

# gear

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**AUGUST 2024**

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**Investing in  
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**Clean Steel**

**Workholding**

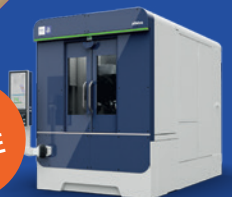
**Honing**

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## **TECHNICAL**

**Hard Fine Machining of E-Components  
in the Border Area of Quality  
Requirements and Productivity**

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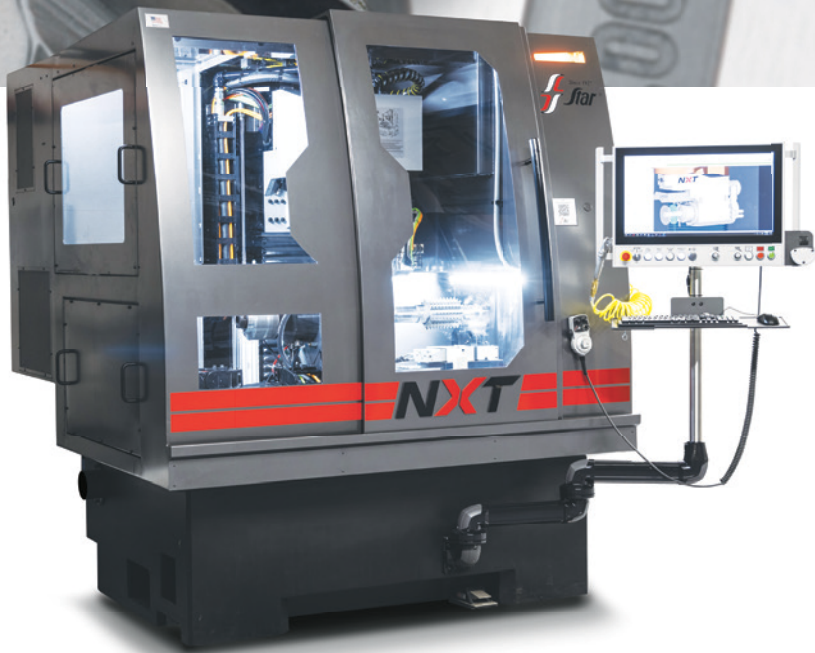
- Gear hobs
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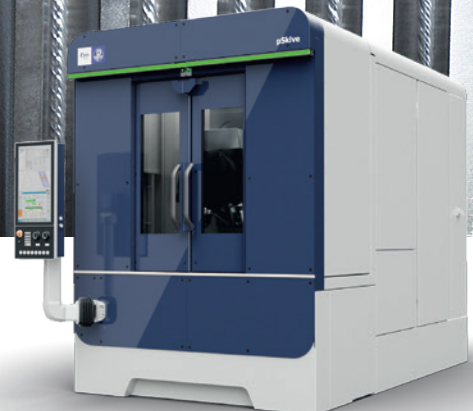


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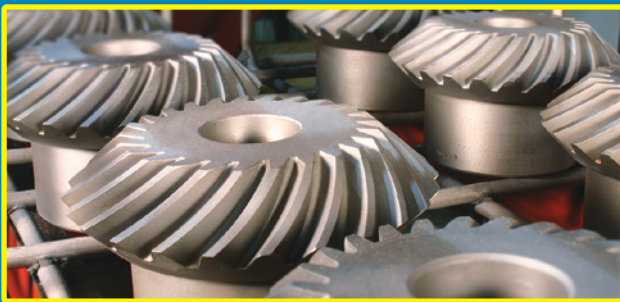
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# gear TECHNOLOGY®

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# Skiving of rings and shafts

## Skiving<sup>3</sup>: machine, tool and process

Gear skiving machines LK 180/280 and  
LK 300/500

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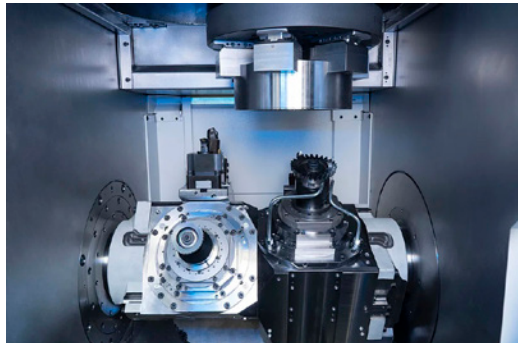
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## GT VIDEOS

### EMAG VSC 400 PS

The EMAG VSC 400 PS offers the integration of power skiving and turning technologies in one machine, a solution that significantly increases both the flexibility and efficiency of production. By using up to four gear skiving tools and six turning tools, you can produce even complex gears in a single clamping operation, which increases productivity enormously.



[geartechnology.com/media/videos/play/280](https://www.geartechnology.com/media/videos/play/280)

## AS SEEN IN PTE

### Flexibility in Gear Design

Conventional gearbox designs based on nominal power and speed are generally not sufficient to meet the diverse requirements of modern applications, such as resource efficiency at high power density, high efficiency, and long service life.

[powertransmission.com/articles/9753-flexibility-in-gear-design](https://www.powertransmission.com/articles/9753-flexibility-in-gear-design)

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Michael Goldstein founded *Gear Technology* in 1984 and served as Publisher and Editor-in-Chief from 1984 through 2019. Thanks to his efforts, the *Michael Goldstein Gear Technology Library*, the largest collection of gear knowledge available anywhere, will remain a free and open resource for the gear industry. More than 40 years' worth of technical articles can be found online at [geartechnology.com](https://www.geartechnology.com). Michael continues working with the magazine in a consulting role and can be reached via e-mail at [mwg42@hotmail.com](mailto:mwg42@hotmail.com).

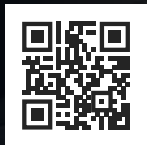
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# Technology on Display

Next month, much of our team will be heading to IMTS (Sept. 9–14 in Chicago) to explore all the latest technology in manufacturing. As always, the show promises to include a wide variety of ways for manufacturers to improve their quality, productivity and profitability.

In particular, I'll be paying attention to how machine tool manufacturers and suppliers to industry are embracing AI, industry 4.0, automation and software. In essence, I want to know how the tools we use are getting smarter. Many of you cut chips for a living. Your world is grounded in a very physical reality of feeds and speeds. But there is a lot of potential in all those electrons buzzing around.

I recently visited a shop that was making very good use of some very old machines. Those old Barber-Colmans continue to crank out gears, year after year. But that same shop is also using AI to manage its supply chain, resulting in the ability to turn around orders in 48 hours or less.

The point is, you should embrace the electrons. I'm going to IMTS to learn as much as I can about the possibilities, and I encourage you to do so, too. If you happen to be at the show, please stop by and see us in booth #237314. I'd love to talk with you about how *your* company is making the best use of technology.

If you want to know about some of the gear-related exhibitors at this year's show, please take a look at our IMTS special coverage beginning on page 28.

But don't stop there. This issue is so full of great stuff, you almost have to read it cover to cover. There's Part II of our series on implementing lean manufacturing for job shops (p. 18), an article on how clean steel can help you optimize gear designs (p. 22), an example of how the right type of flexible workholding can get you to a "lights-out" hobbing operation (p. 26), Southern Gear's role in an upcoming Mars Mission (p. 40) and two articles on technical aspects of finishing e-drive gear components (p. 44 and 52).

Yeah, whether you're going to IMTS or not, you should definitely read this issue cover to cover, because there's lots of technology on display here, too.



Randy Stott

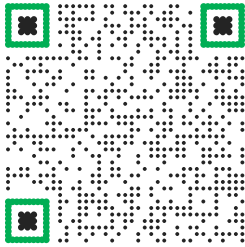
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# EMAG Intelligent Automation

ASSISTS MR COMPONENTS WITH PRODUCTION CAPACITY AND QUALITY

MR Components, a medium-sized company from Grigno, Italy, has significantly increased its production capacity and simultaneously improved quality by introducing intelligent automation with EMAG machines. The company, which specializes in the production of parts for differential and planetary gears, now produces around 80,000 components per month, with some of the machines running unmanned in the evenings.

Alessandro Reguzzo, the founder and managing director of MR Components, started out in 1995 with just one CNC lathe in a garage. Since the business grew quickly, Reguzzo invested in additional machines and moved to a larger production hall. In 2006, the company built its first own production hall with 2,500 m<sup>2</sup>. In January 2024, the company finally moved into its new, modern 6,000 m<sup>2</sup> headquarters.

Reguzzo sees the key to success in the consistent automation of production. “The use of automated machines was the key to speeding up production,” said Reguzzo. “The machines run unmanned, allowing us to produce in the evening hours without having to introduce a night shift.”

MR Components relies on EMAG machines that are equipped with integrated measuring probes. “This allows us to check all components 100 percent,” explained Reguzzo. “The stable design and high quality of the machine components are essential in batch production in order to stand out from the competition.”

The company uses various manufacturing systems from EMAG to meet the different production requirements of its customers.

“In one of our production lines, we work with VL 7 machines, where the operator manually places the workpieces on the automation belt,” said Reguzzo. “In other production lines, we work with VL 4 machines that are equipped



with TrackMotion automation. Here, the automation is very fast and we have greater autonomy, so we can also run the machines in unmanned mode.”

There are also other manufacturing systems, VL 4 and VL 6, which are automated with robots. The decision was made to use a system with robots here, as many components must undergo other operations in addition to turning, such as marking, which can be carried out very easily and flexibly with the robot.

Unmanned production in the evening hours allows MR Components to significantly increase its production time.

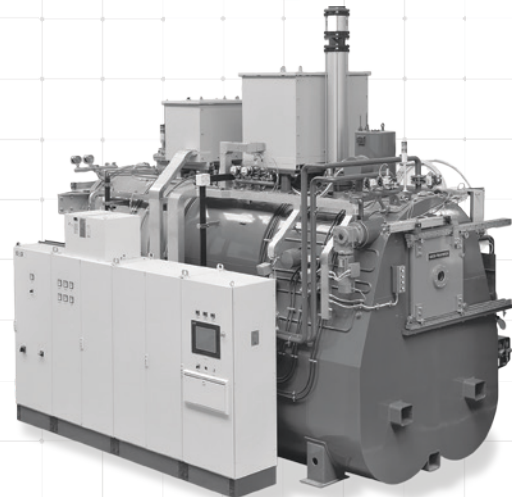
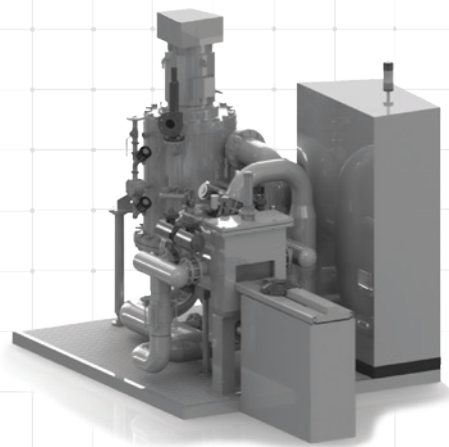
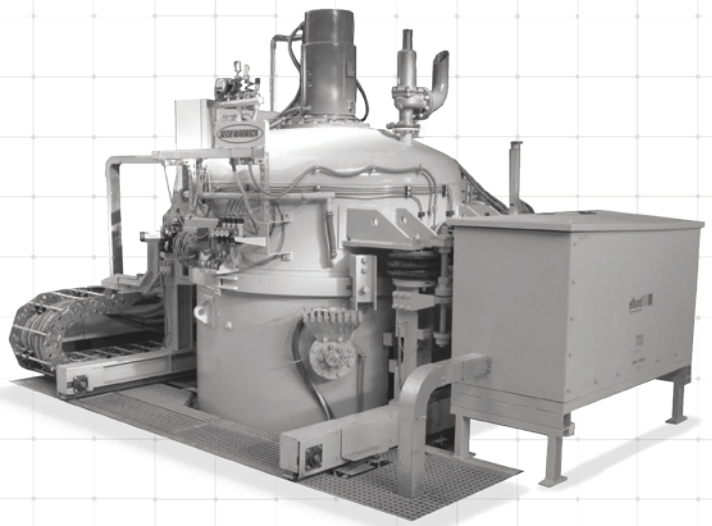
“We call this time ‘free’ hours, as it allows us to produce without additional personnel costs,” explained Reguzzo. “This is a great advantage, as it is difficult to find staff for the night shift these days.”

MR Components has planned further investments for the future.

“We are planning to use two VL 8 machines in combination with robots to machine components with a diameter of up to 450 mm,” said Reguzzo. “We also want to further develop our gear cutting and assembly technologies in order to be able to offer our customers even more comprehensive solutions.”

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# Mahr MWF GmbH

## DEVELOPS MEASURING MACHINE FOR DOUBLE-FLANK GEAR ROLL TESTING

Mahr MWF GmbH has developed and built a measuring machine for double-flank gear roll testing to meet the individual requirements of a customer. This machine tests the form feature concen-

tricity deviation  $F_r$  on the internal tooth-thing of gears. The noise development of the subsequent gearbox can then be predicted based on the measurement results. This is an important aspect, particularly in electromobility.

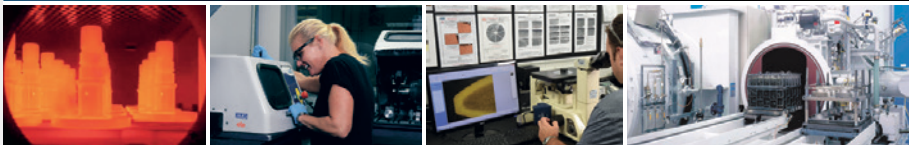
The aim of this measuring principle is to test how well gears mesh or work together. To do this, two gears rotate away from each other in the measuring machine. The tooth flanks, i.e., the internal diagonal lateral contours of the gears that touch each other on



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the pitch circle, are tested. The more balanced they run, the less noise they cause in gearboxes.

The measuring machine for double flank gear testing consists of a rotating measuring table with clamping device and a tactile measuring system. The gear wheel to be measured is clamped on the measuring table and rotated around its own axis. A second gear, a so-called master gear, is then used. This is a high-precision component that is the ideal counterpart to the workpiece to be tested. This master gear is adjusted on a special slide and is pressed into the test piece via a spring. A dynamic measurement is carried out by rotating the component holder 360 degrees, with the master gear moving with it.

The master gear makes linear relative movements as it plunges during the 360-degree rotation. These can be detected tactilely: a measuring probe is permanently in contact with the carriage that moves the master gear and records the relative movements. The probe deflections in the micrometer range are in turn recorded and converted by the *MarWin* software: A Fourier analysis determines the fundamental oscillation and thus evaluates the entire measurement. This ultimately provides the customer with a



meaningful measurement result, including graphical visualization, with which they can work practically.

“Our double flank rolling test is a particularly realistic measurement that simulates the behavior of the gears in subsequent operation,” explains engineer David Hagel, head of design and mechanical engineering at Mahr MWF. “The customer can measure very quickly: The result is available after only around 45 seconds. The measuring process records every single tooth of the component to determine ( $F_r$ ) the run-out deviation.”

And finally, the MWF measuring solution can be used universally and is very flexible, as various set-up sets ensure that different gears can be measured.

[metrology.mahr.com/en-us/](http://metrology.mahr.com/en-us/)

## Rego-Fix LAUNCHES ONLINE PRODUCT FINDER

Rego-Fix has launched a new online product-finder resource, which allows U.S. manufacturers to quickly and easily find and purchase the Rego-Fix solution that best meets their application needs. Using a variety of search criteria, users

can find and learn more about the full lineup of products.

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# Horn

## INTRODUCES SINTERED CHIP BREAKING GEOMETRY FOR SUPERMINI

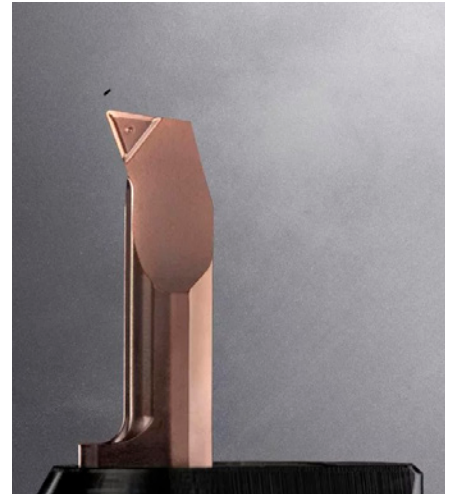
Horn recently announced another milestone in the history of the Supermini with a sintered chip breaking geometry for the Supermini type 105.

“With a lot of hard work, we have managed to solve economically the problems of long chips when internally

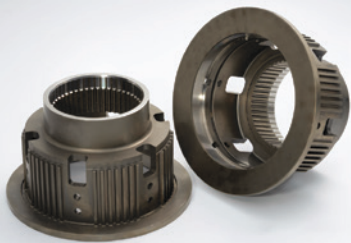
machining small-bore diameters,” says Managing Director Markus Horn.

Boring, profile turning, internal grooving, threading, chamfering, face grooving, drilling and slot broaching: The Supermini tool system can be adapted for numerous machining operations. The solid carbide inserts are used for boring from a diameter of 0.2 mm to around 10 mm. Horn developed the carbide blanks for the tool as a teardrop shape. This enables large, precise contact surfaces in the tool holder,

which results in greater rigidity of the overall system. Furthermore, the teardrop shape prevents the insert from twisting, which leads to consistently precise positioning of the center height of the tool. With long tool overhangs, it reduces deflection and minimizes vibration during turning. Depending on the application and the diameter to be machined, Horn offers the inserts in three different sizes (types 105, 109 and 110) and different blank types. All types allow internal coolant supply directly to the cutting zone. The Horn tool portfolio contains around 2,500 different standard variants of the Supermini. In addition, Horn solves users’ machining problems with countless customized solutions.



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control even with small infeed settings. The geometry can be used universally for different material groups and is suitable for internal, face, copy and back turning.

In addition to the geometry, Horn optimized the carbide blanks of the inserts to have greater rigidity and an even more stable cutting-edge area. The coolant supply has also been revised. The new insert is compatible with numerous types of 105 tool holders. Horn offers the inserts as standard in three lengths (15.0 mm, 20.0 mm and 25.0 mm) and in carbide grades TH35 and IG35. The corner radius is 0.2 mm. The tool is suitable for use with a bore diameter of 6 mm. The wide range of applications for the inserts goes hand in hand with their cost-effectiveness, as the price of the new Supermini is like that of the standard insert without geometry.

Users can choose the appropriate solution for their application from a wide range of different types of tool holder. These include round shank, square shank, interface and adjustable tool holders for different machine manufacturers. Horn offers four different solutions for clamping the inserts: a classic ball pressure screw, a face clamping element and a lifting element. For confined spaces, Horn also offers a compact system with clamping via a union nut.

[horn-group.com](http://horn-group.com)

## Weiler Abrasives

ANNOUNCES NEW  
BLENDING DISC PRODUCT



Weiler Abrasives has announced its new blending disc product lineup that is ideal for a wide range of blending, weld cleaning and polishing needs. The blending discs can help operations save time and

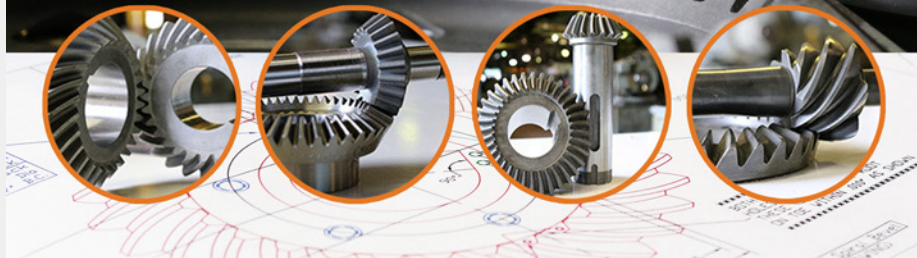
money through faster material removal and longer product life in such applications as shipbuilding, structural fabrication and welding.

“These new blending discs improve performance and results across the entire product portfolio, including significant gains with our top-performing ceramic offerings,” says Andrew Koch, product manager, Weiler Abrasives. “Operations can make big strides in productivity because these products work more efficiently and last longer.”

The blending discs are available in ceramic, zirconia alumina and aluminum oxide grain options. The new ceramic discs feature a denser grain coating that provides more cutting surface area, increasing the material removal rate. In addition, an improved ceramic grain formulation is designed to micro-fracture, breaking down to provide more sharp edges for enhanced performance. In product testing, the new ceramic blending discs increased material removal by 35 percent and



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product life by 50 percent compared to previous offerings.

The improved zirconia alumina and aluminum oxide blending discs also deliver better performance and product life. In addition, the expanded blending disc portfolio provides more connection types, with all of the grain options in the lineup now available in Type S and Type R connections. All the discs are now available with a resin fiber or cloth backing. The resin fiber backing helps reduce the pressure an operator must apply to the disc to maximize the cut rate. It also helps retain the grain on the disc, increasing disc life. The cloth backing offers a more comfortable disc that gives the operator greater control of material removal. The Weiler Abrasives blending disc portfolio also includes a line of aluminum discs that remains unchanged.

“The focus is on helping our customers find the right disc and the most cost-effective disc for their application,” Koch says.

[weilerabrasives.com](http://weilerabrasives.com)

## Dillon Manufacturing

### CUT JAW CHANGE TIME



Fast-Trac Jaw Nuts from Dillon Manufacturing allows users to change jaws in half the time, according to customers who have made the switch. This system lets users preassemble the jaws required for the next operation while the machine is running a separate job, thus minimizing jaw change time and maximizing productivity and profitability. In addition to saving on labor costs, quick change capability allows more components to be machined per shift. Better utilization of machine

time enhances efficiency, bolsters the productivity per square foot of manufacturing space, and generates more profit. It is ideal for facilities of all sizes and capabilities.

Dillon Jaw Nuts, T-nuts, and Keys are available to fit all popular power chucks from 6 in. dia. to 24 in. dia. including Forkhardt, Gamet, Howa, Kitigawa, Matsumoto (MMK), Nikko, Pratt Burnerd, Rohm, Samchully, Schuck, SMW, SMW-Autoblok, and more. Standard sizes are stocked for immediate shipment. They are ideal for workholding applications requiring durability and high strength such as high-speed machining.

Dillon also offers special T-Nut designs and manufacturing services for custom workholding requirements.

[dillonmfg.com](http://dillonmfg.com)

## Ceratizit

### LAUNCHES SIX-FLUTE END MILL FOR TITANIUM AND SUPER ALLOYS

Ceratizit added to its OptiLine Series of solid-carbide end mills with the launch of a six-flute end mill. OptiLine end mills are versatile and optimized for various materials, machining strategies and part applications. The company designed and developed

the new six-flute OptiLine end mill specifically for titanium and super alloys (ISO-S).

Engineered from the ground up, the OptiLine six-flute end mill features a premium substrate and advanced tool geometry. The end mill's asymmetrical variable helix and variable index flute configuration ensures enhanced stability during cutting operations and includes chip splitters designed for applications involving 2.5 x D cutting lengths. Refined cutting edges and Ceratizit's Dragonskin coating technology improve chip control and reduce adhesion for longer tool life.

“We started with the six-flute's foundation ensuring the substrate provides high toughness without sacrificing hardness,” says Scott Walrath, business development manager, solid round tools, Ceratizit. “The six-flute's other key differentiator is the asymmetrical flute design because each tooth on a different helix angle delivers stability when machining a workpiece at varying angles.”

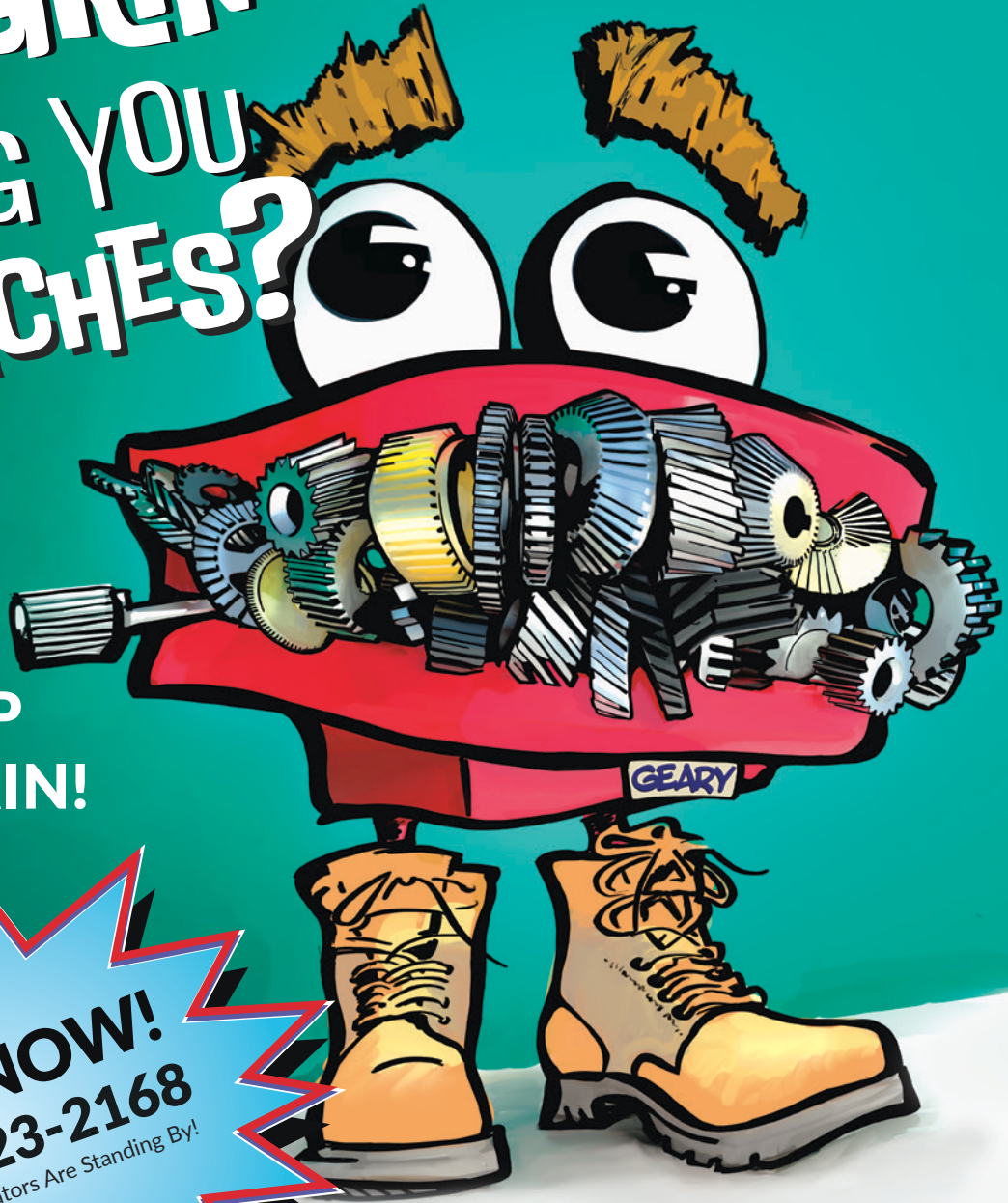
To accommodate customers across U.S. industry sectors, the new six-flute end mill will be available in inch assortments. OptiLine inch-type end mills, including the new six-flute, are manufactured at Ceratizit's facility in Sacramento, CA.

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# Investing in Industry 4.0 for the Gear Manufacturer/Job Shop (Part 2)

Assessing and modifying production systems prior to IoT implementation

Shahrukh Irani



This article requires that the reader be familiar with Job Shop Lean, an approach to adapt the principles of lean manufacturing for a job shop, regardless of its size or industry sector. The following articles will give the interested reader a sufficient background on the many differences between Job Shop Lean and Lean:

1. Adapting Lean for High-Mix Low-Volume Manufacturing Facilities (*Gear Technology*, August 2012)
2. A Quick-Start Approach for Implementing Lean in Job Shops (*Gear Technology*, October 2012)
3. Remaster the Five Principles of Lean Manufacturing (*The Fabricator*, August 2018)
4. Investing in Industry 4.0 for the Gear Manufacturer/Job Shop (Part 1) (*Gear Technology*, July 2024)

A job shop typically executes a different schedule every day. Each day's schedule could have a different mix of jobs, due dates, lot sizes, and number of gear operations. Regardless of all these differences, it is important that the shop receives a feasible schedule that does not exceed available capacity constraints on key resources (machines, labor, materials, dies, etc.).

If a job shop desires to do daily work order releases that will not exceed resource capacity constraints, they should not expect their ERP (Enterprise Resource Planning) system to do this. The typical ERP system uses an MRP (Material Requirements Planning) or MRP-II (Manufacturing Resources Planning) engine to plan production and schedule operations. MRP assumes infinite capacity, fixed lead times, batch production to reduce setup times, etc. Instead of relying on an ERP system, the logical alternative is to use commercial FCS (Finite Capacity Schedulers) like *ORTEMS*, *Opcenter*, *Tactic* or *Schedlyzer*. It is not feasible to manually decide the set of jobs to release into production every day after taking into consideration resource capacity constraints, material shortages, changes in vendor deliveries, machine breakdowns, due dates, etc.

In the case of a manufacturing cell, there may not even be a need for scheduling software. Ideally, all the machines needed to produce any part in its part family (except vendor operations or external monuments like heat treat) will be co-located inside the cell. At the daily morning huddle, the cell's team could meet with the production controller. They could eyeball the jobs in process or in queue from the previous day and determine if the cell's bottleneck could process any new jobs. A cell guarantees start-to-finish control of the flow of its orders within a small area of the shop. Apart from unforeseen emergencies, the operators in the cell are empowered to work and execute as a team to ensure on-time completion of all jobs by their due dates. My years in industry as a full-time consultant have taught me to never underestimate the "do-or-die" determination of a cell's team to complete orders on time and below costs.

## Water Spider Utilization

Once an ERP system is integrated with a commercial FCS, a job shop is able generate a feasible daily schedule for each cell—

external monuments that are shared by the cells and support departments (receiving, shipping, inspection, etc.).

Next, they must release that schedule to the shop floor, execute it and, at the end of each shift, communicate the current shop floor status of all active jobs back to their ERP. The role of schedule execution and status updating in the ERP is fulfilled by an MES (Manufacturing Execution System). If the facility is large (> 100,000 sq. ft.), then there is merit in implementing a fully integrated PPC (Production Planning and Control) system comprised of an ERP (*SAP*), a Finite Capacity Scheduler (*Opcenter*) and an MES (*Factory Viewer*). However, in the case of a single-location high-mix low-volume job shop, especially a small family-owned job shop, it may not be advisable to immediately purchase an MES. Instead, I will advise every job shop to create the position of water spider(s) by freeing up one or more employees on the shop floor.

A water spider is a role centered around timely and accurate stock replenishment. The water spider team member refills the production line with the required materials to maintain a steady workflow.

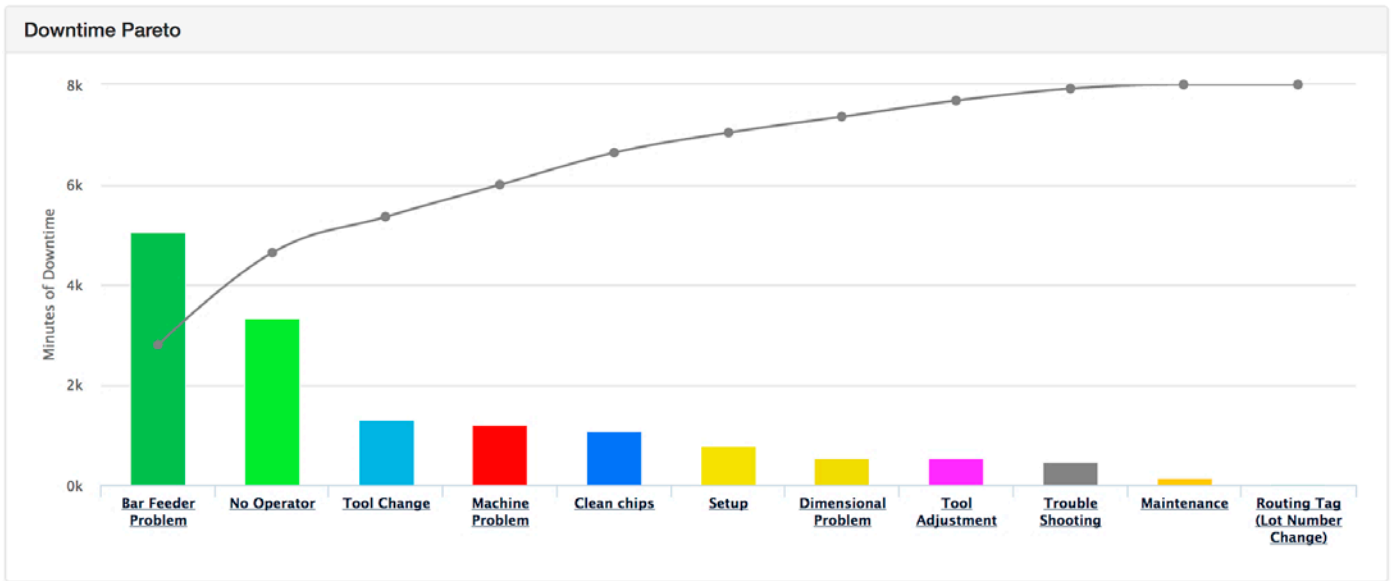
Imagine a job description for a new position that combines the work that is typically done by a material handler (who reports to the plant manager) and an expeditor (who reports to the production controller).

Water spiders will handle all shop floor logistics related to moving raw materials, in-process batches and finished parts between machines as specified in the routers of the different parts. By virtue of being all over the shop floor, the water spiders have the "situational awareness" and authority needed to execute, monitor and update the daily schedule that was released to the floor. In a recent Job Shop Lean implementation project, the two water spiders eliminated the previous practice where every employee—including the skilled CNC machinists—was responsible for moving the pair of screws that they finished on their machine to the next machine in the parts' routings. The typical process for moving a batch from one machine to the next involved (1) walking across the shop to fetch the bridge crane and docking it at their machine, (2) walking around the shop to find a cart on which the screws would be loaded, (3) returning to the machine to unload the screws off their machine onto the cart, (4) pushing the cart to the next machine and (5) returning empty-handed to their machine to wait for their next job.

Significant savings were realized once they consolidated the non-value-added walking time of all shop employees into the work done by just the two water spiders.

## Machine Monitoring Implementation

*The Goal* is a book written by Dr. Eliyahu Goldratt that introduces his Theory of Constraints (TOC). A cornerstone of this theory is the idiom "A chain is no stronger than its weakest link". In the case of an on-demand machining cell that produces different parts in a part family, the cell can only complete as many orders as the cell's constraint machine (aka bottleneck) can complete. The cell's bottleneck is that machine which is always having orders in queue (WIP) during each shift while the other machines remain idle.



Start	Duration	Workcenter	Reason	Message <sup>▲2</sup>	Planned
Feb 27, 2017 04:13:3...	1 minute, 54 seconds	Star-15	Machine Problem	Back fin alarm	Unplanned
Mar 02, 2017 05:30:2...	3 minutes, 31 seconds	Star-10	Trouble Shooting	Conveyor belt stacked	Unplanned
Mar 02, 2017 03:29:4...	4 minutes, 24 seconds	Star-02	Machine Problem	Part eject problem	Unplanned

Figure 1—Pareto plot of capacity loss categories. Courtesy of MachineMetrics.

Dr. Goldratt proposed a five-step Process of Ongoing Improvement (POOGI) whose first step is to exploit the constraint in the cell. The focus is to “win back” all the avoidable losses of capacity such as setup time, idle time due to non-arrival of the next job, machine stoppages due to CNC program errors, unscheduled breaks taken by the operator, time to change broken tools, etc.

With the abundance of machine monitoring systems on the market (FactoryWiz, Memex, FORCAM, MachineMetrics), it is possible to do 24/7 monitoring in any job shop of the bottleneck machines in all the cells as well as the monuments. Figure 1 shows an example of one of the many reports from an MMS that summarizes the capacity losses on a CNC machine. Do you notice that “No Operator” is one of the top three reasons for capacity loss for this machine? In contrast, traditional methods such as video monitoring or random visits by supervisors project a lack of trust on the part of management. Plus, such reports can be used to conduct a series of kaizens with the sole purpose of improving value-added machine utilization thus increasing its daily order completion performance.

Figure 2 presents a systematic description of the four categories into which the time recorded by the MMS for different activities performed on any machine during an eight-hour shift can be categorized.

TEEP (Total Effective Equipment Performance) is a performance metric that provides insights as to the true capacity

of any manufacturing operation. It considers both equipment losses (as measured by overall equipment effectiveness) and schedule losses (as measured by machine utilization). It is desirable that the TEEP for a cell’s bottleneck be around 80–85 percent. It is not surprising that machine monitoring systems are aggressively advertised for supporting effective maintenance programs for individual machines or multi-machine cells.

Plant Not Open	Schedule Losses	TEEP takes into account Schedule Losses.
Production Not Scheduled		
Setup & Adjustments	Six Big Losses	OEE takes into account the Six Big Losses, which map to OEE Losses as follows:
Breakdowns		
Reduced Speed		
Small Stops		
Production Rejects		
Startup Rejects		
Fully Productive Time	OEE / TEEP	OEE is the ratio of Fully Productive Time to Planned Production Time. It takes into account Six Big Losses.  TEEP is the ratio of Fully Productive Time to All Time. It takes into account Schedule Losses and Six Big Losses.

Figure 2—Components of the eight hours of theoretical available capacity on any machine. Courtesy of oee.com.

## The Reliance on an ERP System for Shop Floor Management

There is a widespread misconception that could limit US job shops from gaining additional lean benefits. Some believe lean and ERP are incompatible. ERP systems, in fact, are here to stay whereas the manual paper-and-pencil tools could go away. ERP systems can support lean in three ways:

1. They have the functions/modules to implement lean.
2. They have the data to support lean projects.
3. They can integrate with third party software that implements lean practices.

Unfortunately, the fundamental shortcoming of contemporary ERP systems is that they do not have up-to-date, complete and accurate data. In fact, some ERP systems appear at best to support accounting and customer relationship management professionals.

Here are questions a leadership team should ask their production controller regarding the symmetry between lean and ERP:

1. Can an order be accurately located with a reliable estimate of its completion date?
2. Can the daily schedule be accessed as an electronic Gantt Chart from any shop floor terminal in the shop?
3. Can the water spiders receive an accurate daily dispatch list of orders during a shift?
4. Can the water spiders communicate in real-time with the office to update the daily schedule in the ERP system?
5. Can the ERP system support daily morning huddles on the shop floor or meetings in the conference room by providing data analytics and reports on demand to support decision-making?
6. Can the ERP system plug-in to third party tools for Digital Visual Management (iObeya or Leankit)?

If any shop wishes to determine if all their IT systems are able to help them to pass my SAT (Situational Awareness Test), I encourage them to schedule a 2-3-day kaizen, invite a representative from every department, select any in-process shop floor order and determine its location and shipping status.

I can send a copy of the Job Shop Lean Assessment Tool and assess the current situation in your manufacturing facility.

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### Editor's Note:

The author encourages gear manufacturers to post any lean questions they may have for a future "Ask the Expert" article in *Gear Technology*. Submit your questions to [shahrukhirani1023@yahoo.com](mailto:shahrukhirani1023@yahoo.com) or [jaster@agma.org](mailto:jaster@agma.org).

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# Clean Steel Standards and Optimizing Gear Design

Reduce the risk of nonmetallic inclusion-induced failures

Troy Kaczorowski, Principal Process Metallurgist, Charter Steel



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Gears serve as essential mechanisms in a wide range of mechanical equipment, helping to transmit torque, adjust rotational speeds, transfer power, distribute load and more. Used in necessary applications such as automobiles, energy systems, aerospace and industrial equipment, gears must be able to operate for long periods without maintenance. While gears can be made from a diverse assortment of materials, carbon and alloy steel offer superior benefits in terms of strength, durability and cost efficiency. As a remarkably recyclable material, steel may also be a preferable choice for environmentally conscious manufacturers.

While steel is a common choice for gear design, the numerous available options in grades, strengths and treatments can be daunting. The most important first step for gear manufacturers when investigating steel grades and applications is selecting a steel supplier with the capability to produce clean steel and provide technical support. This is crucial because having clean steel helps in consistently achieving the desired chemical, mechanical and physical properties for the final product.

### Clean Steel—A Key Component in Modern Gear Design

Innovations in steel manufacturing have greatly improved the quality of steel that can be used for gears. These innovations have largely focused on the development of advanced “clean steel” practices. This phrase refers to steel that lacks detrimental nonmetallic inclusions, making it more durable. If not properly removed, certain nonmetallic inclusions can lead to fractures in gears, risking the chance of a recall and safety hazards.

To consistently develop components that balance reliability, performance and sustainability for high-stress applications, gear manufacturers need access to supremely clean steel. While no reputable steel supplier will aim to create a product riddled with

imperfections, there are ways to identify suppliers that are more conscientious of their product’s cleanliness. For example, a detail-oriented supplier with precise processes focused on preventing the formation of these detrimental inclusions, as well as a continual investment in monitoring equipment and lab testing capabilities, will be better equipped to deliver the

highest-quality steels for gear applications compared to those that don’t devote time, effort and resources to such practices.

### Ensuring Clean Steel Quality: A Guide for Gear Manufacturers

While it is one thing for a supplier to say that they are focused on providing

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clean steel, a gear manufacturer that recognizes the correct procedures will be well prepared to identify and select the right supplier to help meet their high-performance and durability standards.

Throughout the various phases of steel manufacturing, there are key processes and procedures within each phase that can help showcase a supplier's dedication to clean steel. During the melting phase, the type

of furnace used can be the first indicator. While blast furnace sourced steels were once considered the cleanest steel, advanced process controls paired with electric arc furnaces (EAFs) are now producing clean steel while also operating more sustainably. Using electrical currents to melt recycled steel, EAFs help reduce CO<sub>2</sub> emissions by 75 percent compared to the alternatives in the market. Opting to use steel made from

recycled materials at an EAF mill can not only mean a cleaner end product but can help gear manufacturers see a reduction in their carbon footprint.

Beyond the melting phase, gear manufacturers should seek additional benchmarks in their steel partner's processes, such as maintaining full slag coverage to mitigate atmospheric exposure. Synthetic slag is also essential for ensuring steel cleanliness, performing several critical functions. Besides simply collecting nonmetallic inclusions, synthetic slag also helps prevent atmospheric reoxidation, protects insulating refractories, and insulates electrode arcing.

During the remaining processing, argon rinsing at the ladle refining station and subjecting the liquid steel to pressure between 170 Torr to 1 Torr at the vacuum degasser are crucial practices for producing clean steel by promoting the removal of nonmetallic inclusions. Argon rinsing accelerates the flotation of nonmetallic inclusions to the surface of the ladle, while vacuum degassing reduces unwanted dissolved gases and prevents the reintroduction of oxygen during stirring.

A reputable clean steel supplier will maintain stringent measures through



*Argon rinsing at the ladle refining station promotes flotation of nonmetallic inclusions.*



*A reputable clean steel supplier will maintain stringent measures through the teeming and casting phase.*

the teeming and casting phase. This includes using specialized refractory equipment, such as low-moisture tundish refractories, to limit oxygen introduction from water. Anticlogging techniques may also be used for preventing nonmetallic buildup, minimizing the risk of contamination in molten steel.

Despite how meticulous some of these processes can be, the commitment to performing and enhancing these measures helps demonstrate a supplier's dedication to delivering clean, high-quality components for the gear industry. With this background, gear manufacturers can evaluate each supplier's methodologies and distinguish between a reliable supplier and one that may fail to meet their standards.

### Why Clean Steel Matters

For special bar quality (SBQ) forgers and gear manufacturers, using clean steel can significantly reduce the risk of nonmetallic inclusion-induced failures, thus minimizing the need for over-engineering parts in terms of size, weight and cost. Clean steel contributes to reducing the overall weight

of machinery, which in turn decreases energy consumption. This is particularly beneficial in automotive and aerospace applications, where efficiency is crucial. Additionally, clean steel offers superior mechanical properties, enhancing the durability, performance and lifespan of high-precision applications.

Choosing the right steel partner is essential. A dependable partner offers full metallurgical support through close collaboration, aligning their expertise with the gear manufacturer's

goals. To find a reliable steel partner, prioritize those committed to continuous improvement and collaboration. Partnering with suppliers dedicated to developing cleaner, higher-quality steel variants will enable SBQ forgers and gear manufacturers to produce high-performance products while contributing to a greener, more sustainable future.

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# The Importance of Workholding Flexibility

Automated cell delivers “lights-out” hobbing operations at Precision Gears with assistance from Hainbuch mandrels

Frank Burke

*Finished gear wheel on mandrel after hobbing.*

The 67,000 sq. ft. facility occupied by Precision Gears Inc. in Pewaukee, WI, contains a full range of gear manufacturing equipment to meet the varied customer demands of the many industries it serves. Founded in 1919, the company possesses both the technologies and experience to efficiently serve the multiple requirements of manufacturers in fields as varied as agriculture, lawn and garden, foodservice, power transmission construction, pumps, and others.

According to Dalton Campbell, manufacturing engineer at Precision Gears, “We manufacture virtually all types of gears in all types of materials. Production can involve CNC turning, milling, broaching, grinding, and ancillary services. Although we typically run lots from 100 to 2,500 pieces, we recently received an order for a much larger quantity and expect to be handling higher production runs in the future.”

The complex requirements of gear production, combined with the shortage of qualified people, caused Dalton to explore the possibility of incorporating an automated manufacturing installation. Prior to designing the cell, several parameters were established.

“Our typical sizes range from 1 to 5 inches,” Campbell said. “As a result, the demand for flexibility was key to our plan. Also, we wanted to be certain that the various components were mutually compatible and capable of consistently meeting our quality standards. Although our typical tolerances range from .001 to .002, the diversity of our customer base means that we might occasionally have to meet tighter standards. It was also determined that the automated unit would initially be used for the production of external gears only.”

As developed, the cell consists of a Nidec GE20A CNC gear hobbing machine designed for dry cutting. The machine can handle parts with a maximum diameter of 200 mm and hobbys up to 130 mm in diameter and 230 mm in length.

“Because we employ dry hobbing, we are unable to use oil for temperature control. Instead, we cool with an air blast, and chip management is handled with a small amount of coolant,” Campbell said.

Nidec software controls the hobbing process.

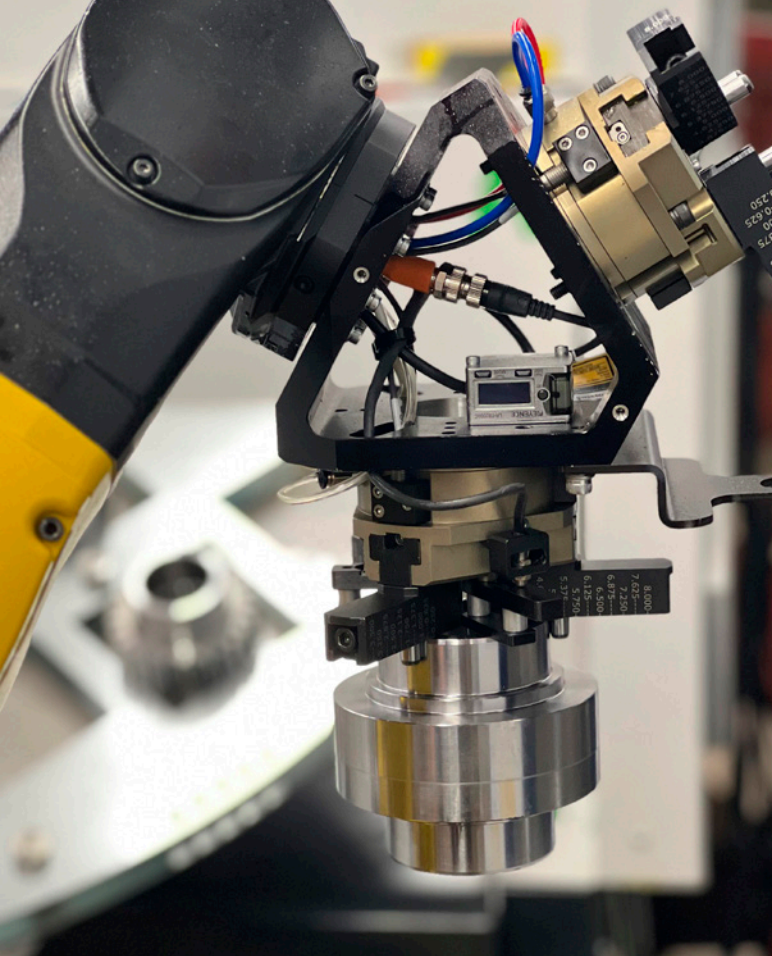
Loading and unloading functions are handled by a Fanuc M-10iD/12 robot in a Load & Go RC front load installation.

Parts are loaded on a pivoted angled dual-sided table. In addition to loading and unloading parts from the hobbing unit, the robot turns the table when operations are completed on one side.

Critical to both the flexibility and precision requirements of the cell are Hainbuch Mando T211 and Mando G211 mandrels. The T211 delivers extremely high clamping force in the 20–200 mm range. Vulcanized clamping elements reduce vibration and protect the internal diameter of the part.

Designed specifically for gear cutting, the Mando G211 is a standard segmented mandrel with slim interference contour, as well as radial clamping with pull-back effect. Three end-stop levels offer significant size flexibility.

The first part selected for hobbing on the automated system is a so-called “gear wheel.” Prior to hobbing operations, gear teeth on the ID have been broached, and hobbing is the last step prior to deburring.



Blank part on robot (all photos courtesy of Hainbuch).



Finished gears - Completed gear wheels.

“On the fully automated ‘lights-out’ shift, we typically run two dozen of the gear wheel parts, and each part is completed in about eight minutes. Of course, if we are running smaller gears, production can be significantly increased by switching templates for up to a maximum of 166 parts. The system has been in operation since October of 2023, and there have been no problems,” Campbell said.

Much of the system’s success can be attributed to the close relationship that exists between Precision Gears staff and suppliers. Michael Kucera, regional sales manager for Hainbuch America Corp., explained, “When it comes to automation, simplification is key to success. For instance, our Mando T211 and Mando G211 chucks feature Hainbuch’s standard design. As the bushing is depressed onto the cone, the vulcanized segments expand the bushing, ensuring a secure grip. The G211, which was designed for gear making, allows for easy loading and maximum gripping power—major considerations when it comes to robotic operations.”

“Mike was extremely helpful to us in selecting the proper equipment,” Campbell said. “He guided us to a standard bushing and a larger mandrel that meet our requirements without having to go to the expense of customized bushings. Since adopting the system, we have machined a wide variety of part stops in varying sizes to accommodate different gears. We plan to automate production of smaller bore parts utilizing Hainbuch’s size 0 G211 in the near future.”

The success of the automated cell is being felt throughout the Precision Gears operation. The next phase includes

planning for the replacement of a 26-in. gear generating machine along with all new machines preset for automation.

Michael Larson, marketing director at Hainbuch America, sees Hainbuch’s development of products relating to gear manufacturing as an ongoing commitment: “As with so many other areas in manufacturing, modern technology is challenging traditional methods of gear manufacturing. Automated systems, like the one at Precision Gears, demonstrate the importance of versatility, flexibility, and fast change capability without sacrificing precision. The Mando G211 is demonstrative of Hainbuch’s commitment to leadership in that area.”

“In an industry such as ours, the idea of moving into fully automated systems can sound difficult, if not threatening. However, the process has come a long way. Advanced CNC technology now makes it possible to produce many different gear configurations on one machine rather than requiring a number of specialized units,” Campbell said. “The marriage of increased flexibility and automation is significantly advancing capabilities within the gear making industry. With the right team and the right suppliers, it opens the door to a really bright future.”

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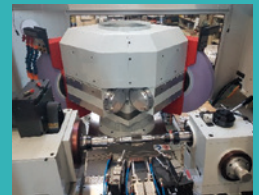
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# Step Right Up! It's Time to Preview IMTS 2024

A practical guide to the latest from the manufacturing world

Aaron Fagan, Senior Editor

The International Manufacturing Technology Show (IMTS)—September 9–14 at Chicago's McCormick Place—is the largest manufacturing technology show and marketplace in the Western Hemisphere, and it's right around the corner!

With visitors from more than 110 countries, IMTS is where the creators, builders, sellers and drivers of manufacturing technology come to connect and be inspired. But with more than 1.2 million square feet of exhibit space, where do you begin? Here at *Gear Technology*, we do our best to help you make the most of your show experience by assembling booth previews that will be worthy of your attention.

Attendees will discover advanced manufacturing solutions that include innovations in CNC machining, automation, robotics, additive, software, inspection, and transformative digital technologies that drive our future forward. The staff at AGMA, *Gear Technology* and *Power Transmission Engineering* look forward to seeing you—please visit us at BOOTH #237314.

## Affolter Group (Rotec Tools)

BOOTH #237223

Affolter offers high-precision gear hobbing solutions that increase the productivity of customers with fast and efficient in-house software development.



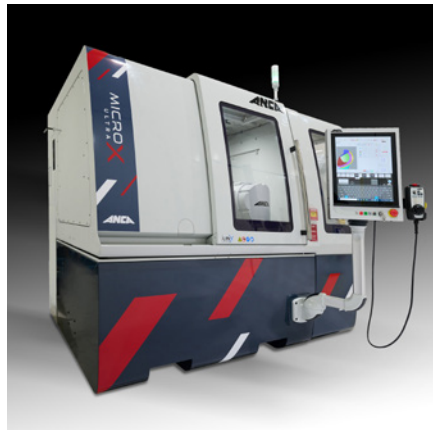
Tailored to customers' needs, the Affolter specialists develop new options and fine-tune the 8-axis CNC gear hobbing machine AF160. Get a first-hand look at the innovative AF160 and talk to the experts of Affolter and their U.S. representative Rotec Tools

[affoltergroup.ch](http://affoltergroup.ch)

## ANCA

BOOTH #237406

At IMTS 2024, ANCA CNC Machines has much to offer the market. In addition to the introduction of an advanced, high-precision tool grinder, the MicroX ULTRA, as well as the next generation of integrated manufacturing technology, AIMS Connect, ANCA will further highlight its commitment to offering solutions for tool grinding production, start to finish, with the celebration of its 50th anniversary in business (1974-2024) and the recent opening of its newest Tech Center in Temecula, CA, to serve its fast-growing West Coast market base.



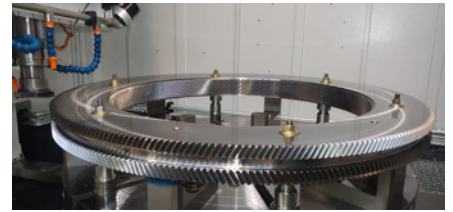
Pat Boland, ANCA co-founder, remarks, "For 50 years, ANCA has been on a journey to change the shape of the cutting tool industry. To celebrate our 50th anniversary, we look forward to meeting with our customers and partners at IMTS. As innovation has motivated us throughout our history, new products and developments will be at the center of our celebrations. ANCA's future is exciting, we are focused on continuing to invent and deliver groundbreaking technology to help take cutting tool production into areas not previously thought possible."

[anca.com](http://anca.com)

## Cincinnati Gearing Systems (CGS)

BOOTH #236776

Located in Cincinnati, Cincinnati Gearing Systems (CGS) is a recognized leader in precision component gear manufacturing and design engineering. More than just a gear manufacturer, CGS offers customers over 100 years of experience in producing high-quality, reliable, and cost-effective component gearing and gear units for a wide range of power transmission applications. Configurations include epicyclic gear units, multiple pinion gear units, parallel shaft designs, vertical and horizontal offsets, dual and single input, single and double helical, and hybrid designs. CGS has in-house full-service manufacturing, design engineering, testing, and heat-treating capabilities. Whether it is a clean-sheet design or a standard design, CGS is the single source to satisfy your specific gearbox requirements.



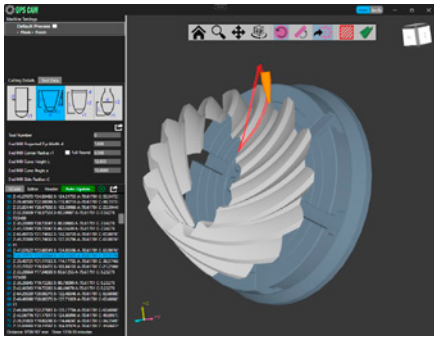
CGS is IATF 16949 certified and has over 30 years of experience in producing custom component gears for various automotive and off-highway Tier 1 and Tier 2 customers as well as leading-edge electric drive applications still in development. From pinions, spur gears, and helical gears, to powertrain shafts, CGS can be your one-stop shop for all your component gearing needs. With over 100 years of gear manufacturing experience with our own heat-treating facility, CGS offers full-service precision gear manufacturing for prototypes, production, and high volume.

[cincinnati gearingsystems.com](http://cincinnati gearingsystems.com)

## Dontyne Systems

BOOTH #237227

The *Gear Production Suite* software for Dontyne Systems has a range of options to assist in the design and manufacture of gear components. The concept of the software is to provide a common platform for designers and manufacturers to improve production efficiency. The software can design gear systems and analyze them under operating conditions, then automatically calculate tool forms and confirm the accurate generation of workpieces by simulation of the intended production method. Potential problems can be detected at this stage and any changes that need to be implemented before machining. Machine processes such as hobbing, profile grinding, shaping, shaving, skiving, and honing as well as forming techniques such as sintering, forging and injection molding can be considered. Measurement data can be imported into the system to assess the accuracy of the surface and define any corrective action. Increasingly this is possible using devices on the shop floor for in-process control. The software has been in use for 20 years worldwide with major markets in the USA, Europe and Japan. Dontyne will be demonstrating integrated solutions of the design software machine tools and digital gauges for workbench and on-machine devices at IMTS 2024.



Recently Dontyne has added *GPS* CAM module to simulate production on 5-axis machines. The simulation can be for End Mill tools for small batches enabling versatile, economic manufacture for fast turnaround and fixed tools for larger batch sizes or faster machining times. The calculated surface points are converted to G-Code by the software based on tool selection. The process can be enhanced by using *GPS* inspection files which can be exported directly to gear checking machines or CMMs. Dontyne Gears was formed to support R&D projects and offer design and prototyping services to our clients. The workshop facilities can be used to validate *GPS* system by producing customer parts from project files on the machine tools both roughed and finished, and inspection on a range of devices depending on intended production levels. Once proven the approach is brought in-house by the client, facilitated by the *GPS* software. Aerospace, motorsport and luxury car sectors have been quick to take up this capability for complex bevel and hypoid forms, but the software has been applied to cylindrical gears too for the rapid development of new gearbox arrangements. Project work has seen the design and machining of gear pairs days rather than weeks to ISO Grade 5 or better, and surface finish well within aerospace tolerance levels. See the brochure on our website for details or visit the Dontyne booth at IMTS.

[dontnesystems.com](http://dontnesystems.com)

## DTR

BOOTH #237017

DTR manufactures a full line of gear-cutting tools—such as hobs and milling cutters—and provides new tool design solutions for a global market, serving customers in over 20 countries.



DTR adds value for customers with high-quality/performance tools, competitive pricing, fast/on-time delivery and technical support from expert technicians.

[dtrtool.com](http://dtrtool.com)

## DVS Technology Group

BOOTH #236920

DVS and its subsidiaries will have experts on-site to present their latest, advanced solutions for metalworking and automation. Gear-specific competencies include skiving, chamfering/deburring, internal/external gear-cutting tools, grinding, honing, and more.



Visit DVS and discover their integrated and synergistic solutions for hard-finish machining, their solutions in the field of future technologies, and their tool and CNC machine program.

[dvs-technology.com](http://dvs-technology.com)

## EMAG

BOOTH #237047

Visit EMAG to learn more about its portfolio of automated machining solutions that make entire production processes quicker, less prone to error and more cost-effective. Whether needing to simply speed up production or add a “lights out” shift, EMAG has a tailor-made system to fit your unique components.



Featured technologies include VL 3 DUO Turning Machine with bin picking automation, WPG 7 Universal Cylindrical Grinding Machine for workpieces up to 250 mm, and the VT 4-4 Turning Centers for demanding shaft production.

[emag.com](http://emag.com)

## Federal Broach & Machine

BOOTH #237238

Federal Broach & Machine, a division of Nidec Machine Tool Corporation of Japan, will exhibit their Vertical Rising Table Broach Machine (VRT). The machine is capable of fully automatic broaching of internal spur splines. In addition, the companion Federal Broach tools will be available for show attendees to review.



The machine can be built with five to 20 tons of force for a wide range of applications. Capable of hard broaching, the VRT has a small footprint and is suitable for mass production as well as job shop installations. According to Ken Kernen, President of Federal Broach, “The new Vertical Rising Table Broaching Machine is our newest and most flexible machine, and we are proud to be exhibiting it for the first time at IMTS 2024.” Kernen added, “The modular design allows the force, stroke, tool length, coolant type and CNC control type to be tailored to the exact needs of the customer.”

[nidec-machinetoolsamerica.com](http://nidec-machinetoolsamerica.com)

## Gleason Corporation

BOOTH #236909

Gleason is a global leader in gear technology. Gleason’s “Total Gear Solutions” range from gear and transmission design software to the development and production of gear manufacturing machines and related accessories, gear metrology equipment and automation systems. Gleason products are used by customers in the automotive, commercial vehicle, aerospace, agricultural, mining, energy, construction, power tool, marine and many other industrial equipment markets.



As gear industries advance, so does the need for unparalleled precision. Gleason’s Phoenix 100C Bevel Gear Cutting Machine has been designed to bring speed, flexibility and ease of use to the high-volume production of precision bevel gears for robotic, power tool and other applications of similar size. The 175GMS nano Gear Metrology System heralds the advent of a new era, where nano-level inspection is no longer the exception, but the rule. The 175GMS nano and Phoenix 100C Bevel Gear Cutting Machine can be experienced live at IMTS.

[gleason.com](http://gleason.com)

## GMTA

BOOTH #237126

GMTA will present its comprehensive range of solutions for producing gears and powertrain components. Whether you need a standalone machine or a complete system cell, GMTA offers tailored solutions designed to deliver a high ROI and optimize your production processes.



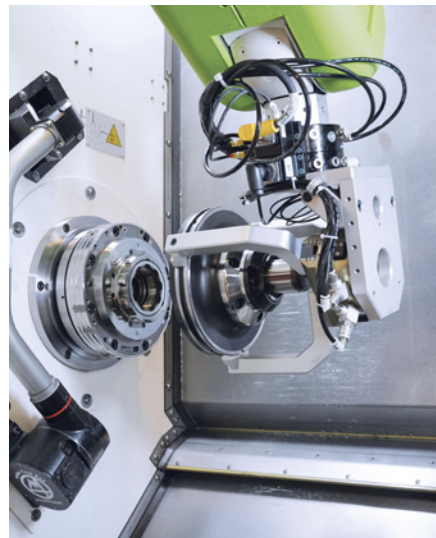
Featured in the GMTA booth is the TOYO TGG-26-2W Gear Grinding Machine that offers versatile gear grinding (accommodating workpieces with an outer diameter of up to 10 in.). This machine includes two work heads for efficient workpiece installation, removal, cleaning, and gear adjustment during machining, significantly reducing non-grinding (idle) time. It is also equipped with an auto-balancer and AE sensor for automatic balance and position adjustment, minimizing alignment time. Our proprietary teeth surface correction application ensures ideal gear grinding with a user-friendly interface.

[gmtamerica.com](http://gmtamerica.com)

## Hainbuch America

BOOTH #431636

Hainbuch America will unveil its latest machining innovation, the AC (Automated Change) Line. This solution is a fully automated system for workholding device changeover for manufacturing efficiency and precision.



The AC Line streamlines transitions between workholding devices with speed and accuracy. This workholding solution reduces downtime and enhances overall productivity, allowing manufacturers to maximize their machining capabilities.

[hainbuchamerica.com](http://hainbuchamerica.com)

## Helios Gear Products

BOOTH #236906

Helios Gear Products of South Elgin, IL, will feature gear manufacturing solutions including the Hera 90 CNC gear hobbing machine, the M673 CNC gear shaping machine, and the MSR rotary magazine with automatic loading. Helios will feature the high-speed shaping capabilities of the M673. With shaping speeds of up to 2,000 strokes per minute, the capability to accommodate versatile shaper cutter types (disc, bell, and shank) and flexible automation system options, manufacturers can achieve their precision shaping goals.



Advancing gear manufacturing productivity even further is the new MSR. This rotary magazine with automatic loading offers comprehensive, versatile automation by integrating manufacturing cells with operations such as gear generation, washing, deburring, and laser marking. The MSR features stackable workpiece towers that offer more capacity than rotary conveyors and is offered with a variety of robotic loading options to feed up to 4 machine tools at a time for fully optimized gear manufacturing operations.

[heliosgearproducts.com](http://heliosgearproducts.com)

## HWR Workholding USA

BOOTH #431579

The North American subsidiary of one of Germany's premier workholding providers, HWR Workholding USA provides manufacturers with innovative workholding systems that achieve high levels of flexibility and security. The company is best known for its zero-point workholding system for milling applications and patented self-centering compensating chucks for turning applications. HWR partners closely with machine tool builders and automation providers to develop solutions that are easily integrated into advanced manufacturing operations.



HWR Workholding USA has announced that it will be bringing its full line of innovative workholding products to IMTS 2024. Exhibiting at IMTS for the first time, HWR will be highlighting new and existing solutions for both turning and milling applications. Additionally, the booth will feature a RoboJob automation cell demonstrating the ease with which HWR products facilitate process automation.

[hwr-usa.com](http://hwr-usa.com)

## Index BOOTH #339119

Index will be demonstrating its full range of high-precision machining solutions, which will include the North American debut of its C200 Fanuc, a cost-effective new variant of its production machining center. The company will also showcase the Index iXperience, its comprehensive portfolio of value-added services that provide manufacturers with an optimized solution, from the acquisition and installation of a single machine to the

development and delivery of a turnkey production system.



# INVOLUTE

Gear & Machine Company



[www.involutegearmachine.com](http://www.involutegearmachine.com)

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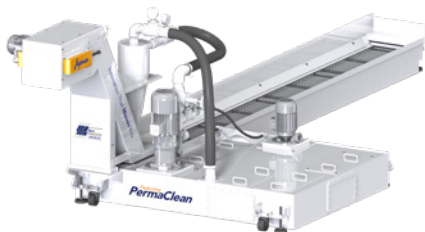
With eight motorized spindles, the MS40-8 CNC multi-spindle allows for extremely short cycle times on both complex and simple parts. The machine is available with dual synchronized spindles and can be operated in a double four-spindle mode to produce two complete parts with every full rotation of the spindle drum. The machine can be configured with up to 18 CNC slides, as well as additional Y axes, to perform a diverse range of processes. All the machine's motorized spindles are fluid-cooled and can operate independently of the other seven, allowing each to apply cutting data optimized to the process being performed.

[index-group.com/en\\_us](http://index-group.com/en_us)

## Jorgensen Conveyor and Filtration Systems

BOOTH #338009

With over 70 years of experience in designing and manufacturing advanced conveyor, coolant filtration and chip processing solutions for machine tool, metalworking, and material handling, Jorgensen Conveyor and Filtration Solutions offers a wide range of standard and customized systems to companies across North America and globally. Jorgensen will feature its PermaClean coolant filtration system that's combined with the new EcoFilter 80 self-cleaning conveyor and automated coolant solution.



The EcoFilter 80 enables efficient filtration of fine chips to 80-microns nominal and is the first economical non-drum style conveyor below 100-micron filtration. EcoFilter conveyors use a two-stage chip removal and filtration process that carries out large chips on a hinged or scraper belt. Fine chips flow with used coolant between the belt runs to a flow-through EcoFilter cell where they are separated from the coolant.

[jorgensenconveyors.com](http://jorgensenconveyors.com)

## JTEKT Machinery Americas Corp.

BOOTH #338700

JTEKT Machinery Americas Corporation will feature 7 new metal-cutting machines and automation solutions at IMTS booth 338700, plus IoT solutions and technology presentations. Showcasing a complete range of production solutions powered by JTEKT, the company's new offerings include horizontal machining centers, a WELE 5-axis VMC as well as a vertical turning center, Takisawa Taiwan CNC turning centers and two new production cylindrical grinding machines.



JTEKT will use IMTS to demonstrate its FH5000 Series high-speed horizontal machining centers (HMC) with advanced pallet automation, specifically, a pallet pool for efficient flexible machining system operation. The competitive advantage of FH5000 machines is that they offer 25 percent more machining capacity than other machines in their size range.

[jtektmachinery.com](http://jtektmachinery.com)

## Kapp Niles

BOOTH #237024

Kapp Niles offers precise and cost-effective technology for grinding and inspection of parallel axis involute gears and other sophisticated components. With Kapp Niles' purpose-built machine series, it meets the needs of every gear application and noninvolute precision profiles.



Kapp Niles provides a wide spectrum of machine models suited to the processes of discontinuous profile grinding and continuous generating grinding. As a manufacturer of gear and profile grinding machines, Kapp Niles also offers custom grinding and dressing tool technologies that can be utilized on any brand of machine.

[kapp-niles.com](http://kapp-niles.com)

## Liebherr Gear and Automation Technologies

BOOTH #236914

In the gear skiving machines, the process, tools, machine and automation system, come from a single source, since Skiving<sup>3</sup> is primarily about delivering a complete solution for the customer. The process provides high-quality assurance and productivity when machining internal and external gears. Skiving<sup>3</sup> is especially suited for internal gears of medium size and quantity, as it is much faster than shaping and more economical than broaching.



Liebherr will showcase the LK 280 DC gear skiving machine for shafts and rings. The LK 280 DC offers rigid design, a ringloader for fast automatic loading, tailstock for shaft machining and optimum workpiece clamping and optional chamfering during the machining process. Liebherr offers tool design and manufacturing of conical and cylindrical skiving cutters, process-optimized tool design and tools in PM-HSS & carbide versions. Additionally, Liebherr's process includes analysis and simulation for optimal cutting conditions, availability of application engineers for optimal customer support and 3D collision analysis of part, tool, holder, automation, and machine.

[liebherr.com](http://liebherr.com)

## The L. S. Starrett Co.

BOOTH #134130

The L.S. Starrett Co., a global manufacturer of precision measuring tools and gages, metrology systems and more, will be demonstrating the latest in quality control inspection technology. "Supporting smart manufacturing and connectivity, we are excited to demonstrate at IMTS the very latest solutions in wireless measurement data collection and transmission, in addition to our wide breadth of leading metrology solutions," said David Allen, Vice President, The L.S. Starrett Co.



Starrett will be displaying a broad range of wireless, electronic, and mechanical precision measuring tools, and will be debuting its innovative, all-new, W4900 Wireless Digital Indicator utilizing touchscreen technology, that redefines comparative indicating measurement. It is an intuitive, fast, easy-to-use gage. The latest electronic and wireless micrometers, bore gages, calipers and height gages will also be demonstrated, supporting Industry 4.0 initiatives via DataSure wireless data acquisition.

[starrett.com](http://starrett.com)

## Nagel Precision, Inc.

BOOTH #236945

Nagel Precision Inc., established in 1982, is an affiliate of the Nagel Group (Established in 1948) and located in a ISO 9001 & ISO 14001 certified manufacturing facility in Ann Arbor, MI. Nagel Precision specializes in honing and superfinishing and will feature Variogear specifically engineered for honing gears.



Equipped with electromechanical honing spindles and the latest generation of the Nagel control system, Variogear offers flexibility for high output levels enabling extremely short setup times. Variogear allows post-process measurement after each of the three possible honing operations giving an effective feedback control for each separate process stage. The machine can be loaded automatically or manually. The rotary table transportation serves to reduce nonproductive time for efficient productivity.

[nagelusa.com](http://nagelusa.com)

## Nidec Machine Tool America

BOOTH #237238

Nidec Machine Tool America manufactures gear cutting and finishing machinery, broaching machinery, gantry and boring mills, OD grinders, 5-axis machining centers, 3D printing machinery, wafer bonding technology, gear-cutting tools and broach tools and tooling.

Nidec will showcase the LAMDA500, a mid-sized powder Directed Energy Deposition (DED) metal 3D printer. Designed for diverse metal additive manufacturing needs, the LAMDA500 boasts a generous build volume of 500mm x 500mm x 500mm and five-axis functionality, ideal for producing complex industrial metal parts.



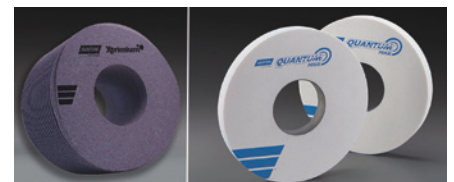
Also featured is the CF26A, a cutting chamfering machine that is used to machine the chamfered portions of gears. The machine is designed to achieve high-precision and high-efficiency machining, and it is particularly well-suited for the machining of gears for electric vehicles.

[nidec-machinetoolamerica.com](http://nidec-machinetoolamerica.com)

## Norton | Saint Gobain Abrasives

BOOTH #237042

Norton | Saint-Gobain Abrasives, will be highlighting a range of high-performance abrasive grinding products and technology. Gear grinding solutions that feature a new high-performance bond designed for gear grinding in extreme, tight tolerance environments will be highlighted. The portfolio of gear grinding products is specifically designed by category to provide higher profile accuracy, supreme form holding and burn-free grinding in worm, profile, and bevel applications.



Norton Quantum Prime grinding wheels which feature proprietary nano-crystalline ceramic grain offer high productivity gains across a wide range of applications will also be highlighted. The Quantum Prime grain delivers high grinding efficiency and part quality, as well as significantly longer wheel life than

traditional ceramic grains. Wheels are available in a range of types including OD, ID, gear grinding, toolroom, disc grinding, mounted wheels, surface grinding, creepfeed and flute grinding.

[nortonabrasives.com](http://nortonabrasives.com)

## Sandvik Coromant

BOOTH #338348

Sandvik Coromant, a global supplier of cutting tools, machining solutions and advanced manufacturing knowledge, will showcase an extensive array of holistic engineering products and services to help shops with data-driven solutions and machining technology. Booth visitors can expect an immersive experience that brings together the company's products, expertise and digital machining technology for a wide range of industries, with solutions that drive greater productivity and manufacturing wellness in advanced machining applications.



"Our presence in the Machine Tool Hall underscores our commitment to providing a streamlined and comprehensive experience for attendees as a one-stop destination for all their machining needs," said Veronica Messersmith, Americas President for Sandvik Coromant. "With all of our offerings under one roof, visitors can easily explore the full breadth of our advanced technologies and services and discover new ways to drive efficiencies and productivity gains across the entire value chain."

[sandvik.coromant.com](http://sandvik.coromant.com)

## Speedgrip Chuck Co.

BOOTH #432268

Speedgrip Chuck Company's QCR (Quick-Change Receiver) is a manually actuated cam-lock receiving plate that attaches to CNC lathe spindles and reduces the time needed to change work-

holding clamping devices. Like tool retention in the spindle, the QCR features automatic release of draw connections.



With the QCR, the time needed for operators to switch ID/OD collets, jaw chucks or face driver workholding devices on their machines is cut from an hour to five minutes, making them well-suited for just-in-time production. Visitors to IMTS 2024 can see the QCR along with the company's other premier engineered workholding solutions firsthand

[speedgrip.com](http://speedgrip.com)

## Star Cutter Company

BOOTH #237013

Star Cutter Company will unveil its newest generation tool grinder—the FLX. This 5-axis grinder offers high-efficiency carbide tool manufacturing within a compact footprint. It has been designed with a focus on flexibility, enabling users to modify features to exactly match their grinding needs. For unattended machining, FLX features a broad range of automation capabilities, producing large numbers of parts continuously.



In addition to the new FLX grinder, other Star Cutter products to be featured include: TRU TECH T93X Centerless Grinder; Louis Belet Swiss Cutting Tools; solid carbide drills and reamers, deep hole drilling solutions, PCD and 3D printed tooling; hobs, shapers, Scudding and skiving cutters; carbide blanks and preforms; and more.

[starcutter.com](http://starcutter.com)

## Star SU

BOOTH #237013

Star SU—part of the Star Cutter family of companies—offers a wide variety of gear-cutting machinery, tools and services including vertical hobbing and chamfering and deburring machines; hob sharpening machines; hobs, milling cutters, Scudding and skiving tools, shaper cutters and shaving tools; chamfer and deburring tools; gundrills and reamers; form tools; and tool life cycle management services.



Star SU brand and technology partners include Star Cutter Company, Modul MT, Louis Belet Swiss Cutting Tools, and GMTA, Inc. / Profilatör.

[star-su.com](http://star-su.com)

## Wenzel America

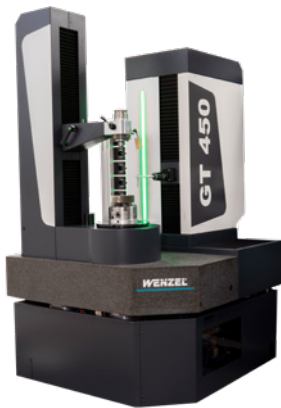
BOOTH #134718

Wenzel America brings a broad portfolio to IMTS, offering scalable solutions for modern manufacturing. Built around a unified software platform in WM |Quartis, Wenzel offers systems that can solve any measurement challenge. The exaCT line of CT systems offers metrology-grade inspection to keep pace with the evolving needs of additive manufacturing. The GT450 brings solutions out of the gear lab and into production, with the integration of automated loading.

Wenzel invites you to see for yourself how we are bringing metrology

[geartechnology.com](http://geartechnology.com)





forward with an innovative combination of modern, efficient software solutions, coupled with traditional robust mechanical design, to offer the most comprehensive metrology solutions available.

[wenzelamerica.com](http://wenzelamerica.com)

## Zoller

BOOTH #432018

Zoller will premiere its latest automation system and showcase its complete system of manufacturing efficiency solutions. In addition to presenting the new coraMeasure LG, Zoller will display its range of tool presetting, measuring, inspection, heat-shrinking, balancing, tooling, tool management and automation technology.

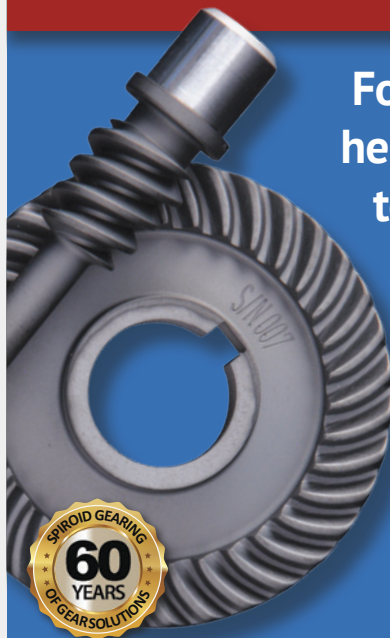


“For nearly 80 years, Zoller has been a pioneer in developing technology to optimize processes around cutting tools,” said Zoller Inc. President Alexander Zoller. “Today, we’re proud to provide a complete roadmap to efficient manufacturing from CAM to finished part that can benefit manufacturers in every market segment.”

[zoller-usa.com](http://zoller-usa.com)



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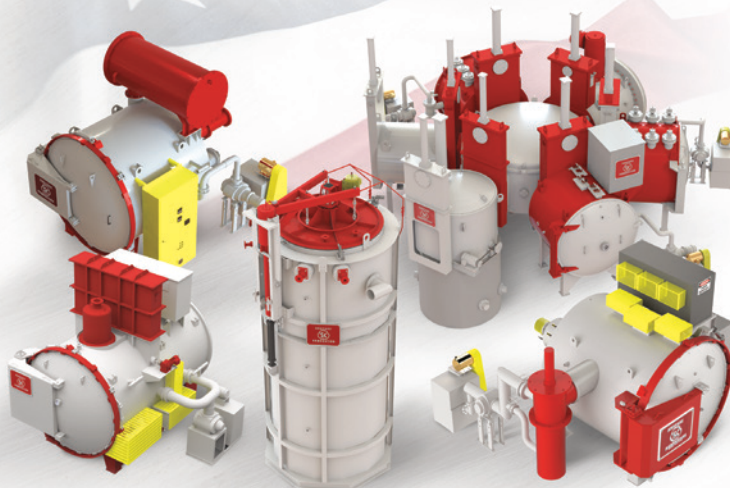
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# Mission to Mars

## Gears that go “above and beyond”

Jim Granitsas, National Sales Director, Southern Gear & Machine, Inc.

If all goes as planned, NASA will launch its Sample Retrieval Lander (SRL) Mars mission from Florida’s Space Coast in June 2028, the start of its latest, and greatest, mission to Mars. By sometime in the early 2030s, the SRL mission will have succeeded in traveling to Mars; gathering samples already collected by the Perseverance Rover; launching them into Mars orbit; and capturing and returning them safely to Earth. For NASA’s scientists, the SRL mission is the culmination of a decades-long series of Mars explorations designed to find evidence of life outside of Earth or, at the very least, provide important insights into the origin of life here on Earth.

The mission is among the most ambitious, and risky, ever devised by humankind. After a two-year journey and landing on Mars, the SRL will rendezvous with NASA’s Perseverance Rover, which landed on Mars in 2021 and is busy now exploring an ancient river delta and collecting samples that could show the potential for ancient life. These samples will either be collected by the Sample Retrieval Lander via Sample Transfer Arm or, if Perseverance can’t make the rendezvous

point, retrieved by two Sample Recovery Helicopters. Sample tubes then will be loaded into an Orbiting Sample container atop the Mars Ascent Vehicle (MAV) carried by the SRL. The MAV then is launched into orbit around Mars, where it’s met by yet another vehicle: the Earth Return Orbiter (ERO). The Orbiting Sample container is transferred from MAV to ERO, which then delivers the samples to Earth.

Just a few hours south of where this mission will launch in 2028, on the factory floors of Miami-based Southern Gear & Machine, work is underway to help make this mission a success. Southern Gear is playing a small but important role, by helping to design, develop, and perfect the critically important gears and shafts used for the actuation of the legs and Sample Transfer Arm on the SRL. This vehicle must be both lightweight enough to get to Mars, and robust and reliable enough to withstand the rigors of space, a surface landing, successful transfer of the samples, and then launch the MAV and its precious cargo back into orbit. A lot is riding on the performance of these gears, says Southern Gear Engineering



*Southern Gear puts all the resources for the machining of gear blanks, gear cutting, gear grinding, assembly and inspection under one roof—all close to the Space Coast.*



*Southern Gear streamlines production from engineering through final inspection—making it faster and more economical for prototype development of gears.*

manager Sebastian Fajardo. “The project has unfolded over many months, starting in April 2023,” recalls Fajardo. “We were challenged by our customer to produce a series of high precision spur gears and internal splines, which sounds simple enough until you factor in the very thin walls required for weight savings, and the need to hold exceptionally tight tolerances to help ensure the highest levels of repeatability.”

Despite these challenges, Southern Gear’s President Karen Malin says her company was eager to take on the work and go ‘above and beyond’. “We have all the necessary resources in-house,” she says, “And the know-how derived from our long-time aerospace and defense work to find ways to make parts like these more easily manufacturable.”

The first parts produced were a drive gear, an idler gear, and an output gear—each a combination of straight spur gears and internal splines. The internal spline in particular was a challenge, with a design that required Southern Gear’s engineering team to devise ways to make it more manufacturable. Every part was machined complete, requiring a combination of



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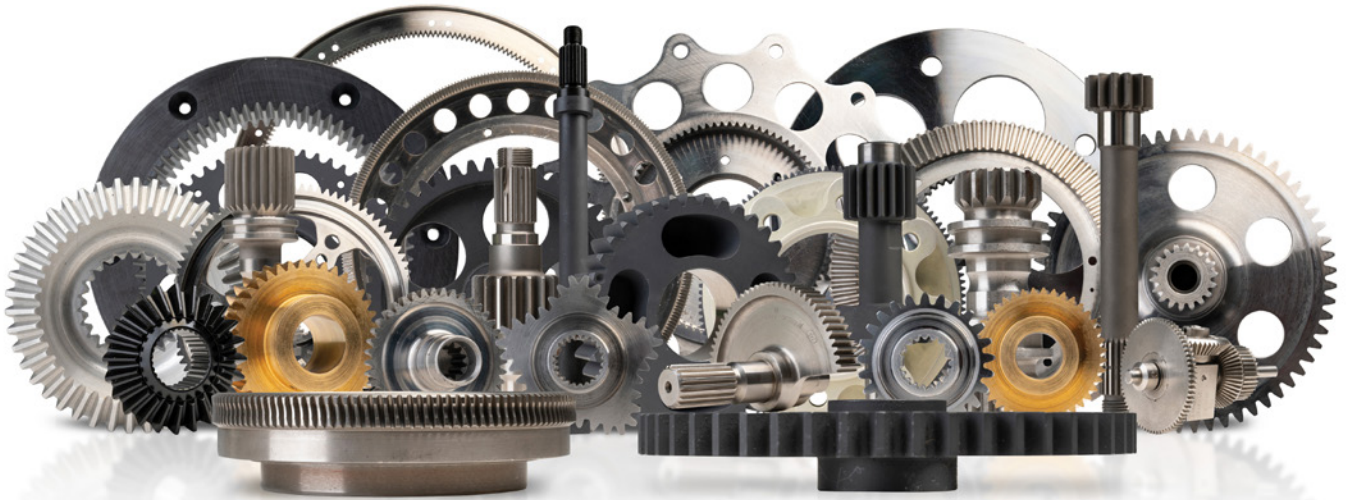
at [geartechnology.com](http://geartechnology.com)

*Southern Gear adheres to stringent AS9100 D, ISO 9001:2015 certified quality systems.*

operations that included turning, external gear hobbing, internal spline shaping, and milling. Of special note was the output gear. With its very thin walls, heat treat distortion posed a significant challenge, requiring Southern Gear to utilize a non-conventional approach in order to compensate for, and minimize, heat treat distortion and allow for the machining of the part in the annealed state.

With the successful production of the first parts, Southern Gear was asked to produce two more challenging parts for this same program: a spline shaft assembly and its mating

part. Both of these parts initially had some features that were not easily manufacturable but after a consultation with the customer, Southern Gear was able to deliver many innovative design alternatives that would allow for the production of both parts much more quickly and efficiently. The shaft was particularly complex, with an acme thread with tapped holes for helical inserts and a spline at the end. It also required that tight tolerances be held in features that wouldn't normally require such accuracies, such as undercuts. Even the nut was complex, with an internal and external spline, an internal acme



**Southern Gear's products run the gear gamut: fine, medium, coarse pitch; spur, helical and face gears, shafts, splines, sprockets, worms, straight bevel—and now, gears for Mars exploration.**

thread, and tapped holes on the side which needed helical inserts, which Southern Gear assembled.

Upon successful completion of this second phase, Southern Gear was tasked with producing three more components for the SRL leg assembly: an upper hard stop, a lower hard stop, and a hard stop cap. The upper hard stop is a thin-walled external spline with internal features that require extremely precise milling. The lower hard stop and the stop cap had thin walls with an internal spline and a

cam-like external feature that required very fine milling cuts to achieve the surface finish requirements. To produce this last batch of parts, Malin says the company pulled out all stops, to meet the customer's aggressive delivery schedule—and to help keep the Mars mission on track.

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# Combi Honing of Gears

## Unique possibilities for e-drive applications

Dr. Antoine Türich, Director Product Management Hard Finishing Solutions, Gleason Corporation

As the automotive industry continues to move towards e-mobility, the manufacturing world is adapting to the respective requirements. Large gear ratios are necessary to reduce the high input speeds of electric motors to the required speed of the drive wheels. At the same time, masking noise of combustion engines is now missing, posing challenges to the noise level of transmissions. Principally, two main transmission concepts have become established for e-drive applications: two-stage layshaft transmissions with four gears, and planetary transmissions (Figure 1).

Planetary transmissions have the advantage of creating high gear ratios in a very limited space, using so-called “synchronized stepped pinions,” as shown in Figure 2, both gears on the pinion must be exactly timed to each other within very tight tolerances which pose particular challenges to the hard finishing processes.

Due to the tight tolerances and the noise sensitivity of transmission components, hard finishing by grinding or honing is indispensable. Gear honing proves to be particularly advantageous since honed surfaces have proven

to result in lower noise behavior than ground surfaces due to their specific, curved surface structure. Gear honing is also well suited for the hard finishing of gears with interfering contours, as is the case with the smaller gear on stepped pinions.

This is due to the small necessary cross-axis angle between the honing tool and the component and the fact that no tool overrun paths are required, as is the case, for example, with grinding. Hence, honing is the mandatory process to finish the smaller gear, whereas the larger gear could also be ground. However, this would require the application of two different processes, bringing with it several disadvantages. Not only would two different machines with different clamping fixtures and tools be required, but the process control would also be extremely challenging, especially to achieve a very tight timing tolerance between both gears. Using two different machines also doubles the unproductive idle time required for loading and unloading as well as for indexing both gears.

Gleason’s Combi Honing process can eliminate these disadvantages. Combi Honing offers the possibility of using two honing rings in parallel within the honing head of a 260HMS Honing machine, hence delivering an ideal solution for honing both gears of the synchronized stepped pinions in one clamping (Figure 3).

As simple as the idea may seem, there are still important details to consider. If only one honing ring is used, its working point will always match with the swivel point of the honing head (A-Axis). Instead, if two honing rings are used—as in the case with Combi Honing—at least one honing ring will not be in the swivel center point as shown in Figure 4. This situation results in an offset of the actual operating point in Y-direction which, if

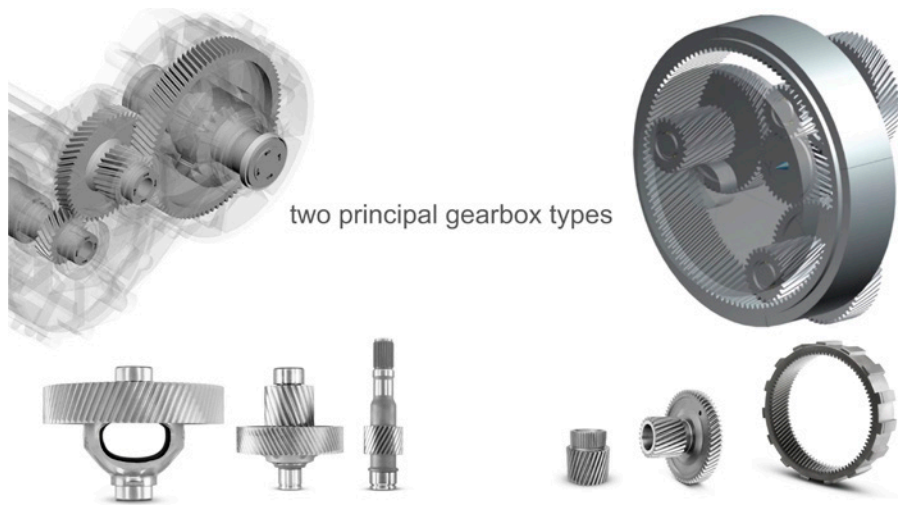


Figure 1—Two principal gearbox types for e-drive applications.

Synchronized stepped pinions have a tight timing tolerance between Gear I and Gear II



Figure 2—Synchronized stepped pinions with timing tolerance.

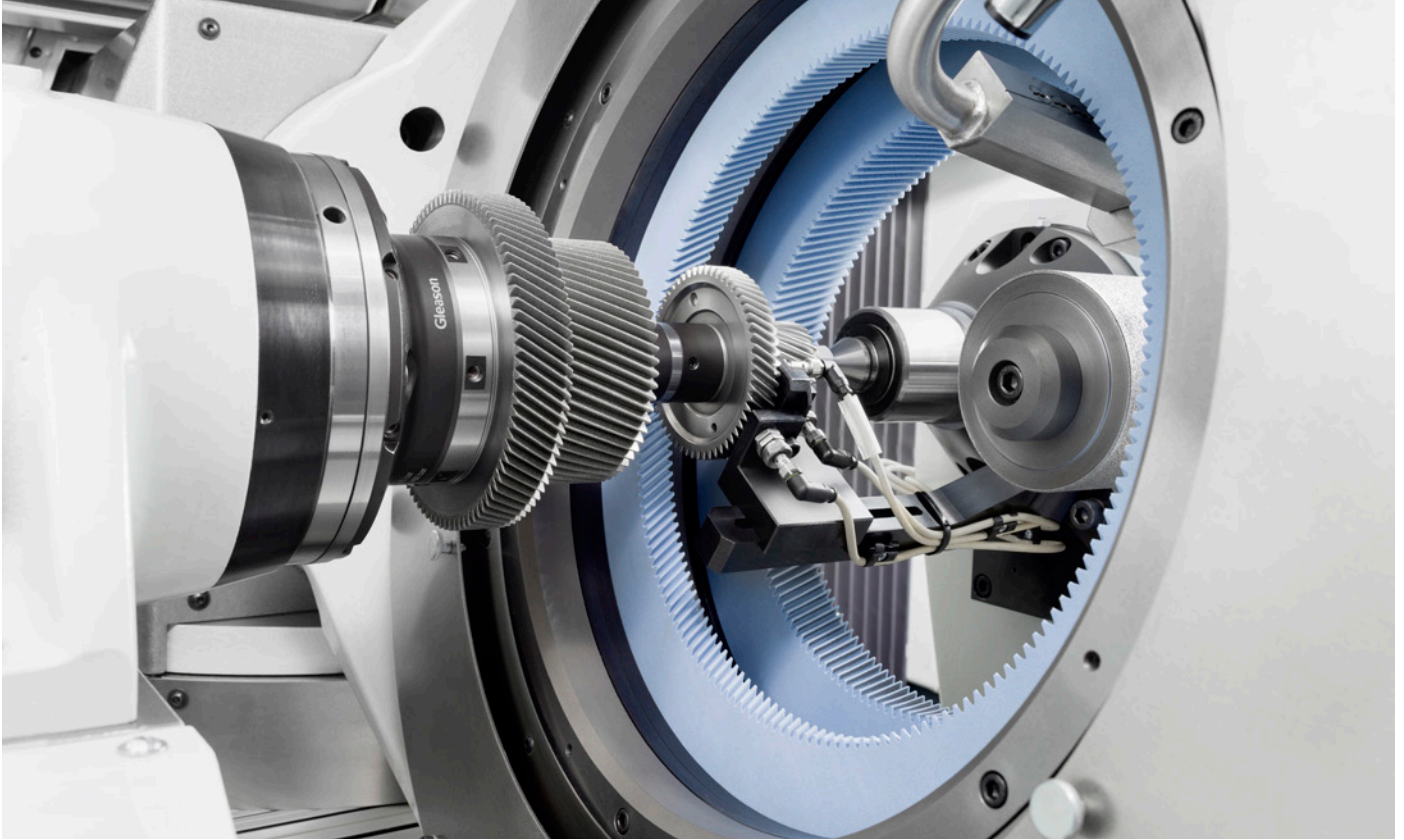


Figure 3—Combi Honing on a 260HMS Honing machine.

not compensated for, will cause tapered gears, clearly visible as flank line deviations ( $f_{Hresign\beta}$  deviations on the left and right flank).

To compensate for this unwanted effect, Gleason honing machines are equipped with an additional B-axis (swivel axis), which is also used to influence flank line modifications such as crowning and desired lead deviations.

The Combi Honing process starts with finishing the larger gear with honing ring no. 1, then finishing the smaller gear with honing ring no. 2, all in the same clamping. During the second operation, the larger gear is positioned between the two honing rings. A particular challenge is achieving the reliable and accurate positioning of the timed gears in relation to the honing rings. When indexing, i.e., centering gear teeth and tools, both teeth of the large and the small gear must be detected while corresponding exactly to the required timing and the tolerances of the index hole on the face side of the gear. The latter guarantees the final correct installation position of the stepped pinion in the planetary transmission. Three indexing sensors (Figure 5, right) are used to measure the position of all teeth of both gears as well as the

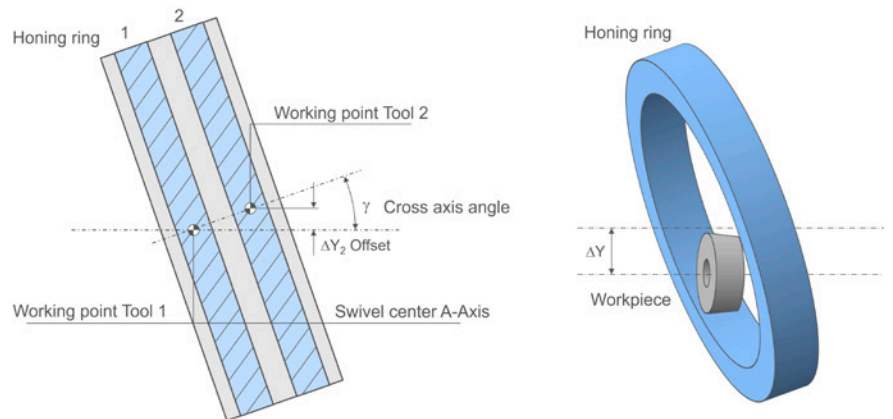


Figure 4—Offset in Combi Honing.

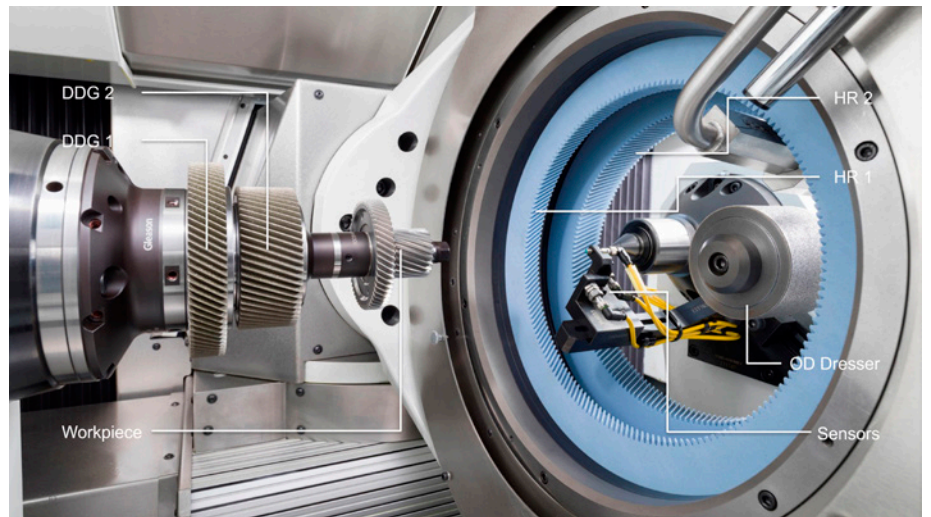


Figure 5—260HMS setup for Combi Honing.



gear I

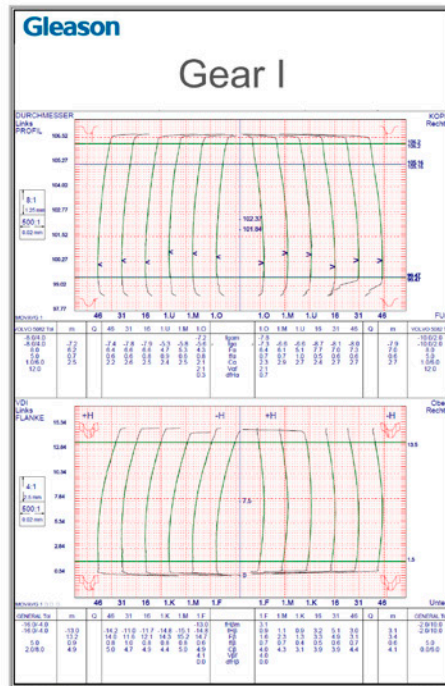


Figure 6—Quality example.

Polish Grinding  
Rz < 1 µm



Polish Honing  
Rz < 1 µm



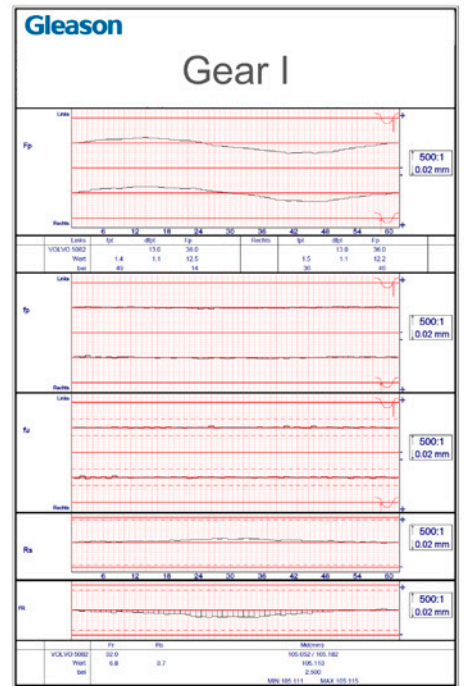
Figure 7—Polish grinding and polish honing.

position of the index hole on the face side. A corresponding algorithm calculates the correct position of the gear teeth in relation to the honing rings. Parts with excessive hardening distortions or insufficient stock, which do not fit the requested input quality and cannot be honed in the required tolerances aligned to the index bore, are automatically ejected.

Another important feature determining quality is the fixed position of the two diamond dressing gears on the work spindle (Figure 5). The location of the dressing tools ensures that the position of the teeth on the honing rings does not change either absolutely or relatively—even after dressing

of the honing rings. Loading/unloading of dressing tools to the work spindle, as is often the case in other honing applications, cannot reliably support this important quality aspect. For example, Figure 6 shows the gear quality achieved on the larger of two sample pinion gears. Profile, lead, pitch and concentricity show excellent values in the range of quality DIN 5 and better. The required synchronization (timing) of both gears required relative to each other within tolerance of 5 µm is reliably achieved and represents a true breakthrough regarding the quality of such parts.

Another advantage of the Combi Honing process is the possibility of



superfinishing of gears with polish honing. The requirements for increased transmission efficiency and reduced noise levels demand a superior surface quality of hard-finished components. While polish grinding using a two-zone polish grinding worm is a proven approach, a similar process has not, until now, been possible with gear honing.

But with the possibility of using two honing rings in one clamping, Combi Honing can also be used to apply two different honing ring specifications on one particular gear, similar to a polish grinding process when using a two-zone grinding worm. The left-hand side of Figure 7 shows two different honing ring specifications used for polish honing. The blue ring is made of ceramic material and is used for material removal in the first honing step, whereas the light grey honing ring is a resin-bonded ring using a very fine grit size to polish the surface afterward. This makes it possible to achieve the surface qualities of  $Rz \leq 1 \mu\text{m}$  typically required for polish grinding utilizing gear honing and offers an interesting alternative especially when grinding cannot be applied.



# Resolve Before the New Year

Mary Ellen Doran, AGMA Director,  
Emerging Technology

*Nidec's LAMDA series local shield nozzle eliminates oxygen in an ambient environment during a laser powder directed energy deposition (LP-DED) 3D printing to prevent oxidation of metals, such as titanium, aluminum, and other oxygen-averse materials, deleting the need for an atmospheric chamber. (Photo courtesy of Nidec.)*

Instead of waiting until the beginning of next year to make a resolution to learn more about emerging technologies, I suggest taking advantage of the learning opportunities available right now. Engaging with AGMA's emerging technology (ET) initiatives will help you stay current, expand your knowledge base, and potentially add to your itinerary for IMTS.

Each ET Committee with AGMA has multiple meetings scheduled throughout the remainder of 2024. For exact dates, you can visit the AGMA website or reach out to me directly at [doran@agma.org](mailto:doran@agma.org). These committee meetings offer diverse opportunities; for instance, the Robotics Committee is actively working on a white paper addressing human-centered robotics safety, focusing specifically on advancements in service and humanoid robot technologies. Meanwhile, the Electric Vehicle Technology and 3D Printing committees will host engaging speakers, providing opportunities to interact with people pushing boundaries and possibly creating new things which you will work on or with in the future. The IIoT committee is reviewing AI products and services that may have relevance to manufacturing. Depending on your expertise, you will find an interesting topic in our upcoming committee meetings.

For those preferring a more flexible learning format, Emerging Technology Webinar series hosts four more live events before the year concludes. Join us on the first Wednesday of the month at 1:00 pm Eastern Time. Topics include practical applications of AI for manufacturing, a next-generation procurement platform for manufacturing equipment, the latest in nanocoatings technologies, and strategies for integrating collaborative robots in gear-centric high-mix, low-volume manufacturing environments.

Also, especially before the new year, take advantage of the on-demand emerging tech webinars. We currently have 21 webinars available. However, please note that the 12 videos from 2023 will

be removed from the website on December 31 to make room for the 2025 series. These webinars cover a wide array of topics essential to modern manufacturing. For instance, in additive manufacturing, topics range from the application of CT scanning technology and the utilization of 3D printed molds for rapid prototype development to an overview of powder DED technology. The Electric Vehicle Technology sessions cover subjects such as achieving ultrafine surface finishes, digitalization trends, the current requirements of EV gearboxes, clean steel developments, and the implementation of digital twin technology in manufacturing processes. The IIoT webinars delve into critical areas like blockchain applications in manufacturing, cybersecurity measures, and practical ways to leverage AI in manufacturing operations. Robotics sessions explore practical insights on integrating robots into factory floors, best practices for gearing in robotic applications, and future trends in robotics technology.

If you are looking for recommendations, I have two suggestions. If you are doing anything with the Department of Defense, you will need to become CMMC compliant. Our February 2024 webinar with Derrich Phillips provides a great primer. If you want to watch a webinar that is truly emerging, I recommend watching Sara Jordan's discussion on AMEC (Additive Manufacturing Evaporative Casting), which explores a revolutionary approach to casting techniques enabled by additive manufacturing technologies.

By engaging with AGMA's resources and events focused on emerging technologies, you will not only stay informed but also position yourself to harness new opportunities and innovations within your field. Whether through committee meetings, live webinars or on-demand sessions, there are ample opportunities to deepen your understanding and forge meaningful connections with industry experts and peers alike.



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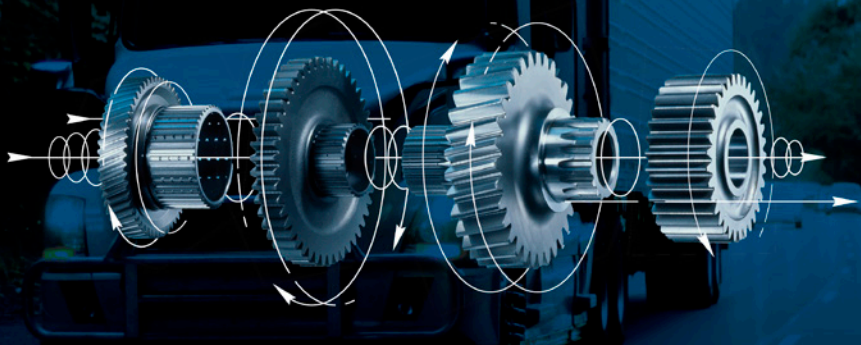
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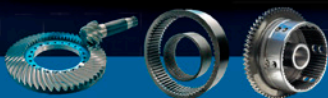
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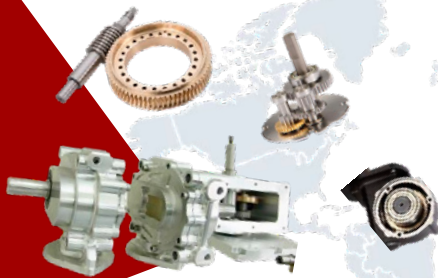
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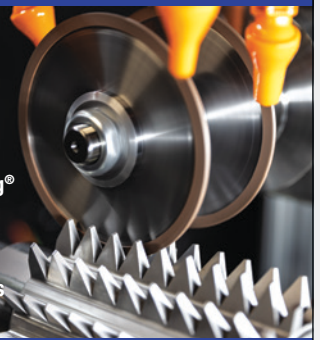
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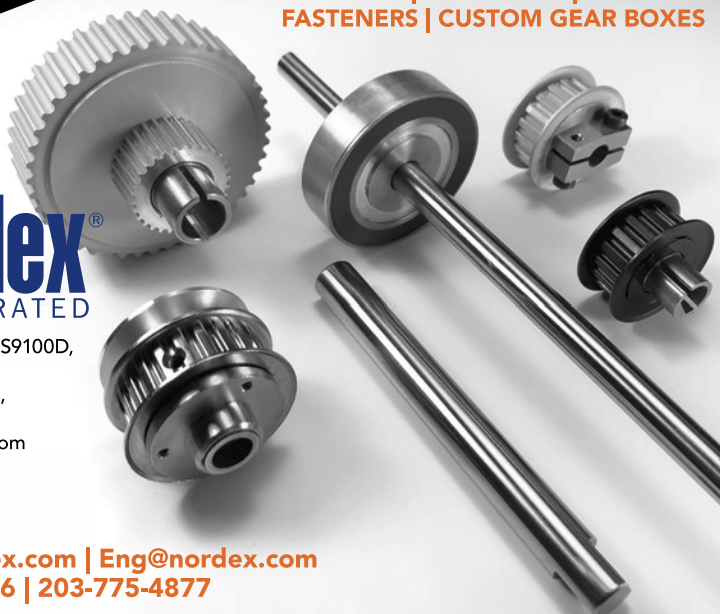
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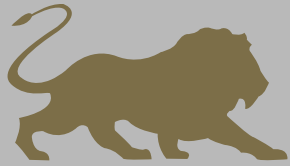
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# What the Heck Is an FTM?

Todd Praneis, AGMA Vice President, Technical Division

If you are a true gear geek, you are probably aware of AGMA's Fall Technical Meeting (FTM). However, we have true gear geeks attending the FTM for the first time each year, and we are thrilled to see that!

So, what is an FTM? At its heart, it's a very technical conference on anything related to gearing and power transmission. The current single-track format, peer-reviewed papers, and unpublished content requirement provide a unique opportunity to hear the latest and greatest work from across the world on materials, heat treatment, gearing applications, design and rating, efficiency, noise and vibration, manufacturing, inspection and quality control.

More than that, the FTM provides many opportunities to network with other gear geeks! Whether it's chatting over coffee during breaks, in-depth conversations at lunches, or casual introductions at networking events, you will find plenty of chances to get together with others in this industry.

This year we have plenty to offer in the way of programming. Our authors will cover many topics including:

- Durability and performance rating procedures for plastic gears
- Design methods of system tolerances for cost-efficient optimization of the excitation behavior
- Gear involute deviations under press-fit conditions

- The influence of nonlinear cumulative damage in gear life-time analysis
- Influence of material removal rate on residual stress
- Nanocomposite coatings for gears
- Plus, many more!

We will have approximately 30 papers presented over the 2-1/2 day event. As always, we will have a Q&A period at the end of each session for the audience to get more specific information from the author.

This year, we are working with our friends at the local chapter of the Society of Mechanical Engineers (SME) for a special Heat-Treating Seminar to be planned for immediately before the FTM. They are planning for three experts to talk about heat treatment of gearing. Keep an eye on the AGMA website [agma.org](http://agma.org) for information on this event.

A must-attend is our networking event. You can see how we "gear geeks" can have a lot of fun! From bowling and axe throwing in the past, this year will be no different with our networking reception held at Dave and Busters. It's always nice to get together in a casual atmosphere and unwind with your peers.

I'm excited to see you in Chicago on October 7-9, 2024. Please keep up to date with the FTM by visiting our page: [agma.org/event/2024-fall-technical-meeting-ftm/](http://agma.org/event/2024-fall-technical-meeting-ftm/)



# Hard Fine Machining of E-Components in the Border Area of Quality Requirements and Productivity

Dr.-Ing. Philip Geilert, Technology Development, Kapp Niles GmbH & Co. KG



Overall developments and widespread public awareness of man-made climate change are transforming the way people think. The awareness has inspired a shift towards a more ecologically sustainable way of life. Driven by policymaking and technological innovation, ambitious efforts are underway to reduce greenhouse gas emissions to curb the rise in average temperatures. A key focus of these efforts is the mobility sector. Several different forecasts from major consulting companies indicate that, over the next 10 to 15 years, we can expect to see a clear trend away from combustion engines and towards the use of electric vehicles (Ref. 1).

By replacing the combustion engine with an electric motor, this new drive concept eliminates one of the main sources of noise in the car. As a result, undesirable sounds, which had previously been masked by the optimized sound design of combustion engines, can potentially come to the foreground. To illustrate this, the following figure charts the qualitative behavior of sound pressure levels from various sources of noise in the vehicle interior as a factor of speed.

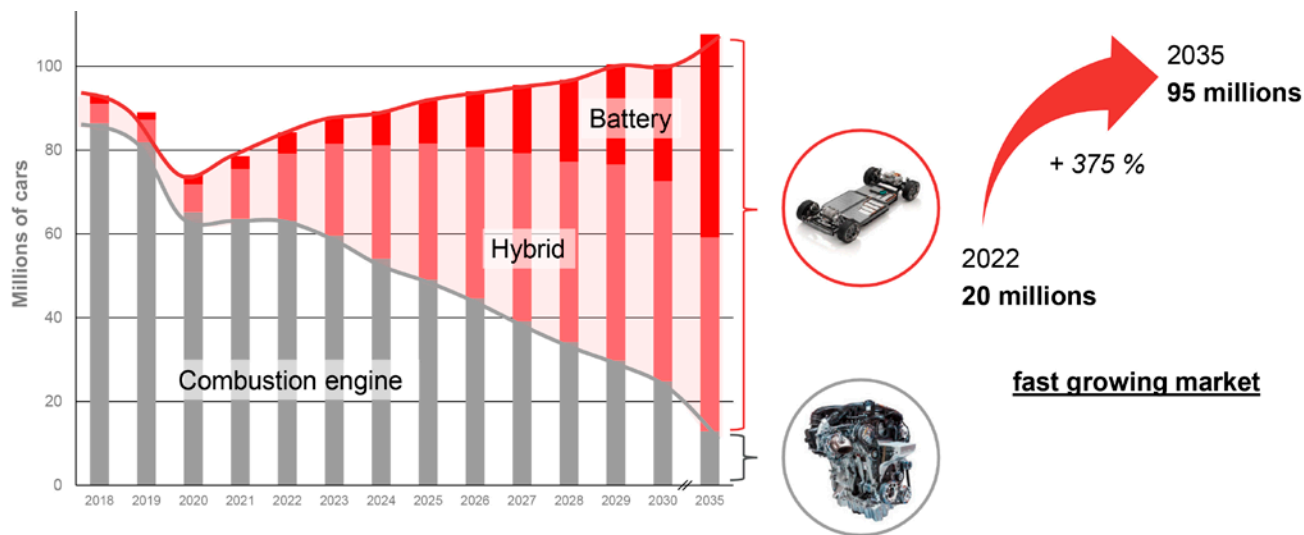


Figure 1—EV sales forecast (Ref. 1).

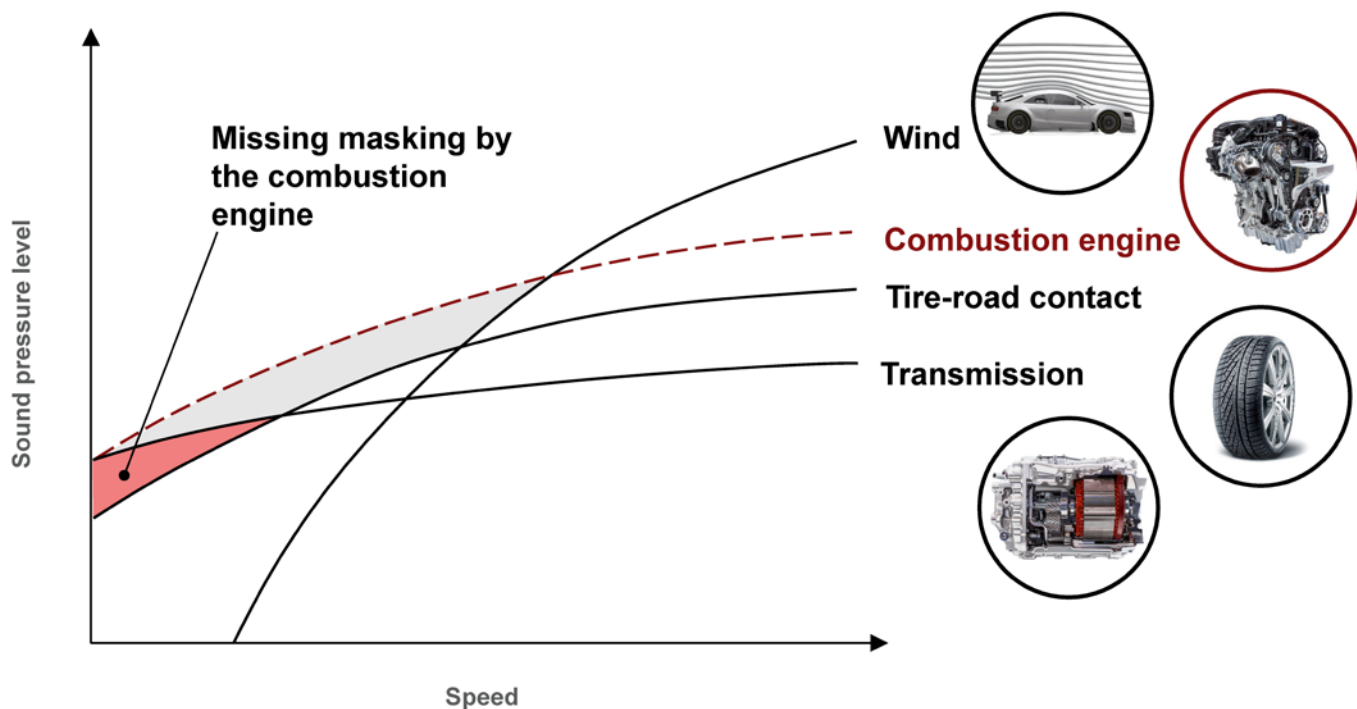


Figure 2—Noticeability of transmission noise (Ref. 8).

Notice how the transmission noise had previously been masked by the sound of the combustion engine. With this engine gone, the sound of the transmission comes to the foreground. Once a certain speed is reached, the tire-road contact gains dominance, concealing the sound of the transmission (Ref. 8).

### The Interaction of Transmission Noise, Grinding Technology, Machine and Digitization

The sound profile of the transmission can be optimized using various methods. According to VDI 3720, noise emissions can be minimized by reducing sound radiation, structure-borne sound transmission or structure-borne sound excitation (Ref. 12).

The first two methods of noise reduction (secondary measures) include all types of insulation and damping of structure-borne sound waves as well as adapting the natural oscillation behavior of the structure-borne sound conduction and radiation of affected components (Ref. 11). The most effective method of reducing transmission noise is to minimize the sound excitation (primary measure) itself. Excitations can be induced in the transmission by bearings, loose members or, most importantly, gearing. Reducing the excitation of this last component has the biggest effect (Ref. 10).

Gear wheel excitations can stem from meshing impact excitation (deviation from ideal gear meshing) and changes in tooth rigidity (changing number of meshing teeth) (Ref. 2). Due



to the broad load and RPM ranges of the EV transmission, resulting in different deformation of gear teeth and therefore different gear meshing conditions, there can be no optimal condition for tooth meshing across the entire load range of the gearbox (Ref. 3).

Using the appropriate grinding methods, such as generative grinding, gear wheels can be hard finished very quickly and cost-effectively. This technique can be used very effectively to create flank modifications (crownings, reliefs, biases, etc.). Design engineers can take advantage of the flank modification capabilities of grinding machines and specifically design the gear mesh for wider load and RPM ranges, to reduce the impact excitation caused by premature meshing of deformed teeth. In a grinding project, it's possible to set up many different modifications and simulate them directly on the grinding machine control system. The required crownings, reliefs or angle modifications can be produced easily and at low cost with conventional generative grinding. Biases can be specifically influenced by topological profile grinding. Biases can be produced separately for the left and right flank utilizing a multi-axis interpolation of the paths of motion, both for dressing and for grinding (Refs. 5, 6). In addition to specially generated macro geometries and modifications, it is also crucial to precisely match the specified geometry and reduce tiny deviations. Utilizing the right grinding tools, dressers and grinding parameters, the target geometry of the flank can be reproduced very precisely, thereby minimizing the audible noises that would be produced as the teeth mesh. Minor deviations which are still within the required tolerance specifications, but which customers often evaluate visually and subjectively (e.g., negative crowning or singular elevations) can be reduced. These improvements are reflected not only in the subjective visual assessment of the gear measurement report but also in a tactile spectral analysis, which then shows a reduction in the amplitudes of the tooth meshing frequency and its multiples.

The roughness of the tooth flank can be influenced both by the choice of tool and by the grinding technique. In structural shifting, the amount of shifting is increased until regular structures which are typically created by generative grinding are broken and replaced by irregular structures. Stringent surface quality and roughness specifications required by our customers can be met cost-effectively and reproducibly using multistep processes with fine grinding or polish grinding. Typically, this involves the use of a 2-piece dressable grinding worm with differing specifications. While rough grinding (standard generative grinding) utilizes a conventional grinding worm specification, fine grinding and polish grinding are done using special specifications. Fine grinding is likewise done with a vitrified bonded wheel but with a different type and size of grain. Surface finishes of  $Rz = 1-3$  microns can be reliably achieved.

For even more exacting surface finish requirements, polish grinding can be used with its elastic polyurethane or resin bonded wheels. This makes it possible to achieve surface qualities of  $Rz < 1$  micron. As a result, this work process helps increase the efficiency and service life of the gearbox (Refs. 4, 5).

In addition, the foregoing technological factors, the grinding machine itself is fundamental and a key element which must be understood and optimized to obtain optimal grinding results

regarding waviness and noise excitation. Straight ghost orders or sidebands not directly associated with the tooth meshing frequency, or its multiples most often originate from the grinding machine. Even the smallest error-based deviations on a scale of less than 0.1 microns, especially if they are integral concerning the gear circumference, can lead to noticeable noises during gearbox operation (see also process monitoring example). A potential cause can be the axis drive, including its measuring system. Deviations in the measuring system can lead to a minimally uneven rotation, resulting in a waviness in the component. The oscillating torques generated by electric motors can likewise produce such effects. Noise can also be influenced by spindle bearings or the balance condition of the axis. Moreover, every machine has its own natural resonances, which can vary by machine type and workpiece clamping set-up. At Kapp Niles, these listed points are already being implemented to minimize any potential sources of error (Ref. 13).

Nonetheless, deviations can still occur in production. This is where digitization comes in by maximizing transparency, it helps to optimize quality. There are countless networking, production, machine and support solutions available to help users with manufacturing. The closed loop is a digital tool which has proven itself to be important and effective for dealing with trend-based deviations. Through the cross-manufacturer GDE (Gear-Data-Exchange) interface, gear measurements are fed back to the grinding machine in a closed loop—using preselected tolerance bands, the grinding machine selects correction values based on the measurements and optimizes the grinding process. In case of unexpectedly high deviations, a machine operator is needed to make decisions. Condition monitoring routinely checks and logs the condition of the grinding machine itself. Regular, automatically triggered reference runs are used to obtain reference values that reflect the condition of the rotational and translational axes. For high-precision components, it is crucial the axes be in good condition since worn axes can have a significant impact on the grinding result. Part tracing is a type of digital twin, a file capable of receiving all the information from the grinding process (workpiece, technology and process data). This enables traceability and the exchange of information, especially in case of inconsistencies in production between different departments, locations and companies (e.g., between manufacturing and gearbox assembly). It also simplifies and speeds up both communication and action.

One fundamental component which can be integrated into part tracing is the process monitoring data pertaining to vibrations and irregularities in the grinding process. These data are explained in more detail in the next section (Ref. 9).

## Process Monitoring for Noise-Related Components

Typically, to assess the grinding process, a small sample is inspected by tactile measurement, however, individual outliers cannot be reliably detected. This is where Kapp Niles' own process-monitoring system comes in, enabling 100 percent evaluation in real time. Based on internal signals from the machine control system and their multiple acceleration sensors, characteristic values are obtained which can be used to evaluate both the grinding and dressing processes.

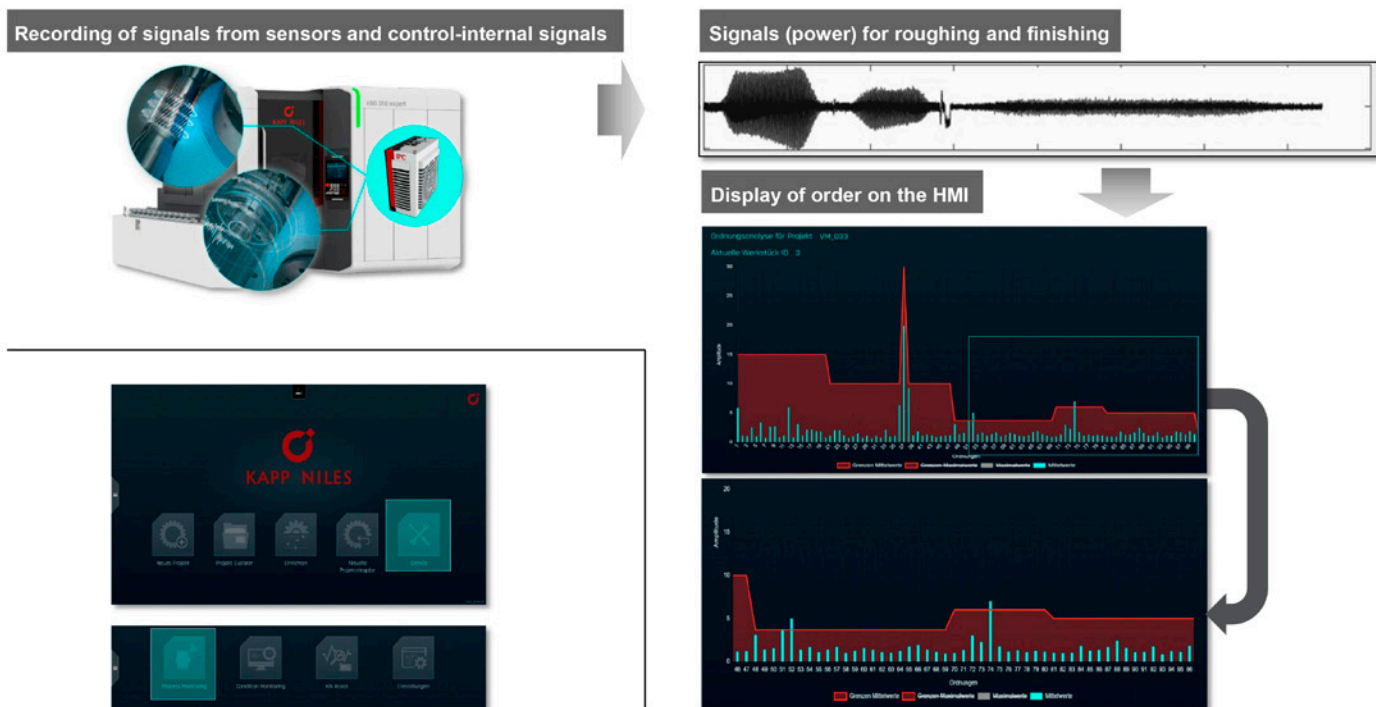


Figure 3—Process monitoring.

For the dressing process, a single index is compiled which reflects the entire dressing process, thus also indicating the condition of the grinding worm. This index can then be clearly represented in a diagram and compared with the preceding dressing cycles. Threshold values for this characteristic make it possible to initiate an action on the part of the machine. It is also possible to perform a deep analysis of the raw data from the dressing cycle directly in the machine control system.

Compared to the dressing process, the grinding process is more complex and requires many various characteristic values to be described effectively. In the simplest case, this means maximum or mean values. For the most exacting quality requirements regarding waviness and noise-vibration-harshness (NVH) behavior, characteristic values are obtained by breaking the time-discrete grinding signals down into frequency components and analyzing them (see Figure 3, above).

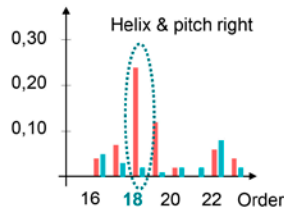
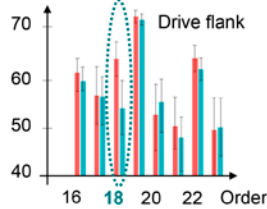
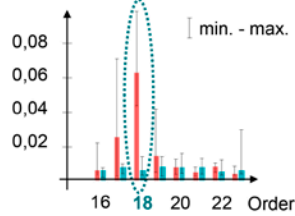
This process monitoring method is comparable to the method used in tactile spectral analysis, the roller and the end-of-line (EOL) test bench. In all cases, a signal (albeit from different sources) is broken down into frequency components and associated with a wheel revolution. The order spectra generated in this manner can be correlated with one another and contain similar information. It should be noted, however, that as opposed to tactile measurement, the values are not absolute. Rather, these are values that must be statistically analyzed and compared to the other measuring processes to obtain effective threshold values.

The following practical example shows how the grinding process can be effectively monitored regarding the noise

characteristics of the gears. In the case illustrated here, anomalous gears are repeatedly identified in the EOL test by cross-exchanging the gearbox components. Such an anomalous gear excited the gearbox in the frequency of the 18th order to such a degree that undesirable noises were produced in the vehicle. Subsequent analysis showed that both a tactile spectral analysis and a roller test indicated irregularities in the 18th order in the anomalous gears. Kapp Niles aided by performing a deeper analysis of the raw data from these measurements. To optimize the grinding, process monitoring was installed on the affected grinding machine. After a few components, it was possible to reliably detect the 18th order. After the fault in the grinding process was eliminated by optimizing the rotor shaft, a significant reduction in the 18th order could immediately be seen in the process monitoring data. The tactile spectral analysis, the roller test bench result and the EOL test all corroborate the process monitoring data (see Figure 4, page 57).

It was demonstrated that the process monitoring system developed by Kapp Niles is capable of effectively detecting noise-generating components during grinding. Warning or abort thresholds can be input.

These thresholds can be determined in production based on good parts and rejects through a feedback loop from the geometry measuring process, roller or EOL test bench. To get to the root of the issue, consult with the experts at Kapp Niles, since this requires extensive empirical knowledge of error patterns and their correlation with gear quality. Development work is currently underway to enable the grinding machine itself to learn the limits for characteristic values of new components.



## Summary

The current shift towards the electric drive concept in the mobility sector comes with drastically increased demands on gears. To meet these requirements, Kapp Niles has taken a holistic approach to this issue and plans to continue to focus on the subject of electric gearboxes and to further develop products. Currently, we are already able to help our customers meet the high demands of the electric vehicle sector with numerous technologies, optimized grinding machines, digital solutions and trained service technicians.



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grinding

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Before optimisation

After optimisation

Figure 4—Comparison of different quality control methods to describe noise characteristics.



**Dr.-Ing. Philip Geilert** works in the division of technology development at Kapp Niles. From 2016–2018 he was gear technology team leader at Leibniz IWT—Institut für Werkstofforientierte Technologien.

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## MPIF

## ANNOUNCES 2024 POWDER METALLURGY (PM) DESIGN EXCELLENCE AWARDS



The winners in the 2024 Powder Metallurgy (PM) Design Excellence Awards competition, sponsored by the Metal Powder Industries Federation (MPIF), demonstrate outstanding examples of PM's diversity and ability to meet critical requirements. From electric vehicles to medical implants, once again, parts fabricators have demonstrated PM's versatility and unique ability to challenge competing technologies. These award-winning components use PM's flexibility to push forward new concepts and process controls to demonstrate the inexhaustible range of PM's capabilities.

Ten Grand Prizes and seventeen Awards of Distinction were given in this year's competition, segmented into 3 categories: Conventional Press and Sinter PM; Metal Injection Molding (MIM); and Metal Additive Manufacturing (AM).

A Grand Prize in the Automotive—Transmission Category for Conventional PM components has been awarded to AMES Group Sintering S.A. for a hub used in the clutch of a transfer case of a four-wheel drive car. The customer qualified the parts by applying four bench tests—a static strength test, a pulse fatigue test, a dynamic fatigue test, and a balancing rotary test. The PM route was selected rather than a machined forging due to its ability to combine complex part shape, high accuracy of some characteristics without machining, low material waste, and a competitive cost. A 25 percent reduction in material waste was achieved compared with machining the part from a forging.

In the Lawn and Garden/Off-Highway Category for Conventional PM components, an Award of

Distinction has been given to Capstan Atlantic and their customer Ardisam Inc. for a multi-component gear assembly used in Ardisam's Earthquake brand—Pioneer Rear Tine Tiller. A special heat-treatment cycle was developed to maintain hardness but also maximize ultimate tensile strength and impact energy. Tight tolerance machining and machining of the teeth without burrs required the development of special machining cycles and insert materials.

In the Hand Tools/Recreation Category for Conventional PM components, an Award of Distinction has been given to Capstan for a stainless-steel drive gear used in a throttle system with a stack-up of three stainless-steel PM gears. Multi-level tooling was used to create the five separate levels of the part and intricate powder transfer and motions were required to displace material for the "slot" surface due to the thin cross-section. The compaction process achieved about 60 percent of the final shape of the part and secondary CNC lathe turning and milling operations were used to achieve the bore depths, hub diameter, groove, and tapped hole.

[mpif.org](http://mpif.org)

## Emuge—Franken USA

### CELEBRATES 40TH ANNIVERSARY



Emuge-Franken USA is celebrating its 40th Anniversary. The company officially entered the U.S. marketplace with a handful of employees under the name Emuge in 1984 in a Northborough, MA sales and warehousing facility. The Emuge brand was aggressively marketed

and demand for products grew rapidly. Today 40 years later, Emuge-Franken is recognized as a leading brand in cutting tool innovation, quality and performance throughout a wide range of industries and products across North America, with over 80 employees in the United States and Canada.

"We are very proud to celebrate this milestone," said Bob Hellinger, president of Emuge-Franken USA. "Over the past forty years we have experienced strong and continual growth in North America, which is a testament to our people and our reputation for quality, innovation and expertise in the metal-working manufacturing marketplace."

Since Emuge was incorporated in the United States, many changes and developments have taken place with the company. Sustained growth required more employees, a larger warehouse and a machining technology center. In 2006, the company constructed an all-new 50,000 square foot facility in West Boylston, MA.

With more employees and a larger facility, product line expansion continued steadily for the next 10 years. In 2015, Emuge began manufacturing some of the company's products in the United States with the opening of a reconditioning center for Emuge cutting tools. The headquarters were expanded again in 2019, doubling the size of its original facility to over 100,000 square feet with the addition of an expanded technology center and additional manufacturing space.

By 2021, the Emuge Corp. name was officially changed in North America to "Emuge-Franken". The new branding was incorporated in recognition of Emuge's Franken milling division and the addition of full-scale carbide end mill manufacturing in West Boylston.

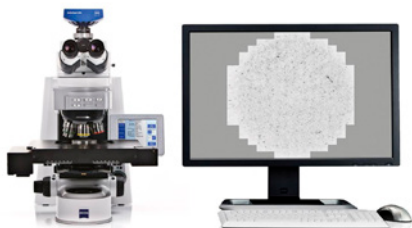
Today, the company is committed to further expanding its precision engineering capabilities to innovate and manufacture high-quality cutting tools that meet the challenges of industries such as aerospace and space exploration, automotive, and medical. The company's growth strategy is focused on leveraging the most advanced cutting tool technology to increase productivity for machinists, job shop owners and OEMs.

[emuge-franken-group.com](http://emuge-franken-group.com)

[geartechnology.com](http://geartechnology.com)

# Zeiss and CleanControlling

## COOPERATE ON INDUSTRIAL ANALYSIS TECHNIQUES



Zeiss and CleanControlling, a leading test laboratory for technical cleanliness, signed a cooperation agreement in April. The goal of the cooperation is to optimize products and industrial analysis techniques, and to set new market standards.

In automotive, aviation/aerospace and medical technology, technical cleanliness has for many years played a critical role in guaranteeing the functionality and lifespan of sensitive components. Due to the increasing miniaturization and complexity of products, cleanliness measures have become indispensable in other industries as well. This requires an adaptation of technical cleanliness standards for different industry branches.

CleanControlling has helped companies implement technical cleanliness standards since 2006. "As a laboratory, manufacturer and consulting firm, we are very close to the customer and know exactly what challenges they have to overcome in technical cleanliness," says Volker Burger, CEO of CleanControlling. As part of this cooperation, Zeiss will benefit in particular from the close cooperation between CleanControlling and its customers and their experiences in using Zeiss solutions.

"With the feedback we get from this important market player, we will be able to orient our products and solutions in the field of technical cleanliness even faster and more efficiently to the needs of our customers in the future," said Werner Renz, product marketing manager at Zeiss Industrial Microscopy Solutions.

As a result, companies will soon have even more pre-configured and optimally assembled solution packages at their disposal for different application cases.

As a result of the cooperation with Zeiss, CleanControlling will get access to solutions that take particle analysis to a whole new level, thanks in part to the use of machine learning. CleanControlling believes that the automation of analysis steps will lead to significant productivity gains and key information insights. Zeiss and CleanControlling concur that their partnership will allow them to set new and leading standards in the field of technical cleanliness.

[zeiss.com](http://zeiss.com)

material handling, increasing efficiency and ensuring consistent quality. Automation also improves productivity and process reliability.

Environmental sustainability is a priority at the new facility. A central filtration system recycles coolant at several places throughout the facility. Advanced air purification systems capture and treat oil mist in the machines to maintain a clean factory environment and minimize emissions.

[us.bigdaishowa.com](http://us.bigdaishowa.com)

## KISSsoft

### ANNOUNCES NEW MANAGING DIRECTOR

Dr. Ulrich Kissling, founder and managing director of KISSsoft AG recently stepped down as managing director of KISSsoft AG as he partially transitions to retirement. Dr. Kissling will continue with KISSsoft AG focusing on representation for Gleason/KISSsoft AG on various technical committees and providing technical support to the engineering and sales teams.



*Hanspeter Dinner*

Hanspeter Dinner, former deputy managing director, becomes a managing director of KISSsoft AG with responsibilities including sales, marketing, support and engineering services, as well as various administrative functions. Dinner has been working with KISSsoft AG in different roles for more than 20 years and brings an

## Big Daishowa

### OPENS FACILITY TO INCREASE MANUFACTURING CAPACITY



Earlier this year Big Daishowa Seiki Co., Ltd. (Osaka, Japan) opened its ninth production plant at its Awaji, Japan, manufacturing facility. The 49,500-square-meter plant is designed to meet today's production needs and accommodate future growth.

The facility, which began operations in January 2024, is equipped with 21 multitasking machines and 23 automatic lathes. The initial production target is 20,000 tools per month, with the potential to double this output. Production will focus on BBT and BT tool holders in taper sizes 30-50.

A Mega VIP Center welcomes visitors and highlights the company's technologies and commitment to innovation.

Automation plays a key role in the plant's operations. Robots and Automated Guided Forklifts streamline

extensive engineering and application know-how to the new position.

Dr. Stefan Beermann, currently a managing director for KISSsoft AG will continue to lead the software development teams, human resource functions and provide strategic leadership to both KISSsoft AG and the broader Gleason organization on design software topics.

John Perrotti, chairman and chief executive officer of Gleason Corporation welcomes Dinner to the management team: "As we strive to expand our global market leadership in gear and drivetrain design software, we have managed a smooth and customer-oriented transition in KISSsoft AG Management. With Hanspeter we have found a knowledgeable and visionary leader, who will carry the joint Gleason-KISSsoft philosophy to the next level."

[kisssoft.com](http://kisssoft.com)

## Fanuc America UNVEILS NEW ROBOTICS AND AUTOMATION CAMPUS



Fanuc America has officially unveiled its new 650,000 square foot West Campus facility in Auburn Hills, Michigan. The expansion increases the footprint in Michigan to over 2 million square feet and is part of Fanuc America's strategic investment plan to support and advance industrial automation in North America. The West Campus represents a \$110 million investment built on 67 acres of land.

Fanuc America's industry growth and customer demand has created over 400 jobs in Michigan since 2019. The West Campus provides advanced product manufacturing and customized automation systems and includes warehouse space for over 6,000 quick delivery robots and tens of thousands of parts.

"This major expansion represents our growth strategy in the U.S. and our

steadfast commitment to the future of the automation and robotics industry," said Mike Cicco, president and CEO, Fanuc America. "While manufacturers continue to adapt to changing market demands, our ongoing upward trajectory allows us to better support our customers with cutting-edge robotic and automation solutions, helping to drive more efficiency across all industries."

Since 2019, Fanuc America has invested over \$187 million including a 461,000-square-foot North Campus facility in 2019, and new headquarter facilities in Mexico and Canada in 2023.

Investments will continue with the renovation of a former law school on the site of the company's West Campus that will soon become the Fanuc Academy, an advanced automation customer training center.

"Advanced automation requires new skills, and training is key to keeping manufacturing strong in North America," added Cicco. "The Fanuc Academy will become the largest corporate robotics and industrial automation training facility in the U.S."

After completion of the new Fanuc Academy and other infrastructure projects, Fanuc America will have invested over \$250 million in North America, fortifying its position as an industry trailblazer.

"We are excited that Fanuc continues deploying and investing its world-class technologies in Michigan! We know the future will be built by innovators, risk-takers and hard-working Michiganders—and it's clear Fanuc knows this too," said Quentin L. Messer, Jr., CEO of the Michigan Economic Development Corporation. "As Team Michigan continues to execute its 'Make It In Michigan' economic development strategy focused on People, Places and Projects, we are enthusiastic about the ongoing impact that Fanuc will have as their continued successful investment in our state enables more Michiganders to 'Make It' in Michigan."

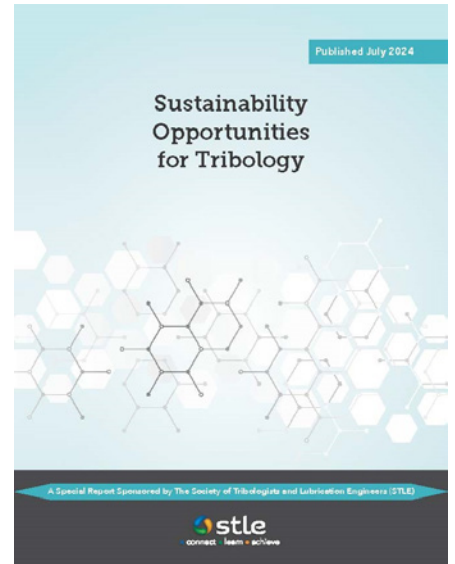
Fanuc America's West Campus grand opening ceremonies included remarks delivered by several state and local dignitaries such as Messer, Jr.; David Coulter, Oakland County Executive; and Brian Marzolf, Mayor of Auburn Hills.

Fanuc's robots and automation are applied in a wide range of industries

including automotive, aerospace, agricultural, consumer products, food, pharmaceuticals, warehousing and more.

[fanucamerica.com](http://fanucamerica.com)

## STLE RELEASES SUSTAINABILITY REPORT



The Society of Tribologists and Lubrication Engineers (STLE) is pleased to announce the release of its new free digital special report, Sustainability Opportunities for Tribology.

This special report summarizes key findings discussed at the Sustainability Forum during the 2024 STLE Annual Meeting & Exhibition. It explores views on sustainability in the lubricants community, sustainability of electric vehicles, the value of sustainability in manufacturing and more.

"Regarding sustainability, it is crucial to acknowledge the long-term advantages of saving energy, lowering emissions and eventually reducing operating costs," said STLE President Jack McKenna, Sea-Land Chemical Company. "This special report acknowledges that as more organizations implement sustainability using proper tribology practices, the benefits will become apparent leading to acceptance that lubricant use is a critical part of the move toward sustainability."

[stle.org](http://stle.org)

[geartechnology.com](http://geartechnology.com)

AUGUST 9–14

**Turbomachinery and Pump Symposia 2024**



*TPS (Houston) is a vital industry event, offering a forum for the exchange of ideas between rotating equipment engineers and technicians worldwide. TPS is known for its impact on turbomachinery, pump, oil & gas, petrochemical, power, aerospace, chemical and water industries. The TPS technical program is hand-selected by advisory committees made up of key industry players and led by highly respected practitioners and leaders in their fields. Topics cover maintenance, reliability, troubleshooting, instruction on emerging designs, technology, and best practices that include case studies with real-world relevance on problems solved and lessons learned. The Symposia is organized by the Turbomachinery Laboratory, part of the Texas A&M Engineering Experiment Station (TEES) and The Texas A&M University System.*

[gartechnology.com/events/5103-turbomachinery-and-pump-symposia-2024](http://gartechnology.com/events/5103-turbomachinery-and-pump-symposia-2024)

SEPTEMBER 10–14

**AMB 2024**



*The metalworking fair (Stuttgart, Germany) promises developments for metal-cutting and metal-removing, machine tools, precision tools, measuring systems and quality assurance, robots, workpiece and tool handling, industrial software & engineering, components, assemblies and accessories. Digital concepts will be a recurrent theme at the exhibition and will network machine tools, their control units, automation solutions relating to machines, embedded measuring systems and collaborative robotics. Digitalization is therefore driving the industry forward on the road to producing more sustainably and more efficiently, and also competing internationally. Exhibitors include Gleason, Hans-Jurgen Geiger, Kapp, Klingelnberg, Liebherr, Reishauer, Siemens, Star SU and more.*

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OCTOBER 15–17

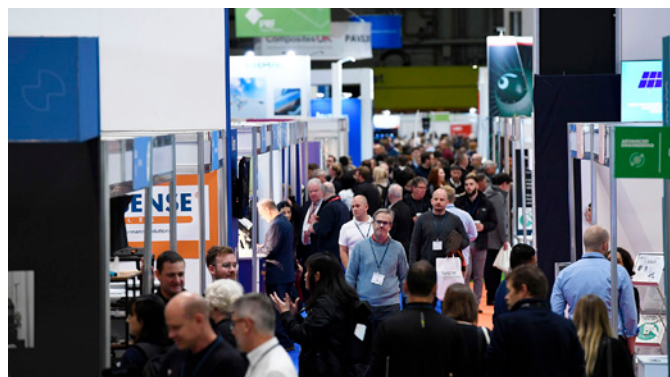
**Fabtech 2024**

*Fabtech (Chicago) provides a 'one-stop-shop' for metal forming, fabricating, welding, and finishing trade show. Attendees can meet with 1,300+ suppliers, discover innovative solutions, and find the tools to improve productivity and increase profits. There is no better opportunity to network, share knowledge and explore the latest technology. Gain insights into industry trends that will help you prepare for what's ahead, all here in one place. The Fabtech Conference combines 60–90 minutes sessions and workshops covering the latest in advanced fabrication technology, workforce, and management topics.*

[gartechnology.com/events/5075-fabtech-2024](http://gartechnology.com/events/5075-fabtech-2024)

OCTOBER 30–31

**Advanced Engineering 2024**



*Advanced Engineering (Birmingham) has rebranded to celebrate the evolution and new developments in industrial manufacturing. Sectors include aerospace, automotive, defense, composites, marine, rail, energy, medical and more. To ensure that visitors and exhibitors can still easily find relevant contacts, Advanced Engineering exhibitors will now be categorized by the services, products and solutions offered. They will have the opportunity to highlight all of the sectors they work in, removing any limitations created by the specific show zones. Advanced Engineering will welcome back a full speaker program with representatives from some of the leading companies in UK manufacturing including GE, Shell, ZF, Bosch, Siemens, 3M, IBM, Airbus and more.*

[gartechnology.com/events/5081-advanced-engineering-2024](http://gartechnology.com/events/5081-advanced-engineering-2024)

NOVEMBER 6–7

**Aachen Conference on Gear Production 2024**

*Although gears have been indispensable components in various areas such as mechanical engineering, the automotive industry and industrial gear production for many decades, increasing requirements and current market developments are constantly presenting the drive technology sectors with new challenges. The aim of the Aachen Conference on Gear Production is an exchange of knowledge and experience between engineers who work in or are responsible for the design, development, production, assembly and application of gears.*

[gartechnology.com/events/5101-aachen-conference-on-gear-production](http://gartechnology.com/events/5101-aachen-conference-on-gear-production)

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# AI and the Digital Roadmap

## Unlocking mining production through AI transformation

Matthew Jaster, Senior Editor

During a recent conference session on AI and manufacturing in Las Vegas, one presenter made a valid point about simplifying and accelerating shop floor processes. “AI has the potential to revolutionize the way companies design, develop, manufacture and operate.” This is happening in gear manufacturing shops, automotive OEMs, production plants—even mining facilities.

To maintain growth in its Americas copper operations, for example, Freeport-McMoRan needed to increase production. But with a portfolio of mature mines and aging technology, it was looking at significant cash outlays and lengthy permitting to open new mines.

The alternative was to increase copper production from the mines it had. Freeport believed the answer would lie in improving operations with advanced analytics, but it lacked the technology skills and capabilities to design and deploy AI at scale.

Data engineers, metallurgists, and mining engineers from Freeport collaborated with McKinsey’s data scientists and experts to improve operations at a single aging mine in Bagdad, AZ. The goal was to create a digital solution that could improve every aspect of operations, prove its value, and be easily scalable to all Freeport’s mines.

This was the start of an analytics journey for Freeport. McKinsey helped Freeport create a digital roadmap using AI, advanced analytics, and agile work methods to increase productivity at every step of Freeport’s processes. The new approach favored minimum viable products that could be continuously improved, rather than the traditional goal of “perfecting” a solution before it was deployed.

To entrench this capability, McKinsey brought in agile coaches to train teams to operate faster and better.

“One of the key things that McKinsey brought to the table was developing the model with the users in the room, so that they’re building ownership and conviction right from the very get-go,” said Cory Stevens, president, mining services at Freeport. “This helped with the acceptance and the adoption, creating co-ownership across the team.”

Freeport had a big leg up for its AI transformation because it had built a central cloud-based data architecture. A key component was a data warehouse to store the data collected from sensors installed on the company’s trucks, shovels and stationary machines, allowing Freeport to capture second-by-second performance readings. It used that data to train an AI model custom-designed and built by McKinsey to find operational improvements that could increase output at lower cost.

Instead of running the plant at a single setting all day, Freeport could now adjust settings every hour to maximize production from a given type of ore, quickly boosting production by 5-10 percent. The amount of additional copper production Freeport is projected to unlock over five years is equivalent to one new processing facility without the eight to ten year wait to bring a new facility online. Once the AI models were built in a modular way, Freeport was able to easily adapt and scale throughout its mines in the Americas.

Through this invaluable case study, Freeport cultivated a culture of experimentation and an openness to change. This AI-journey led to a +200 million increase in annual copper production across mines and, more significantly, the avoidance of building a new processing facility costing between \$1.5–2 billion.

“Modern mining is a complex and technical undertaking. Technologies such as cloud, centralized data warehouse, wireless mesh networks, and IoT sensing, allowed us to bring the data closer to the field and learn from past experiences,” said Bertrand Odinet, chief information officer and chief innovation officer at Freeport.

This case study was part of McKinsey’s “Rewired in Action” showcase that provided real-world examples of digital and AI transformations. Learn more here:

[mckinsey.com/capabilities/mckinsey-digital/how-we-help-clients/rewired-in-action](https://mckinsey.com/capabilities/mckinsey-digital/how-we-help-clients/rewired-in-action)





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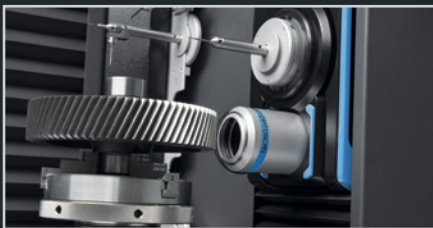
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