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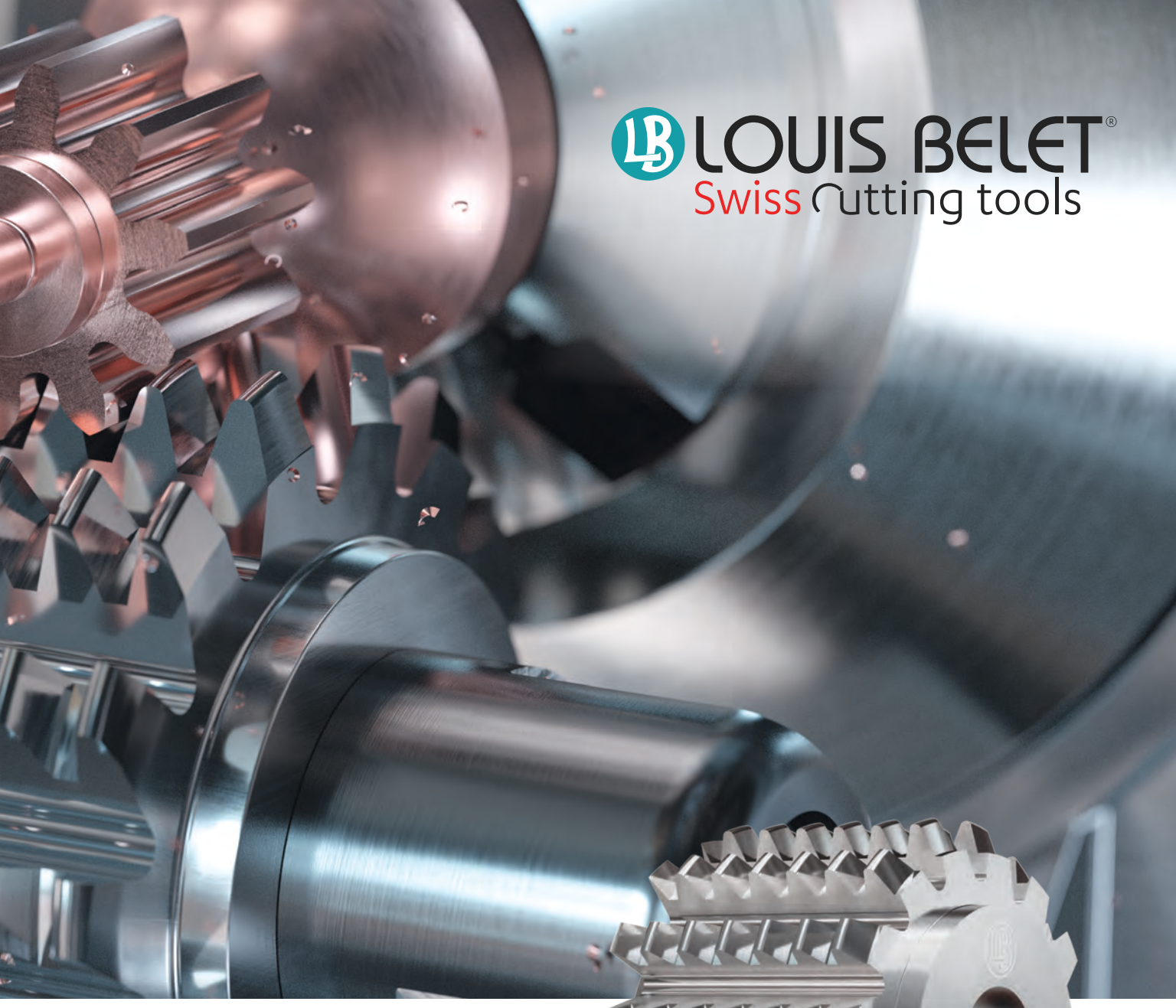

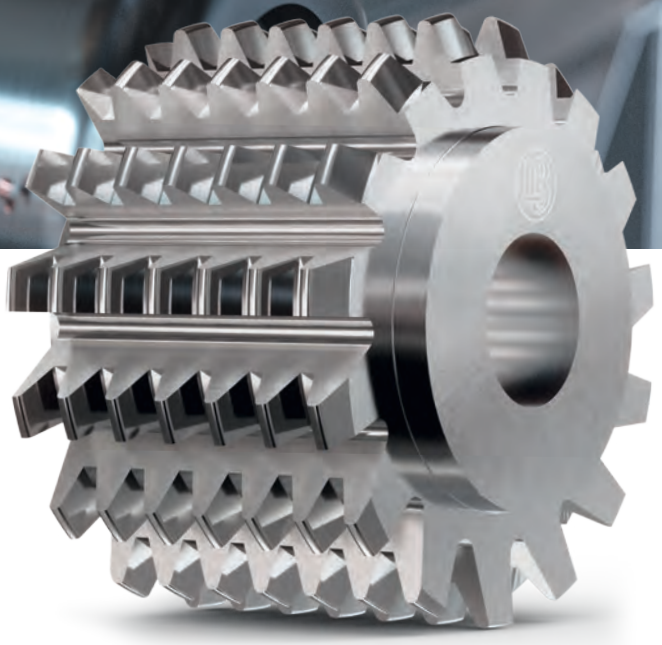

The Louis Belet series 8100 hob cutter puts Swiss fine-pitch expertise directly into your Swiss-type machine. Transform your existing equipment into a gear cutting powerhouse with just a single toolholder. You can now produce flawless, high-quality gears without the cost, complexity, and footprint of a dedicated hobbing machine.

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Cost-effective optimization of tooth flanks

New application areas for twist-free gearing

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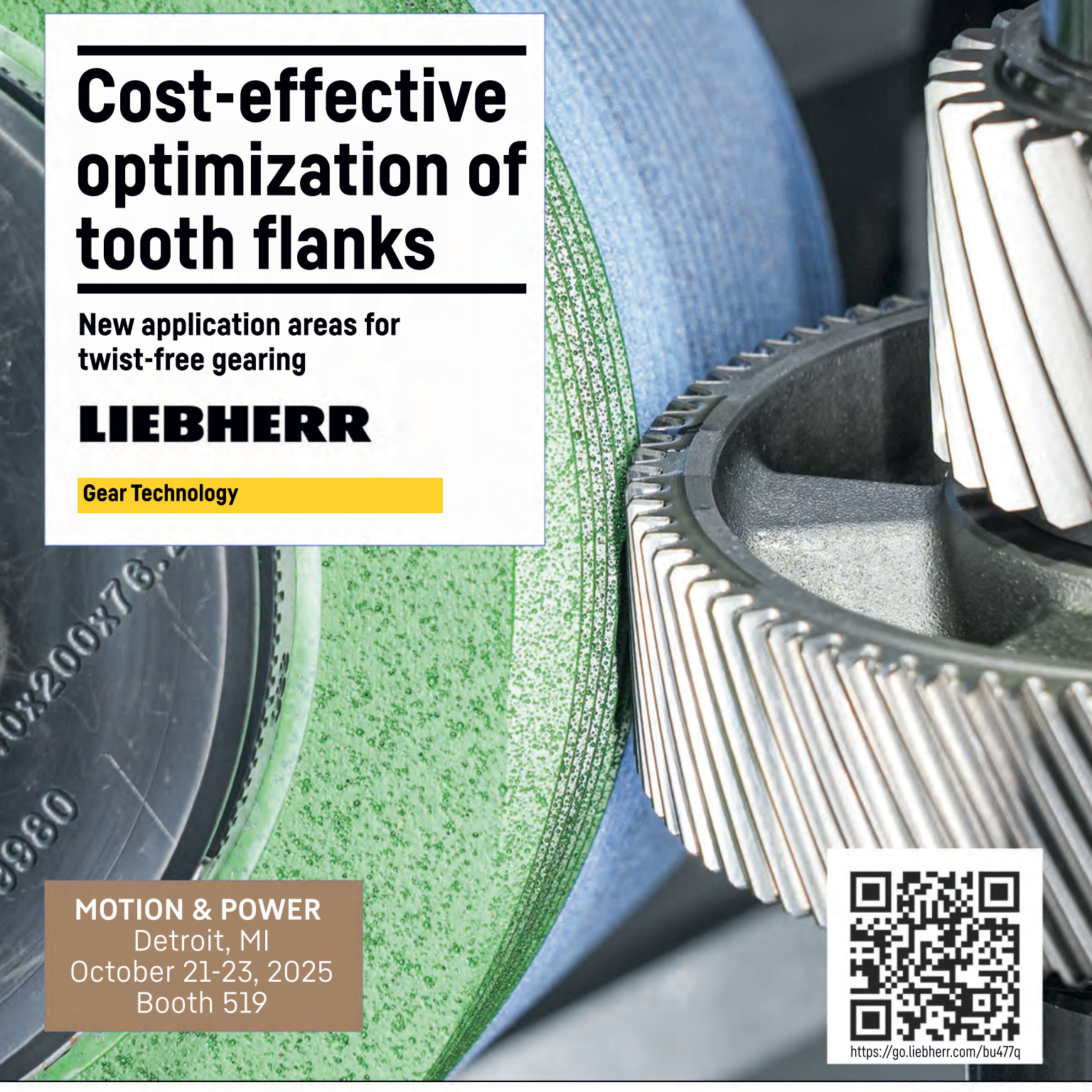
Gear Technology



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Efficiency gains in twist-free generating grinding

By advancing twist-free generating grinding, Liebherr-Verzahntechnik GmbH is elevating efficiency and quality in hard-fine machining to the next level The machining times when using dressable grinding worms have been reduced to almost the same level as conventional methods – even with asymmetrical gear teeth.

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Vol. 42. No. 7

gear TECHNOLOGY®

GT REVOLUTIONS

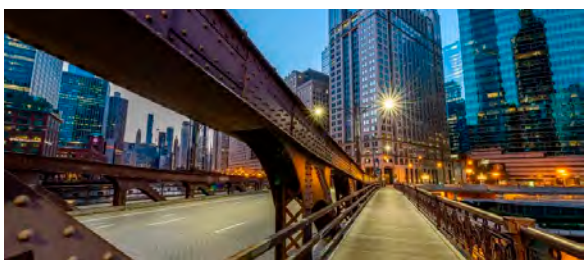
Multidomain Innovation at MPT Expo 2025

The Motion + Power Technology Expo (MPT Expo) returns to Detroit from October 21–23, 2025, bringing together a comprehensive cross-section of the mechanical, fluid, and electrical power transmission sectors. Hosted in one of North America's manufacturing hubs, the event serves as a convergence point for engineers, technologists, researchers, and decision-makers involved in the design, production, and integration of power transmission systems.

geartechnology.com/multidomain-innovation-at-mpt-expo-2025

Automation, Robotics and Digital Manufacturing Highlight Fabtech 2025

Spanning more than 850,000 net square feet, Fabtech showcased 1,700+ suppliers and attracted 45,000+ professionals seeking the latest technologies to boost productivity, strengthen supply chains and address workforce challenges.



geartechnology.com/automation-robotics-and-digital-manufacturing-highlight-fabtech-2025

Technology Drives IAA Mobility 2025

Sustainable mobility can only be achieved through the integration of new innovative technologies. New software solutions, cloud platforms, AI-powered applications, and advanced sensor technologies play a central role in developing autonomous vehicles, smart cities, and digital business models. A total of 748 exhibitors from 37 countries, a record share of 57 percent international companies, more than 500 speakers, and over 350 world premieres and innovations were recently on hand during IAA Mobility in Germany to celebrate mobility and transportation innovations.

geartechnology.com/technology-drives-iaa-mobility-2025

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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.* Michael continues working with the magazine in a consulting role and can be reached via e-mail at *mwg42@hotmail.com.*

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www.cti-symposium.world

Marketing Mensch

This issue we say farewell to a longtime colleague and friend, Dave Friedman, who is retiring at the end of October.

As Associate Publisher, Dave's main role has been in advertising sales, and although his name and face didn't often appear in our pages, that doesn't mean he wasn't an important contributor since joining our team in 2009.

In fact, in many ways, Dave has been the face of our organization for nearly 16 years, representing our publications at trade shows, industry events and in-person meetings with our advertisers.

Many in the industry have come to appreciate Dave's gift for storytelling, his deep understanding of marketing, and his overall professionalism. Instead of being a high-pressure sales guy, he has always taken a consultative approach, helping our customers understand the best ways to use our resources to accomplish their marketing goals.

Which is not to say he's been a pushover.

In fact, his character combines dogged persistence, a positive attitude and a passion for what he does, so it's no wonder he's been such a valuable contributor over the years.

I'm confident that as Dave enters the next chapter of his life, those qualities will continue to serve him well, no matter what endeavors he undertakes.

On behalf of our organization, I thought it appropriate to acknowledge Dave for his years of service. But on a more personal level, I wanted to thank him personally for the collaboration and guidance that have helped me direct the activities of our magazines. Whatever success we've been able to achieve, Dave has been a part of.

So thanks, Dave! Good luck and best wishes!

P.S. For those of you wondering about what's next, you can rest assured that we're still in good hands. For the past year, Dave has been working closely with Katie Mulqueen (*mulqueen@motionpower.org*) and Rebecca Brinkley (*brinkley@motionpower.org*) as we've transitioned to a more comprehensive sales approach that includes all of the resources of *Gear Technology*, *Power Transmission Engineering* and the Motion + Power Manufacturers Alliance. Reach out to them if you'd like to learn more about advertising, sponsorship or exhibiting at MPT Expo!

Randy Stott

Publisher & Editor-in-Chief
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The Career-Lasting Impact of Motion + Power Technology Expo

Shane Hollingsworth, Vice President Sales, Kapp Niles

If you are not familiar with the trade show world, it can be quite overwhelming. In a matter of days (with months and even years of planning behind it), you will see a large, empty convention center turn into a city filled with booths and exhibits that are bustling with companies all vying to showcase their products and solutions. Motion + Power Technology Expo (formerly Gear Expo) remains one of my favorite shows of all time. It not only taught me about the importance of face-to-face networking, but it truly helped me in my professional development.

I fondly remember in 2007, attending my first show as a young manufacturing engineer and just being in awe. I instantly noticed months' worth of business accomplished in a week from having so many customers coming to one place. I got the opportunity to meet hundreds of industry peers, subject matter experts and find my own place in this unique and niche sector of power transmission solutions.

Having attended MPT Expo for several years and in different roles from different companies, I can attest that each show has delivered value: I have come away with two to three major leads that justified the investment of exhibiting (as a machine tool exhibitor and a gear manufacturer). Although MPT Expo is an affordable show, companies need to prioritize their best return on investment, and for Kapp Niles, 2019 MPT was officially the best show we have ever exhibited at for North America in terms of machines sold—we look forward to surpassing that this October at Booth #219.

Not only are we exhibitors at MPT Expo, but I also believe in the show's success and value to the industry. I joined the MPMA Trade Show Advisory Committee to help develop the Expo and its programming. As a steward for the association and the show, I do have some advice on how to best capitalize on the experience:

- Bring your developing staff members to help them learn. There are educational classes, technical conferences and speaking opportunities that will provide professional development to your team.
- Include your engineers in the Expo experience so that they can witness the latest technology to hit the market in person. They will also be able to help understand the full sales process and feel more included in the overall strategic goals.
- Go to the networking events. Of course, you will want to take your customers out while you have them in person but also attend the show happy hours to meet new people. We often get leads at MPT Expo from brand new customers, which makes it imperative to meet them at the open events.
- If you are an exhibitor, become a sponsor, work with the show media to boost your presence and get involved with programming. MPMA has fantastic resources that will help with brand awareness, story telling and connecting you to thousands of readers, members and listeners through their advertising platforms.

If you are looking to go to a large show, you might find yourself getting lost in the shuffle. However, if you want to be found easily by customers that truly need your solutions, attend MPT Expo this October 21–23 in Detroit. This show has not only helped my company with quality business development, but it has also been a training tool that has helped me further my career. I hope and look forward to seeing you there and would encourage you to use our guest pass for a free Expo-Only entry: **MPT004**.

Shane Hollingsworth
Vice President Sales, Kapp Niles

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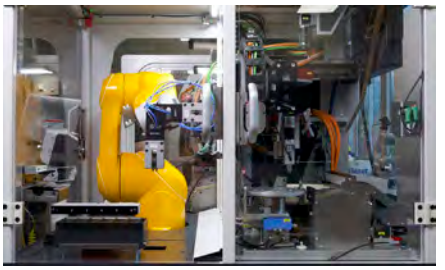
Affolter Group

DEBUTS THE AF140 GEAR HOBBING MACHINE

The Swiss Affolter Group announces the launch of the state-of-the-art AF140. The innovative company's newest gear hobbing center is designed for small gears up to 40 mm in diameter and a maximum module of 1.0 mm. Positioned between and replacing the AF90 and AF100, the AF140 delivers the strengths of its predecessors while introducing next-generation automation and connectivity features.

The AF140 was developed in close collaboration with users and industry partners to meet the growing demand for simplicity, compactness, versatility, and ingenuity in gear hobbing. Designed primarily for the watchmaking sector, the machine is equally suited for precision applications in micromechanics, aerospace, automotive, micromotors, robotics, and medical technologies.

"With the AF140, we are offering our customers a perfect balance between performance, flexibility, and innovation," reports Mikael Affolter, head of sales at Affolter Group. "Its compact footprint makes it ideal for workshops where every square centimeter matters, while its compatibility with existing loaders and the option of a robotic arm provide new levels of automation and productivity. Combined with remote service features, the AF140 represents a true step forward in precision gear hobbing."



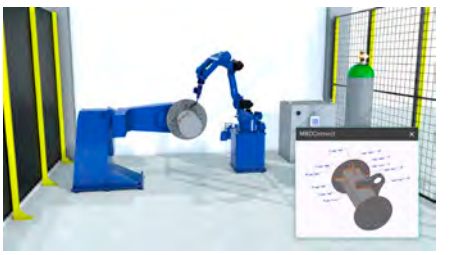
The AF140 reaches cutter rotation speeds of up to 16,000 rpm and workpiece rotation speeds of up to 5,000 rpm. The new and customizable robotic arm option for automatic loading and unloading significantly boosts the productivity of the AF140, enabling seamless automation and reliable 24/7 production. At the same time, the machine remains fully compatible with established loaders such as W20, W25, W31, AF45, deburring units and more. Built on the powerful Pegasus CNC platform, the AF140 provides digital integration with IO-Link sensors, simplified commissioning, and advanced remote service for real-time support and updates.

With the launch of the AF140, Affolter has streamlined its product line, replacing the AF90 and AF100 with a clear and future-ready two-machine portfolio: AF140 and AF160. Mikael Affolter explains: "This simplification of our product portfolio further enhances our customer service capabilities, strengthens operational efficiency, and creates a solid foundation for growth and innovation in the coming years."

affoltergroup.ch

Visual Components

INTRODUCES SOFTWARE PLATFORM AT FABTECH 2025



Visual Components, a leader in simulation and robot offline programming (OLP), debuted its highly anticipated *Visual Components 5.0* software platform during Fabtech. The platform provides all-in-one manufacturing simulation and advanced OLP. The company's flexible and customizable software eliminates guesswork for manufacturers implementing automated processes and systems.

For all-in-one simulation, *Visual Components 5.0* refines digital manufacturing workflows through a unified platform for layout design, process simulation and virtual commissioning. Its debut brings significant advancements in performance, connectivity and customization for better versatility among manufacturers and system integrators.

"Ultimately, *version 5.0* runs faster and puts more control in the hands of users," said Graham Wloch, director of business development at Visual Components. "For engineers, production floor managers, CEOs and everyone working through the steps of digital production planning, it increases clarity of the process and confidence in the results."

The upgraded end-to-end simulation capabilities are complemented by the most advanced level of OLP automation to date. Now, manufacturers can fully leverage model-based engineering from the earliest stages of production planning to final execution. *Visual Components 5.0* supports model-based definition and product manufacturing information in one environment with compatibility across multiple brands. In turn, vital data is extracted directly from current CAD files for the robotic program.

"Brand-specific requirements create barriers for manufacturers or, at best, force them to use unreliable manual processes for data transfer," Wloch said. "We eliminate the barrier to ensure tolerances, dimensions, surface finishes and additional specifications move seamlessly to the automated system."

The new platform also supports modern scripting with a variety of programs, which gives its users the ability to tailor simulations, automate repetitive tasks and work with widely used libraries. For manufacturers with a welding applications focus, *Visual Components 5.0* integrates automated welding parameter applications, collision-aware path solving and compatibility with other welding systems.

Connectivity is also widely expanded compared to its original version to support real-time simulation data across multiple hardware and robot systems. In addition, smarter collision geometry ensures smooth and accurate simulation even in complex environments.

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Nord continuously develops and improves digital solutions for their customers, providing an efficient, transparent purchasing experience. The myNord online customer portal is designed to help customers streamline their processes, easily manage their quotes and purchases, and collaborate with colleagues. Whether you are an engineer, purchasing agent, sales representative, or aftermarket support, there is functionality withing the tool that provides added benefits over traditional ordering processes.

The myNord online customer portal has expanded to become a fully-fledged e-commerce platform with over 26,500 users worldwide. It offers 24/7/365 access to customer information for flexible collaboration, unit specific documentation, and access to Nord sales and service support. The Product Search Tool offers numerous search parameters, i.e., input power, output speed, and output torque, that make it easy to find and select the appropriate products. Thanks to the plausibility check, the configurator dynamically displays the options matching the entered requests and adjusts as changes are made. Additional information, explanatory texts, and images support the user and further facilitate the configuration process. myNord allows for the online configuration and conformity checking of Nord's standard product portfolio of gear units, motors, and drive electronics.

The myNord Dashboard section gives quick visibility to recently quoted projects, product configurations, and order history. Products for new applications or crossover applications can be selected from the Product Search while replacement drives can be directly configured via the Product Configurator tool. After a configuration is complete, it can be saved as a formal quote with account-specific pricing and then either submitted to Nord for processing or saved to the company's dashboard for colleagues to review.

Documentation such as operating and maintenance manuals, spare parts lists, certificates, 2D/3D drawings, and more can also be downloaded based on the serial number, order number, or by scanning the QR code on the unit. The user interface also offers an option to contact Nord directly through the portal if additional support is needed.

An additional feature of myNord is the online Spare Parts Shop. Registered users can order Universal worm gear units, AC motors, variable frequency drives, motor starters, and replacement parts such as bearings, seals, gearing, gaskets, and more with free standard shipping on all parts ordered via the portal. Parts can be easily located via existing part number or

the Unit Identification tool. The Unit Identification tool includes interactive unit-specific diagrams featuring a complete bill of materials with selectable parts, current availability from all U.S. facilities, pricing, and expected ship dates. After the chosen parts are added to the cart, customers can select which facility the parts will ship from as well as select free standard delivery or customer-paid expedited shipping. Additionally, cart inventories can be downloaded in PDF format, serving as a quote document with account-specific pricing.

Nord is also working on adding the availability of the configured product to give customers accurate shipping time frames as well as a new seamless integration into their internal ERP system, enabling faster processing and customer assistance. Continuous expansion of Nord's product range and special functions for authorized service and sales partners is also planned.

The goal of myNord is to support customers at all stages of the ordering process when and where they need it. Whether you need product data, configurations, drawing files, order information, or pricing, myNord is the one stop shop for project management.

nord.com

Universal Robots

UNVEILS UR8 LONG COBOT

Universal Robots (UR) has introduced a new addition to its portfolio, the UR8 Long. Showcased for the first time this week at Fabtech in Chicago, the long-reach industrial collaborative robot is designed to tackle the most demanding automation challenges across industries. UR8 Long is available for order now, with shipping to begin in October.

With the same 1,750 mm (68.9 in) reach as the popular UR20 and a significantly slimmer profile, UR8 Long combines reach, stability and precision in a rugged, compact, lightweight form, featuring an 8 kg (17.6 lbs) payload. This makes it ideal for space-constrained setups and industrial tasks, from complex weldments to precision dunnage picking and flexible multipoint inspections.

"The UR8 Long is a smart robotic arm that can reach farther and do more than ever before. It's designed to help people and businesses work faster, more safely, and with less physical effort," said Jean Pierre Hathout, president of Universal Robots. "Whether it's lifting, moving, or handling tasks that are repetitive or hard on the body, this robot makes the job easier. Its longer reach means it can cover more space, and its advanced features open new ways to automate work that used to be done by hand."

UR8 Long runs with both *PolyScope 5* and *PolyScope X*, UR's software platform, and can be extended with MotionPlus—UR's new advanced motion control technology that allows for ease of integration with linear axis, rotary positioners and rotary turntables for precise control, smoother trajectories, and consistent accuracy.

Combined with UR's upgraded freedrive capabilities, users can manually guide the arm with precision and ease—making lead-to-teach programming more intuitive and enabling quick, ergonomic setup even on complex parts, all without the need for layered interfaces or external tools. UR8 Long's lighter mass—30 percent less than the UR20—and compact wrist design also makes it perfect for mounting on gantries, rails, or overhead systems, where external axes can operate more efficiently.

With its long reach, advanced motion control and stellar precision and repeatability, UR8 Long is ideal for welding. "UR8 Long delivers an easier teaching experience than traditional welding robots, better weld quality than manual welding, and less overall rework, saving time and money," said Will Healy III, global industry manager for fabricated metals at Teradyne Robotics. "Following feedback from fabricators around the world, the UR8 Long was designed with the collaborative welding process in mind, boosting productivity and helping leaders to attract new talent who are often more motivated to operate a robot than perform repetitive manual welding."

universal-robots.com

Jergens

OFFERS MT-S SPINDLE GRIPPER FOR UNATTENDED MACHINING

Jergens adds MT-S to its range of workholding products for automated and unattended applications for greater machine utilization. The MT-S spindle gripper allows continued machine cycles by picking and placing finished components in a temporary part loading tray located on the machine table.

Functioning as a first level automation solution—without a robot—MT-S is stored in the tool magazine like any tool

and engaged at the end of each cycle. Depending on the part size and configuration, many pieces can be machined and stored with little or no operator intervention. Pre-machined parts are loaded, machined, and placed (unloaded) by MT-S, allowing a continuous cycle until the part loading tray is full. An easy-to-adjust gripping force plus counterbalance function ensures that all components are optimally protected.

MT-S comes with several gripper styles and easy to change inserts that match part geometrical needs. The unit's power source can be either pneumatic (air through the spindle) or hydraulic (coolant supply). The spindle gripper reduces set-up times for small to medium-sized batches of workpieces up to 17.6 lbs. (8 kg).

The new gripper requires no additional floor space, has a lower initial investment compared to robotics, and is easy to train without extensive programing. MT-S is one of several automation solutions that also include a machine washdown tool, Zero Point System (ZPS), and a range of pneumatic and hydraulic devices.

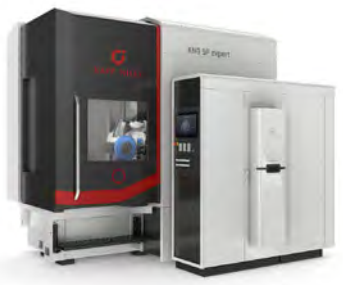
jergensinc.com

Kapp Niles

PRESENTS NEW PROFILE GRINDING MACHINE

High flexibility in a compact design: The new KNG 5P expert profile grinding machine from Kapp Niles is ideal for the precise machining of external and internal gear teeth. As a next level development of the successful ZE series, it combines the advantages of the previous model with enhanced features. "The KNG 5P expert can be used for a wide variety of applications and enables efficient work with excellent gear quality," emphasizes Boris Maschirow, Kapp Niles product specialist.

The KNG 5P expert is characterized by its outstanding set-up efficiency. To change the diamond dressing tool, the direct driven dressing spindle swivels into an ergonomic accessible position. Dressing tools can thus be conveniently changed from outside the machine. The optimized tailstock features a stroke of 850 mm and a swiveling mounted tailstock with adjustable pressure up to 2,000 N significantly extending the range of applications for clamping between centers.



From gear wheels to pinion shafts and worms, the KNG 5P expert can grind a wide variety of workpieces with a face width of up to 670 mm. The grinding spindle is direct driven with speeds of up to 9,500 rpm and drive torque of up to 64 Nm. This allows the use of grinding wheels with diameters ranging from 60 to 350 mm.

The 400 mm diameter rotary table is a direct drive solution and features a deep bore for long shafts. Despite its extremely wide range of applications and sturdy main components, the machine has a small footprint thanks to its compact design.

Complex modifications can be produced efficiently and almost twist-free by means of double-flank grinding on the KNG 5P expert thanks to 5-axis interpolated grinding via an open swiveling axis. For grinding worms, the dressing arm swivels completely out of the working area of the grinding slide, allowing the full stroke of 675 mm to be used.

The machine can be equipped with automatically CNC-controlled cooling lubricant nozzles. In addition, the KNG 5P expert can be optioned with a loading hatch for automated loading of the machine.

"With the KNG 5P expert, we are consistently continuing our long-standing successful ZE series. In addition to all the advantages of this proven series, the profile grinding machine impresses with additional and new features that offer the user maximum flexibility," summarizes Maschirow.

kapp-niles.com

Rego-Fix USA

FEATURES TOOLHOLDING SYSTEM AT WITS

Reg-FIX USA will travel to the "Air Capital of the World" to feature its powRgrip (PG) 48 toolholding system for large-diameter tools and aggressive machining at the Wichita Industrial Trade Show (WITS), Oct. 21–23, at the Century II Expo Hall in Wichita, KN. Visitors to booths #314 and #316 will see how the PG 48 toolholding system reduces the risk of cutter vibration, runout and pullout with big, long cutters during heavy machining operations such as those in aerospace manufacturing.

For cutters up to 40 mm (1.500") in diameter, the PG 48 holder ensures concentricity and total indicated runout (TIR) with deviations of less than 3 µm (0.0001") for tool lengths up to 3 × diameter and length preadjustment with a repeat accuracy of less than 10 µm (0.0004"). The holders also incorporate special cap nuts from the Rego-Fix secuRgrip tool locking system that essentially eliminate cutter pullout when using large-diameter tools in heavy material removal applications.

The powRgrip system uses a taper-to-taper, press-fit collet holding design that creates a vibration-damping gap to interrupt the strength and severity of vibration waves. Three components make up the powRgrip system: holders, collets and press-fit assembly mounting units.

WITS attendees will also experience the Rego-Fix PGA 9500 Clamping Unit that provides a simple but effective method of automating the tool setup process when using the powRgrip toolholding system.

The PGA 9500 easily connects via an industrial or collaborative robot to other equipment, such as presetters, as well as to tool storage areas. The system features an Ethernet-based bidirectional communication protocol and can be accessed for commissioning and maintenance via a human-machine interface (HMI) dashboard from a web browser or any internet-enabled device, including a mobile phone.

Its automatic door and easily controllable clamping device make the PGA 9500 well-suited for working within existing automation systems. Speed and consistency are significant elements of any automated system, and the PGA 9500 is capable of 122 tool changes per hour. That change rate translates to cycle times of approximately 30 seconds. When full automation is neither desired nor necessary, the system can easily be changed to its regular configuration.

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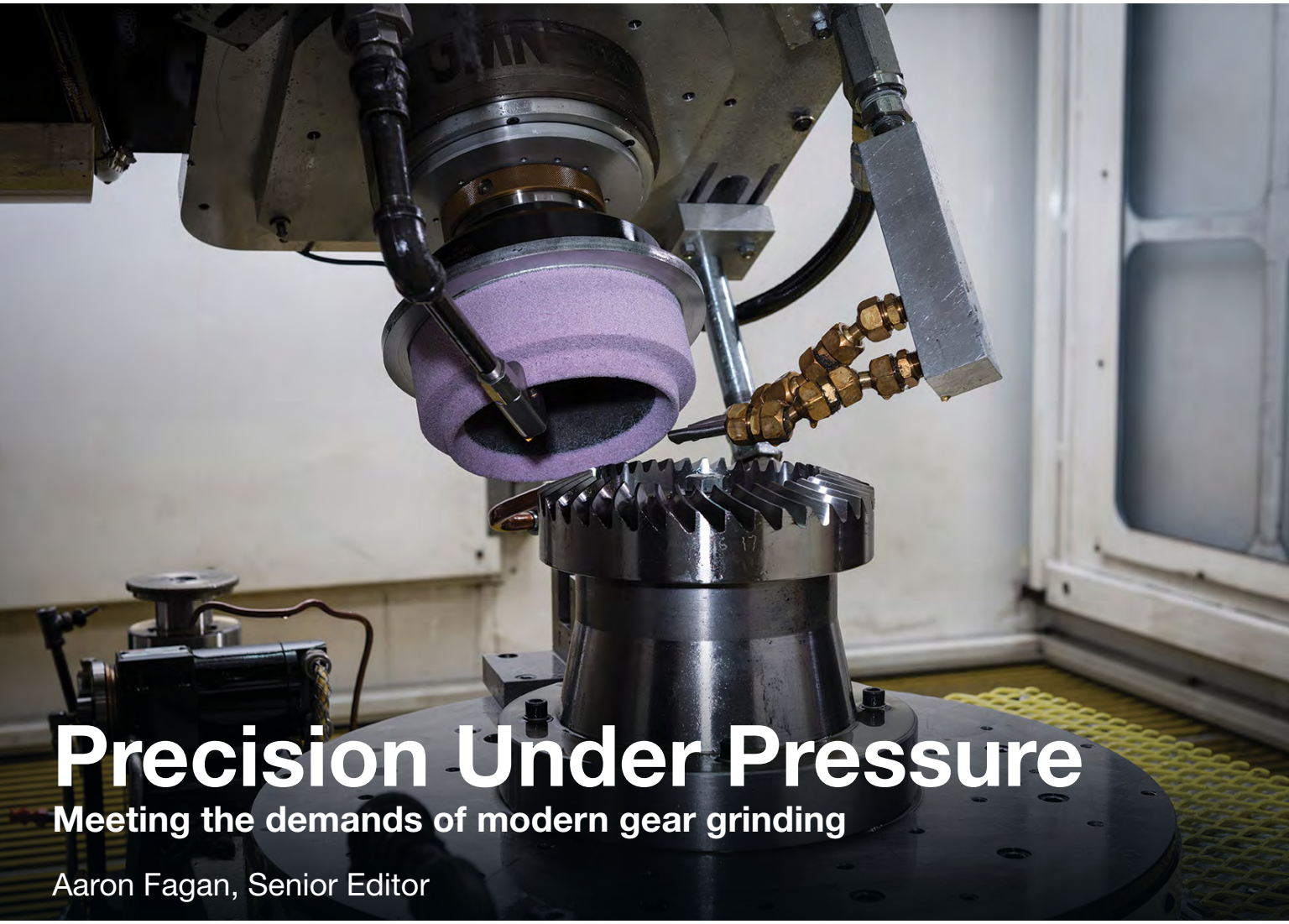


Precision Under Pressure

Meeting the demands of modern gear grinding

Aaron Fagan, Senior Editor

As gear manufacturers face increasing pressure to meet tighter tolerances, achieve higher profile accuracy, and deliver superior surface finishes, grinding technology is playing a more central role than ever in precision transmission manufacturing. Norton Saint-Gobain Abrasives is addressing these challenges head-on with the rollout of its next-generation grinding solutions—most notably, a new bond system known as VS3PN.

A Bond That Does More Than Hold

According to Spencer Artz, senior application engineer at Norton|Saint-Gobain, the VS3PN bond represents a significant departure from traditional wheel design. "An ideal bond in any grinding wheel will effectively retain the sharp abrasive, have enough porosity for coolant and grinding chips, and release any worn abrasives when they are no longer efficient," Artz said. "Additionally, a high-quality bond will reduce interaction between the bond and the workpiece to avoid heat generation."

The VS3PN bond goes a step further. "The bond incorporates a novel technology in which friction between the bond and workpiece is significantly reduced," he explained. This lowers grinding temperatures and forces while improving grinding wheel performance and workpiece surface integrity, particularly important for heat-sensitive components and high-accuracy gear forms.

Cost Savings Through Longevity and Support

Artz emphasized the business case as well as the technical gains: "Early adopters of the technology have experienced significant cost savings through increased parts per dress and reduced dressing passes." He also noted that Norton's process support plays a crucial role in successful implementation. "While the abrasive technology is top tier, the application support we provide to optimize the wheel and process cannot be understated. Customers will have peace of mind that their new process will be optimized, stable, and burn-free."

Superabrasives: Where They Fit

While conventional bonded abrasives remain dominant in many gear grinding operations, Norton is also pushing the performance envelope with superabrasives, particularly vitrified cBN.

"There's no single rule for when to switch," Artz explained. "A typical example is when the customer has a very

Grain & Bond Selection Guide for Gear Grinding*

Application Priority	Recommended Grain Type	Bond System	Notes
High stock removal	TQ / TQX shaped grains	Vortex 2 or VS3PN	Strong cutting action with good chip clearance
Tight tolerances	Quantum Prime (NQN)	VS3PN	Best for form holding and cool grinding
Difficult to grind materials	cBN	Vitron 7	Ideal for superalloys or high volume production
High wheel speeds	Quantum Prime	VS3PN (qualified for 100 m/s)	Balance of strength and cool cutting
Cost-per-part focus	Aluminum oxide blends	VS3, VTX2	Suitable for mid-performance applications

*Consult application engineers to determine machine compatibility, dressing system limitations, and cooling requirements.

difficult-to-grind material and the cost per unit with conventional abrasives would be higher than a superabrasive grinding wheel. Another example involves the volume of material removal—if a lot of volume is involved and material removal rates are high, that helps justify the switch."

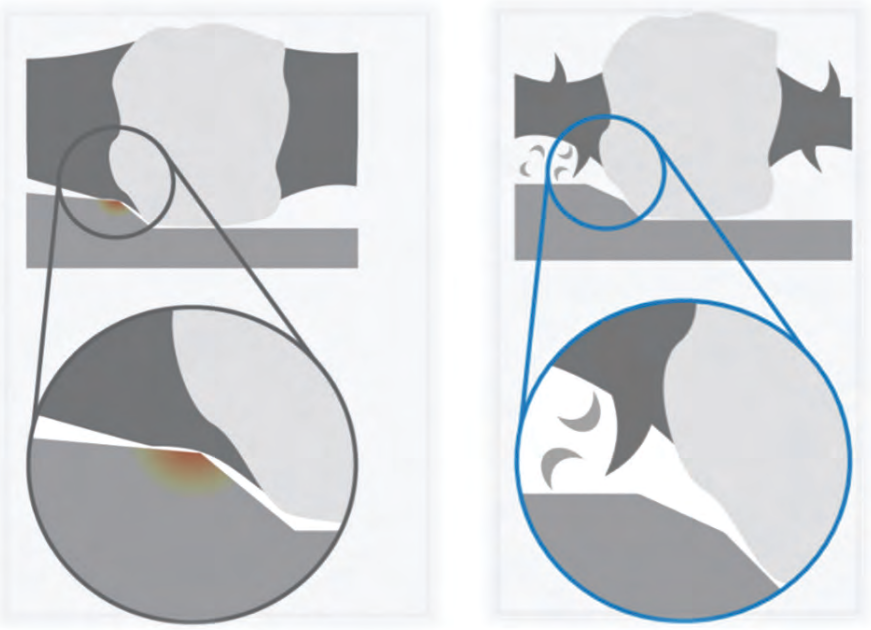
High production volume applications requiring tight tolerances, short cycle times, and low grinding temperatures are particularly well-suited to vitrified cBN.

Targeting Performance Improvements

"When it comes to superabrasives, we strive to achieve at least 20 to 30 percent more performance with each new generation," Artz said. That includes better form-holding, longer wheel life, and reduced risk of burn—all critical when working with hardened steels, carburized surfaces, or aerospace-grade components.

The Right Grain for the Job

Grain selection is increasingly application specific. Norton offers a growing lineup of abrasive grain types—including Quantum Prime (NQN), shaped grains like TQ and TQX,



Standard bond (left) vs. Next Generation VS3PN Norton Bond (right).

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and various agglomerates of aluminum oxide with Vortex Generation 2 and 3. These grain types are paired with optimized bonds, including the latest VS3PN system. "Depending on market and customer requirements—whether cost, quality, or productivity—we tailor grain and bond combinations accordingly," said Artz.

He also noted that the debate between bonded and superabrasive solutions often comes down to how performance is measured. "Cycle time could be measured by wheel life—in which case superabrasives have an advantage—but if you go by cost per part, then bonded abrasives with elongated grains and the new ceramic grains may be more economical."

Technical Variables and Gear Grinding Strategy

Artz outlined a set of key factors manufacturers should consider when selecting a grinding wheel:

- **Machine capability**
- **Workpiece material**
- **Grinding stock allowance**
- **Part sensitivity to heat or burn**
- **Cycle time**
- **Process stability**

These variables combine to dictate not only the tool choice but the stability and repeatability of the entire grinding process.

High-Speed Trends and the 100 m/s Frontier

Worm gear grinding speeds are increasing. "Most, if not all, OEMs now offer 100 m/s wheel speeds for worm gear grinding to further reduce cycle times," Artz said. While 80 m/s is still standard, Norton has already qualified wheel specifications for the next threshold.

Higher wheel speeds reduce machining time but place greater structural and thermal demands on grinding wheels. "Gear precision is constantly evolving to address transmission life, fuel efficiency, and noise," Artz said. "Form holding can simply be improved by increasing the amount of bond in the wheel, but that increases the risk of burn—which is a nonstarter."

With the VS3PN bond, Norton aims to thread that needle. "VS3PN, paired with premium grain technologies like Quantum Prime, allows us to provide the longest-lasting, coolest-cutting worm gear grinding wheel in the industry."

Conclusion: From Process Step to Strategic Tool

Gear grinding is no longer just a finishing step—it's a critical part of modern precision manufacturing. With new bond systems like VS3PN, superabrasive vitrified cBN offerings, and a portfolio of premium grains, Norton Saint-Gobain is giving gear manufacturers the tools they need to achieve accuracy, speed, and repeatability in one package.

As gear design, material science, and process automation evolve, abrasive technology must evolve with them. With performance-focused innovation and a commitment to application support, Norton is helping transform gear grinding from a constraint into a competitive advantage.

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Keeping Tomorrow Moving

Highlights and innovation at MPT Expo + Heat Treat 2025

Aaron Fagan, Senior Editor, and Matt Jaster, Senior Editor

The Motion + Power Technology Expo (MPT Expo) returns to Detroit from October 21–23, 2025, colocated with Heat Treat 2025, creating one of North America's most comprehensive gatherings for mechanical, fluid, and electrical power transmission, materials processing, and thermal treatment technologies. This year's events bring together engineers, researchers, technologists, and decision-makers from across industries to explore, connect, and advance the design, production, and integration of cutting-edge systems that keep modern manufacturing moving.

Attendees will engage with more than 300 exhibiting companies showcasing solutions across gear design and manufacturing, electric drive systems, hydraulic and pneumatic components, motion control, inspection technologies, and thermal processing. From industrial automation to advanced materials, the combined events spotlight innovations aimed at improving efficiency, reliability, miniaturization, and system interoperability across multiple sectors.

Structured to encourage collaboration across traditional silos, MPT Expo and Heat Treat provide a platform for attendees to interact with experts in gears, splines, gearboxes, enclosed drives, bearings, machine tools, cutting tools, furnaces, and inspection systems. The 2025 edition also marks the official debut of the Motion and Power Manufacturers Alliance (MPMA), uniting AGMA and ABMA under a forward-looking umbrella designed to advance standards, education, and innovation across the motion and power transmission community.

The Unveiling of the MPMA

One of the biggest moments at this year's Motion + Power Technology Expo will be the official public debut of the Motion + Power Manufacturers Alliance (MPMA), a newly formed organization uniting two of the industry's cornerstones, the American Gear Manufacturers Association (AGMA) and the American Bearing Manufacturers Association (ABMA).

Back in April, the memberships of both associations voted to merge, with the new structure officially taking effect on May 1. While both the AGMA and ABMA names will remain active in the marketplace—preserving more than a century of brand recognition and trust—the MPMA represents a new, forward-looking alliance designed to deliver greater value across the motion and power transmission supply chain.

Visitors to Booth 444 will experience this milestone firsthand in a setting designed to feel like "home." The booth emphasizes the familiar warmth of two trusted institutions coming together as one—a space where members and attendees can connect, reflect on the legacy of both organizations, and look ahead to the future of keeping tomorrow moving.

As Sara Zimmerman, incoming MPMA Chair and Vice President of Customer Experience and Product at Sumitomo Machinery Corporation of America, notes: "The creation of the MPMA comes at a crucial time in our industry, where we are seeing a growth in gearing and bearing sales, and a consolidation of the companies that create these mechanical power solutions."

With more than 425 combined member companies, MPMA will expand opportunities for standards development, workforce education, industry publications, and advocacy efforts, while continuing to serve as a unifying voice for power transmission professionals worldwide.

Networking and Social Highlights at MPT Expo

While the exhibit halls and technical sessions will be a hub of innovation, MPT Expo also offers a variety of networking and social events designed to connect professionals across manufacturing, engineering, and power transmission. One of the week's first opportunities comes on Tuesday morning with the Women in Manufacturing and Engineering Breakfast, hosted by AGMA and ASM. From 7:00 to 9:00 a.m., women at all stages of their careers—from new employees to high-level executives—can gather for a networking breakfast and panel discussion. The session will feature

industry leaders sharing experiences and strategies for career advancement, navigating the workforce, and advocating for oneself. It's a chance not only to gain advice from accomplished professionals but also to forge new relationships across all sectors of manufacturing and engineering.

On Wednesday evening, attendees can experience The Materials Fusion Experience, a social networking event that blends Detroit's industrial heritage with contemporary innovation. From 6:00 to 9:00 p.m., participants can immerse themselves in an environment designed to inspire conversation and collaboration, while exploring the city's vibrant culture. The event offers a dynamic opportunity to connect with peers and thought leaders from MPT Expo, the Heat Treat Conference & Exposition, and IMAT events, fostering meaningful connections that extend beyond the show floor.

The week concludes with the Fall Technical Meeting Networking Reception on Thursday evening at the Corktown Taphouse, from 6:30 to 8:30 p.m. This high-energy reception brings together professionals from across the gear industry in a relaxed, entertaining setting. Guests can enjoy interactive games such as augmented reality darts and duckpin bowling, along with more than 70 self-pour beverage options, including craft beers, ciders, wines, and non-alcoholic choices. It's a chance to meet new colleagues, reconnect with familiar faces, and celebrate a week of innovation and collaboration. Full FTM passholders have access included, while tickets are also available for single-session passholders and MPT Expo attendees.

From career-focused networking to immersive social experiences, these events offer more than just conversation — they provide a space to exchange ideas, gain perspective, and build the relationships that will shape the future of motion and power transmission.

Fall Technical Meeting

Dive into the latest advances in gear technology at AGMA's Fall Technical Meeting, where leading researchers and industry experts from around the world share peer-reviewed findings, emerging trends, and practical insights. From design and rating to manufacturing, inspection, materials, and efficiency, this five-day program highlights the full spectrum of gear innovation. Attendees can engage directly with presenters, ask questions, and explore how cutting-edge research is shaping the future of the gear industry.

The sessions cover a wide array of topics, including advanced bevel and planetary gear design, performance-driven e-drive systems, NVH optimization, surface integrity and heat treatment processes, and the integration of new materials and additive manufacturing techniques. Each presentation provides technical depth suitable for engineers, academics, and decision-makers seeking to stay at the forefront of power transmission technology.

Education Courses

MPT Expo offers a robust lineup of education courses designed for gear and power transmission professionals at every stage of their careers. Taught by industry experts, these courses cover everything from foundational gear principles to advanced analyses, materials, and manufacturing techniques. Conveniently located near the exhibit floor, participants can pair classroom learning with hands-on exposure to the latest technologies on display.

Courses include the full AGMA Fall Technical Meeting, featuring peer-reviewed research on gear design, analysis, manufacturing, materials, heat treatment, and more. Specialized seminars cover topics such as EV and hybrid vehicle powertrains, gear noise management, integrated gear and bearing systems, analytical gear inspection, plastic gear design, and materials selection and heat treatment. With full-day sessions and in-depth hands-on exercises, these programs provide both practical knowledge and strategic insights to help engineers optimize performance, efficiency, and reliability in their designs.

Whether you're seeking to expand your foundational understanding or tackle cutting-edge challenges in advanced gearing, the Education Courses at MPT Expo provide unmatched access to technical expertise, networking, and industry-leading instruction.

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What's Brewing Power Breakfasts

Kick off each morning at the Motion + Power Technology Expo with What's Brewing Power Breakfasts, a dynamic series of expert-led discussions designed to fuel your knowledge and connections. These engaging sessions bring together industry leaders to explore key trends shaping the future of power transmission, including opportunities in robotics development, the latest aerospace innovations, and critical workforce and advocacy insights. Enjoy breakfast while gaining valuable perspective to help drive your business forward.

Pricing for the breakfasts is $230 for a three-day pass for members and $260 for non-members when purchased in advance through October 20, or $260 for members and $285 for non-members if purchased late or onsite. Individual sessions are $85 for members and $95 for non-members in advance, or $95 for members and $105 for non-members late or onsite. Full FTM attendees receive complimentary access to all breakfast sessions as part of their registration.

What's Brewing in Robotics: Breakfast and Panel

Tuesday, October 21
8:00 am–10:00 am

This expert panel will explore the future of robotics. The discussion will cover key challenges and opportunities in the development of robots, particularly how safety, reliability, and cost considerations will shape electro-mechanical actuation systems. With the increasing demand for humanoid robots, the panel will delve into the projected growth of these technologies, addressing whether the forecasted numbers of robots will materialize. Through expert insights, the panel will provide a comprehensive view of the future of robots, exploring both the opportunities and challenges ahead, and the vital contributions of mechanical drive systems and gear manufacturing to this evolving field.

What's Brewing in Aerospace and Defense: Breakfast and Panel

Wednesday, October 22
8:00 am–10:00 am

Join a panel of leading experts for a series of short presentations exploring the latest innovations in aerospace, including new aircraft designs, advancements in electric vertical take-off and landing (eVTOL) vehicles, and the broader future of air mobility. The discussion will also cover how manufacturers are approaching training for these advanced systems and the implications for power transmission, supply chains, and workforce development.

The panel features Theodore Angel, Executive Director of the National Advanced Air Mobility Center of Excellence (NAAMCE), who brings extensive experience in aviation, aerospace, and defense, including 27 years in the U.S. Air Force and leadership in regional aerospace development initiatives. Noel Mack, Chief Technology Officer at LIFT, adds more than 35 years of engineering and design experience, overseeing large-scale projects aligned with Department of Defense priorities and helping accelerate advanced manufacturing technology and talent development. Dr. Amy Thompson, Chief Technology Officer at the Connecticut Center for Advanced Technology (CCAT), rounds out the panel with expertise in digital engineering, model-based systems engineering (MBSE), smart and energy-efficient manufacturing, and workforce training, leading CCAT's mission to support manufacturers in scaling technology adoption and strengthening industrial supply chains.

Together, this panel offers a comprehensive view of how cutting-edge aerospace and defense technologies intersect with power transmission, providing insight into both the opportunities and technical challenges ahead.

What's Brewing in Workforce and Advocacy: Breakfast and Panel

Thursday, October 23
8:00 am–10:00 am

In this session, hear from a panel of experts on how to leverage local resources for grant funding, business visibility, and talent recruitment for US manufacturing companies. Explore how the current administration's approach to grant funding shapes opportunities for manufacturers, and dive into industry pain points—what the sector needs and how to amplify its voice. Learn about critical local and state resources for manufacturers, including workforce development, continuing education, and advocacy strategies. This session is tailored to those looking to better navigate funding, recruitment, and industry growth.

MPT Expo Podcast Studio

The MPT Expo Podcast Studio (Booth 251) returns, bringing live, on-site interviews with industry leaders, innovators, and experts. Hosted by Tony Gunn—Director of Global Operations at MTDCNC, CEO of TGM Global, and host of The Gunn Show podcast—the studio offers a dynamic platform for real-time conversations that spotlight the latest in power transmission, gear manufacturing technology, and workforce development.

Throughout the three-day event, attendees can watch live interviews directly from the show floor, engaging with thought leaders and gaining insights into cutting-edge trends and solutions. These sessions will be recorded and shared across multiple platforms, reaching a global audience of hundreds of thousands of viewers and listeners.

Whether you're a first-time attendee or a seasoned professional, the Podcast Studio offers a unique opportunity to connect, learn, and stay informed about the evolving landscape of power transmission and gear manufacturing.

The Solutions Center

At the heart of the exhibit hall, the Solutions Center (Booth 751) offers companies a dedicated space to present their innovations, share insights, and engage directly with attendees. Each sponsored session provides 30 focused minutes in the spotlight, giving companies a platform to showcase new products, walk through recent case studies, demonstrate live solutions, or deliver thought leadership talks.

Designed to be relaxed yet professional, the space comes equipped with a monitor, podium, and microphone, allowing presenters to focus entirely on their message. Sessions are promoted ahead of the show and featured in on-site materials, helping draw an audience eager to learn and interact. Whether it's a live demonstration, a Q&A session, or a product launch, the Solutions Center is the ideal venue to connect with potential customers, spark conversation, and generate leads—all in a highly visible, high-traffic location.

MPT Expo Exhibitor Highlights

Helios Gear Products Booth #137

Helios Gear Products invites attendees to discover its complete gear manufacturing systems at Booth 137 during the Motion + Power Technology Expo 2025. The exhibit will feature the company's full workflow

solutions for gear cutting, deburring, cleaning, marking, inspection, and automation and a live gear cutting demonstration of the Hera 350 CNC gear hobbing machine.

Capable of processing parts up to one meter in diameter and pitches ranging from micro to coarse, Hera hobbing machines combine Fanuc CNC, direct-drive torque motors, x-axis linear scales, and intuitive dialog programming. Optional unified automation further simplifies integration for manufacturers seeking higher throughput and repeatability.

"Visitors can watch the Hera 350 cut spur and helical gears on demand and learn how the same core technology scales across eight machine sizes," said Adam Gimpert, president of Helios Gear Products. "Our goal is to give job shops and OEMs a dependable, productive, and cost-effective path to higher capacity without a steep learning curve, and we've done it by pairing the Hera lineup with our suite of workflow solutions."

Because every Hera model shares identical controls and mechanical architecture, expanding capacity requires minimal additional training or system integration. Combined with globally competitive pricing, a compact footprint, and responsive domestic support, the Hera platform has become a popular choice for manufacturers that need to scale quickly.

Matt Davis, owner of Buffalo Gear, reports significant gains with his Hera 350:

"I would say we are about 50 percent more efficient with our setups. The guys no longer bend down to swap change gears. You load the blank, program the part, and you are saving someone's back. With the larger gears this machine can run, it is just unbelievable."

heliosgearproducts.com

Klingelnberg Booth #177

Klingelnberg Group will present innovative solutions at the Motion + Power Technology Expo (MPT) in Detroit, USA. Organized by the American Gear Manufacturers Association (AGMA), the trade fair is considered a central platform for manufacturers, suppliers, and users of gearboxes.

The MPT Expo brings together international industry experts and provides a forum for discussing technical standards, continuing education, and current economic information. As part of the global AGMA network, Klingelnberg will present the latest developments and technologies in the field of gears. Visitors to the trade fair will have the opportunity to learn about innovative products and services at Booth 177 and talk to the company's experts.

"Participating in MPT Expo is an excellent opportunity for us to present our latest products and technologies to an international audience of experts and to make valuable contacts," says Fabian Wolf, CEO of Klingelnberg America, Inc., looking forward to the upcoming event. "All trade fair participants are cordially invited to visit our booth and see our innovations for themselves."

klingelnberg.com/en

Norton Saint-Gobain Booth #505

Saint-Gobain Abrasives will be highlighting a range of high performance, innovative production grinding wheels and technology during MPT Expo. Innovative Norton Quantum Prime Grinding Wheels, which feature proprietary nano-crystalline ceramic grain offering unprecedented productivity gains across a wide range of applications, will be featured. The Quantum Prime grain delivers exceptionally high grinding efficiency and part quality, as well as significantly longer wheel life than traditional ceramic grains.

Also, attendees can see high performance Norton IDeal-Prime Internal Diameter Grinding Wheels for precision applications featuring Quantum Prime nano-crystalline ceramic grain. The combination of the micro-fracture properties of the ceramic grain and the retention capability of the advanced bond, ensures long wheel life, excellent grinding efficiency and consistent part quality with superior surface finishes which results in cost savings of 30 percent and more.

Additional key Norton grinding technologies at Motion + Power Technology Expo include:

- A range of gear grinding solutions including new VS3PN bond technology designed for high performance gear grinding in extreme, tight tolerance environments will be featured. 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.
- For the high performance external grinding of cam and crankshafts and internal grinding applications in automotive and bearing industries, Vitron7 cBN grinding wheels have a high-precision vitrified bond.
- Norton Finium abrasive microfinishing film rolls for precision applications are designed with a patented topside resin system alongside two backing types and an innovative grit size color coding. This combination is specifically engineered to deliver high material removal and exceptional surface finish uniformity.
- Norton Stellar inserted-nut grinding wheels for double and single disc grinding offer improved wheel life, increased parts per wheel and lower cost per part.

nortonabrasives.com

Heat Treat 2025

Heat Treat 2025, co-located with MPT Expo, offers an in-depth technical and educational program on heat treating, material technology and more. Show highlights include:

Keynote Presentations

"Electrification of Industrial Heat," takes place on Wednesday, October 22 from 9:15–10:00 am, presented by Dr. Sridhar Seetharaman, CEO, EPIXC, chief science officer, Fulton School of Engineering, Arizona State University.

Industrial heat accounts for nearly one half of the on-site energy used by the energy intensive industries in the US, which is dominated by five sectors, chemicals/petrochemicals, iron and steel, cement, paper and pulp and food and beverage. EPIXC (Electrified Processes for Industrial Excellence), US DOE's 7th Manufacturing Innovation Institute, aims to develop technologies which improve energy efficiency, process control and/or product quality for energy intensive industries.

"Solution Left: The Story of Virtual Heat Treatment Simulation at General Motors," takes place Thursday, October 23 from 9:15–10:00 am, presented by Justin Persinger, senior manufacturing engineer, manufacturing process analysis at General Motors.

Virtual heat treatment simulation tools have been employed at General Motors over the last decade. Solution Left is the concept of leveraging these tools to better understand and make decisions about product and heat treatment manufacturing processes further left in the development life cycle with the objective of reducing program costs and time to launch.

Joint AI Panel Discussion

Tuesday, 2:30–4:00 pm, co-hosted with IMAT + Motion + Power Technology Expo. AI isn't coming—it's here. Learn how artificial intelligence is already streamlining workflows across the supply chain, and what it means for materials science, manufacturing, and beyond.

Heat Treat is part of a one-of-a-kind experience that includes IMAT (ASM's Annual Meeting), ICRS-12, and the Motion + Power Technology Expo. That's 600+ exhibitors, thousands of attendees and an environment for networking, deal-making and discovery.

www.asminternational.org/heat-treat-2025

Heat Treat 2025 Preview

Ipsen Booth #1401

Ipsen vacuum furnaces offer a wide variety of roles for heat-treating professionals, most commonly serving up solutions for tempering, annealing, hardening, and brazing. Ipsen customers routinely count on our expertise in building, servicing, troubleshooting, and optimizing our furnaces to ensure maximum uptime and throughput.

Sales Director for Southeast Asia, Janusz Kowalewski, will present on discoloration in vacuum heat treatment during Heat Treat 2025—what causes it, how to prevent it, and best practices to ensure high-quality results. Learn how to reduce contamination risks, extend furnace life, and improve part quality. This presentation explores the key sources of contamination in vacuum furnaces, including outgassing, backstreaming, leaks, and particle generation. Learn how to identify, evaluate, and prevent contamination using best practices for furnace maintenance, cleaning cycles, and process optimization.

From understanding oxidation limits to identifying metal sublimation effects, this presentation provides actionable insights for heat treaters looking to improve quality control. By implementing proper contamination prevention techniques, manufacturers can enhance process reliability, extend furnace life, and ensure high-quality, defect-free heat-treated parts. The presentation takes place on Wednesday, October 22, at 4:50 pm.

Seco/Warwick Group Booth #1317–1321

At the 33rd Heat Treating Society Conference and Exhibition, Seco/Warwick-Group will focus on vacuum and atmospheric heat treatment technologies, including the following products:

Vector—a single-chamber vacuum furnace using gas quenching for a wide variety of heat-treating processes and applications. This technology provides important capabilities for obtaining highly uniform results in heat-treated parts, high process consistency in workloads, and high speeds in batch processing with low consumption of electrical power and process gases.

CaseMaster Evolution T—a triple-chamber vacuum furnace designed for high-volume heat treatment processes such as low-pressure carburizing (LPC), annealing or vacuum brazing, combined with gas or oil quenching in semi-continuous production mode. The system is built with three separate, functional chambers: the loading and pre-heating chamber, process chamber, quenching and unloading chamber.

4D Quench—a vacuum heat treatment system solution for individual quenching of component parts such as gears, shafts, bearing races, rings, selves, etc. made of standard or custom case and through hardening steels. The system operates under nitrogen. It provides excellent distortion control and notably increases precision and repeatability of heat treatment while reducing unit and overall production costs.

ZeroFlow—a modern, energy-saving, and ecological gas nitriding technology used in HRN/VRN type furnaces, enabling the precise development of the preset composition of the nitrided layer, composed only of alpha, alpha+gamma' or alpha+gamma'+ epsilon phase, while maintaining minimum ammonia consumption, and thus, minimum emissions of post-process gasses.

Rotary Retort Furnaces—rotary retort furnaces are specifically designed for continuous production and uniform heat treating of small parts, such as coins, small hardware, nails, bearings, chain components, and fasteners, such as nuts, bolts, and screws.

Roller Hearth Furnaces—roller hearth furnaces are designed to heat treat a wide variety of products economically with uniform, repeatable results. Efficient, continuous annealing of steel castings and forgings.

Mesh Belt Type Furnaces—are designed for heat treatment and thermo-chemical treatment of small elements, ensure homogeneous, repeatable technological results.

secowarwick.com

Looking Ahead

MPT Expo and Heat Treat 2025 present a unique chance to experience the full breadth of innovation in power transmission, materials processing and thermal treatment under one roof. From next-generation gears and bearings to advanced robotics, aerospace solutions and state-of-the-art heat treatment technologies, the events showcase the tools, expertise and systems driving the industry forward.

motionpowerexpo.com

Eliminating Gear Noise Before It Starts with Inline Process Monitoring

Detecting micro-deviations on gear geometries at an early stage to eliminate increased noise emissions

In electric vehicles, the meshing of the gears can cause disruptive gearbox noise excitations. It is therefore becoming increasingly important for automotive manufacturers and suppliers of electric motors to identify and eliminate the causes of unwanted noise at an early stage. With the *LHProcessMonitoring* software, Liebherr-Verzahntechnik GmbH has developed a tool that detects deviations during gear production. This saves costs and reduces rejects—and is therefore also of interest to manufacturers of conventional gearboxes.

The NVH (noise-vibration-harshness) behavior of a vehicle is significantly affected by the quality of the gears used. This makes it all the more important to detect anomalies in the micro-geometry of the tooth flanks at an early stage—and manufacturers are increasingly emphasizing this too. If noise abnormalities are only detected at the end-of-line (EoL) test bench, it is usually too late and can be very costly to rectify. Ideally, deviations should be detected when the gears are being produced.

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at geartechnology.com

Clear visualization of parameters, warnings and limit violations.

Digital Tool for E-Mobility

The *LHProcessMonitoring* software from Liebherr-Verzahntechnik GmbH for inline process monitoring visualizes the manufacturing process and uses the data obtained to determine limit values in the form of envelope curves, which are used to check the manufacturing process. These can then help identify any deviations that could lead to noise anomalies. The software is optionally available as part of the *LHGearTec* operating and programming interface, and is therefore "the logical continuation and expansion of our product portfolio of digitalization modules with a focus on e-Mobility," says Florian Schuon, head of digital solutions at Liebherr-Verzahntechnik GmbH.

Detecting Deviations at an Early Stage

Thanks to continuous recording and transparent evaluation, the software enables the operator to optimize and stabilize the manufacturing process. Limit violations are automatically detected, and do not enter the value chain. *LHProcessMonitoring* ensures the consistent quality of each individual gear and can replace a downstream full inspection that uses a single flank gear testing system or master gear, which in turn saves investment and set-up costs—all at a comparatively low investment. At the same time, a significantly higher degree of accuracy is achieved. "It's often only at the end of the supply chain that you realize something is wrong. Our software improves the traceability of parts at an early stage, not just during the EoL inspection. Manufacturers of conventional gearboxes also benefit from the improved gear quality," says Schuon, explaining the advantages of the software.

Dynamic Envelope Curve Analysis

Like the *LHGearTec*, the *LHProcessMonitoring* software also has an intuitive graphical user interface. It evaluates the parameters of the drive motors, and limit values can be easily set using a slider. Dynamic envelope curves indicate warnings or stops in the event of limit value violations, while signals from individual parameters such as motor position, power and torque allow direct conclusions to be drawn about the source of the fault. The machine is "trained" using reference parts and immediately informs the operator of any deviations or anomalies, so that faulty parts don't make it to the EoL test stage. The software is initially available for generating grinding, profile grinding, and skiving, and it can also be used for dressing. In the future, it will also be extended to other gear cutting methods.

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The Next Generation of Gear Industry Training

AI meets video-based learning

Joe Arvin

In gear manufacturing, precision isn't just for the products—it's a necessity for the people who make them. Whether it's a new hire learning the basics or a seasoned operator adapting to new processes, effective training is essential for maintaining quality, safety, and competitiveness.

But let's be honest: training budgets are tight, time is limited, and inefficiency is expensive. Every minute spent on learning must translate into value on the shop floor.

As many of you know, delivering high-impact, cost-effective training has been a primary objective of mine since starting Arvin Global Solutions in 2015. But my roots in workforce development go much further—to the early 1980s at Arrow Gear. At that time, video-based training was first becoming a practical option for forward-thinking manufacturers, and we jumped into it wholeheartedly. Over the years, we have developed a robust video training library that proved to be an asset for our entire workforce. By harnessing the power of video, we were able to scale our training efforts across a broad range of key topics.

Today, video remains one of the most effective training tools available to manufacturers. It offers consistency, accommodates different learning speeds, and presents complex topics in visual form—often with demonstrations and animation that bring concepts to life. But as effective as it is, video also has its limitations. As a rule of thumb, viewers retain just three to five key concepts before their focus begins to fade.

When a Five-Minute Video Isn't Enough

Imagine giving your employees access to on-demand video training—then pairing it with a tool that allows them to ask follow-up questions, explore related topics, or clarify concepts in real time. That's not a future scenario. It's available now.

Thanks to advancements in artificial intelligence, particularly custom AI-powered chatbots, companies can now augment traditional video-based learning with interactive, searchable support—available any time, day or night.

At AGS, we've recently been involved in the development of AI-integrated training platforms for a very different but equally demanding environment: public education. We partnered with Dr. Kara Coglianese, superintendent of the Crete-Monee School District 201-U in Illinois, to strengthen her district's professional development systems. After starting to build a library of video training content, we worked with the district to integrate chatbots that allowed staff to access answers to frequently asked questions, navigate district policy, and retrieve HR-related information quickly and easily—all without placing additional demands on administrative staff.

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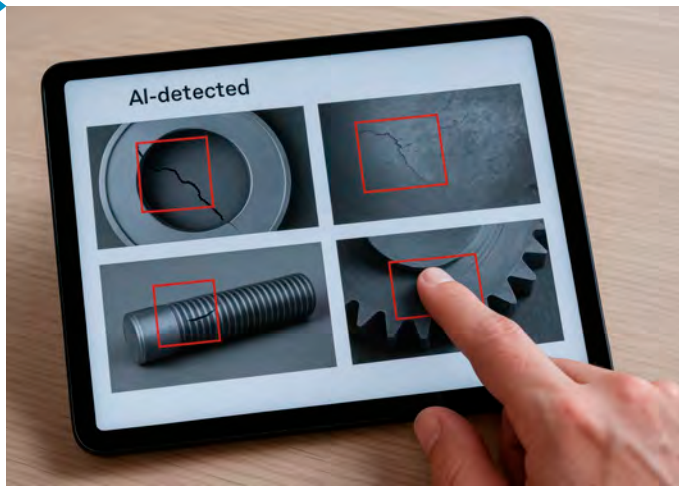

"Our goal was to simulate the individualized experience people expect today," said Dr. Coglianese. "More than ever, people want specific answers on demand. They're not reading long documents—and they're not willing to wait around for emails or returned phone calls. By pairing video-based training with AI chatbots, we're giving our staff 24/7 access to policy information, HR procedures, and training reinforcement in a format that fits their fast-paced lives. The chatbot doesn't replace training, but it supplements it—meeting people where they are, on their own time, and in the style they're most comfortable with."

The success of that initiative made one thing clear: this model could be just as effective in the gear manufacturing sector.

You might be thinking, "Hang on, Joe—how am I supposed to afford AI programming for my training?"

Here's the short answer: integrating custom AI chatbots with video-based learning is a lot easier—and more affordable—than you might think. While getting into the technical details is beyond the scope of this article, the ease and accessibility of this approach may soon have you thinking it's something you can't afford to ignore.

From Theory to Practicality: A Gear Industry Example

Consider the learning curve facing a new employee in a gear shop. Let's say they've just completed a video module introducing basic gear geometry. A week later, they come across the term involute and want a clearer understanding. Instead of tracking down an engineer or thumbing through a dense training manual, they simply open the chatbot interface and type in their question.

Within seconds, they receive a response that defines the term, includes visual references, and may even link to a segment from the original training video or a related resource. In essence, the chatbot becomes an on-demand mentor—reliable, patient, and always available.

And the applications don't stop there. Beyond simple definitions, one of the biggest advantages of pairing AI chatbots with video-based training is the ability to provide quick, specific job-ready reminders at the moment of need.

For example, after training, a machinist might ask the chatbot:

- "What is accumulated tooth spacing?"
- "What feed rate should I use when hobbing a 4140 steel gear at 30 Rockwell C?"
- "What are the steps to balance a grinding wheel?"
- "What is tooth tip relief modification?"
- "What PPE is required when loading parts into a quench press?"

The real value lies in how the chatbot delivers the response. Instead of simply reciting raw training material, it summarizes and frames the answer in context—much like an experienced co-worker or mentor offering a quick, practical reminder.

This technology also addresses one of manufacturing's most persistent challenges: preserving tribal knowledge. These are the insights, tips, and troubleshooting techniques that live in the minds of veteran employees—the kind of knowledge that rarely makes it into formal documentation. By strategically capturing that expertise in a structured, searchable format, companies can ensure it remains accessible long after those experts have retired or moved on.

Now imagine you have a respected engineer on your team—let's call him Fred. Over the years, Fred has acquired decades of expertise. He knows more about your operation than anyone else. Now imagine making Fred's knowledge accessible to the entire company—not just to those who can catch him in the hallway. With an AI chatbot, new hires and experienced staff alike can ask questions and receive thoughtful, experience-based answers anytime. This is what AI can do.

"We've seen firsthand how AI chatbots can make a real difference as a supplement to video-based training—especially during stressful or complex situations," Dr. Coglianese explained. "Whether it's a cybersecurity issue, a bomb threat, or just a question about Workers' Compensation, the chatbot delivers clear, logical steps without the emotional noise that can cloud decision-making. It's also taken a lot off our HR team's plate. The chatbot is a consistent, patient, and visual tool for getting answers fast. Especially for visual learners or people who are uncomfortable asking for help, this kind of support can be a game-changer."

The Future of Learning Is Already Here

AI is already transforming manufacturing—from machine learning algorithms that optimize cutting paths to predictive maintenance systems that anticipate equipment failures. Training is simply the next frontier. Video learning has proven its worth but pairing it with AI opens the door to something far more dynamic, responsive, and scalable.

As new technologies continue to reshape the shop floor, our approach to training must evolve as well. The ability to deliver flexible, just-in-time learning—supported by institutional knowledge and responsive AI—isn't just a competitive advantage. Increasingly, it's becoming a necessity.

For those of us in the gear industry, this evolution presents a powerful opportunity. It's a chance to retain the depth and craftsmanship that define our work, while embracing the tools that will help us train better, faster, and smarter.

Because in this business—as in any—you're either advancing, or you're on your way to becoming obsolete.

Your Input Needed: Emerging Tech for 2026

Gear Technology has always attracted a sharp and forward-thinking audience—engineers and engineer-adjacent professionals who not only enjoy reading about new developments but are often the ones driving them. As we look ahead to 2026, we want to hear from you: Which emerging technologies should MPMA spotlight in the coming year?

Over the years, I've had the privilege of facilitating conversations around some of the most exciting advancements in our industry. One of our earliest forays into emerging tech came in 2017, when metal 3D printing was still in its infancy. At the time, we invited a scientist from Oak Ridge National Laboratory to speak at the AGMA SRN event (now known as SNL). That moment marked the beginning of what has become a long-standing exploration into additive manufacturing.

Since then, we've showcased breakthroughs in gear and hob printing, highlighted successes in 3D-printed jigs and fixtures, and even explored Skuld's new forging technique. Most recently, we covered a case study where a company successfully repaired a gear using Directed Energy Deposition (DED) technology—something that would not have been expected a decade ago.

But additive isn't the only tech frontier we've explored.

The IIoT committee has tackled a range of timely topics from cybersecurity frameworks like CMMC to the implications of artificial intelligence on manufacturing workflows. Meanwhile, our Robotics committee has hosted presentations from four different new gearbox innovations—two of which have now entered production.

And the conversation is far from over.

In September, we hosted a joint session between the EV and Robotics committees to discuss the Hoop Drive, a new gearing concept developed by a cutting-edge inventor with potential implications across multiple industries.

As 2026 approaches, we're more committed than ever to providing timely, relevant coverage of the technologies shaping the future of manufacturing. But to do that well, we need your input.

One area I'm strongly considering for 2026 is the creation of an Aerospace, Defense, & Space Emerging Technology Committee. I am closely watching both public and private capital flowing into next-generation products and services in this sector.

Joby is building eVTOLs in Ohio. Drone technology is now being deployed on the battlefields of Europe. The challenge now isn't discovering innovation—it's developing agile supply chains capable of scaling the innovations that break through. Gears and bearings will be needed on the front lines of these efforts—and more importantly, the people who really know how to design them will be essential to the conversation.

I will be speaking with the aerospace panelists at the upcoming Motion + Power Technology Expo, including Ted Angel, executive director of the National Advanced Air Mobility Center of Excellence; Amy Thompson, PhD, CTO at the Connecticut Center for Advanced Technology; and John Keogh, PhD, vice president, technology at LIFT. We'll explore how gear and bearing manufacturers can take a more active role in this sector—what companies to watch and which voices need to be part of the discussion.

So now, over to you.

What topics, trends, or tools do you want to learn more about? Whether it's breakthroughs in AI, sustainability in gear manufacturing, advanced sensors, or something we haven't yet imagined—reach out and let me know.

Let's shape the conversation together.

Send your thoughts to Mary Ellen Doran, VP, Emerging Technology at *doran@motionpower.org*

Three Newly Revised Standards

Phillip Olson, Director, MPMA Technical Services

MPMA is pleased to announce the publication of three new revisions to standards. ANSI/AGMA 6011-K25, Specification for High Speed Helical Gear Units, written by the AGMA High Speed Gearing Committee, ANSI/ABMA 20-2025, Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types - Metric Design, written by the ABMA ASC B3 committee, and ANSI/ABMA 4-2025, Tolerance Definition and Gauging Practices for Ball and Roller Bearings also written by the ABMA ASC B3 committee.

ANSI/AGMA 6011-K25

ANSI/AGMA 6011-K25 includes design, lubrication, bearings, testing and rating for single and double helical external tooth, parallel shaft speed reducers or increasers. Units covered include those operating with at least one stage having a pitch line velocity equal to or greater than 35 meters per second or rotational speeds greater than 4500 rpm and other stages having pitch line velocities equal to or greater than 8 meters per second.

Changes in the 2025 edition include: Clause 5.5 was expanded to apply allowable stress numbers for case hardened gears at 55 HRC minimum, and similar values were reintroduced from AGMA 421.06. In the lubrication section the maximum allowable filtration values as defined in ISO 4406 were tightened and the minimum recommended helix angle was increased. In Annex B, the derating factor was assigned to pitch line velocity limits in calculating the load function. The Annex D example problem was expanded to provide examples for both through hardened and case carburized gears. And formula calculations have been added to the summary tables for guidance on how the calculations should be applied.

ANSI/ABMA 4-2025

ANSI/AGMA 4-2025 includes terms and definitions of tolerances for the boundary dimensions, running accuracy and internal clearance of ball and roller bearings listed in other ABMA and ISO standards, as well as includes descriptions of methods of measuring, which are commonly used by bearing users and which, as a rule, give an accuracy sufficient for practical purposes.

The 2025 revision was updated to align symbols and definitions to ISO nomenclature, redraw the figures for readability, and align the formatting to the current ABMA style.

ANSI/ABMA 20-2025

ANSI/AGMA 20-2025 specifies boundary dimensions, tolerances and radial internal clearances for metric radial ball, cylindrical roller, and spherical roller bearings in common usage in the United States.

The 2025 revision was updated to align symbols and definitions to ISO nomenclature, redraw the figures and tables for readability, and align the formatting to the current ABMA style.

On behalf of the bearing and gearing industry, MPMA would like to extend a sincere appreciation for the participation and the valuable contributions of the following experts. In addition, MPMA would like to especially thank the companies of these experts whose foresight and generosity made their participation possible.

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Prospects of Asymmetric Gears in EV Gearbox

Dr. Alexander Kapelevich and Zhang Longzhou (Lutz)

The gear transmission system in an electric vehicle (EV) differs significantly from that of a conventional gasoline or diesel-powered vehicle. This distinction primarily stems from the unique torque and speed characteristics exhibited by electric motors, as compared to internal combustion engines. In most cases, EVs employ a single-speed, two-stage helical gearbox configuration (see Figure 1).

Figure 1—EV gearbox (Ref. 1).

Although relatively simple in design, the gearbox of an EV must meet several critical performance requirements. These include high load-carrying capacity while maintaining a compact and lightweight structure, as well as ensuring high operational efficiency and optimal noise, vibration, and harshness (NVH) performance. The study referenced in Ref. 2 provides an in-depth analysis of these specific requirements and the distinguishing features of EV transmission systems. This study focuses on reducing the size and weight of gears utilized in EVs.

Optimizing the geometry of gear teeth is essential for enhancing the technical performance of EV gearboxes. EV gearboxes typically operate unidirectionally, experiencing high torque and prolonged operation during forward driving. In contrast, during reverse motion, deceleration, and power recuperation phases, the torque levels are significantly lower, and the duration of operation is shorter. These distinct operating conditions involve opposite flanks of the gear teeth, thereby enabling the full benefits of an optimized asymmetric gear tooth design to be realized.

The primary design objective of asymmetric tooth gears is to enhance the performance of the drive flanks under heavy loading, while permitting a degree of compromise on the coast flanks, which are subjected to less frequent and lighter loads. The implementation of the Direct Gear Design method for asymmetric gears enables comprehensive optimization of tooth geometry. This approach results in a significant improvement in power transmission density, maximized load capacity, and a reduction in both the size and weight of the gearbox—advancements that exceed the performance limits of conventional symmetric tooth gears currently used in automotive applications.

Asymmetric Gear Design Approach

Modern gear design standards do not account for the geometry of asymmetric-tooth gears. Consequently, a conventional symmetric gear design is commonly applied to asymmetric gears featuring different pressure angles on their opposing tooth flanks. This methodology employs a customized asymmetric basic or generating rack to define the tooth geometry. Although technically practical, this approach restricts the full potential benefits that asymmetric gears can offer.

An alternative design approach for asymmetric gears eliminates the reliance on a basic or generating rack in defining gear tooth geometry. The Direct Gear Design method determines the asymmetric gear tooth profile by employing the drive and coast involute flanks derived from two different base circles, separated by the tooth thickness at the reference diameter. Additionally, a tooth tip circle prevents a pointed tooth tip. The optimized tooth root profile aims to minimize bending stress while preventing interference with the mating gear's tooth tip.

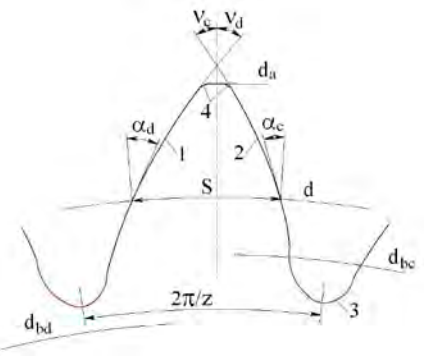

Figure 2—Asymmetric gear tooth profile; 1—drive tooth flank, 2—coast tooth flank, 3—tooth root profile, d_a—tooth tip circle diameter, d—reference circle diameter, S—tooth thickness at the reference diameter, d_{bd} and d_{bc}—drive and coast flank base circle diameters, v_d and v_c—drive and coast flank involute intersection angles, α_d and α_c—drive and coast flank profile angles at the reference diameter, z—number of teeth.

The gear tooth asymmetry factor K is

$$K = \frac{d_{bc}}{d_{bd}} = \frac{\cos\alpha_c}{\cos\alpha_d} = \frac{\cos\upsilon_c}{\cos\upsilon_d} > 1.0 \tag{1}$$

The tooth thickness S at the reference diameter d is

$$S = \frac{d_{bd}}{2 \times \cos\alpha_d} \times (inv(\upsilon_d) + inv(\upsilon_c) - inv(\alpha_d) - inv(\alpha_c)) \tag{2}$$

where $inv(x)=tan(x)-x$—involute function of angle x (in radians).
The asymmetric gear mesh is shown in Figure 3.
The drive and coast operating pressure angles are defined by Equations 1 and 3

$$inv(\alpha_{wd}) + inv(\alpha_{wc}) = \frac{1}{1+u} \times \left[inv(\upsilon_{1d}) + inv(\upsilon_{1c}) + u \times (inv(\upsilon_{2d}) + inv(\upsilon_{2c})) - \frac{2 \times \pi}{z_1}\right] \tag{3}$$

The transverse drive and coast contact ratios are

$$\varepsilon_{ad} = \frac{z_1}{2 \times \pi} \times [\tan\alpha_{a1d} + u \times \tan\alpha_{a2d} - (1+u) \times \tan\alpha_{wd}] \tag{4}$$

$$\varepsilon_{ac} = \frac{z_1}{2 \times \pi} \times [\tan\alpha_{a1c} + u \times \tan\alpha_{a2c} - (1+u) \times \tan\alpha_{wc}] \tag{5}$$

Ref. 3 provides a detailed description of the definition of asymmetric tooth gear geometry.

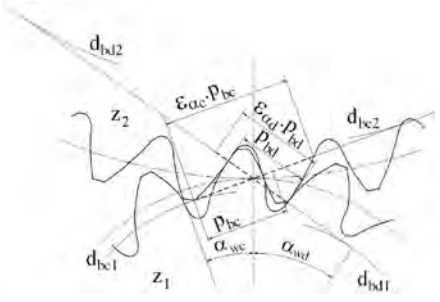

Figure 3—Asymmetric gear mesh; 1, 2—indexes for the pinion and gear, α_{wd} and α_{wc}—drive and coast operating pressure angles, p_{bd} and p_{bs}—drive and coast base diameter pitches, ε_{ad} and ε_{ac}—transverse drive and coast contact ratios.

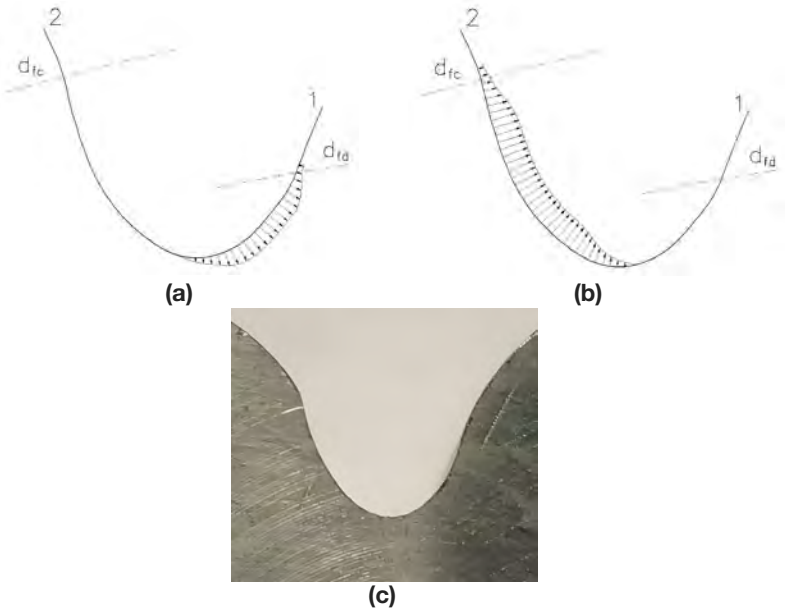

Figure 4—Asymmetric tooth root profile optimization; (a) and (b)—tensile and compressive root bending stress charts along the optimized root profile; 1—drive involute flank, 2—coast involute flank; (c)—photo of optimized tooth root profile.

Asymmetric Gear Tooth Optimization

Asymmetric tooth gears are not standardized, which enables the optimization of virtually any combination of gear tooth geometry parameters. However, the specific optimization goals are determined by the intended application and the performance priorities of the gear drive system. In high-performance applications, such as automotive gearboxes, minimizing stress at the gear tooth root becomes a critical design objective.

The Direct Gear Design methodology incorporates a tooth root optimization approach developed by Dr. Yuriy Shekhtman. This technique employs two-dimensional finite element analysis (FEA) using linear triangular elements for stress calculations. It is integrated with a random search algorithm to facilitate multiparametric iterations throughout the optimization process. The method utilizes trigonometric, polynomial, and exponential functions to accurately define the optimized root profile. As demonstrated in Figure 4, asymmetric tooth root optimization results in a uniform distribution of tensile and compressive bending stresses along the root profile, leading to a significant reduction in peak root stress values (Ref. 3).

Comparison of Symmetric and Asymmetric Gears for EV Gearbox

Table 1 presents a comparative analysis between the 2nd symmetric tooth gear stage of a two-stage EV gearbox and its optimized asymmetric tooth version. The objective is to assess the potential advantages associated with the implementation of asymmetric tooth gears.

For the purpose of initial comparison, both the symmetric and asymmetric gear stages maintain the following identical dimensions and parameters:

- Number of teeth
- Center distances
- Hand of helices
- Gear face widths
- Gear materials
- Maximum torque and related rpm

The symmetric gear stage was designed using conventional methods in accordance with established standards, whereas the proposed asymmetric gear stage was developed employing the Direct Gear Design methodology. Due to the differences in design approaches, the normal moduli and helix angles of the symmetric and asymmetric gears exhibit slight variations.

The asymmetric gear stage has an increased drive pressure angle, which is intended to increase the load-carrying capacity of the drive tooth flanks. The coast pressure angle is reduced with the aim of increasing the contact ratio on the drive flank. To achieve the same objective, tooth tip thicknesses are minimized to the allowable lower limit for carburized gears, ranging from 0.3 to 0.4 times of the module value (Ref. 4).

Figs. 5 and 6 show the symmetric and asymmetric gear tooth profiles. Fig. 7 demonstrates the experimental symmetric and asymmetric gears.

Table 2 presents the results of the stress analysis, demonstrating a significant reduction in tooth root stress for asymmetric gears. This improvement is achieved through an increase in tooth root thickness and the optimization of

Tooth shape (Design method)	Symmetric (Traditional)		Asymmetric (Direct Gear Design)	
Gear	driving	driven	driving	driven
Number of teeth	24	83	24	83
Normal module, mm	2.380		2.382*	
Normal drive pressure angle	22°		28°	
Normal coast pressure angle	22°		18°	
Helix angle	18°		18.015°*	
Center distance, mm	134		134	
Hand of helix	Left	Right	Left	Right
Profile shift coefficient	0.3102	-0.2608	N/A	N/A
Reference diameter (RD), mm	60.060	207.706	60.112**	207.888**
Drive base diameter, mm	55.278	191.171	52.468	181.453
Coast base diameter, mm	55.278	191.171	56.884	196.723
Tooth tip diameter, mm	66.839	212.498	66.714	212.784
Normal tooth tip thickness, mm	1.08	1.36	0.92	0.83
Tooth tip chamfer, mm	0.30 x 45°	0.30 x 45°	0.20 x 0.20	0.20 x 0.20
Root diameter, mm	54.042	199.701	54.168	200.238
Face width, mm	47.0	45.0	47.0	45.0
Normal tooth thickness at RD, mm	4.253	3.155	4.290***	3.029***
Drive transverse contact ratio	1.56		1.48	
Coast transverse contact ratio	1.56		1.86	
Overlap ratio	1.86		1.86	

*Normal module and helix angle of asymmetric gears are at operating pitch diameters.
**Reference diameters of asymmetric gears are equal to operating pitch diameters.
***Normal tooth thicknesses of asymmetric gears are at operating pitch diameters.

Table 1—The geometric parameters of the symmetric and asymmetric gears.

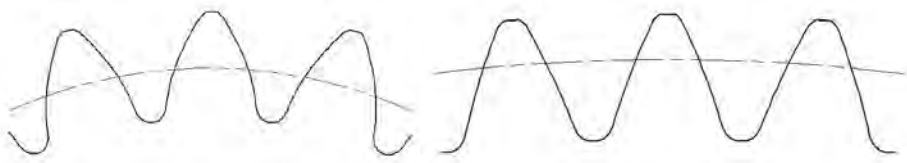

Figure 5—Symmetric gear tooth profiles; (a)—24-tooth pinion, (b)—83-tooth gear.

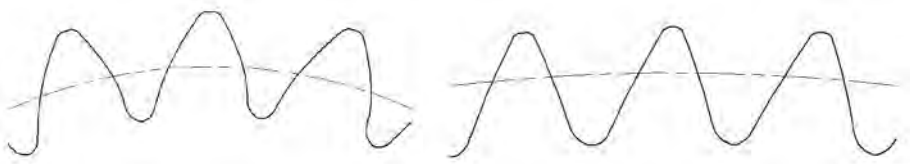

Figure 6—Asymmetric gear tooth profiles; (a)—24-tooth pinion, (b)—83-tooth gear.

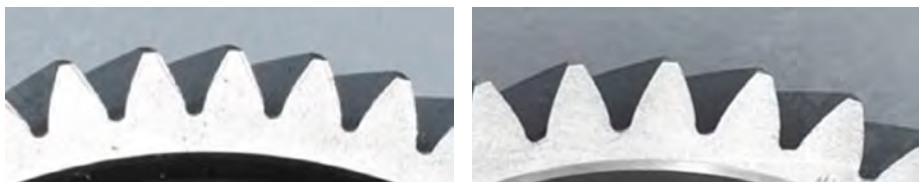

Figure 7—Experimental gears; (a)—with symmetric teeth, (b)—with symmetric teeth.

Tooth shape (Design method)	Symmetric (Traditional)		Asymmetric (Direct Gear Design)	
Gear	driving	driven	driving	driven
Number of teeth	24	83	24	83
Center distance, mm	134		134	
Material	AISI 8620H	AISI 8620H	AISI 8620H	AISI 8620H
Stress Analysis Results (Drive Flanks)				
Max. torque, Nm	1306	4518	1306	4518
RPM @ max. torque	2105	609	2105	609
Bending stress, MPa	928	1002	740 **(-20.3%)**	773 **(-26.8%)**
Contact stress, MPa	1632		1514 **(-7.2%)**	
Stress Analysis Results (Coast Flanks)				
Max. torque, Nm	523	1809	523	1809
RPM @ max. torque	2105	609	2105	609
Bending stress, MPa	415	448	292 **(-29.6%)**	319 **(-28.8%)**
Contact stress, MPa	1033		1008 **(-2.4%)**	

Table 2—The stress analysis results.

Tooth shape (Design method)	Symmetric (Traditional)		Asymmetric (Direct Gear Design)	
Gear	driving	driven	driving	driven
Number of teeth	24	83	24	83
Normal module, mm	2.380		2.222*	
Normal drive pressure angle	22°		28°	
Normal coast pressure angle	22°		18°	
Helix angle	18°		18.015°*	
Center distance, mm	134		125	
Hand of helix	Left	Right	Left	Right
Profile shift coefficient	0.3102	-0.2608	N/A	N/A
Reference diameter (RD), mm	60.060	207.706	56.073**	193.917**
Drive base diameter, mm	55.278	191.171	48.943	169.261
Coast base diameter, mm	55.278	191.171	53.061	183.503
Tooth tip diameter, mm	66.839	212.498	62.231	198.467
Normal tooth tip thickness, mm	1.08	1.36	0.86	0.78
Tooth tip chamfer, mm	0.30 x 45°	0.30 x 45°	0.20 x 0.20	0.20 x 0.20
Root diameter, mm	54.042	199.701	50.555	186.791
Face width, mm	47.0	45.0	47.0	45.0
Normal tooth thickness at RD, mm	4.253	3.155	3.996***	2.820***
Drive transverse contact ratio	1.56		1.47	
Coast transverse contact ratio	1.56		1.84	
Overlap ratio	1.86		1.99	

*Normal module and helix angle of asymmetric gears are at operating pitch diameters.
**Reference diameters of asymmetric gears are equal to operating pitch diameters.
***Normal tooth thicknesses of asymmetric gears are at operating pitch diameters.

Table 3—Outlined here are the reductions in center distance, module, and other critical dimensions, as well as minor deviations in the drive and coast contact ratios and the overlap ratio of the asymmetric gear stage. Importantly, the normal drive and coast pressure angles, helix angle, tooth tip chamfers, and face widths of the asymmetric gears remain constant.

the root profile. Moreover, an increased drive flank pressure angle, along with an increased contact ratio, contributes to lower drive flank contact stress. Additionally, the increased coast flank contact ratio leads to a modest decrease in coast flank contact stress in asymmetric gear designs.

The maximum contact stress is a primary factor in determining the size of a gear stage. Compared to symmetric tooth gears, optimized asymmetric tooth gears enable a reduction in gear stage dimensions while maintaining equivalent drive flank contact stress levels under identical drive flank loading conditions.

Tables 3 and 4 provide a comparison between the symmetric gear stage and the reduced-size asymmetric tooth gear stage. The modified dimensions and parameters are highlighted in blue.

Fig. 8 shows an overlay of the original symmetric and reduced-size asymmetric gear stages, demonstrating a substantial reduction of the asymmetric gear stage cross-section.

The dimensional reduction of the asymmetric tooth gear stage, as demonstrated in Table 3 and Figure 8, facilitates an assessment of the potential weight savings achievable through the application of asymmetric gears. The size reduction of asymmetric gears is characterized by their transverse cross-sectional profile, while maintaining identical face widths compared to symmetric gears. Consequently, gear weight can be approximated as proportional to the transverse cross-sectional areas of both symmetric and asymmetric gears, as illustrated in Figure 8.

Gear weight is primarily determined by its structural design, which typically includes a central bore and machined relief areas aimed at weight reduction, as well as specific features that support integration with other gearbox components. Figure 9 presents common configurations for gear body design.

Tooth shape (Design method)	Symmetric (Traditional)		Asymmetric (Direct Gear Design)	
Gear	driving	driven	driving	driven
Number of teeth	24	83	24	83
Center distance, mm	134		125	
Material	AISI 8620H	AISI 8620H	AISI 8620H	AISI 8620H
Stress Analysis Results (Drive Flanks)				
Max. torque, Nm	1306	4518	1306	4518
RPM @ max. torque	2105	609	2105	609
Bending stress, MPa	928	1002	841 (-9.4%)	866 (-13.6%)
Contact stress, MPa	1632		1629 (-0.2%)	
Stress Analysis Results (Coast Flanks)				
Max. torque, Nm	523	1809	523	1809
RPM @ max. torque	2105	609	2105	609
Bending stress, MPa	415	448	334 (-21.9%)	349 (-22.1%)
Contact stress, MPa	1033		1083 (+5.0%)	

Table 4—This confirms that the drive flank contact stresses of both the symmetric and asymmetric gear stages are nearly identical. Furthermore, the root bending stresses of the reduced-size asymmetric gears are significantly lower compared to those of the symmetric gears. The observed 5 percent increase in coast flank contact stress is considered acceptable, as it remains substantially below the drive flank contact stress levels.

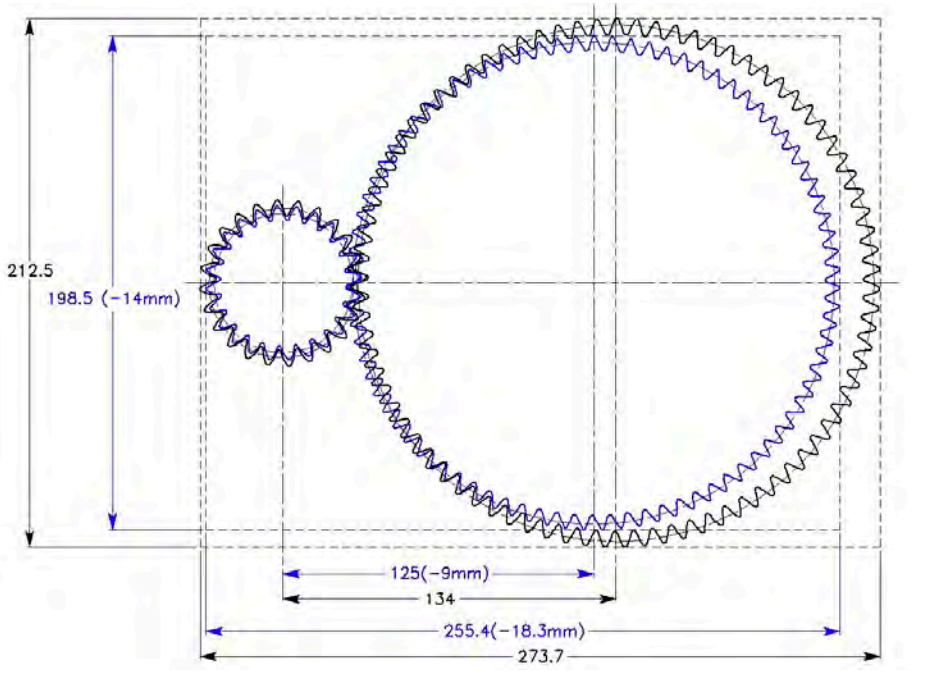

Figure 8—Overlay of symmetric (black) and reduced asymmetric (blue) gear stages.

Tooth shape (Design method)	Symmetric (Traditional)		Asymmetric (Direct Gear Design)	
Gear	driving	driven	driving	driven
Number of teeth	24	83	24	83
Center distance, mm	134		125	
Material	AISI 8620H	AISI 8620H	AISI 8620H	AISI 8620H
Face width, mm	47.0	45.0	47.0	45.0
Transverse cross section area*, mm2	2900	33382	2536	29071
Gear weight, kg	1.77	4.02	1.55 (-12.4%)	3.50 (12.9%)

*defined from the gear model transverse cross sections.

Table 5—This provides a comparison of the weight of symmetric and asymmetric gears.

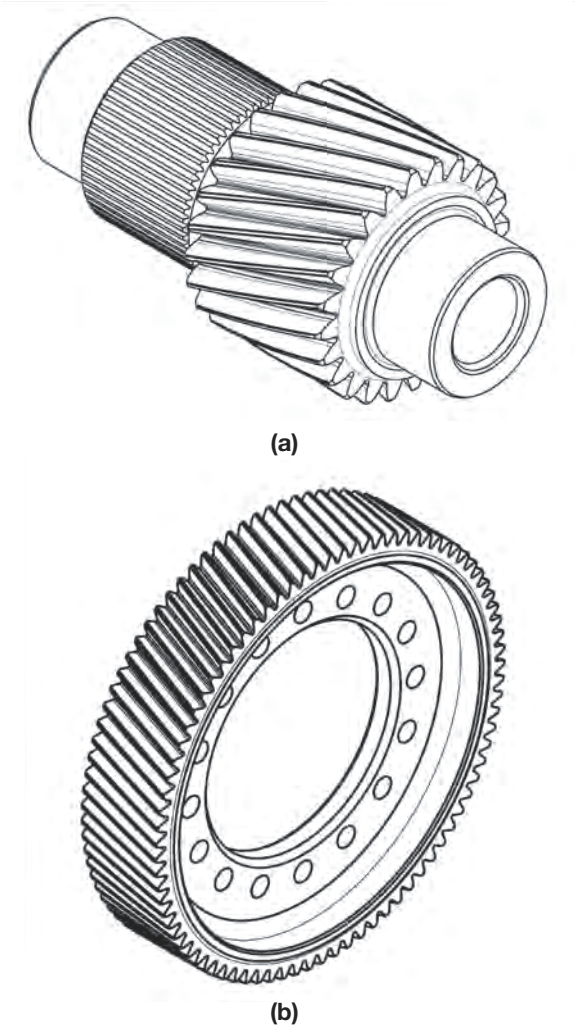

Figure 9—Typical driving (a) and driven (b) gear body designs.

Summary

- Operating modes of EV gearboxes support the implementation of asymmetric tooth gears.
- A comparative analysis between the conventionally designed symmetric gear stage and the optimized asymmetric gear stage, evaluated at the same center distance, demonstrates a significant reduction in tooth stress for asymmetric gears.
- This stress reduction enables a notable size reduction of 7 percent in the asymmetric gear stage relative to the symmetric counterpart.
- An evaluation of gear weight shows a potential reduction of approximately 13 percent for the asymmetric gear stage compared to the symmetric gear stage.
- The study validates the capability of asymmetric gears to improve the performance of EV gearbox systems.

Dr. Alexander Kapelevich, founder of AKGears, LLC, specializes in custom gear design with over 40 years' experience. Holding Master's and Doctoral degrees in Mechanical Engineering, he is an authority on gear transmission architecture, planetary systems, and asymmetric tooth gears, and author of *Direct Gear Design* and *Asymmetric Gearing*.

Zhang Longzhou (Lutz), senior mechanical engineer at Xiaomi EV (Beijing), holds a bachelor's degree from Hubei Automotive Technology University. With 15 years' experience in traditional and EV transmission components, he previously spent over a year in Germany at Getrag (now Magna Powertrain) developing dual-clutch transmission gears.

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The Intrinsic Pitch Cones in Hypoid Gears

Dr.-Ing. Igor Zarębski

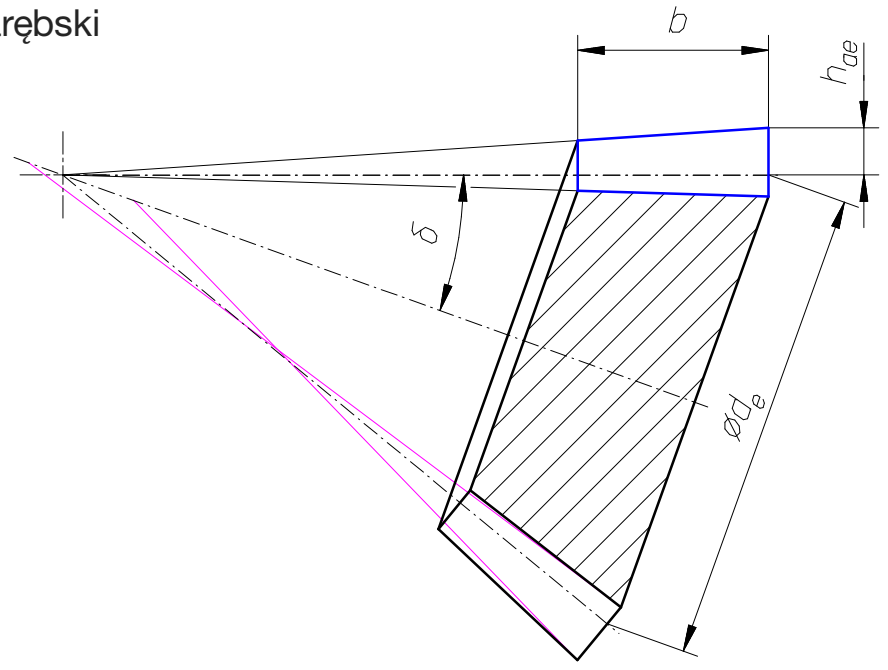

Figure 1—Macrogeometry of a bevel gear—axial section.

Introduction

Bevel gears fall into two categories: the non-offset bevel gears (including straight bevel gears and spiral bevel gears) and the hypoid gears. An idealized non-offset bevel gear pair can be visualized as two cones rolling on each other without sliding. These cones are commonly referred to as pitch cones, and their angles can be calculated based on explicit relationships to the gear ratio and the shaft angle (Ref. 1).

In the case of hypoid gears (i.e., bevel gears with hypoid offset), the two rolling cones are replaced with one sheet hyperboloids. In the axial sections of the gears, these hyperboloids are represented as curves, which are usually simplified to straight lines, and so cones are created, which are again referred to as pitch cones. Due to the nature of hyperboloids, an infinite number of hyperboloid configurations exist for each hypoid gear set; therefore, additional criteria need to be applied to select a specific configuration. These criteria include checking the limit radius of curvature of the tooth trace (Ref. 1) and optimizing the contact ratio (Ref. 2). Consequently, the pitch cones can only be calculated iteratively, and they depend not only on gear ratio and shaft angle (as in the case of non-offset bevel gears), but also on hypoid offset, tool radius and other factors (Ref. 1). Considerations on an actual face cutter having different radii on its internal and external sides and at different profile heights, on a tilted face cutter having local radius of curvature dependent on further parameters, and on contact ratio being derived from tooth contact analysis lead to the conclusion that when pitch cones are calculated this way, they are dependent on specific gear cutting technology, tooling and microgeometry modifications. Therefore, a method for calculating pitch cones in hypoid gears based on macrogeometry parameters similar to that used in the case of non-offset gears is sought after in this paper.

Symmetries

A spiral bevel gear set from Ref. 3—Method 0 is taken as an example. To calculate the pinion's pitch cone angle δ_1 we need to know the shaft angle Σ and the numbers of teeth z_1 and z_2.

$$\delta_1 = arctan\left(\frac{\sin\Sigma}{\cos\Sigma + \frac{z_2}{z_1}}\right) = arctan\left(\frac{\sin 90^\circ}{\cos 90^\circ + \frac{39}{14}}\right) = 19.747^\circ$$

For the gear:

$$\delta_2 = arctan\left(\frac{\sin\Sigma}{\cos\Sigma + \frac{z_1}{z_2}}\right) = arctan\left(\frac{\sin 90^\circ}{\cos 90^\circ + \frac{14}{39}}\right) = 70.253^\circ$$

We refer to these as intrinsic pitch cones because they are derived solely from the gear set's macrogeometry, independent of manufacturing tooling or technology-dependent parameters. Gear sizing includes choosing the pinion's outer pitch diameter d_{e1}=63.5 mm, the face width b=25.4 mm, and the pinion's outer addendum height h_{ae1}=6.281 mm. The dedendum height is used for illustration and can be set arbitrary. With these parameters, it is now possible to draw the pinion as shown in Figure 1.

The pitch cone, the face cone and the root cone share the same apex. The face cone and the root cone often get technology-related modifications, an example of which is indicated here with pink. A corresponding basic planar crown gear, based on the unmodified macrogeometry, is drawn blue. The addendum height is directly proportional to the cone distance.

The visualizations starting with Figure 2 show translucent crown gear bodies, so it is possible to see their alignment with

Figure 2—Spiral bevel pinion and its crown gear.

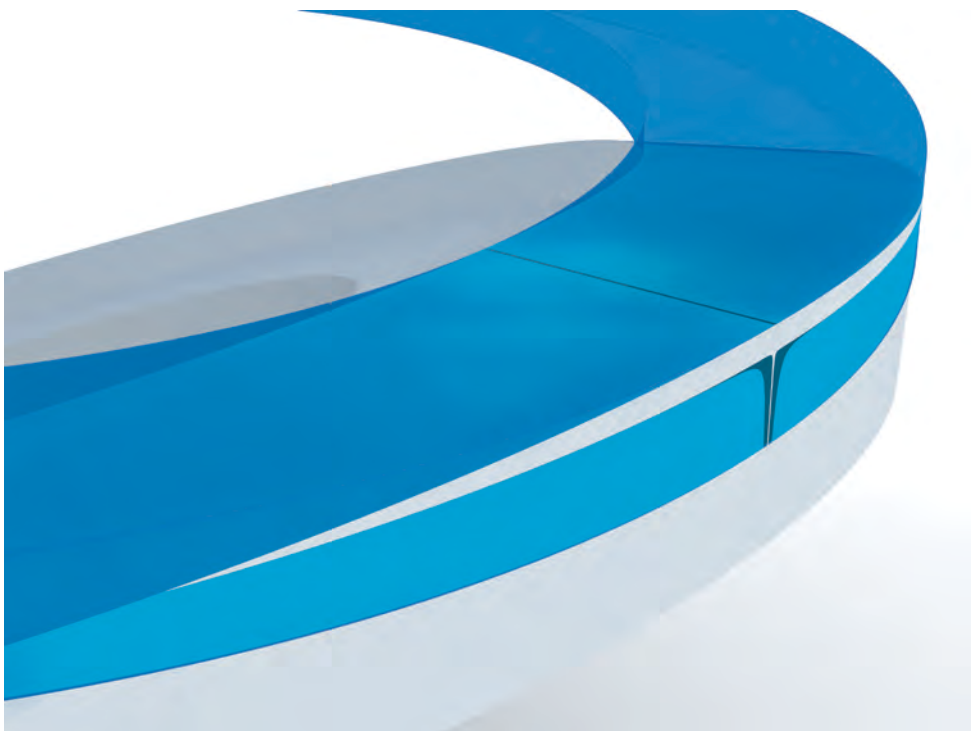

Figure 3—Spiral bevel gear and its crown gear.

the corresponding gears. They were created in *POV-Ray* software, which is capable of calculating objects and their interactions in a mathematically exact way (Refs. 4, 5). The pinion's face cone and the corresponding crown gear's cone in Figure 2 are tangent to each other, and they make contact along a straight line; the same applies to gears in Figure 3. The interactions of curvatures on the back cones actually indicate the locations of theoretical pitch diameters.

Some of the bevel gear manufacturing methods use non-planar crown gears (with pitch cone angle ≠ 90 degrees) (Ref. 1), or with that angle being effectively varied in the gear cutting process by modifying the roll motion. In the case of non-offset bevel gears that does not change the resulting pitch cones.

When hypoid offset is applied to a spiral bevel gear set, a difference in spiral angles of the mating members is created, while they still share an operating normal pitch. Since the transverse pitch is related to the normal pitch in a non-linear way incorporating the cosine of the spiral angle and the pitch diameter is directly proportional to the transverse pitch, the pitch diameter and angle are affected by changes of the spiral angle also in a non-linear way. Therefore, the spiral angle β must be evaluated in gear sizing and included in the initial hypoid data specification, so it can be used in the calculation of the pitch cones.

A sample hypoid gear set from Ref. 3—Method 1 is taken as an example.

Figures 4 and 5 reveal that in this case the face cones do not line up with the corresponding crown gear cones. The iterative pitch cone calculating procedure in this example loops until the lengthwise tooth mean radius of curvature limit is met (Ref. 3). However, the proprietary spiral bevel and hypoid gear calculation software developed at Oktoida (Ref. 6) is capable of taking the cone line-up condition into account. To do that, the crown gear axial positions of points of interaction between the face cones and the crown gear cones at the inner and outer cone distance are matched using the modified Newton's method. It is not surprising that in this way it is possible to select a pitch cone that allows for meeting the cone line-up condition for one of the members. Calculations showed that for each hypoid gear set one special pitch cone pair could be found with which that condition is satisfied for both members. A gear set based on these special pitch cones exhibits the symmetries found in non-offset bevel gears. Their calculation is based on macrogeometry parameters without necessity to reach out for any other prerequisites, like, e.g., for technology-related cutter radius. Therefore, these special pitch cones will be referred to as the intrinsic pitch cones. In this example, they were calculated δ_1=20.239 degrees and δ_2=69.389 degrees.

Parameter	Symbol	Unit	Value
Shaft angle	Σ	°	90
Hypoid offset	A	mm	15
Number of teeth, pinion	z_1	-	13
Number of teeth, gear	z_2	-	42
Outer pitch diameter, gear	d_{e2}	mm	170
Face width, gear	b_2	mm	30
Mean spiral angle, pinion	β_{m1}	°	50
Outer addendum, pinion	h_{ae1}	mm	4.502
Outer addendum, gear	h_{ae2}	mm	2.112
Calculated pitch cone angle, pinion	δ_1	°	21.288
Calculated pitch cone angle, gear	δ_2	°	68.323

Table 1—Hypoid gear parameters—Method 1.

Figure 4—Hypoid pinion and its crown gear—Method 1.

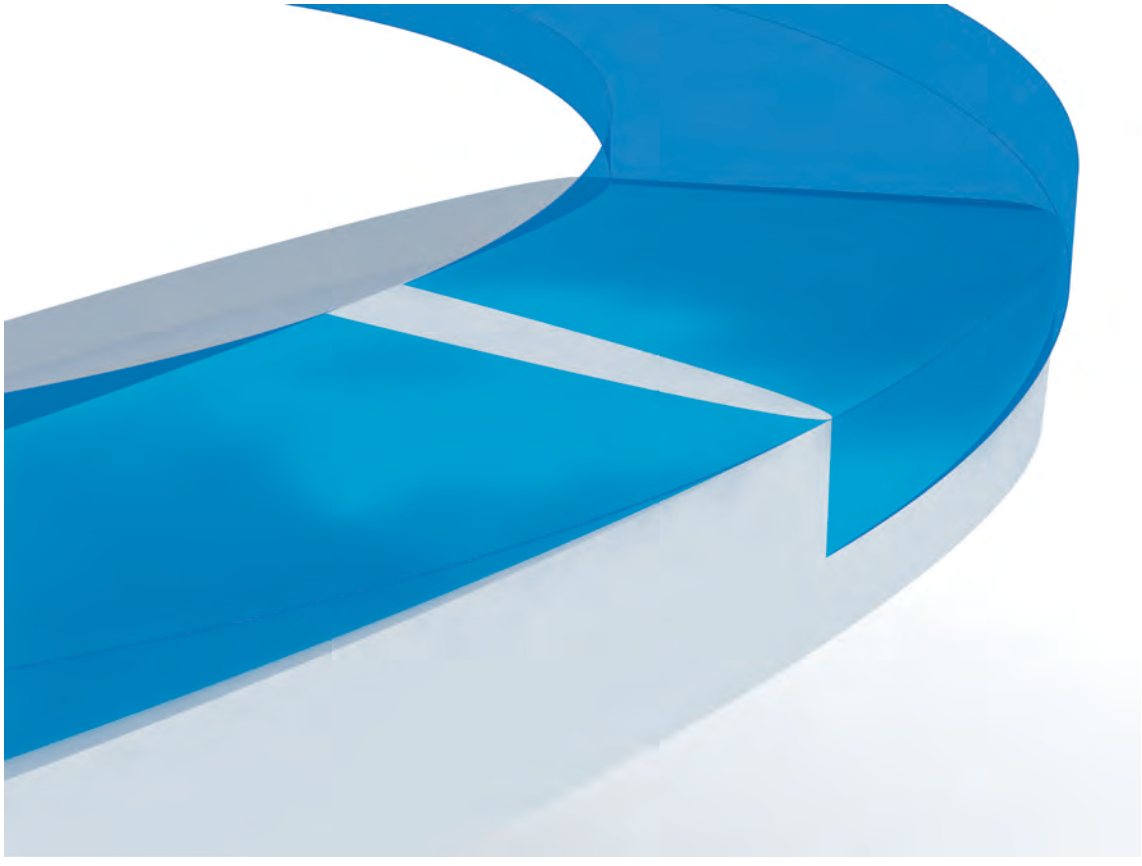

Figure 5—Hypoid gear and its crown gear—Method 1.

Figure 6—Hypoid pinion and its crown gear—Method 1 with the intrinsic pitch cone.

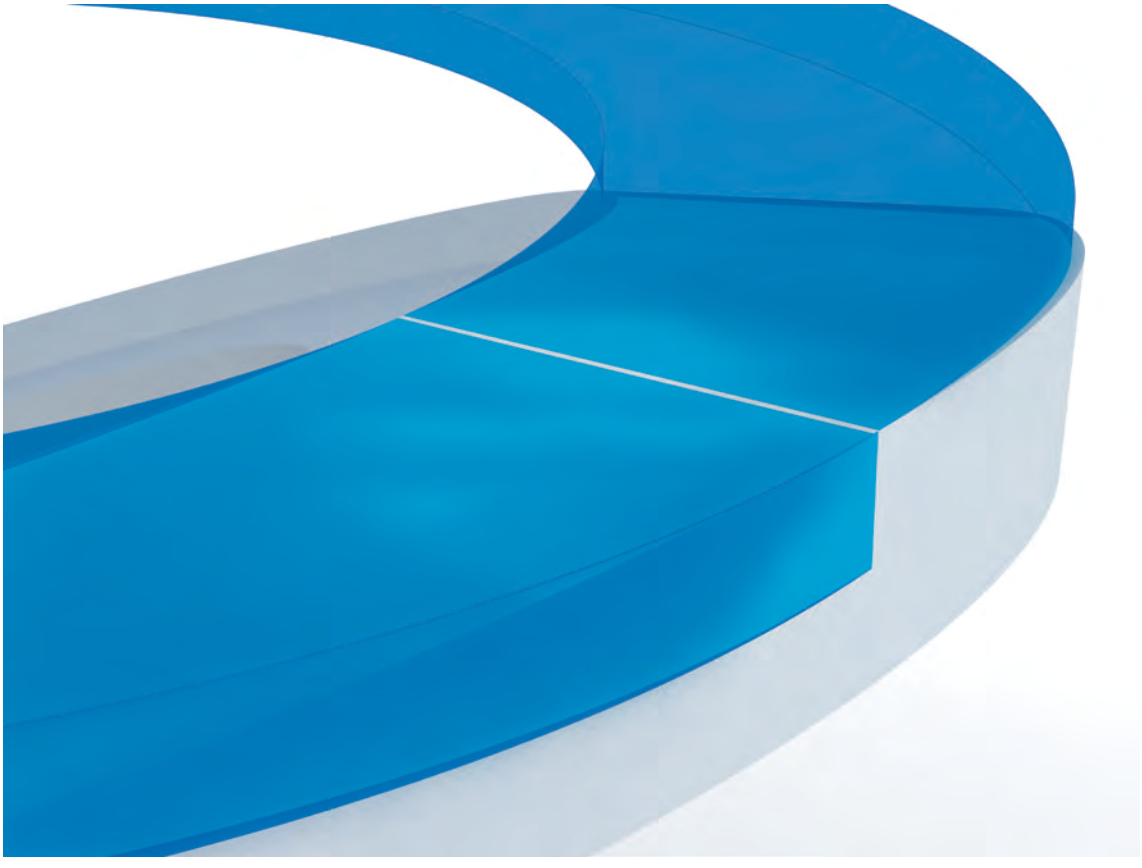

Figure 7—Hypoid gear and its crown gear—Method 1 with the intrinsic pitch cone.

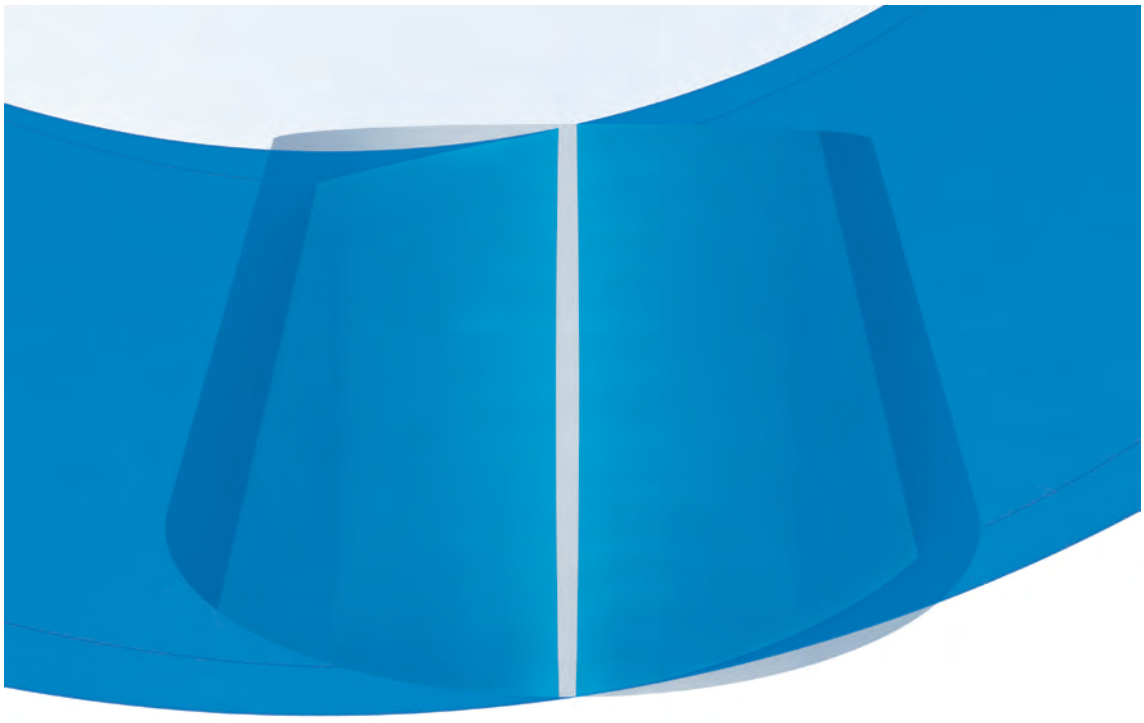

Figure 8—Hypoid pinion and its crown gear—Method 1 with the intrinsic pitch cone—view from above.

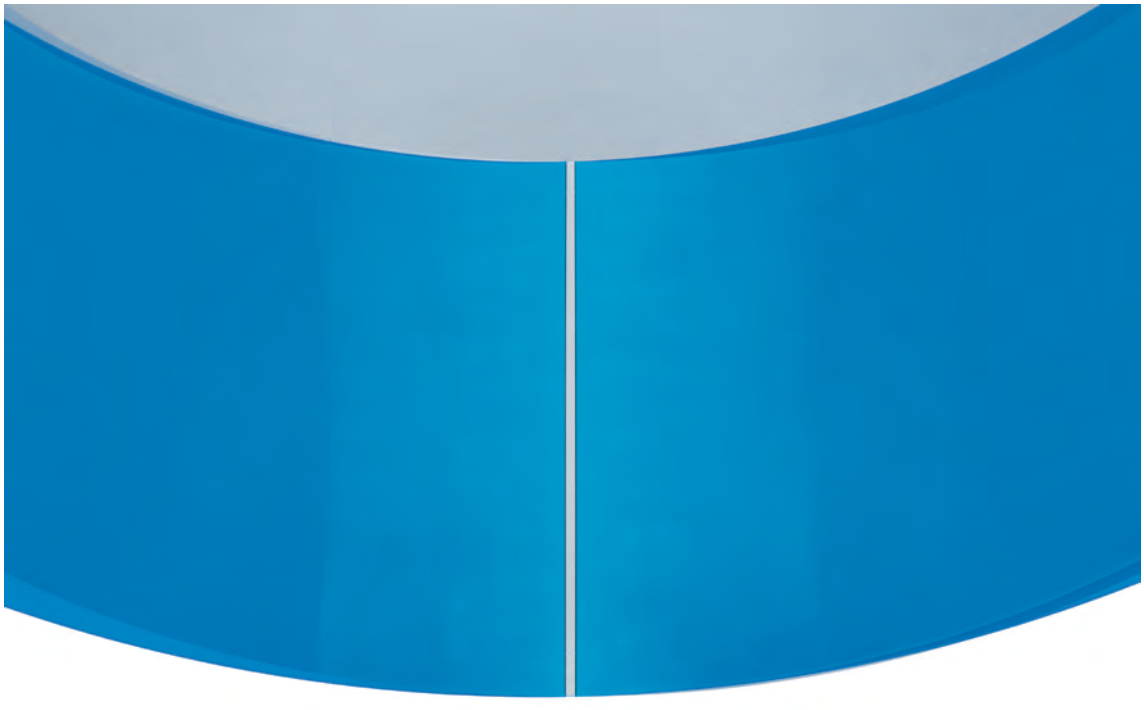

Figure 9—Hypoid gear and its crown gear—Method 1 with the intrinsic pitch cone—view from above.

Examination of Figures 6–9 reveals that the cones intersect along a curve and that the edges on both ends of the cones concur with that curve. Therefore, the cones are situated in a one-and-only arrangement, and any movement of one in relation to the other would diverge the intersections. The only degree of freedom left is a rotation around an axis passing through the points of intersection on both ends. However, any additional rotation of such would alter the offset and the mounting distances.

The cones are not tangent to each other as in the case of non-offset bevel gears; instead, they intersect at a small angle. As a result, a thin contact line (Figures 2–3) is replaced with a stripe (Figures 6–9). In this example, those cone interaction stripes are located left from the curve of intersection of the cones. No information about such a phenomenon has been found in the literature.

The cone interaction stripes tend to be wider in the middle of their length, which can be best seen in Figure 8. This is explained by the aforementioned simplification of hyperboloid shapes by replacing them with cones. As the cone angles get bigger, the cones tend to differ less from the corresponding hyperboloid shapes; therefore, the cone interaction stripes get more uniform in width (Figures 7 and 9).

In Figure 8, the pinion axis is positioned right in relation to the crown gear center; therefore, the back cone of the pinion protrudes out of the crown gear also on the right side. The gear in Figure 7 is also set off to the right. However, when the gear set is brought to its operational arrangement, one of the members will be turned upside down to face the other member. Then, both the member offsets will add up to the total operational offset in the gear set. In the case of the gear set based on non-intrinsic pitch cones (Figures 4 and 5), the members are set off in opposite directions. Therefore, to achieve the specified operational offset, the pinion must generate an offset bigger than specified, and the gear offset is subtracted from it.

Figure 10 shows an axial section of a hypoid pinion based on data from Table 1 but with the intrinsic pitch cone δ_1=20.239 degrees. The original geometry with non-intrinsic pitch cone is drawn in pink. The pinions are positioned in their mounting distance MD; the center of the mating hypoid gear is marked with a circle. The pitch cones intersect in the middle of the face width. To visualize differences between topographies of flanks based on the intrinsic and non-intrinsic pitch cones, Oktoida's spiral bevel and hypoid gear calculation software was utilized to calculate flank

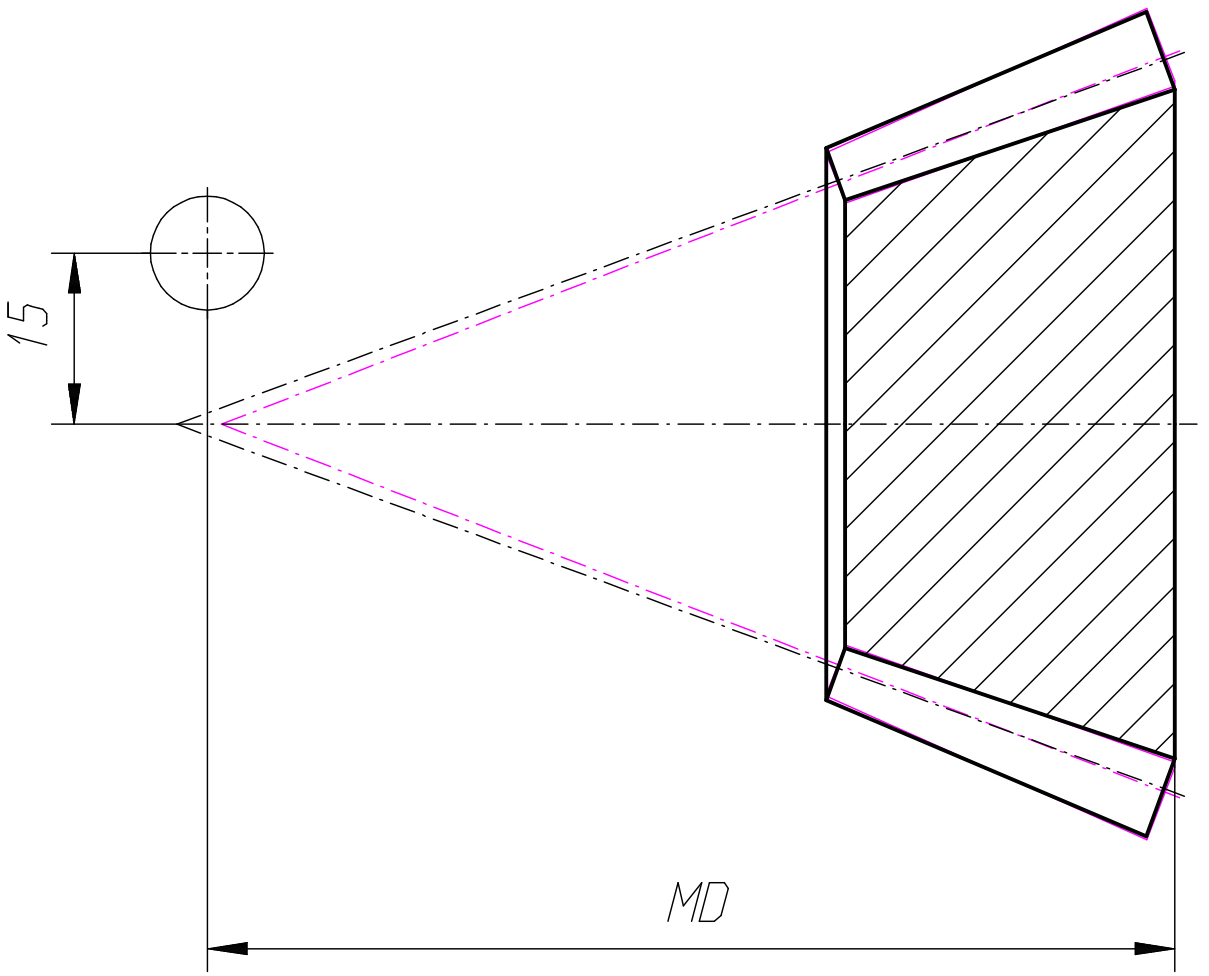

Figure 10—Hypoid pinion—Comparison of the intrinsic and non-intrinsic pitch cone-based geometries—Method 1.

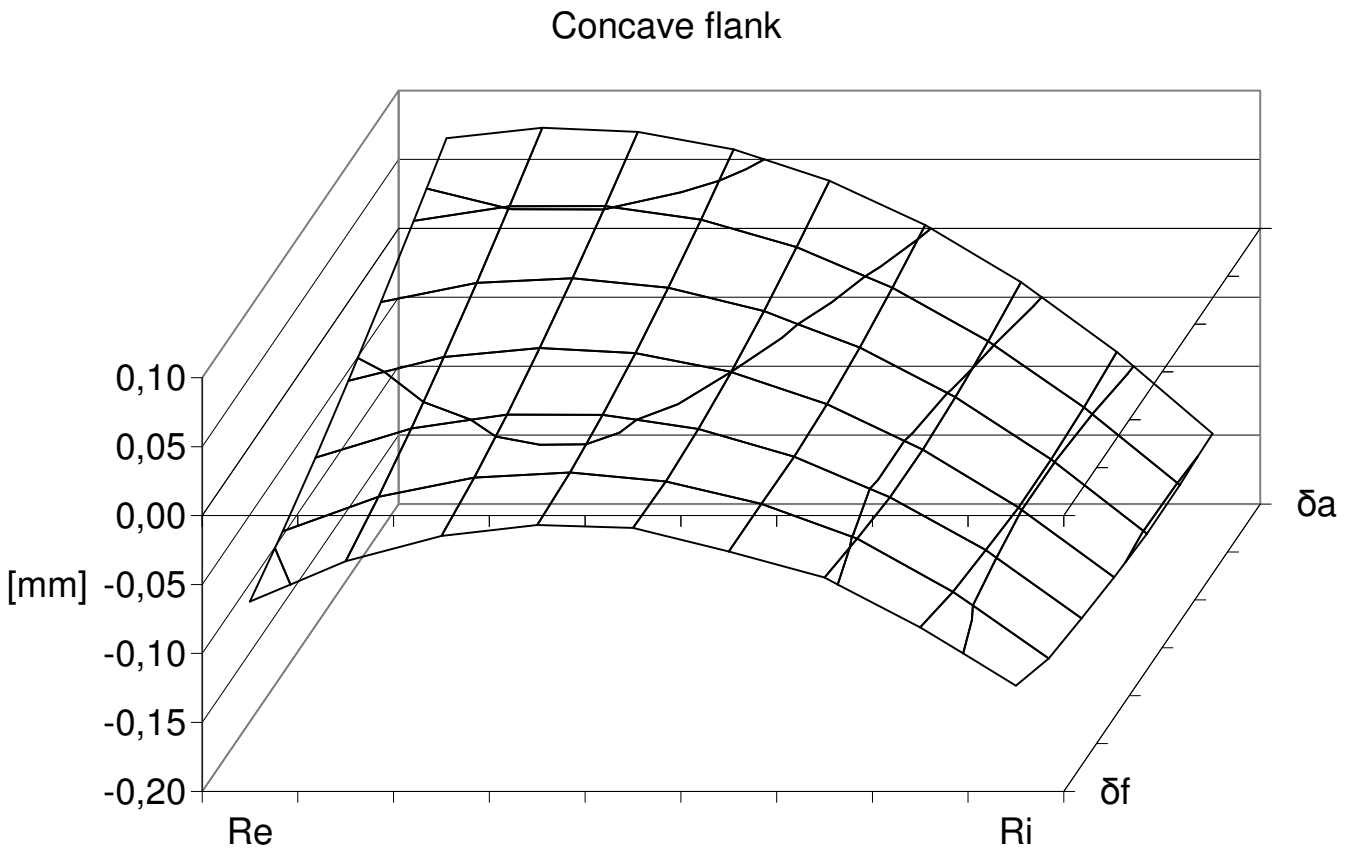

Figure 11—Hypoid pinion—Differences between the intrinsic and non-intrinsic pitch cone-based flank topographies—Method 1—Concave flank.

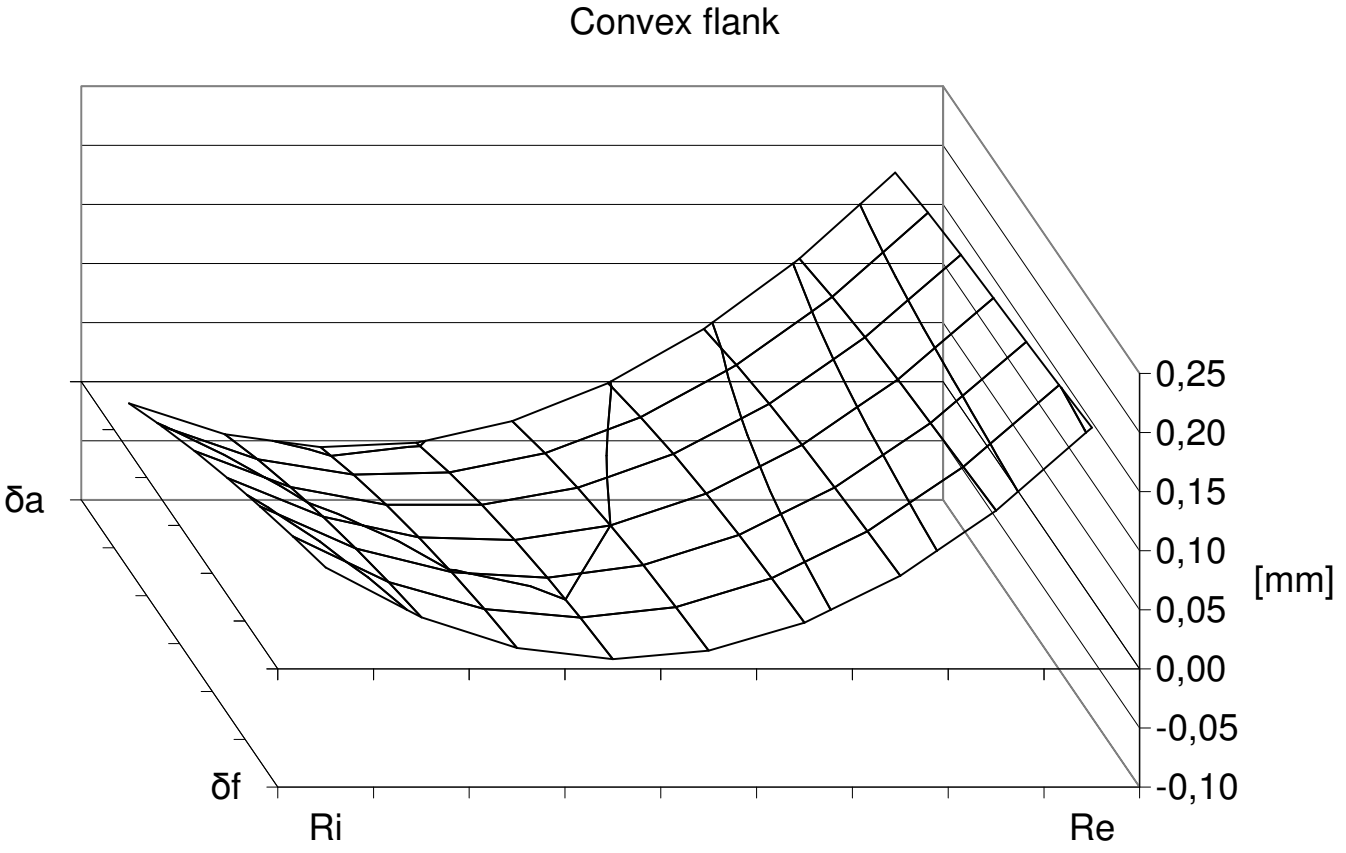

Figure 12—Hypoid pinion—Differences between the intrinsic and non-intrinsic pitch cone-based flank topographies—Method 1—Convex flank.

point clouds along with corresponding normal vectors. In that software, clouds and vectors can be calculated in theoretical or technological mode. In the latter case, calculations are based on technology-related parameters, like exact specifications of face milling cutters that will be used to cut the gears or machining kinematics. As such parameters are typically evaluated in a later stage of technology development, the clouds and vectors in this example were calculated in the theoretical mode, and the results were used to create graphs in Figures 11 and 12. The magnitudes of these flank topography differences reveal their potentially significant influence on gear's operation.

For a basic crown gear deviating from a planar one by 1 degree, the intrinsic pitch cone angles in this example were calculated δ_1=20.275 degrees and δ_2=69.352 degrees. It indicates that the basic crown gear's pitch angle has only a minor influence on the resulting intrinsic pitch angle in a gear. Due to the fact that the basic crown gear's pitch angle is a technology-related parameter that might remain undefined at the gear macrogeometry design stage, I propose to always use a planar crown gear (with δ_0=90 degrees) in calculations of the intrinsic pitch cones.

The intrinsic pitch cone angles of two remaining sample hypoid gear sets Method 2 and Method 3 from Ref. 3 were calculated, and the results are shown in Table 2.

Parameter	Symbol	Unit	Value	
			Method 2	Method 3
Shaft angle	Σ	°	90	90
Hypoid offset	A	mm	31.75	40
Number of teeth, pinion	z_1	-	9	12
Number of teeth, gear	z_2	-	34	49
Outer pitch diameter, gear	d_{e2}	mm	169.91	400
Face width, gear	b_2	mm	26	60
Mean spiral angle, pinion	β_{m1}	°	44.99	42.922
Outer addendum, pinion	h_{ae1}	mm	5.840	7.278
Outer addendum, gear	h_{ae2}	mm	2.215	4.852
Calculated intrinsic pitch cone angle, pinion	δ_1	°	17.696	15.762
Calculated intrinsic pitch cone angle, gear	δ_2	°	70.729	73.848

Table 2—Two further sample hypoid gear sets from Ref. 3—Input parameters and calculation results.

Conclusion

The pitch cone is one of the fundamental concepts in bevel gear design and manufacture, having considerable influence on gear geometry and operation. In the case of hypoid gears, for each gear set one unique pitch cone configuration can be found that exhibits symmetries similar to those existing in non-offset gears. The calculation of these cones is based on macrogeometry parameters with the spiral angle (or, in the general case, the lead angle) β_m additionally included in the input data set. This intrinsic pitch cone concept has been proven in the field, being used by default in the spiral bevel and hypoid gear calculation software that has been utilized in Oktoida for over 15 years.

Dr.-Ing. Igor Zarębski is the director at Oktoida. His main interests are gear calculation methods, including cylindrical gears, straight and spiral bevel gears, hypoid gears, worm gears, non-circular gears, skew-axis and face gears, as well as gear tools—hobs, shaper cutters and milling cutters.

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6. Oktoida is a company based in Poland that manufactures gears and gear units.

In Memoriam: Dennis Gimpert 1948–2025

With heavy hearts, we share the passing of Dennis Gimpert on August 29, 2025. Dennis devoted his life to serving the gear industry and the people who make it what it is today. He began his career in 1972 at Barber-Colman as an applications engineer and later joined American Pfauter as an applications engineer and regional sales manager. In 1988, he partnered with the Koepfer family to found Koepfer America in South Elgin, IL, bringing modern automation plus hands-on application and manufacturing support to North American gear shops.

He was always guided by his customers, so he focused on practical solutions that make innovation possible and enable gear manufacturers to compete and contribute globally. His leadership extended across the industry. Dennis served as chairman of the American Gear Manufacturers Association in 2008–2009, then chaired the AGMA Foundation from 2011 to 2014, helping strengthen the organization and expand scholarship programs for the next generation. In 2015, AGMA recognized him with its Lifetime Achievement Award for decades of service, mentorship, and advocacy.

In 2019, Dennis stepped back from day-to-day responsibilities and then formally retired in 2023 at the Motion + Power Technology Expo in Detroit.

Dennis will be remembered for his kind heart, quick wit and steady presence. Whether it was through his work, his friendships, or the countless small acts of love he offered every day, he touched the lives of many and left an indelible mark on all who knew him. He had a way of making everyone feel seen, valued, and cared for.

Outside of his family, Dennis enjoyed flying, music and wine. He found fulfillment in tinkering in the garage, playing his guitar on the lanai, cooking his infamous jambalaya, and boating, leaving behind memories that will be cherished forever.

In lieu of flowers and physical gifts, a donation may be made to the Lustgarten Foundation for pancreatic cancer research:

events.lustgarten.org/fundraiser/6608155

Piselli Enterprises

CELEBRATES "GIVE BACK" PROGRAM FOR AGMA FOUNDATION SCHOLARSHIP FUND

During Rich Piselli's tenure with the AGMA Foundation, the president of Piselli Enterprises, Inc. dedicated his efforts to enhancing the scholarship program. "I wanted to give back to the gear industry because there weren't many young people entering it, and I understood the financial burden of college. Our aim was to support the next generation of gear engineers and keep them on track," he explained.

Years later, Piselli continues to support the AGMA Foundation Student Scholarship Fund through his company's own "Give Back" initiative program. As of 2025, "Give Back" contributes two percent of every qualifying in-stock gear equipment purchase to the scholarship fund. To date, over $855,000 in eligible gear machine sales has resulted in more than $21,000 in scholarship money. The initiative applies exclusively to qualifying in-stock machines that are wholly owned by Piselli Enterprises and sold to AGMA members.

"My objective this year is to reach $50,000 and encourage other stakeholders in the gear community to participate as well," Piselli stated. "Every contribution aids these students, as their financial situations can vary greatly. Ultimately, we aim to generate greater interest in the scholarship fund—perhaps reaching $200,000 annually in the future," he added.

Piselli Enterprises, Inc. ranks among the largest dealers of used gear cutting equipment. Based in Statesville, NC, the company provides high-quality gear equipment and industry-wide support for gear, spline and gearbox projects. As the founder of multiple manufacturing firms, Piselli has built a significant presence in machinery sales, becoming one of the largest dealers globally.

He's also a strong advocate for involvement in AGMA programs and contributions to the AGMA Foundation. "Whether at the Annual Meeting or the Strategic Networking and Leadership Forum, there are always opportunities to engage more deeply in the gear industry and help prepare the next generation of skilled workers," he emphasized.

The emergence of AI has introduced a complex dynamic in society. "The world is evolving," Piselli said. "Fewer individuals are engaging in manufacturing; many believe they can rely solely on a few clicks to find solutions. We aim to demonstrate the significant value a career in gear manufacturing offers to high school and college students."

For decades, the challenge of filling new positions in gear manufacturing has affected the industry. The focus must shift to authentic, real-world problem-solving and illustrating how these students can make an immediate difference in their communities.

"You need to motivate the next generation. It's essential to spark their interest in manufacturing and engineering,"

Piselli asserted. "We need to advocate that these are prestigious careers. Although they are often viewed as less desirable compared to banking or investment roles, these positions will be crucial moving forward—things must be built, produced, used and repaired. This is the essence of our industry."

To stay updated on the "Give Back" program and view the latest donation figures along with the gear companies supporting Piselli's scholarship initiatives, visit

piselli.com/give-back-scholarship-drive

DN Solutions

ACQUIRES GERMAN HIGH-END MACHINE TOOL MANUFACTURER HELLER

DN Solutions recently signed an agreement to acquire Heller Group, a German cutting-edge machine tool manufacturer. Heller, founded in 1894, is a 130-year-old company recognized for its world-class machining center technology, specializing in demanding, high-precision processes.

Once the integration is complete, DN Solutions' consolidated sales are expected to approach $2.3 billion USD.

On August 26th, Won-jong Kim, CEO of DN Solutions, met with the Heller family, the largest shareholder of Heller Holding SE & Co. KGaA in Nürtingen, Germany, and signed a contract to acquire all its shares.

With this deal, DN Solutions will gain Heller's world-class machining center technology, developed over more than 130 years. This integration will broaden DN Solutions' portfolio and strengthen its position as a top-tier brand in the global machine tool market.

By combining their production networks, the two companies will become an even stronger global partner for customers. Heller operates five major plants in Germany, the UK, the U.S., Brazil, and China, while DN Solutions runs facilities in Korea and China and is constructing a new plant in India.

This global production footprint will provide both companies with the flexibility to respond effectively to regional demand shifts, supply chain dynamics, and trade policy changes. In particular, the U.S. plant is expected to act as an effective safeguard against the impact of recent changes in U.S. tariff policies.

With more than 130 years of experience in the machine tool industry and a broad installation base, Heller brings deep customer service expertise and resources. This will serve as a catalyst for DN Solutions' ongoing innovation in pursuit of service excellence.

Heller also has an extensive track record of working with leading global companies in the automotive, aerospace, and defense industries—sectors that demand the highest levels of technological capability. This experience will enable DN Solutions to gain stronger insights into key customer industries.

For Heller, DN Solutions provides financial stability and synergy through its strong capital base, global sales network, and broad product portfolio. Together, the two companies expect to achieve stronger sales, greater cost competitiveness through economies of scale, and improved profitability.

DN Solutions CEO Won-Jong Kim said: "DN Solutions has been competing on the global stage. By combining our strengths with Heller's 130 years of expertise in machining centers, this partnership will deliver groundbreaking innovations to the manufacturing industry. Furthermore, the two companies will offer unique value to customers and reinforce their position as a high-end brand in the global machine tool market."

Heller CEO Dr. Thorsten Schmidt said: "This partnership gives us the opportunity to accelerate innovation and expand our global reach. By uniting Heller's process expertise with DN Solutions' strong resources and fast-moving spirit, we will set new standards for the machine tool industry."

dn-solutions.com

Stäubli

APPOINTS ADRIEN BROUILLARD AS EXECUTIVE PRESIDENT OF ROBOTICS DIVISION

Stäubli has announced the appointment of Adrien Brouillard as executive president of its Robotics division, effective September 5, 2025. Brouillard has successfully served in the role on an interim basis in recent months and will now lead the division's global strategy and operations.

Since joining Stäubli in 2008, Brouillard has held various leadership roles within the Robotics division, most recently serving as global head of business for general industry and customer services and as local robotics director in France. He brings extensive international experience shaped by hands on work with customers and teams worldwide, including a year based in Stäubli's Hangzhou unit in China to deepen market proximity and support the company's strategy in the region.

"Adrien combines deep robotics expertise with a strong track record in execution and customer impact," said Gerald Vogt, CEO of the Stäubli group. "His leadership and international perspective will help accelerate value for our customers and partners in key markets."

"I'm honored to lead Stäubli Robotics and to build on the division's strong foundation," said Brouillard. "Together with our teams worldwide, we will continue to advance reliable, high-performance automation that improves productivity and quality for customers across industries."

Brouillard is a French national and holds a master's degree in Automation

and Electrical Engineering. Fluent in French and English, he has led numerous initiatives focused on organizational effectiveness and growth. His expertise includes business strategy, complex project management and operational excellence—particularly in cross functional, international environments.

staubli.com

MPMA

ADDS LANCE BROWN AS FIRST SENIOR TECHNICAL INSTRUCTOR

The Motion + Power Manufacturers Alliance (MPMA) is pleased to announce that power transmission engineer Lance Brown will join the organization as its first senior technical instructor. Brown spent his entire 28-year career with CGI, Inc, recently purchased by The Timken Company. Brown will both instruct industry professionals on a variety of gearing and bearing classes, and also develop intellectual property for the Alliance.

"MPMA is thrilled to have Lance join the organization as we expand our capabilities across a wide range of power transmission topics," noted Matthew E. Croson, president of MPMA. "His expertise will allow MPMA to broaden our focus to new education topics and meet the growing demand for in-plant training classes."

In addition to being a long-time engineer at one of MPMA's most respected companies, Brown has been an instructor for MPMA's Gear Failure Analysis class, and was a member of the Technical Division Executive Committee, which oversees the development of AGMA, ABMA and ISO standards.

"I am excited about this new opportunity to give back to the sector, while learning new things at a respected organization like MPMA," noted Brown. "I have so much respect for the technical precision of MPMA's legacy classes and the incredible line up of subject matter experts who deliver the training, with real world examples. It will be great to be part of the team."

Brown joined the team on October 1, 2025 and will telework from his Reno, NV home base. He will be part of the MPMA Business Division, working directly with Senior Director of Education and Events, Leah Lewis.

Since 2016, MPMA has doubled the size and scope of classes and education capabilities. With 35+ classes covering all facets of the mechanical power transmission, the MPMA Education Team supports one of the primary challenges facing the industry: highly trained employees. Adding a full-time technical instructor will allow MPMA to continue to grow and develop curriculum designed to train the next generation of power transmission professionals.

"MPMA's educational programming bridges the gap left by both college and technical school training," adds Lewis. "While they cover the basics, we take it further, with courses focused on design, production, failure analysis, covering bearings and gears. Having Lance on board will bring fresh value and momentum as we work to secure the future of our industry's workforce."

agma.org

ANCA

UNVEILS LATEST SUSTAINABILITY STRATEGY

ANCA has launched its inaugural Sustainability Strategy 2025–2030, a bold and transformative roadmap that embeds environmental responsibility, innovation, and community impact at the core of its operations. Designed with the same engineering precision that has defined ANCA for over 50 years, this strategy represents a shift in how the company is shaping the future of advanced manufacturing.

"Sustainability is not a finish line—it's a commitment to evolving how we think, design, and operate," said Martin U. Ripple, CEO of ANCA Group. "As engineers, we know progress is built on deliberate, smart steps. We're proud to take this next step in our journey by integrating sustainability into every layer of our business."

As part of its environmental commitments, ANCA has aligned its climate goals with the Science Based Targets initiative (SBTi)—a globally recognized framework that helps businesses reduce greenhouse gas (GHG) emissions in line with the latest climate science and the goals of the Paris Agreement.

ANCA has committed to reducing absolute Scope 1 and 2 GHG emissions by 42 percent by 2030 from a 2023 baseline, and to cutting Scope 3 emissions by 25 percent in the same timeframe.

The SBTi alignment demonstrates ANCA's dedication to ambitious, science-driven climate action. Emissions reductions will be achieved through a combination of energy efficiency improvements, adoption of renewable energy, and collaboration across the supply chain.

"Innovation is our DNA," Ripple said. "Our strategy ensures that every breakthrough doesn't just drive performance—it delivers lasting environmental and social benefit."

"In our business, microns matter. That same level of precision guides our sustainability approach," Ripple added. "Every reduction in emissions, every recycled part, every skill developed—it all adds up. Together, with our employees, customers, and partners, we're not just keeping up with change—we're driving it."

machines.anca.com

OCTOBER 12–14

Women in Manufacturing Summit

Manufacturing is evolving rapidly, creating new opportunities for workers to lead, innovate, and make an impact. From emerging technologies to manufacturing workforce initiatives, these advancements are opening doors for career growth, leadership, and industry transformation. Join four dynamic women in Chicago as they share pivotal moments, the challenges that shaped their careers, and the strategies that helped them thrive. This session will provide tactical, actionable insights to help attendees advance their careers, build strong networks, and contribute to a more globally competitive manufacturing industry. Key topics include aligning career goals with personal aspirations, building collaborations, and leveraging the federally designated Manufacturing USA network of national manufacturing innovation institutes to access cutting-edge skills and opportunities.

geartechnology.com/events/women-in-manufacturing-summit

OCTOBER 21–23

Motion + Power Technology Expo 2025

Produced by AGMA, Motion + Power Technology Expo (Detroit) is a three-day show that connects professionals looking for motion power solutions with manufacturers, suppliers, and buyers. Attendees will find new power transmission parts, materials, and manufacturing processes. Buy, sell, and get business done with organizations in aerospace, automotive, agricultural, energy, construction and more. Forge partnerships at one of the largest gatherings of CEOs, owners, engineers, sales managers, and other professionals in the electric, fluid, mechanical and gear industries. End-users can shop the latest technology, gear products, and services from leading manufacturers. No matter your industry, you will find new ideas and solutions that can benefit your plant and company. Hundreds of exhibitors and attendees means MPT Expo is a unique opportunity to find partners that can help fulfill your specific production needs.

geartechnology.com/events/motion-power-technology-expo-2025

OCTOBER 21–23

Southtec 2025

Southtec 2025 (Greenville, SC) draws manufacturing suppliers, distributors, and equipment builders from across North America and around the world. With hundreds of exhibiting companies, attendees can find all the latest technologies and services – plus the experts who build them—ready to demonstrate solutions that can help them grow their business. Visitors can make side-by-side comparisons, discover integrated equipment, hear about industry trends and forecasts and leverage their purchasing power. Explore more than 300 exhibits featuring areas such as automation, robotics, smart manufacturing, precision machining, software solutions, and industrial IoT.

geartechnology.com/events/southtec-2025

OCTOBER 29–30

Advanced Engineering UK 2025

Advanced Engineering (Birmingham, UK) showcases how manufacturing products and solutions meet capability challenges, enhance manufacturing processes and help companies stay at the forefront of industry trends. In 2025, buyers and procurement teams, decision-makers, R&D and directors from leading OEMs, Tier 1 & Tier 2 companies will be eager to engage with the latest technologies and manufacturing solutions. The show also raises awareness and fosters collaboration among businesses, educational institutions, associations and the government to develop a skilled workforce capable of driving the UK's manufacturing and engineering sector.

geartechnology.com/events/advanced-engineering

NOVEMBER 25–30

Smart Production Solutions (SPS) Nuremberg

With its unique concept, the SPS 2025 (Nuremberg, Germany) covers the entire spectrum of smart and digital automation – from simple sensors to intelligent solutions, from what is feasible today to the vision of a fully digitalized industrial world. SPS is the highlight event of the automation industry. It is a source of inspiration and a platform for innovation. Topics include control technology, drive systems, components, software, sensors, industrial communication and more. One of the key topics at this year's SPS is the use of artificial intelligence in manufacturing technology. Industrial AI is currently making its way into a wide range of industrial products and processes: supporting process engineering, integrated into control devices via diverse AI models, or as part of intelligent tools for predictive maintenance, quality assurance, and adaptive production control. These technologies are fundamentally transforming automation and unlocking new potential for efficiency, flexibility, and resource conservation.

geartechnology.com/events/smart-production-solutions-sps-nuremberg

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The Pattern of Necessity

Aaron Fagan, Senior Editor

Step into an autumn landscape, and it quickly becomes clear that nature has little regard for tidy rules. Leaves spiral unpredictably, pumpkins swell into odd asymmetries, and apples wrinkle and pucker around their stems. Yet engineers have long clung to the comforting principle that form follows function, as if everything were designed purely to serve its purpose without deviation. Harvard's L. Mahadevan, professor of applied mathematics, physics, and biology, reminds us that this is rarely the case. Through studies of crumpled paper, folding brains, termite architecture, and the trajectories of coins, he shows that what first appears chaotic often obeys a hidden logic—intricate, surprising, and unexpectedly beautiful.

Take the brain. As the cortex grows, it expands faster than the underlying tissue. The result? Compression, then folding. Those wrinkled ridges aren't arbitrary; they increase surface area for processing power. But the exact patterns of folds emerge from a balance of growth, physics, and constraints. The form isn't chosen; it's forced.

The involute tooth form tells a similar story. It isn't the product of aesthetic whim but of inevitability. Given the constraints of rotation, rolling contact, and load transfer, the involute emerges as the only workable solution. Much like the folds in a brain, its elegance is less about choice than about necessity.

Or consider termites. Individually, they are simple creatures. Collectively, they build towering mounds that regulate airflow, temperature, and carbon dioxide. No foreman termite draws up blueprints; instead, the mound grows through local feedback loops, with workers responding to humidity and pheromone cues. It's an example of what engineers' term *stigmergy*, where individuals coordinate not by talking but by leaving traces that guide the next action. Out of these simple interactions, grand patterns and complex structures emerge, as if the environment itself were the conductor of a silent orchestra. Function, in this case, doesn't dictate form from the top down, it emerges through interaction.

Sound familiar? A gear is never alone. Its performance depends not just on its tooth form but on assembly, lubrication, housing stiffness, and operating environment. Noise, vibration, and wear emerge not from the tooth itself but from the dance of components working in concert. Like termite mounds, gearboxes are systems where form and function coevolve through feedback.

Mahadevan has even built robotic swarms inspired by termites and ants, machines that, following only simple rules, can construct surprisingly complex outcomes. In the gear industry, we're beginning to see a parallel: AI-driven optimization, where iterative algorithms tweak microgeometry, modify profiles, and adjust materials in search of performance gains. Instead of a master plan, better designs emerge from cycles of feedback and adjustment.

So, what's the lesson for engineers designing quieter, stronger, more reliable gears? Perhaps it's humility. In nature, there is rarely a single correct form. Systems adapt, evolve, and self-organize. Our gear teeth may be involutes out of necessity, but everything around them—their interactions, environments, and feedback loops—remains negotiable. Form and function rarely follow a simple order; like leaves twisting unpredictably in autumn, gears too find their shape through subtle adjustments, emerging over time from a quiet interplay of forces and feedback.

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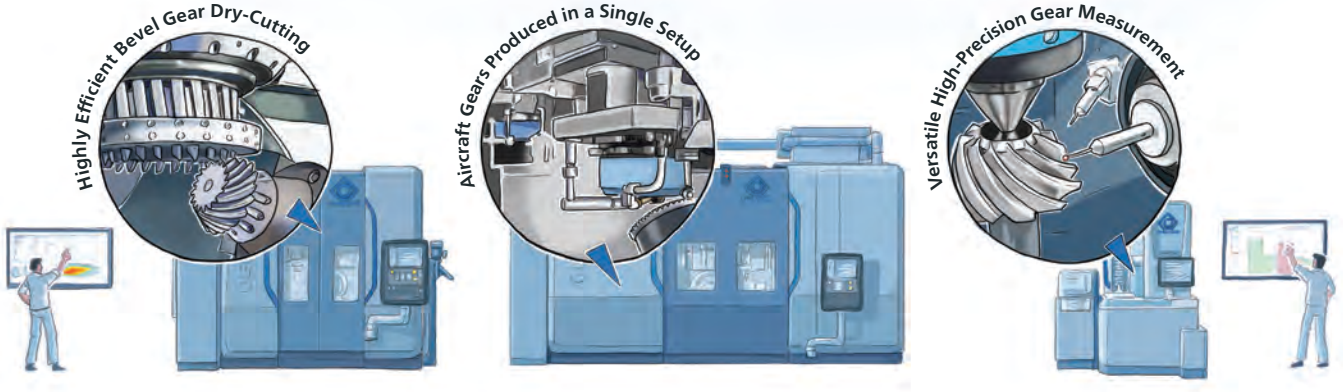
Helicopters are often used in challenging environments and in emergency situations, placing the highest demands on the reliability of the gear transmission. Despite its compact design and low weight, it must efficiently and safely transmit high engine speeds to the rotors, even under extreme loads.



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