool is said to eliminate tool changes, reduce cycle times and enhance efficiency, according to Heule. Tailor-made solutions reportedly offer versatility and adaptability to site-specific manufacturing challenges. Sizes ranging from 9.5 mm to 35 mm are available.



SPEED INCREASERS FOR LATHES, SWISS-STYLE MACHINES.

Platinum Tooling Technologies Inc., the exclusive importer of Heimatec live tools and angle heads, now offers a complete range of Heimatec speed increasers designed for popular live tool lathes and Swiss-style machines offering gear ratios of 1:2, 1:3 and 1:4 with maximum speeds of 48,000 rpm. Design configurations include straight, offset, 9° degree and universal adjustable.



QUICK-CHANGE TOOLHOLDER SERIES.

Sumitomo Electric Industries has added shanks for internal coolant supply without a hose and external turning heads for ISO inserts to its Indexable Head Type Quick Change Tool Holder APM series for small lathes and autolathes. Shank sizes of 10 mm x10 mm, 12 mm x12 mm, and 16 mm x16 mm are available to support various CNC autolathes, with heads for various turning operations.

Machine Tool Accessories for Medical Applications



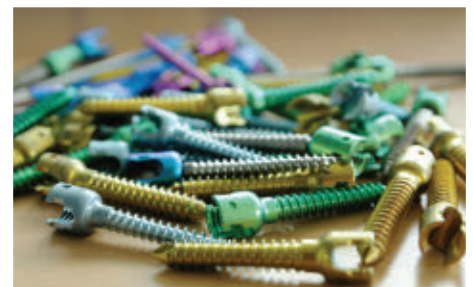
The challenges of manufacturing high-precision medical parts, often from exotic, hard-to-machine materials, are well known. **Platinum Tooling** can help.

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MANUFACTURING SIGNALS POINT TO CAUTIOUS STABILIZATION

A combination of recent manufacturing indicators suggests U.S. industrial activity may be entering a period of stabilization as the industry moves into 2026, even as demand patterns remain uneven across capital equipment, consumables and labor.

In early February, the Institute for Supply Management (ISM) reported that U.S. manufacturing activity returned to expansion territory in January. The ISM Manufacturing Purchasing Managers' Index (PMI®) registered 52.6%, up from 47.9% in December. Readings above 50% indicate expansion in overall manufacturing activity.

The improvement was driven primarily by gains in new orders and production, signaling strengthening demand at the start of the year. At the same time, the employment index remained below expansion, reflecting continued caution among manufacturers when it comes to workforce growth. While PMI data is often viewed as a forward-looking indicator, it offers insight into sentiment and near-term expectations rather than confirmed production activity.

Machine tool orders surge

More concrete evidence of industrial behavior can be found in data tracking actual purchasing decisions. According to the U.S. Manufacturing Technology Orders (USMTO) report from AMT – The Association For Manufacturing Technology, machine tool orders surged at the end of 2025, marking one of the strongest month-to-month increases of the year.

Machine tool orders in December 2025 totaled \$814.3 million, an 86.7% increase from the previous month of November and a 59.9%

increase compared to December 2024. For the full year, 2025 machine tool orders reached about \$5.74 billion, up 22.5% year over year. The December data represents the most current snapshot of capital equipment demand available as manufacturers entered 2026.

The sharp increase in machine tool orders suggests that manufacturers made significant capital commitments late in the year, potentially positioning themselves for higher utilization or longer-term production needs. Historically, machine tool

Agriculture and automotive production remain largely flat, while aerospace and defense continue to operate at elevated levels.

Jack Burley
Chairman of AMT's
Cutting Tool Product Group

orders tend to lead other manufacturing indicators, as investments in equipment often precede increases in output, tooling consumption and employment.

YTD cutting tool orders up 1.3%

Cutting tool consumption data, which provides a closer look at shop-floor activity, shows a more measured picture. According to the Cutting Tool Market Report, a collaboration between AMT and the U.S. Cutting Tool Institute (USCTI), cutting tool shipments totaled \$206.1 million in November 2025, the most recent month reported.

While shipments declined 17.6% from the previous month of October, they were up 9.9% compared to November 2024, indicating year-over-year growth despite short-term volatility. On a year-to-date basis, cut-

ting tool shipments reached \$2.34 billion, an increase of 1.3% over the same period in 2024.

Industry leaders note that recent gains in cutting tool shipments have been driven more by pricing than by unit growth. Jack Burley, chairman of AMT's Cutting Tool Product Group and president of BIG Daishowa, has pointed to rising costs for carbide- and HSS-based products as a key factor influencing shipment values. While manufacturers and importers continue efforts to manage pricing, higher material and production costs are becoming increasingly evident in overall dollar figures.

Burley also highlighted diverging demand across end markets. Agriculture and automotive production remain largely flat, while aerospace and defense continue to operate at elevated levels, providing an important source of demand for cutting tool manufacturers and suppliers. Looking ahead, he expressed optimism that costs and production levels will stabilize as the industry moves into 2026, potentially setting the stage for unit growth following a year of uncertainty.

Seasonality also played a role in the November decline in cutting tool shipments. Steve Stokey, executive vice president and owner of Allied Machine and Engineering, noted that cutting tool consumption typically experiences a drop late in the year. While the three-month moving average reflected this seasonal slowdown, Stokey emphasized that the 12-month moving average continues its gradual upward trend, a sign that longer-term momentum remains intact.

Overall picture

For machine shops and metalcutting operations, the combination of rising PMI readings, strong year-end

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machine tool orders, and steady cutting tool consumption presents a familiar but complex operating environment. Increasing new orders and production activity suggest higher shop utilization, yet flat unit volumes and cautious hiring indicate that many shops are being asked to do more with existing resources.

In practical terms, this environment often leads shops to prioritize productivity improvements, tool life optimization, and process efficiency rather than immediate workforce expansion. Investments in new equipment, reflected in the surge in machine tool orders, may be aimed at improving throughput, automation, or flexibility rather than simply expanding capacity.

The Cutting Tool Market Report is widely regarded as a leading indicator of U.S. manufacturing activity because cutting tools are the primary consumable in metalcutting operations. Unlike survey-based indicators, cutting tool consumption reflects actual production activity, making it a valuable complement to broader economic measures such as PMI.

Taken together, the latest data suggests that U.S. manufacturing may be transitioning from contraction to cautious recovery. Capital investment has accelerated, consumable demand shows modest improvement, and sentiment has turned more positive. However, uneven sector performance, ongoing cost pressures, and labor constraints continue to shape decision-making across the industry.

As manufacturers move further into 2026, the alignment — or divergence — between capital spending, consumable usage and employment will provide important signals about the durability of the recovery and the pace at which production activity ultimately grows. **CTE**

U.S. Machining Market Snapshot

Key Indicators Shaping Metalcutting Activity

Manufacturing Sentiment (Leading Indicator)

U.S. Manufacturing PMI (January 2026)

Indicator	Value	Signal for Machining
PMI	52.6%	Manufacturing returned to expansion
New Orders	Expanding	Increased quoting and backlog pressure
Production	Expanding	Higher spindle utilization expected
Employment	Contracting	Shops doing more with existing staff

Source: Institute for Supply Management

MACHINING TAKEAWAY: Shops typically feel the impact of rising new orders before hiring follows. Expect utilization gains before headcount growth.

Capital Equipment Demand (Investment Signal)

Machine Tool Orders (December 2025)

Metric	Value
Monthly Orders	\$814.3 M
Month-over-Month	+86.7%
Year-over-Year	+59.9%
Full-Year 2025	\$5.74 B (+22.5%)

Source: AMT – The Association For Manufacturing Technology (USMTO)

MACHINING TAKEAWAY: Late-year capital commitments suggest manufacturers are investing in automation, throughput and flexibility — not just capacity expansion.

Cutting Tool Consumption (Shop-Floor Reality)

Cutting Tool Shipments (November 2025)

Metric	Value
Monthly Shipments	\$206.1 M
Month-over-Month	–17.6% (seasonal)
Year-over-Year	+9.9%
YTD Shipments	\$2.34 B (+1.3%)

Source: Cutting Tool Market Report — AMT – The Association For Manufacturing Technology / U.S. Cutting Tool Institute

MACHINING TAKEAWAY: Dollar growth is being driven more by pricing and mix than by unit volume. Tool usage remains steady, not surging.

End-Market Demand Signals

Sector	Current Trend	Impact on Machining
Aerospace & Defense	Strong	High-precision, difficult materials
Automotive	Flat	Stable but cautious ordering
Agriculture	Flat	Limited upside near-term
General Industrial	Mixed	Project-driven variability

MACHINING TAKEAWAY: Shops tied to aerospace and defense continue to see stronger demand and tighter tolerances, while others face uneven workloads.

Cost & Pricing Pressures

Area	Direction	Implication
Carbide costs	Rising	Higher tool prices
HSS products	Rising	Margin pressure
Labor availability	Tight	Automation priority
Energy & overhead	Elevated	Process efficiency focus

MACHINING TAKEAWAY: Productivity gains are increasingly coming from tool life optimization, process control and smarter equipment use, not labor expansion.

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TOWER POWER

By William Leventon

When it comes to machine monitoring, there's a new option on the market that towers above the competition in the developer's eyes.

Designed and manufactured by Lyndex-Nikken in Mundelein, Illinois, the EZ-SmartTower is more than just a light that signals a machine's status to shop-floor personnel. Billed as an easy-to-use and cost-effective monitoring system for all machines in a shop, the product is designed to boost efficiency by helping shops evaluate their machine ROI. In addition to tracking machine performance, the

EZ-SmartTower provides real-time machine analytics aimed at assisting manufacturers in optimizing their processes, tracking employee performance and maximizing productivity.

Looking like a slightly larger version of a conventional status light, the tower sits atop CNC lathes, mills and other shop machinery. Wired to the machine controller, it features LED indicators that show whether the machine is running, idling or down, as well as current cycle and error times. These real-time status updates help operators make on-the-fly decisions that can boost workflow efficiency.

In addition to a separate tower

for each machine in a shop, the EZ-SmartTower system includes an app that allows operational managers to monitor and analyze up to 30 machines from one central computer. The tower is equipped with Wi-Fi technology that enables wireless data transfer from each machine to a master computer in real time. (If other wireless signal traffic in the shop would cause too much interference with the tower's Wi-Fi signal, connections from individual machines to the master computer can also be wired.) For security purposes, data gathered by the app is not transferred to or stored in the cloud — it stays in the shop.

The EZ-SmartTower system cap-

Sitting atop plant machinery, the EZ-SmartTower is designed to provide much more than conventional status lights.



Lyndex-Nikken

tures and displays a wide variety of machine, operator and part data. This data can be helpful in reducing bottlenecks, improving spindle utilization and improving production efficiency.

The system also offers different ways of displaying data on the shop floor. For example, a large screen in the plant can display what Michael Ricketts, automation product manager at Lyndex-Nikken, calls "the shop shot." With individual machines labeled by number or name, by the operator's name or in some other way, the shop shot "is going to show you across the floor how many machines are idling, how many are working, how many are offline, how many are alerting," he said.

For production managers, Ricketts added, another viewing option is a screen with pie charts showing percentages such as how much of the time each machine on the floor is up and running.

For detailed analysis, the free EZ-SmartTower software also lets users produce reports in chart or Excel format that can provide valuable insights into shop operations. For example, data-driven insights can help plant managers track individual employee performance and provide appropriate compensation based on productivity metrics.

Perhaps most important, data from the EZ-SmartTower can point

shops toward economical ways of increasing productivity. "People constantly say they need more throughput," noted Tom Dang, vice president of Lyndex-Nikken. "Some (think this requires) a huge investment,

meaning more spindles, more personnel, expanding your shop. But what if you do a critical analysis of your equipment and realize that you can do more with what you have? That's what this tool is about." **CTE**



about the author

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WORKHOLDING SYSTEM NUTS & BOLTS

By Brandt Taylor

Figure 1

Last issue I wrote about how and why 5-axis milling has become popular. This month I am looking at EMUGE-FRANKEN USA's new clamping solution for this process. EvoGrip is a modular system based on self-centering vises with zero-point plates called EvoPoint that allow for swapping vises while maintaining a zero position index. There are also riser blocks (EvoBlock) that are machinable from the bottom for a custom workpiece height. Three widths of vises, each with three lengths, many shapes and sizes of base plates and riser blocks all make for significant versatility.

The vises are similar to lathe scroll chucks in that they have base jaws, which slide on ways in the vise body, and reversible jaws that bolt to the base jaws. The reversible jaws clamp the workpiece. The base jaws don't protrude above the vise body and have sealed lubrication channels (see Figure 1). The jaws are moved by a lead screw that mounts into a bearing block at the center of the vise. The screw has a left-hand thread on one end and a right-hand thread on the other, so turning the screw moves the jaws simultaneously, toward or away from the center and each other. The bolts used for the reversible jaws are all ISO 898-1 Class 14.9, and exceptionally high clamping forces up to 75kN can be generated. These vises should be tightened with a torque wrench. EMUGE provides tables of torque versus clamping force and recommendations, so the correct force is used for a particular workpiece.

A large variety of reversible jaws are available. There are hard jaws with smooth surfaces or with teeth. The Vario reversible jaw sets can have round or square jaw inserts. The inserts come in sets of four and can be bolted to the reversible jaws to grip round or irregularly shaped parts. There are also soft jaws in steel or aluminum. The reversible jaws have provisions for work stops.

EMUGE's vises can be bolted to a T-slot table with standard T-slot nuts and keys, or used with the EvoPoint

indexing system. Then an EvoPoint base plate (see Figure 2) is bolted to the table with T-slot nuts and keys. There are also EvoPoint plates without table mounting bores for custom arrangements.

Pull studs, such as used on milling machine toolholders, screw into the underside of a vise. They locate and hold the vise to the EvoPoint zero-point plate. Figure 1 shows a vise that has four pull studs on its bottom and a pair of reversible jaws with their associated bolts. Four or eight pull studs are used, depending on the size of the vise. When the studs on the bottom of a vise are put into matching holes in a zero-point plate, a screw is turned on the side of the zero-point plate and all the studs are clamped, pulling the vise against the plate. This system has an industry standard square pull stud pattern of either 52 mm (2.05") or 96 mm (3.78").

EMUGE has hardware available to connect EvoPoint



about the author

Brandt Taylor is the owner of Taylor Engineering, a Berlin, Massachusetts-based machine shop. He can be reached via email at gbrandttaylor@gmail.com.





Figure 2

plates together in a daisy chain arrangement so all the pull studs in a setup are clamped or unclamped simultaneously. There is also hardware so an EvoGrip vise can be used with a competitor's zero-point index plate. Then the competitor's pull studs are used with adaptor sleeves on the threads. However, competitors' pull studs have 2 mm smaller threads. It's my opinion that EMUGE's new workholding system is more robust than other systems currently available.

EvoBlock riser blocks move the workpiece away from the face of the machine's rotary table. There are a variety of standard heights that can be stacked and some are machinable from the bottom side for a custom workpiece height.

And one last thing. If a workpiece is too big to be clamped by a vise, two vises can be used together. Then the leadscrews of each vise are linked by a telescoping coupling, and one reversible jaw is used on each vise so that turning the leadscrew assembly moves the reversible jaws toward or away from each other.

This system is designed for versatility, maximizing 5-axis milling machining capabilities. I can attest that the components of this system have excellent fit and finish.

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POWER OR STIFFNESS?

By Jeffrey Badger, Ph.D.

Dear Doc: What's more important when specing out a grinding machine: motor power or stiffness?

The Doc replies: Stiffness. I almost never see a grinding machine maxing out its motor. In fact, most motors, even in rough grinding, are running at maybe 30% of their maximum horsepower.

But low stiffness? That causes all sorts of problems: deflection in grinding and in dressing, increased chatter risk, the wheel not biting into the part during finish grinding, etc. If I'm suffering in grinding — burn, chatter, surface finish, long cycle times, deflection, and just about any problem — I seldom go to the back of the machine and look at the spindle-motor plate. Instead, I measure the stiffness. What do I find? That I'm working on an unstiff machine. I then have to lower my expectations: lower material removal rates, longer cycle times, more headaches.

That's one reason why I like machines from the 1960s and 1970s: they're often super stiff. Sure, they weigh several tons. But all that weight usually means higher stiffness.

If somebody said to me: "We're designing a new machine. We can give you double the motor power but half the stiffness. Or we can give you half the motor power but double the stiffness." Not knowing anything else, I would take the double stiffness every time.

Dear Doc: I have chatter marks on my workpiece. Is there a quick way to determine if it's coming from an out-of-balance or eccentric wheel?

The Doc replies: Yes. Easy. First, take 4" (100 mm) of length in the

ground workpiece in the direction of grind (for surface grinding or cylindrical grinding). Then count the number of chatter marks (or chatters). Divide the number of chatters by 4" (or 100 mm). That'll give you the number of chatters per inch (or millimeter). Now take the workpiece surface velocity and multiply by the number of chatters per inch (or millimeter). That'll give the chatter frequency in chatters per minute. (Yes, chatter is usually given in chatters per second, or Hz, but here we're doing it in chatters per minute.)

If that result is close to the wheel rpm — maybe within $\pm 10\%$ — then those chatter marks might be caused by an out-of-balance or eccentric wheel. If the answer isn't close, then your chatter is coming from somewhere else.

An example: Joe the Grinder counts 57 chatters in 100 mm. His chatter spacing is 0.57 chatters per millimeter ($57 \div 100$). His workpiece is running at 3,000 mm/minute. His chatter frequency is 1,710 chatters/minute ($0.57 \times 3,000$). His wheel is running at 1,800 rpm. Joe decides 1,710 chatters/minute is close to 1,800 rpm, and concludes he may have an out-of-balance or eccentric wheel.

Another example: Joe the Grinder counts 157 chatters in 100 mm. His chatter spacing is 1.57 chatters per mil-

limeter. His workpiece is still running at 3,000 mm/minute. His chatter frequency is 4,710 chatters/minute. His wheel is running at 1,800 rpm. Joe decides that 4,710 chatters/minute isn't close to 1,800 rpm, and concludes that his chatter isn't caused by an out-of-balance or eccentric wheel.

Dear Doc: I'm doing a cylindrical OD grind in a steel shaft, putting a form into the workpiece. My wheel supplier gave me an H-grade wheel. That seems off. Am I right?

The Doc replies: That's definitely off. Cylindrical-OD operations have a short arc length. Therefore, your starting point is a harder-graded wheel. My chart in *The Book of Grinding* puts OD in the range of J-grade to O-grade. If we have a flat 1A1 wheel, then J-grade works. If we're putting a form in, you need closer to N.

Maybe. Mostly. But there are other factors. Are we worried about burn? Then move to a grade softer, from N to M or L. Are we grinding a difficult-to-grind grade of high-speed steel? The workpiece will dull the wheel, so we need to release those dull grits. Therefore, we go a grade softer, say from M to L. Do we have a small wheel diameter and a fixed wheel RPM? That means a slower wheel surface speed, meaning we have to go a grade harder. Now we're up to O. Unless it's a slow wheel surface speed and a nasty high-speed steel, so we're at N. Or M. Or something else.

None of this is an exact science. And every wheel manufacturer is different in terms of how hard their wheels are. If your salesperson says, "These wheels tend to run hard," then go a grade softer than usual.

But H? That's too soft for just about all cylindrical-OD operations with a form. **CTE**



about the author

Jeffrey Badger, Ph.D., is an independent grinding consultant. He'll be giving his popular High-Intensity Grinding Course in Toledo, Ohio

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FINANCING THE MIDDLE-MARKET GAP

By Ken Spaeth

Middle-market manufacturers occupy a critical but often overlooked segment of the U.S. industrial economy. They are large enough to anchor supply chains, employ hundreds of workers and invest in advanced production capabilities — yet, they're still small enough to feel the constraints of limited capital access, volatile cash flow and tightening credit conditions. As global competition intensifies and technology reshapes the manufacturing landscape, these companies face a financing environment that can either accelerate their growth or hold them back. Recognizing and understanding the financing obstacles they encounter is essential for leaders seeking to modernize operations and remain competitive. So let's delve into these obstacles.

No-man's-land

Middle-market manufacturers often find themselves in a financing no-man's-land. Too big to qualify for many small business lending programs, and too small for capital markets available to large corporations. This disadvantage means they must compete for capital under conditions that rarely favor them. Lenders tend to view manufacturing as cyclical and capital-intensive, which leads to conservative underwriting standards and higher borrowing costs. As a result, even well run companies with strong customer bases can struggle to secure financing.

Collateral challenges

Manufacturing requires expensive, specialized equipment — CNC machines, robotics and more. While

such assets are essential for operations, they're not always attractive to lenders. Equipment can be highly customized, difficult to resell and subject to rapid obsolescence. Banks often apply steep discounts when valuing machinery as collateral, which limits the size of credit options. In the event of liquidation, lenders might see pennies on the dollar.

Similarly, inventory of raw materials and work in-process fluctuate in value, making lenders cautious about extending large working-capital lines secured by these assets.

Cash flow management

Manufacturers frequently face long production cycles, large upfront material purchases and delayed customer payments. This creates uneven cash flow that can strain liquidity, especially during periods of rapid growth or supply-chain disruption. Also, many middle-market manufacturers rely on a handful of major customers. Sometimes a single OEM accounts for more than half of a company's annual revenue. While these relationships can be stable, lenders view such customer concentration as a risk factor, which can mean reduced credit availability or increased collateral requirements.



about the author

Ken Spaeth, CFO and Director of Sales at Cutting Tool Engineering, spent 25 years as a commercial lender with a specialty focus in asset-based lending. If you have a commercial lending question, email it to him at kspaeth@ctemedia.com.



Long-term capital limits

Growth in manufacturing often requires long-term investment: new facilities, automation, digital transformation and workforce development. Yet, long-term capital is precisely what middle-market manufacturers struggle to obtain. Banks prefer short-term working-capital loans tied to receivables and inventory, not multi-year financing for plant expansion or advanced technology. Private equity can fill the gap, but many manufacturers — especially family-owned firms — are reluctant to give up control. Public markets are typically out of reach due to size, compliance costs and the volatility of earnings in cyclical industries.

In recent years, rising interest rates have added another layer of difficulty. Manufacturing is inherently capital-intensive, so higher borrowing costs directly impact margins and investment decisions. At the same time, banks have tightened credit standards in response to economic uncertainty. This combination has made it harder to refinance existing debt, pursue acquisitions or fund modernization initiatives.

Looking ahead

Middle-market manufacturers remain resilient. Many are exploring alternative financing options such as asset-based lending, equipment financing, mezzanine debt and government-backed programs. Others are strengthening financial reporting and operational efficiency to improve their credit profile. Ultimately, the companies that succeed will be those that proactively address financing challenges and align their capital strategy with long-term growth goals. **CTE**

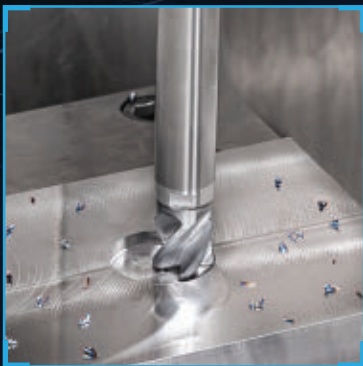
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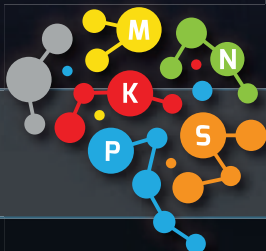


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SCAN ME



AUTO INDUSTRY DRIVES

A look at major manufacturing advancements now commonplace in machine shops.

By Christopher Tate

Entering an automotive machining facility can feel like entering an alternate universe for those who have never experienced it. Automotive manufacturing utilizes common machining processes like milling, turning and broaching, but the demands on machines and people are vastly different.

Automotive manufacturing has stringent quality requirements, requires very fast cycle times, operates on razor thin margins and has no allowance for delays. Creating manufacturing processes that conform to these demands can be challenging, but that's what drives advances in manufacturing. Many of the advancements that have become commonplace in every machine shop can be attributed to the automotive industry. This article looks at the industry's influence on several major machining advancements over the years.

Interchangeable Parts

Consider the concept of interchangeable parts, often attributed to people like Honoré Blanc, Eli Whitney and Henry Maudslay. It was Henry Ford and the automotive industry that perfected the engineering standards and manufacturing techniques that made interchangeable parts common.

A Moving Assembly Line

The moving assembly line is ubiquitous in modern factories. Everything from airplanes to dishwashers rely on moving assembly

lines today. The moving line was another Ford invention that revolutionized manufacturing. Before Ford's introduction, assemblies sat in one place while men and materials moved from place to place in the factory. Stationary assembly is almost unheard of in modern manufacturing — even bespoke items like a Rolls Royce are moved from station to station for assembly operations.

Lightweight Materials

Although the aerospace industry initiated the development of lightweight materials like aluminum, magnesium and carbon fiber, the automotive industry drove the proliferation of these along with the advanced processes needed to manufacture them in a cost-effective manner.

Quality Control

Automotive manufacturers also devised and perfected formal quality systems. Auto makers gave them different names in an effort to dif-



ferentiate their companies in the market, but the systems shared common foundations in statistical process control. Quality professionals from the automotive sector have carried the systems to other industries making them common across manufacturing — making terms like capability, repeatability and process qualification common in manufacturing.

Reducing Costs

Given that cost reductions are a way of life in automotive manufacturing, automation is constantly advancing in the automotive world. Back in 1961, General Motors was the first to use robotics in a production setting. Robots are found in all types of manufacturing today, and are even being sold as options with machine tools like turning centers. GM was ahead of other manufacturers by decades.



about the author

Christopher Tate is the owner of Tate Engineering, a Natchez, Mississippi, firm that helps manufacturers solve efficiency problems. Tate, who holds a master's degree in industrial technology from Mississippi State University, has 32 years of experience in the metalworking industry. Contact him at chris23tate@gmail.com.



MACHINING TECH



Indexable Inserts

Indexable inserts are the standard for machining operations today, especially in turning operations. It was the high volume demands of automotive manufacturing that drove materials research and development that gave rise to the common insert. While the insert was not developed by the automotive industry, its demand for better cutting tools and reduced machining costs drove cutting tool makers to develop these tools.

Forming Techniques

Significant advancements in forming techniques and tooling have come from automakers. The need to reduce manufacturing costs and improve fuel economy have given rise to advancements like unibody construction. Making a car that does not have a traditional frame requires distributing

the forces across the formed components of the body. Formed panels must be stiffer and constructed so that they can be assembled accurately. These requirements resulted in advanced engineering designs and complex forming processes. Over time, like quality systems, these design techniques and forming processes have migrated to other industries like appliance manufacturing.

Lean Manufacturing

One of the most significant and recognizable contributions that has come from the automotive industry is lean manufacturing. Taiichi Ohno, Edwards Deming and Henry Ford were all auto makers or closely associated with auto making, and each played a major role in developing the foundational concepts of lean manufacturing. It was the automotive industry that developed,

documented and propagated what we call lean manufacturing today.

Automotive Industry Impact

In many cases automotive manufacturing has been directly responsible for significant advancements in manufacturing technology. At other times, as early adopters of technology, automotive manufacturing has driven advancements that eventually became common in all manufacturing sectors.

Automotive manufacturing is demanding. Cost pressures, volume and scale create a unique manufacturing environment. Because of this auto makers are routinely on the cutting edge of manufacturing technology, and their advancements benefit all other manufacturing sectors. No other industry has as much impact on "manufacturing" as the automotive industry. **CTE**

SPEED NEEDS PRECISION

Advanced toolholding allows Ed Carpenter Racing to push spindle speeds while holding race-critical tolerances.

IndyCar regulations list several parts race teams can make themselves to help reduce the cost of putting cars on the track. Most of those parts are suspension components, such as dampers and various chassis elements like front and rear rocker components. Teams can also produce other items, such as throttles and brake pedals. When an IndyCar team like Indianapolis-based Ed Carpenter Racing produces parts in-house, the team not only saves money, it also can change and tweak those components to improve the overall racecar performance.

Ultimately, the expectations for

the team's racecars and machine shop are the same: go fast. There is always a need for the parts produced in-house because cars get damaged on the track or parts simply wear out.

The Ed Carpenter Racing team machines most of their parts from 7075 and 7075 T6 aluminum. Many of these parts are for modifications to a car's dampers, which provide stability and help increase fuel mileage.

Currently, the team fields two cars for the full season in the NTT IndyCar Series and three cars for the Indianapolis 500. Ed Carpenter Racing employs roughly 75 people, three of whom run the

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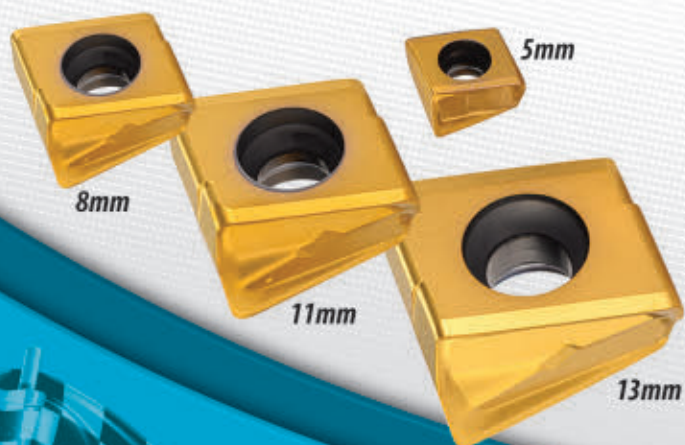
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Speed Needs Precision

team's machine shop, and there are typically four mechanics and one crew chief per car. In addition to building cars, the team also disassembles them throughout the season to conduct part crack tests and check suspension components between races.

The shop typically produces parts for one race season at a time and will make extras beyond that amount for stock. These aren't high-volume jobs, but they require many smaller associated parts that

plained Brent "Woody" Harvey, Ed Carpenter Racing engineering manager. "We need to hold tolerances typically to within ± 0.003 ", but for critical damper parts, tolerances must be within ± 0.0002 ."

With the driver top of mind, Harvey added, "we have to maintain smooth surface finishes because there are several mating components that fit together and slide up and down, and the less friction the better to help the car maintain its stability and handling."

According to Harvey, if the team kept using its original holders, the shop would have to machine at

at speeds up to 42,000 rpm. Additionally, the vibration-damping taper-to-taper, press-fit, collet-holding design of the powRgrip system creates a juncture point, or gap, that essentially interrupts the waves of vibration — caused by runout — to reduce their strength and severity.

With the new holders, Ed Carpenter Racing reports that it maintains precision and critical surface finishes, extends tool life, minimizes tool runout to less than 0.0051 mm (0.0002") and shortens cycle times.

Harvey said the team machines parts at the full 24,000-rpm spindle speed for the majority of the time, which would be impossible without the powRgrip system. As a result, jobs that once took two or three weeks are done in a couple hours. This capability allows the shop to mill more intricate car parts, including those it will eventually 3D print and finish on the milling machine.

According to Jason Clark, Ed Carpenter Racing's director of team partnerships, the powRgrip solution resulted in Rego-Fix becoming a technical partner for the team. "Our Rego-Fix partnership is very important to us and has progressed and strengthened each year over the past three years," Clark said. "They allow us to reap the benefits of high-speed machining with their tooling.

"In turn," he continued, "we provide hospitality for Rego-Fix to utilize at our races throughout the season and promote the partnership through our social channels, and branding on our race cars, as well as on garage and team equipment."

When Ed Carpenter Racing puts drivers in cars made to hit speeds over 321.9 km/h (200 mph), every component is critical, especially those machined in-house. Excessive tool runout during machining costs the team time and money. More importantly, it threatens the integrity of those parts and puts drivers at risk. **CTE**



Rego-Fix USA

To reduce the cost of parts and simultaneously increase production speed, Ed Carpenter Racing acquired a 5-axis CNC milling machine with a maximum spindle speed of 24,000 rpm.

the team needs on a regular basis, such as various types of fasteners and brackets.

To accomplish both part cost reduction and increased production speed, Ed Carpenter Racing acquired a 5-axis CNC milling machine with a maximum spindle speed of 24,000 rpm. Unfortunately, the team quickly realized that cutters spinning that fast required the right toolholders.

"The holders we initially used resulted in some serious runout at 24,000 rpm, which hindered our ability to hold part tolerances," ex-

plained Brent "Woody" Harvey, Ed Carpenter Racing engineering manager. "We need to hold tolerances typically to within ± 0.003 ", but for critical damper parts, tolerances must be within ± 0.0002 ."

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GROWING APPEAL OF PCD

What you need to know about using PCD tools.



By Andrew Schiller

Decades ago, sintered tungsten carbide was a revolutionary new material that reshaped the metal cutting industry. Today, it remains the go-to choice for most metal cutting applications. But the landscape has begun to shift again. Since Horst Lach debuted the world's first PCD tool for metal cutting in 1973, polycrystalline diamond (PCD) has quietly grown from a niche material into a solution that every manufacturing engineer, shop owner and machinist should be asking about.

How might PCD tool technology affect your business? Could it be

the key to faster cycle times, longer tool life and better surface quality? To answer these questions, we must first review what you need to know about using PCD tools.

Some PCD background

PCD stands for "polycrystalline diamond," and the name itself reveals a lot about what the material actually is. Structurally, sintered tungsten carbide and PCD are quite similar. Both are composites — materials made from two parts that retain some beneficial properties of each. In the case of carbide, millions of very hard grains of tungsten carbide are held together in a metallic binder, almost always co-

balt. In simple terms, carbide owes its hardness to the tungsten carbide grains, and its toughness to the metallic binder.

PCD is essentially the same, except that grains of tungsten carbide are replaced with millions of tiny diamonds. Diamonds being much harder than tungsten carbide, the result is a material with a hardness that far exceeds any other cutting tool material.

But simply creating a harder cutting tool material doesn't mean that it should be used in every possible application. Knowing when to use PCD cutting tools requires an understanding of how PCD can be tuned for optimal performance in

different applications.

First, manufacturers can control the average size of their diamond grains. Smaller grains will limit plastic deformation and promote more intimate linking between individual grains (each grain will be touching more neighbors), ultimately making the material harder. Like carbide, PCD made from smaller grains will also be able to hold sharper cutting edges, so these materials are often used for finishing applications. PCD grades made from more coarse

mond grains or more faceted diamond grains will interact with one another and with the binder differently. In some cases grains are chosen to provide a more intimate bonding between neighboring grains during sintering, which improves hardness; in others, a more intimate bond with the binder is desirable, improving toughness. During sintering, the cobalt binder also acts as a catalyst to promote recrystallization, which may or may not be desirable depending on the needs of the application. On the other hand, more sharply faceted grains will not compact as closely and will reduce the bond be-

Eventually these shapes are brazed onto the body of a cutting tool and sharpened. In other cases, PCD is formed inside a “slit” in a tungsten carbide cylinder. These cylinders can be brazed to drill bodies and carefully shaped into drills where the PCD forms only the cutting edges.

Given the fact that PCD is so hard, shaping PCD into an accurate cutting tool has always proved challenging to manufacturers, and many view this step as something that makes their tools superior to others. Three methods are used.

Many PCD cutting tools are physically ground using diamond grind-

PCD is made of millions of tiny diamonds held together by a metallic binder, which results in a composite with a hardness that far exceeds any other cutting tool material.

grains offer better wear resistance in materials like GFRP, CFRP, and high-silicon aluminum alloys.

Second, manufacturers can control the amount of metallic binder used in their PCD. Increasing the binder content will make PCD softer but tougher — more suitable for interrupted cutting — but this will also reduce PCD’s ability to hold a sharp cutting edge, which is essential for applications requiring fine finishes. Depending on how the PCD is manufactured, the binder might be mixed in with diamond grains as cobalt powder before sintering, or manufacturers might simply rely on the movement of liquid cobalt from nearby tungsten carbide when sintering temperatures reach the melting temperature of the cobalt.

Third, and less well-known, manufacturers can also tune the properties of PCD by controlling the shape and size distribution of the diamond grains and the quality of the binder. Monitoring these characteristics is one area where high-quality manufacturers might distinguish themselves from low-cost competitors. For example, more rounded dia-

mond grains offer better wear resistance in materials like GFRP, CFRP, and high-silicon aluminum alloys. Second, manufacturers can control the amount of metallic binder used in their PCD. Increasing the binder content will make PCD softer but tougher — more suitable for interrupted cutting — but this will also reduce PCD’s ability to hold a sharp cutting edge, which is essential for applications requiring fine finishes. Depending on how the PCD is manufactured, the binder might be mixed in with diamond grains as cobalt powder before sintering, or manufacturers might simply rely on the movement of liquid cobalt from nearby tungsten carbide when sintering temperatures reach the melting temperature of the cobalt.

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about the author

Andrew Schiller is an engineering instructor at Utah Tech University in St. George, Utah, where he teaches product design and manufacturing. He spent nine years working in engineering for Caterpillar and GE Appliances before joining Utah Tech. Email him at Andrew.Schiller@utahtech.edu.



there is strong evidence that modern femtosecond lasers eliminate this problem by pulsing the laser so quickly that heat doesn't have time to travel into the nearby diamond (one femtosecond is to one second as one second is to 30 million years). Using femtosecond lasers, ablation is recognized as the most sophisticated way to shape PCD cutting edges, and can be used to make micro-tooling where the entire tool body is solid PCD and cutting edges actually contain sharpened diamond grains; but currently the equipment is very expensive.

When not to use PCD

In practical terms, knowing what PCD is and how it is manufactured will help you understand when to use PCD tools. But it's often more helpful to begin by talking about when not to use PCD, and that requires a discussion about PCD's

limitations.

First, the toughness of PCD is relatively low compared to carbide, thus it is more prone to brittle failure. This means that vibration should be avoided, and highly rigid toolholding and workholding are essential. Toolholders should be clean, stout and as short as possible. Drawbar force should be adequate, the spindle taper should be in good condition, and pull studs (when used) must not be over-torqued or worn badly. Ultimately, this means that PCD cutting tools should not be used without careful consideration of the setup and machine involved. In some cases, the machine or workpiece might not be rigid enough to use PCD tools, despite an operator's best efforts.

Second, PCD is uniquely sensitive to temperature for several reasons. Alone, diamond will decompose into graphite around 1,700° C, but

the diamond in PCD begins to decompose around 700° C because cobalt acts as a catalyst to promote graphitization. Cobalt readily dissolves into diamond, which makes it an ideal binder material that "sticks" to the diamond grains quite well; but this affinity also has negative effects. Cobalt atoms dissolved inside the diamond lattice will weaken atomic carbon bonds and reduce the energy required for decomposition. Graphitization aside, cobalt also has a much higher coefficient of thermal expansion than diamond. If the tool becomes too hot, the cobalt binder can expand so much that individual diamond grains become dislodged from the cutting edge. Furthermore, PCD tools often contain one or more brazed joints, and even the best brazed joints will begin to soften around 600° C to 950° C. All of these concerns are the main



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Growing Appeal of PCD

reasons PCD is not yet used to cut materials like titanium and nickel, where cutting temperatures are usually high.

Third, if they come into contact with iron, the carbon atoms in diamond grains will readily diffuse into the iron and form iron carbide (Fe_3C), especially at elevated temperatures. This will lead to gradual erosion of the diamond as it loses atoms to the iron around it, and this ultimately means that PCD is not effective for cutting ferrous materials in most situations.

Knowing these limitations also helps us see several applications where PCD cutting tools truly shine.

maxing out your spindle speed running carbide, then switching to PCD won't help you in this area.

The second most common reason to use PCD cutting tools is improved surface finish. PCD's hardness and ability to hold a sharp cutting edge make it capable of creating low-roughness surfaces. In situations where roughness must be controlled carefully, either for aesthetic reasons or for functional sealing surfaces, this can make the difference between success and scrap. But vibration must be avoided, and the entire machine and toolholder assembly needs to be considered as a system.

Lastly, PCD cutting tools are used because they offer increased tool life (and thus better process reliability) in abrasive materials. Cast

special woodworking industry is also dominated by PCD cutting tools. The benefit here goes beyond any direct reduction in tooling cost a shop achieves. In many cases manufacturers are seeking to improve process-reliability so that they can trust tools and safely run processes with less oversight and less variation from part-to-part.

Although PCD tools do have more unique limitations than carbide tools, there are companies working to overcome these limitations. Companies like Sumitomo offer "binderless" PCD grades that can be used to machine materials like tungsten carbide and ceramics. Some research also suggests that binderless grades are the future of machining titanium and nickel alloys. Innolite GmbH successfully

Typical surface speeds for PCD in aluminum are three to five times higher than carbide, making cycle time reduction a primary driver for adoption.

When to use PCD

Assuming they are used correctly, PCD cutting tools offer three primary advantages.

The most significant advantage is usually a reduction in cycle time. PCD can hold sharper edges, has a much smoother rake face that reduces built-up-edge (BUE), and has a higher thermal conductivity than carbide. Because of this, typical surface speeds for PCD in aluminum are three to five times higher than carbide. Assuming you have a spindle that allows you to take advantage of these extreme surface speeds, cycle time could be reduced by that same factor, directly affecting your profitability. This potential reduction in cycle time is what might motivate an automotive manufacturer to spend over \$10,000 on a single PCD face mill. The savings from a reduction in cycle very soon outweigh the cost of the tooling. But if you're already

aluminum parts, with their elevated silicon content, are known for wearing carbide tools. In many cases, switching to PCD can increase tool life tenfold (or more). As automotive manufacturers are fighting to make their EVs lighter by using more cast aluminum, their suppliers are turning to custom PCD cutting tools to increase tool life. This helps them machine these components profitably, not only by reducing cycle time, but also by giving them more confidence in the process — something necessary for automation. Beyond aluminum, other abrasive non-metallic materials are often machined using PCD. Aerospace manufacturers are turning to PCD tools to trim carbon-fiber panels and drill holes in multi-material laminations containing carbon fiber reinforced polymers, and circuit board manufacturers are using PCD tools to drill and trim fiberglass-reinforced materials. The commer-

cial uses monocrystalline diamond to machine ferrous materials by oscillating the tool at high frequency, where intermittent contact prevents the diffusion of carbon into the iron. Companies like NS Tool offer spherical PCD tools (without cutting edges) for burnishing steel molds and increasing the diameter of holes. Moving slowly to keep temperatures low, these tools can achieve finishes unthinkable with other tools, even in ferrous metals. Other companies are investigating specialized coatings that promise to protect the PCD substrate from elevated temperatures.

Will PCD change the cutting tool industry in the same way that carbide did, and could PCD tooling offer your shop the next leap in productivity? The answers are not simple, but there are cases in which PCD tools can make a big difference. In the future, chances are those cases will become more common. **CTE**

The A-Tap is made from powdered metal HSS and has OSG's patented V coating to enhance wear resistance.



OSG USA

TIP TOP TAP

High-performance cut taps are effective for demanding threading applications and can be suitable for less challenging scenarios as well.

By Alan Richter

Cutting tool manufacturers frequently offer good, better and best lines of their various offerings, and cut taps are not an exception.

When it comes to high-performance taps, Guhring Inc. in Brookfield, Wisconsin, offers the Pionex brand, said Daniele Mintrone, product manager for taps/tapping tools. Originally designed for tapping stainless steel, eventually Pionex taps also became effective for threading moderate to large

batches of high-tensile steel, cast iron and some aluminum workpieces. "Over time," he noted, "it turned out that this is a pretty good universally used tool."

Based on a geometric modification, the company reports that the contact surface between a Pionex tap has been optimized to reduce torque by up to 30%. A reduction in torque minimizes tool breakages so that the tensile strength of the tool is not exceeded.

"It does not only reduce tool breakages, but at the same time increases tool life," Mintrone said,

adding that tool life is extended about 30% to 50%. With that capability, an end user can choose to run a Pionex tap at least 25% faster than a conventional tool.

To boost productivity, end users sacrifice some tap life. Stephen Putek, product engineer I for OSG USA Inc. in St. Charles, Illinois, noted that he heard from one customer who prioritized productivity over tool life by tapping twice as fast while losing about 40% of the tap life. "But they're happy to get these parts out the door a lot quicker. Then there are others who



YMW Taps USA

The Yonezawa Plant in Japan is the main production facility of the Yamawa group.

Tip Top Tap

just need the thing to last as long as humanly possible, and they'll do whatever it takes to make it last."

The substrate options include HSS, powdered metal HSS and carbide, with powdered metal providing some of the benefits of both HSS and carbide, he explained. Mintrone advises against the use of a carbide tap to cut high-tensile steel because of its enhanced brittleness. A carbide tap is a better choice for threading aluminum and titanium aerospace and medical parts.

About 95% of the taps are coated, Mintrone said,

mainly with TiN or TiAlN, as well as AlCrN and TiCN. The specific coating needs to provide hardness and smoothness to prevent material from sticking to the tap. "I personally advise against using an uncoated tool, mainly because of tool life reasons and chip evacuation reasons." However, an uncoated tool is suitable when cutting a thread by hand.

Prior to coating, the taps are wet blasted with a mixture of water and sand and then dry polished with natural ingredients, as well as diamond dust, he noted. The special finishing processes impart a fine surface finish to reduce tapping friction and torque, which improves chip evacuation.

about the author

Alan Richter, a 40-year veteran journalist, has spent the last 25 years covering the metalworking industry for Cutting Tool Engineering and currently serves as its editor-at-large. Contact him at alanr@ctemedia.com.



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For more information from Guhring about its Pionex taps, OSG USA about its A-Tap series and YMW Taps USA about its VU series taps, view video presentations at www.ctemag.com by scanning the QR code with your smartphone or entering the URL on your web browser: <https://qr.ctemag.com/26mep>.



Geometry at Work

High-performance taps have geometric features to boost their capabilities. One feature is a larger core to strengthen and stabilize the tool, Mintrone noted. Another is a thread relief that's designed to reduce contact between the flanks of the thread lands and the workpiece, preventing the chip from getting between the workpiece and the cut tap.

"It usually depends on the pitch of the tool, but we're talking about like 0.02 mm. It sounds like it's not much, but it is," he said. "We can't go too large with the relief because we want to make sure the tool keeps its self-guidance ability."

The helix also plays a significant role, and the angle depends on the application. "When it's a long chipping material, we usually go with a 25° up to a 45° helix to ensure good chip evacuation," Mintrone said. "When it's short chipping materials like cast iron or bronze, we usually go with a straight-fluted tool or maybe up to a 15° helix."

For OSG's A-Tap cut taps, the helix is 45° at the chamfer and transitions to 15° toward the shank. Putek described the A-Tap as the toolmaker's go-to cut tap and "our best option on the market" for threading steel, stainless steel, cast iron and aluminum. As the



Guhring

Guhring's 4652 Pionex spiral-flute UNC cut tap (top) and the 4658 Pionex spiral-point UNC cut tap. Both HSS-E taps feature the company's Slidur coating.

helix transitions to 15°, the flute space widens to enhance chip evacuation compared to a constant 45° helix where there is more physical distance to disengage chips from the top.

"The 45° helix at the chamfer helps you increase the rake angle up front towards the chamfer, and that's going to make it very easy for the chip to start working its way up the flute," he said. "Then as we get farther and farther back, we want to get those chips away from the flute, and the flute space on our A-Tap actually widens towards the back."

When it comes to the size of the chips, Jun Ahiko, product engineer II for OSG, explained that a tap with a low rake angle generates large chips while a sharp

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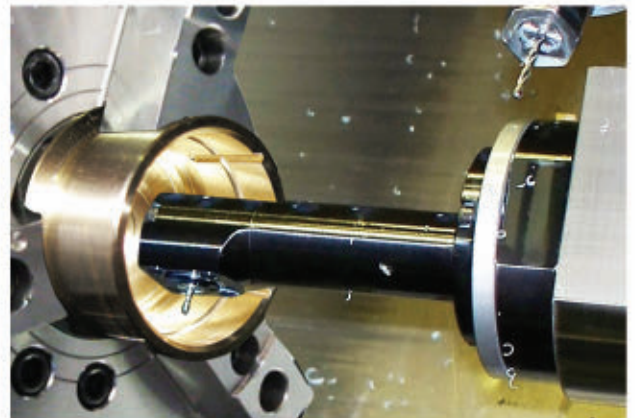
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Tip Top Tap

rake produces smaller chip shapes. "A-Tap has a sharp rake angle on the cutting edge. Generally speaking, a sharp cutting edge is weak and doesn't have enough wear resistance, but the A-Tap has a V coating and a powder metal substrate in order to keep the wear resistance. A-Tap has a good balance between wear resistance and the sharp cutting edge."

Putek added that the V coating is based off of a multilayer TiCN coating to enhance the wear resistance and extend tool life.

Regarding the substrate, Ahiko noted that the powdered metal, sintered with cobalt and vanadium, balances wear resistance and toughness. "That's also heat treated to a hardness of approximately 65 Rockwell just to make sure that it is going to give you the maximum wear resistance."

Carbide is still used as a substrate, Putek said, but the lower toughness and the higher price make it more suitable for niche applications, such as when tapping cast iron to resist wear because the workpiece can be quite abrasive due to its high carbon content.

Another application is tapping aerospace components made of carbon fiber-reinforced composites — another abrasive material. "We have diamond-coated carbide taps in order to maximize the life of the tap in those applications."

Primarily, however, end users typically gravitate toward the A-Tap series for production environments where they are looking to minimize the cost per unit as much as possible, where you are dealing with potentially millions of holes, Putek said.

Another suitable application is in difficult-to-tap materials where issues with chip entanglement occur, such as gummy stainless steel like



The Z-PRO tap series from YMW Taps includes VUSP spiral-fluted taps (top) and VUPO spiral-pointed taps.

304L, according to Putek. "We find that some people gravitate towards the A-Tap just because it's able to control that chip formation and minimize any sort of troubleshooting issues on the spindle regarding chip entanglements or chipping of the tap due to poor chip evacuation."

Material Specific

Another high-performance option is the ZELX taps from YMW Taps USA in Santa Ana, California, which are manufactured by Yamawa Manufacturing Co. Ltd. in Japan. The series includes the ZELX SS taps for stainless steel and other materials, ZELX NI taps for cobalt and nickel- and iron-base exotic

materials, as well as stainless, mold and tool steels harder than 30 HRC, ZELX TI taps for titanium alloys, and ZELX AL for zinc die cast aluminum, wrought aluminum, silicon die cast, copper and magnesium.

Jeff Helfer, president of YMW Taps USA, noted that it doesn't take a lot of torque to break a tap, so the freer cutting the tap is the less torque is required. "Tapping is your last operation, so everybody is scared to tap. We try to make the best geometry for each material that we can to reduce the torque on that particular application."

Based on over 100 years of research and development into threading tools, YMW has set the optimal rake angle for each of the many materials, Helfer said. "The lower rake angle would be for the hardened materials like nickel-base alloys. The higher rake angle is for softer materials. "The ZELX SS is what we call our bread-and-butter tap designed for stainless and below," Helfer added. "It will do low- to high-carbon steels, cold-rolled steels all the way up to 304 and some soft A286."

The ZELX SS and AL taps are

contributors

Guhring Inc.
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OSG USA Inc.
800-387-2223
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YMW Taps USA
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www.ymwtapsusa.com

'I personally advise against using an uncoated tool, mainly because of tool life reasons and chip evacuation reasons.'



OSG USA

OSG reports that its A-Tap spiral point series has unique geometry that enables greater chip control to help produce tightly compacted chips for easy ejection from the hole. The spiral flute series has adopted a variable-helix flute design, which encourages stable chip evacuation and reduces cutting forces.

made with a custom blended high vanadium HSS and the ZELX NI and TI taps are made with powdered metal HSS. "We do make some carbide taps but they are mostly straight-fluted taps," he said.

Helfer pointed out that the TI taps have a large OD and pitch diameter relief. "Titanium alloys have a memory to it, so when the tap backs out it will shrink back down, and we solved that by putting those reliefs on there."

YAMAWA's latest tap offering is the Z-PRO series, which has an extended length to make it easier to evacuate chips and feed coolant, according to Helfer. It makes the chips come out in a wide fan, so they are not tangling up on the

taps — a benefit that's increasing in demand as many manufacturers are introducing high-performance machining centers and promoting automation to improve production efficiency.

"Adoption of the Z-PRO series, which prevents chip related problems and enables stable, continuous machining, is rapidly expanding," Helfer said.

The Z-PRO includes VUSP spiral-fluted taps and VUPO spiral-pointed taps, which come standard with a TiCN coating, he said. "We can make the best recommendations to customers according to what their application is."

Yamawa builds its own thread grinding machines to make taps,

Helfer added. "This is because taps for tapping highly reliable screw threads require even higher precision, and our machine tool manufacturing department can carry out maintenance at the appropriate timing to constantly keep the high precision of our thread grinding machines so that we can continue to produce these high-precision taps stably."

Ultimately, a high-performance tap is not necessarily designed to last longer or thread faster than a conventional tool; it is meant to produce reliable screw threads. "We try to sell taps for the high precision internal threads by price per hole and not price per tool," Helfer said. **CTE**

'SAW WHAT YOU DID THERE

Sinking some teeth into a vital machining process that sometimes gets taken for granted.

By Robert M. Layng

Sawing, in all its forms, is a process between raw bar stock and finished parts for a vast majority of manufacturers. Some use it to remove a blank from bar stock to send to a machine to be cut into a finished part. Some use it as a final operation (fabricators, I am talking to you), and the remainder use it as a de facto finishing process. 80/20 Inc. comes to mind as a member of the latter group.

There are also different forms that sawing can take, some examples include: conventional band sawing using a continuous band of bi-metal saw blade with any given pitch (teeth per linear inch), chop saws that use a circular blade much

like that of a table saw blade or a miter saw in a wood shop, and cold sawing that uses either a rubber-reinforced wheel or a fiberglass-reinforced cut-off wheel. This list is by no means exhaustive, but more of a primer on the matter.

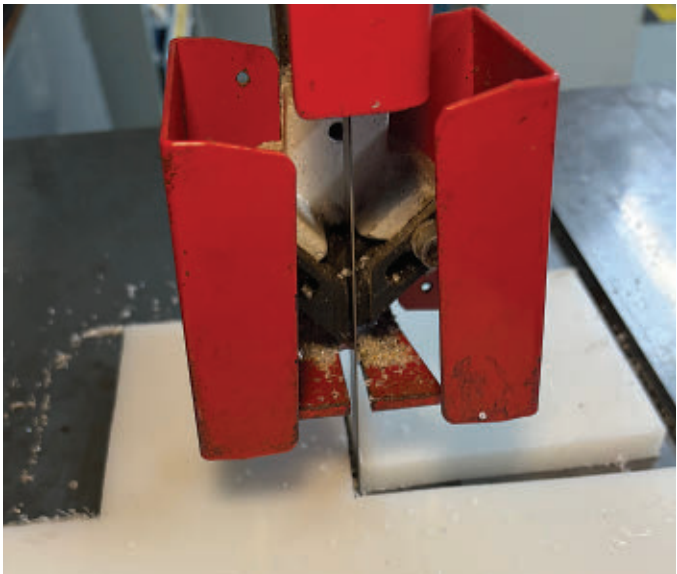
Let's start off by digging into these listed methods for now.

Bandsaws

First, let's tackle the most common method of conventional band sawing, both vertical (see Figure 1) and horizontal. Every shop I have ever worked in had a pair of vertical bandsaws, one with a finer pitch blade for ferrous, stainless steels and tougher materials, and one with a more coarse pitch blade for non-ferrous materials such as alumi-

num, plastics and wood. All good repair and service shops have adopted this model. As to the pitch of a blade, as an example, a 10-pitch blade is 10 teeth per inch, or one tooth per 0.100". This is a good all-purpose blade pitch for everything from wood and plastics to aluminum and most soft machine steels, with finer-pitch blades used for special applications where an overly coarse pitch would lead to an over aggressive cut, leading to damage to both the saw and/or your bar stock or part.

A standard rule of thumb for our vertical bandsaws is that at least three or four teeth should be engaged in the material being cut whenever possible. This reduces the risk of shearing off the teeth of your blade. Super thin sheet metal being the only exception in our shop. The blade is tensioned inside the machine with only the neces-



Robert M. Layng

Figure 1



Robert M. Layng

Figure 2

sary amount of space between the table and the upper blade guide exposed. With the machine on, you gently feed your material into the path of the saw blade, usually following a crude layout line to cut off your desired part or blank from the bar stock. Our machines also have a blower that is powered by the upper tensioning wheel that blows a stream of cool air right at the cut zone to help clear chips, cool the part, and prevent the overload of the teeth and gullets (which causes blade pop, or the dislodging of the blade from the tension wheels or a blade snap at the weld). Make good use of it if you have one on your saw.

On the horizontal saw, which in our shop has a variable pitch saw blade to be able to accommodate anything short of super tough or hardened materials, you clamp the bar stock in the on-board vice at the desired cut-off length, turn the

saw on and wait until coolant starts to flow. Then you set your blade speed, your blade down feed, and start the cutting cycle. Once the blade passes through the stock, it trips a limit switch that shuts off the saw blade and coolant pump. There are some limitations in this machine and in this method that I will now lay out.

Firstly, the distance between the vice jaws and the blade guides. This means if your bar stock is too short, you cannot safely grip it for a cut. Also, if your part is so short that it sits too far from the center point of the vice jaws, the jaws pivot and don't properly hold the part.

But wait, there are solutions! As many of you who've read my past works may know I partake in a healthy diet of "Cheaties" and have come up with ways to get our saw to cut parts that are too short for the jaws to hold in a conventional



Remember to tune in to "The Daily Grind," Cutting Tool Engineering's podcast centered around machining and machine shop culture over a cup of coffee.

We broadcast live at 8 a.m. Eastern time on Mondays, and a recorded version is released on all major podcast platforms on Tuesday mornings.

We will cover this topic and many others in a casual chat, perfect for the commute into the office or shop.



Robert M. Layng



Robert M. Layng

Figure 4

Figure 3



'Saw What You Did There...'

sense. See Figures 2 and 3 for samples of my methods.

To put it simply, I have used bars of sacrificial material to extend the reach of the jaws so I can still clamp shorter parts reliably. Another method I rely on for cutting shorter pieces is to put a "dummy" piece of identical width in the back half of the vice while clamping on my part toward the front end of the jaws. This evens out the clamping forces and prevents the jaws from tilting. The latter method is used both with and without the sacrificial bars to extend the reach of the jaws.

Chop Saws

Now I'll dive into chop saws (see Figure 4). These saws use a circular blade just like you'd see in a wood shop on either a table saw, radial arm saw or miter saw. The tooth geometry merely being optimized for cutting metals and other materials over only woods. The use of the chop saw is rather straightforward. You clamp your workpiece in the included vice at the desired length (whether cutting off a blank or trimming something to length), turn the blade on, and advance the saw right through the material. An excellent exam-

ple that comes to mind is the one I mentioned at the beginning of this article, 80/20 Inc. As an option on their website, you can order pieces of their extrusions cut to a custom length, and, judging by the finish on the ends of the bars, a chop saw was the perfect solution used for this type of work.

Cold Saws

Lastly, I'll briefly cover cold saws. This method is perfect for fabrication shops, weld shops, farms, etc. When you need to cut ferrous metal in a jiffy and super tight precision is not the order of the day, cold saws are the way to go! Simply slap the steel bar or tube into the vice, clamp down, start the wheel and make those sparks fly! These are also a great option when portability is necessary, such as on a farm or, like the race team I belong to, at the track when you need to get something chopped quick. (Tip of the hat to the Flying Farmers, Car #88!). These are also very handy, as there is nearly no mess to clean up; the only waste is sparks.

One last point I'll cover about sawing: The necessity of it and how it's taken for granted as just a hurdle between some bar stock on the steel racks and your finished part(s). Sawing is an efficient way to part off some material from stock, one that cannot be easily replicated on any other machine. Because of this, and it not getting the glorified existence of throwing chips like most other machine tools, it is often taken for granted.

Not many machinists or engineers give the science behind sawing much thought, as the parts are usually cut off and are on their way to another machine before you know it, or before you could give it much more thought. There have been multiple other articles by other authors covering the scientific principles behind sawing, so I won't beat a dead horse or step on their toes. I merely wish to bring awareness to the topic.

To sum up

Sawing — don't take this vital necessity for granted. Be sure to cut it some slack, as without it, your production would grind to a halt.

Thank you for reading, and I hope this primer gets you thinking about this topic the next time you need a piece of something cut from bar stock — in whatever form the sawing takes. **CTE**


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about the author

Robert Layng is an engineering technician/machinist at Lafayette College in Easton, Pennsylvania. He specializes in prototyping and practical design. He can be reached at layngr@gmail.com.



GOLIATH MEETS TOLERANCE DEMANDS

CNC Onsite A/S in Vejle, Denmark, has delivered its custom-built Goliath machine tool to wind tower manufacturer Welcon A/S in Give, Denmark. Welcon is milling 97 bottom tower flanges for 15mW V236 turbines for projects in Germany and the Netherlands. Production began in April 2025, and the first flanges have already exceeded flatness specifications, ensuring a precise fit with the transition piece — enhancing reliability and design flexibility and significantly reducing costly post-production checks.

The milling process ensures that the tower and transition piece align, forming a flat, stable connection between the two flanges, a critical mechanical joint held together with bolts. By implementing CNC Onsite's machining process, tight tolerances are achieved, which elim-

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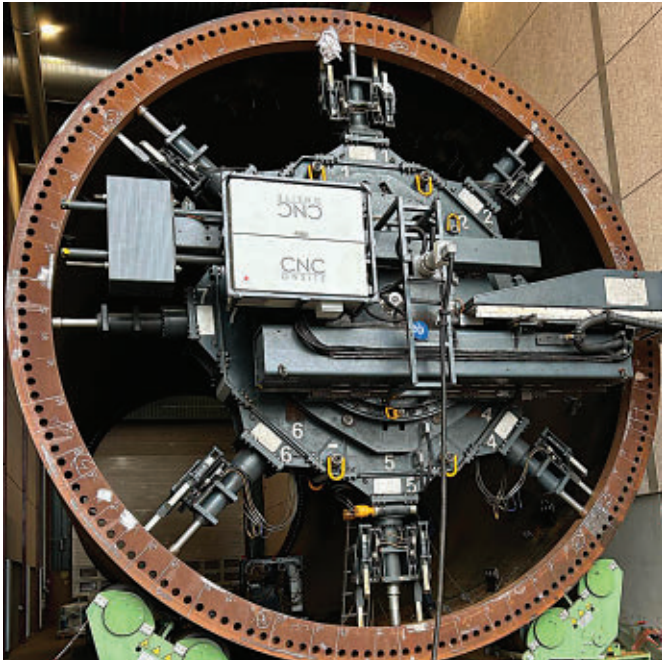
inates the need for heat straightening, a common post-production step to correct flatness issues, while also optimizing the maintenance of bolts during operation.

Heat straightening is a method used to correct distortions in metal components, such as wind turbine flanges, caused by manufacturing, welding or operational stresses. The process involves applying controlled heat to specific areas, causing the metal to expand. Once

cooled down, it contracts, helping to restore the component's original shape.

CNC Onsite specifically designed Goliath to ensure flat flanges for structural strength and fatigue resistance.

"On the first flange, we have achieved a global flatness tolerance of 0.21 mm. The required 1 mm for this project is already well below the common industry standard of 2.5 mm, so we are, of course, very



CNC Onsite

The first flange milled on the Goliath machine from CNC Onsite achieved a tolerance of 0.21 mm (0.008").



CNC Onsite

CNC Onsite's Goliath machine tool prior to being mounted onto the flange.

Productive Times

pleased with the machine's performance," said Soren Kellenberger, sales director and partner at CNC Onsite. "Ensuring a tolerance of 1 mm or better is a significant benefit when it comes to ensuring correct bolt tightening. With 160 bolts in a flange, reducing maintenance costs and downtime due to loose bolts is a considerable cost saver."

Welcon will integrate the flange facing process as a standard manufacturing step, replacing the traditional heat straightening method after welding. By employing Goliath to machine the 97 bottom flanges, the tower manufacturer can ensure a faster, more uniform method.

The consistent flatness across all flanges will provide Vestas Wind Systems A/S, Welcon's customer,

with greater flexibility in flange designs and dimensions, as well as a broader choice of bolt sizes.

"The industry demand for fine tolerances is increasing," said Johnny Hauggaard Skov, vice director of Welcon. "To meet flatness requirements, we need a machine-based process, as heat straightening cannot achieve the necessary precision. We also expect this to improve health and safety by eliminating manual work."

Goliath earned additional praise from Vestas.

"If applied throughout the industry on all flanges, from tower to transition piece, I believe this precision milling will offer a range of benefits," said Peter Sigfred Mortensen, a senior specialist for Vestas' offshore tower structures and towers R&D. "When all flanges are completely flat, it eliminates the costly measurements we have seen both at sea and prior to shipping. It will also provide design freedom, including the option of smaller and even maintenance-free bolts."

As wind turbine tower flanges grow in diameter — now reaching 7.5 m (24.6') for Vestas' new 15mW turbines, the demand for even finer tolerances increases.

Noted CNC Onsite's Kellen-

berger: "It is a challenge to achieve the required precision for 4- to 5-meter diameter flanges. But on today's 7-plus-meter flanges the tolerances are even tighter. This combination of larger diameter and stricter tolerances makes it nearly impossible to meet standards with traditional methods."

Goliath is mounted directly onto the flange, according to CNC Onsite. Using adjustable legs with hydraulic cylinders or optional electric actuators, the machine is securely positioned, allowing easy switching between different flange diameters.

The machine, which is equipped with powerful electric motors to enable fast, high-precision milling, is capable of handling flanges from 6.5 m to 10 m (19.7' to 32.8') in diameter in the standard configuration and can be adapted for larger sizes.

Goliath also can mill flat, tilted and double-tilted flanges, as well as features like gasket grooves.

The machine for Welcon is the third custom-built Goliath machine designed for large-diameter flanges since its launch in 2022. Welcon noted that Goliath, which is currently in use by offshore customers in Denmark and Spain, can be leased or purchased. **CTE**

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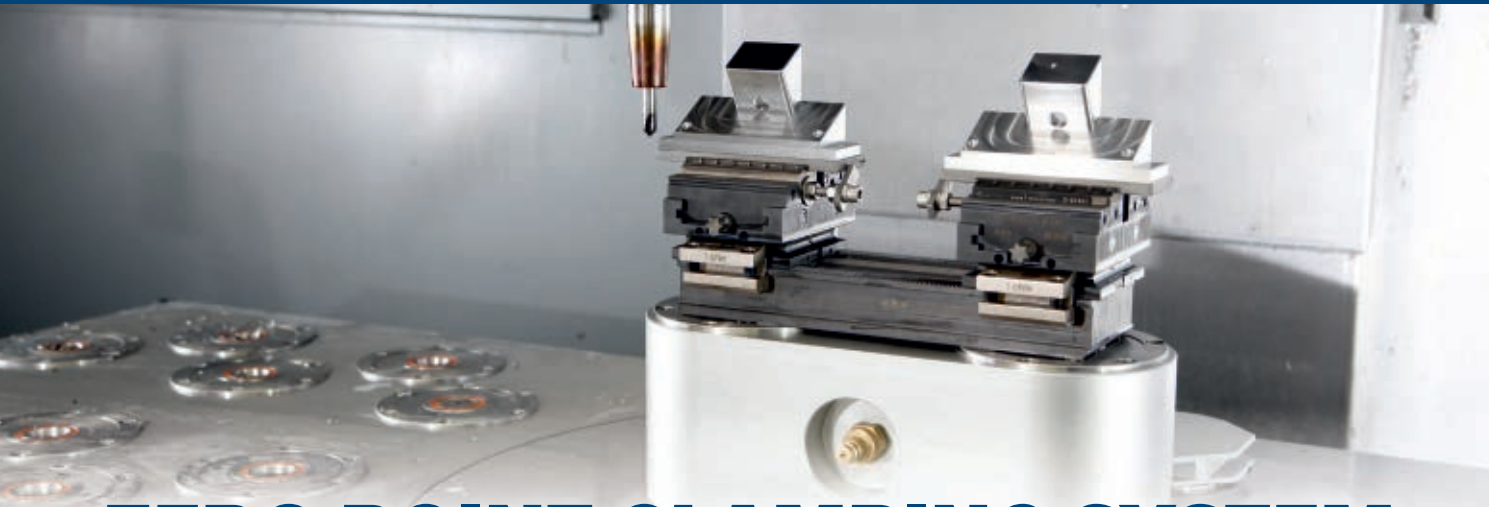


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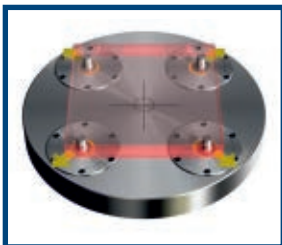
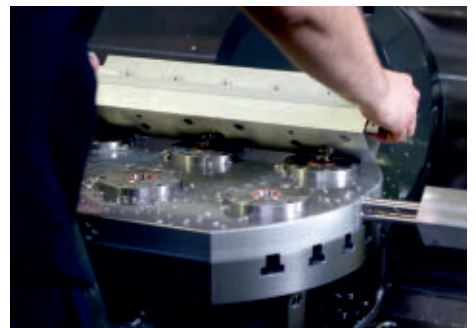
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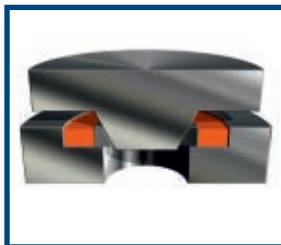
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