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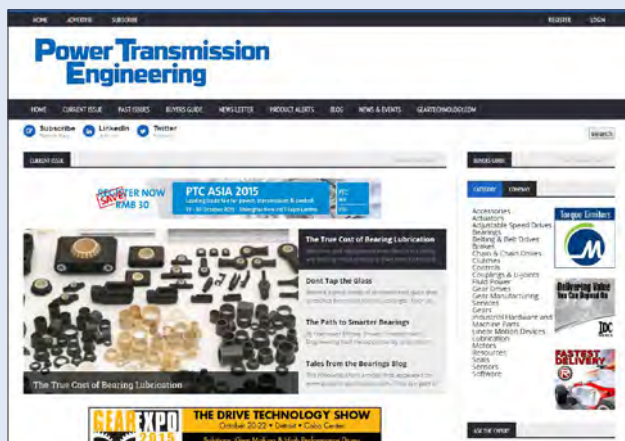
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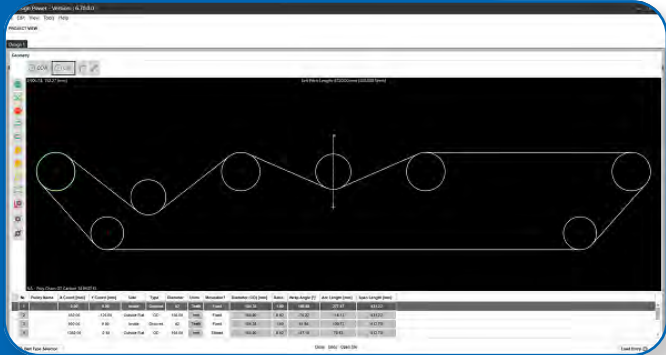
Voith's OnCare.Health monitoring solution includes an easy-to-use system for industrial fan and pump drivetrains. It employs state-of-the-art sensor technology and connected components to increase the system's availability. This allows for easy and reliable monitoring of operating data as well as use in advanced IIoT applications such as predictive maintenance.

powertransmission.com/blogs/1-revolutions/post/8701-data-diagnostics-with-voith



PTE Videos Design IQ with Gates Corporation

This lesson covers the use of Design IQ within Design Power. Design IQ is Gates multipoint belt drive design application. DIQ requires that the user select a Gates product, then allows for a drive design including multiple pulleys with myriad combinations of front bend, back bend, loaded, and unloaded conditions. Design IQ has existed as a standalone application for many years, but it's now a module within our latest software solution, Design Power. All the classic DIQ features remain, and users can now take advantage of Design Power's modern features while working with drives in DIQ.



powertransmission.com/media/videos/play/222

Event Spotlight: WEFTEC 2022

At WEFTEC (New Orleans), the full breadth of the water sector comes together, in one place, for attendees to explore, learn, network, grow professionally, and strengthen their connection to the water community from October 8-12. The show offers water quality education, leading experts and the latest technology and trends. Exhibitors include ABB, Eaton, Emerson, Nidec, WEG and more.

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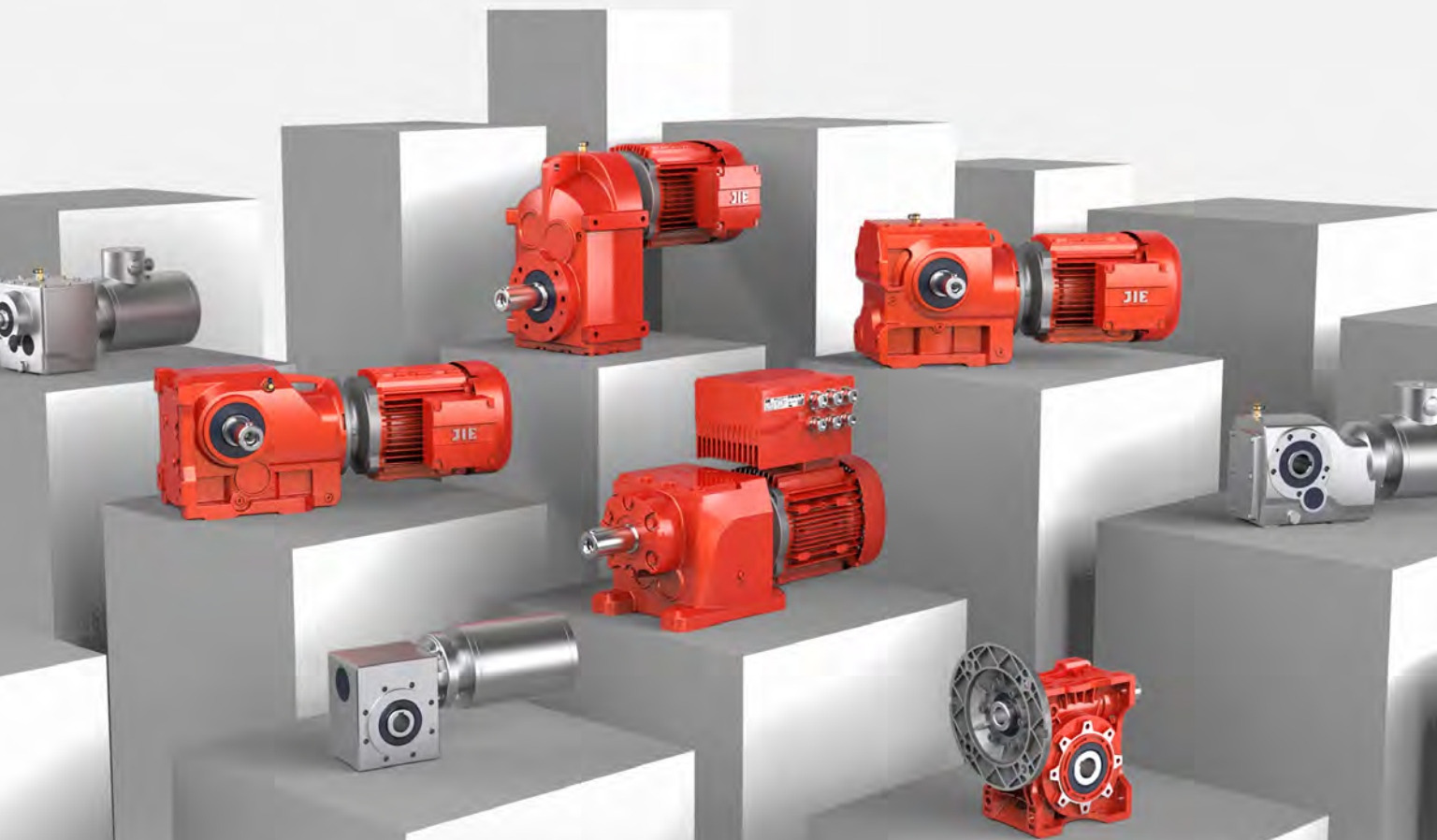
FOUNDER

Michael Goldstein founded Gear Technology in 1984 and Power Transmission Engineering in 2007, and he served as Publisher and Editor-in-Chief from 1984 through 2019. Michael continues working with both magazines in a consulting role and can be reached via e-mail at michael@geartechnology.com.





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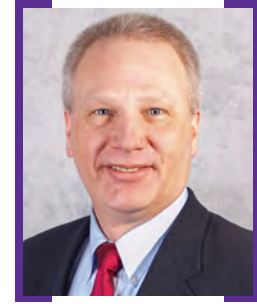


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Are Trade Shows Back?



We're starting to see some encouraging signs of life from the trade show industry.

The Automate 2022 Show and Conference, held June 6–9 in Detroit, celebrated what organizers are calling “the most successful event in its history,” setting new records for registrants (24,000) and exhibit booths (600). For the first time in a long time, our editors and staff attended a busy show full of excitement, commerce and new technology. Even better, the show organizer, the Association for Advancing Automation (A3), already expects next year’s show to be even bigger (for more information, see our coverage on p. 50).

It would be easy to call that particular show an outlier, but we’ve heard of others, too. MODEX, the supply chain-oriented show sponsored by the Material Handling Institute, was held in Atlanta in April. MHI reported significant attendance gains, more than 20% above their last pre-pandemic show in 2018.

I’ll answer the question. Trade shows are back.

And it’s not just trade shows, either. Classes and other in-person events are also seeing an uptick.

Here at AGMA, we’re seeing a lot of progress. Some of AGMA’s classes have begun selling out, including the popular Gearbox CSI and Gear Failure Analysis classes.

“The benefits of attending a program in person are stronger than ever, as AGMA’s members are looking to connect and network with the peers after two years of virtual meetings. Our education programs have rebounded well, with advanced engineering courses, such as the Gear Failure Analysis program, selling out regularly,” said Jenny Blackford, VP of AGMA’s Business Division.

It would seem that there’s a lot of pent-up demand—not just to get out and about, but also to gather the vital information you need to be successful in your jobs. If you’re like most of industrial America, you’re tired of sitting in front of a computer. You have projects that need to be implemented. You have new employees that need to get caught up. You have professional relationships you need to build or nurture.

If any of that sounds like you, I have a few ideas:

1) Step out and get to some trade shows. For example, how about IMTS and Hannover Messe USA, which take place September 12–17 at McCormick Place in Chicago? You can learn what to expect from those shows by reading our article on page 22. We’ll be there in Booth #237314 in the

North Hall, and we hope to see many of you there!

2) Sign up to attend a top-notch technical event, like the AGMA Fall Technical Meeting. The FTM takes place October 17–19 in Chicago. Each year, 30 authors are selected

by AGMA to write peer-reviewed technical papers on topics relevant to the gear industry. Topics include: design, analysis, manufacturing, quality, materials, metallurgy, heat treatment, operation, maintenance, efficiency, and gear failure. You receive copies of all papers and are able to see all the presentations, ask questions to all the presenters, and network with your peers over three days. Registration is now open, and we’re expecting a great turnout.

3) Sign up or renew your subscription to *Power Transmission Engineering*. Every issue, we bring you much of the technical information you crave, plus lots of ideas about where to find more. Visit (and send your colleagues to) www.powertransmission.com/subscribe2022 to fill out the quick and easy form.

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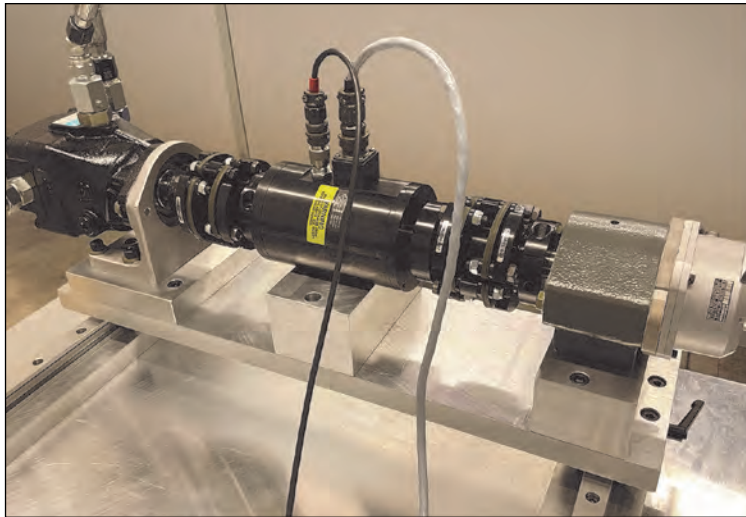
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Torque Transducers and Test Machinery experience extreme demands including high torque loads and high operating speeds which cause stress on connected components. To assure these systems generate accurate test data when experiencing these conditions, system designers specify CD Couplings from Zero-Max.

Utilizing Zero-Max's proprietary Composite Disc-Pack (CD), CD Couplings are unique in design and provide the ideal combination of operating characteristics that improve the accuracy of torque measurements. The key characteristics of the Composite Disc design are: (1) high torque capacity, (2) high torsional stiffness, and (3) low reaction loads under misalignment. Following are the coupling's operating features:

- CD Couplings provide the high torque capacity needed for torque transducers. They can be sized to the required torque for a specific test. Or the coupling can be sized to the overload capacity of the torque transducer so the transducer and test equipment can be re-purposed for other testing.
- CD Couplings provide the needed high torsional stiffness

so that accurate position and torque readings can be obtained. High torsional stiffness is especially important for tests that involve rapid speed and/or direction changes.

- CD Couplings include a unique open-arm disc pack design that increases misalignment capacity and minimizes any reaction loads imparted to the torque transducer and connected test components under misalignment. Low reaction loads are important since torque transducers, by design, have reaction load limitations. This coupling feature ensures accurate and precise test readings.
- To handle high test speed applications and avoid resonance, CD couplings may be dynamically balanced.

CD Couplings designed for Torque Transducer and Test Machinery applications may be custom designed to the specific needs of the test machine and can be adapted to shaft-mount or flange-mount transducers. Zero-Max offers engineering services and decades of experience to help ensure the ideal design. Popular options include in-house dynamic balancing capabilities and a complete selection of shaft tolerances and shaft connections including keyless, keyed, splined, and other shaft designs.

zero-max.com

Lenze

OFFERS NEW GENERATION OF FREQUENCY INVERTERS

Increasing demands for energy efficiency and plant transparency are presenting industry with continuous new challenges. Automation specialist Lenze is offering an intelligent, cost- and energy-efficient solution with its decentralized frequency inverters i-series motec. The main beneficiaries will be machine builders and operators from material handling and logistics, automotive, and consumer goods industries.

The increasing digitalization of industry is taking on a key role. Peter Blatter, head of product management inverters at Lenze, said, "Digitalization widens the scope for sustainable innovations in drive technology. In the i550 and i650 motec frequency inverters, we use intelligent technologies and comprehensive connectivity. This opens up new horizons for efficient production processes."

With its digital functions, the frequency inverter takes on several tasks at once. It acts as an efficient sensor in the system, collecting data and reliably forwarding it to IIoT platforms and higher-level edge systems in a standardized format. The connectivity of the motec accelerates and facilitates ongoing production processes. This is due to the Drives DataHub software provided by Lenze, which enables direct access to important drive data

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via numerous communication interfaces. In particular, the integrated IO-Link master provides machine operators with high-quality information about the drive technology. The sensor data analyzed in real-time paves the way for condition monitoring and predictive maintenance. “This gives customers a comprehensive overview of the condition of their machine, enables them to plan service and maintenance actions in advance, and thus saves time and money,” said Blatter.

Before and during commissioning, the decentralized frequency inverter makes an essential contribution to an improved value chain, because important product data can be viewed at any time. The digital nameplate supports asset management standards and can be read via smartphone, or directly via the frequency inverter. This gives machine operators quick and easy access to relevant data such as product code, CAD files, and spare parts information.

An important lever for saving energy is the motec's integrated regenerative unit. Machine operators can rest assured that regenerative energy is not lost in brake resistors, as the unit feeds it back into the grid automatically and

without additional hardware costs. In addition, the inverter controls synchronous motors completely without sensors. The compact drive package consisting of gearbox, motor, and inverter proves to be particularly energy efficient. In combination, the three components ensure a minimal CO₂ footprint for the application. The savings are particularly evident in material handling and logistics because conveyor lines can be several miles long with thousands of drives in use—and that adds up.

In addition, functions such as “VFC eco” and “PROFIenergy” improve the energy balance of the system. In addition, if Lenze’s EASY System Designer is used, an optimal design of the system is guaranteed. The intelligent software avoids oversizing and leads to energy savings of up to 30 percent compared to previous designs.

The frequency inverter’s connectivity supports the entire system and, thanks to new pluggable M12 push-pull cable technology, simplifies the process chain right from the start. Blatter said, “There is no way to connect an inverter faster and more reliably.” Power-free parameterization,

simple menu navigation, and practical factory settings are other notable features that make commissioning easier.

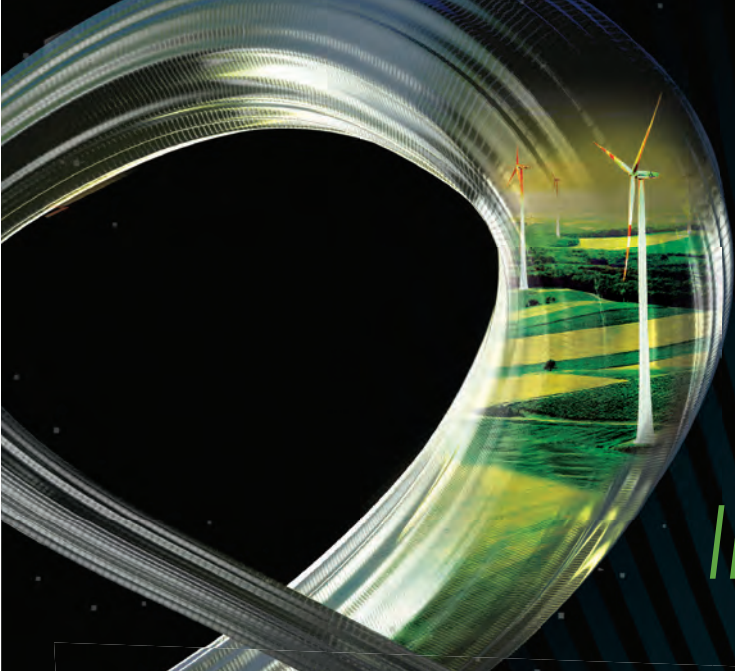
With integrated positioning, the motec additionally masters dynamic motion control that previously only a servo inverter could fulfill. This opens new applications for the inverter, creating further potential for cost savings. In addition, scalable, integrated safety levels from “STO” to “Extended Safety” with functions such as “SLS” to “Safety over Ethernet” lead to comprehensive protection of the machine and guarantee constant productivity. “All in all, our customers have the option of solving decentralized safety applications without sensors, quickly and in a space-saving manner,” Blatter added.

lenze.com

Bosch Rexroth

INTRODUCES GEARBOXES FOR ELECTRIC MOTORS

As part of its new, extensive eLION platform for the electrification of mobile working machines, Bosch Rexroth has developed spur gearboxes which vehicle manufacturers can use to unlock the full potential of



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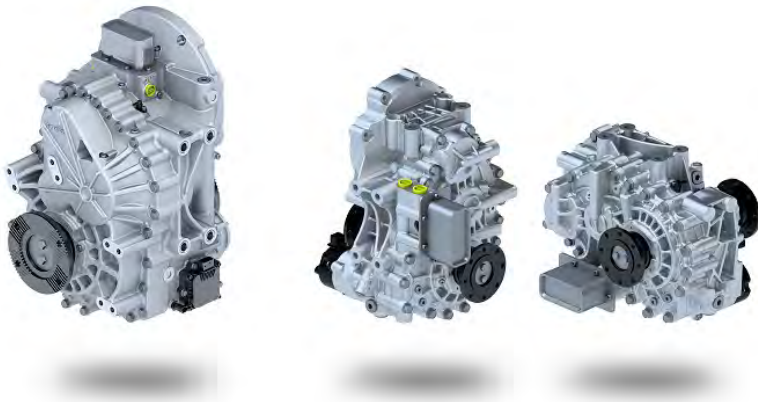
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new electric motors. The one and two-speed gearboxes are installed in the central section of the vehicle and pool the energy to drive up to two axles with just one motor. The clever integration of essential components is evidence of the wealth of practical know-how that was drawn on throughout the development process.

The off-highway market is constantly evolving. Mobile working machines are becoming increasingly efficient. At the same time, exhaust gas and noise emissions need to be reduced. Machine manufacturers from all sectors recognize that electric drives are an important building block for a future-viable, sustainable product portfolio. To support and drive the electrification of off-highway machines, Bosch Rexroth has developed the first two axle drives designed especially for electric motors.

The 1-speed spur gearbox (eGFZ 9100) and the 2-speed shift gearbox (eGFZ 9200) are installed in the central section of the vehicle and therefore open up a range of new options compared to previous approaches with individual wheel drives. Both gearboxes enable high power densities to be achieved while simultaneously ensuring noise optimization for high-speed electric motors such as the Rexroth EMS1H and the Bosch SMG, but also for motors of other manufacturers with similar power.

Permanent-magnet synchronous motors are famed for being compact and highly efficient. However, their high rotational speeds present real challenges in terms of noise emissions, temperature, impermeability, and splines. The eGFZ 9100 and the eGFZ 9200 have been specially developed for these applications. They also

or both vehicle's axles. For all-wheel drive, there is also the option to connect or disconnect an axle. A lockable center differential is also provided for permanent all-wheel drive.

When integrating the gearboxes into the installation space available and into the machine concept, Bosch Rexroth drew on the knowledge and experience gained from fulfilling requirements for previous drives. Gearboxes not only have to be compact and reliable but also easy to integrate. While the 1-speed gearbox (eGFZ 9100) can be installed horizontally or vertically depending on the relevant requirements, both Rexroth series feature a Plug and Drive system. Components such as the heat exchanger and oil pump available in the gearboxes enable both gearboxes to be seamlessly integrated into the existing cooling circuit of the electric drive. Even the sensors for monitoring functions are already integrated into the gearboxes and can be adapted to suit a wide variety of applications using a range of different options. Machine manufacturers pursue different strategies in terms of voltage supply and battery storage requirements. To ensure that the installation space within the frame of the vehicle can always be optimally utilized, the eGFZ gearboxes with DIN ISO-compliant flange types enable a diverse range of drive solutions to be achieved. These can be executed in two-wheel drive as a U-shape or S-shape gearbox version and in four-wheel drive as a Z-shape version.

Company-wide knowledge of telehandlers, wheeled loaders, and municipal machinery as well as tractors and reach stackers was pooled at the start of the development process to

determine which of these drives could be driven electrically and centrally in the future—and with which load collectives. The new eGFZ gearboxes were developed and optimized based on this set of requirements. Bosch Rexroth now intends to work alongside its customers to determine the best solution for each specific application. The eGFZ 9100 and eGFZ 9200, which are currently being used in different pilot projects, will go into series production in 2022 as part of eLION. Rexroth's platform for the electrification of mobile working machines covers the full range of electric motor-generators, inverters, and accessories as well as tailored gearboxes, hydraulics and software.

boschrexroth.com/en/us

Siemens Digital Industries Software

RELEASES LATEST VERSION OF NX

Siemens Digital Industries Software recently announced that the latest release of Siemens' NX software brings greater electronic co-design, collaboration, and intelligence capture and reuse capability. These empower engineering executives across every industry to find productivity improvements and greater efficiencies in their engineering departments.

"Innovators and pioneers, from clean-sheet start-ups to household name brands, are adopting NX and choosing us as a trusted partner, as we explore the future of design, engineering and manufacturing together," said Bob Haubrock, senior vice president, product engineering software, Siemens. "This latest release brings enhancements to our users across the board, enabling them to work more intelligently between multidisciplinary teams, capture and reuse more knowledge and achieve that optimum design more efficiently than ever before. Alongside brand-new functionality, our significant investments to core technologies, such as sketch and convergent modeling, will further improve the toolsets that our community of users relies on every day."

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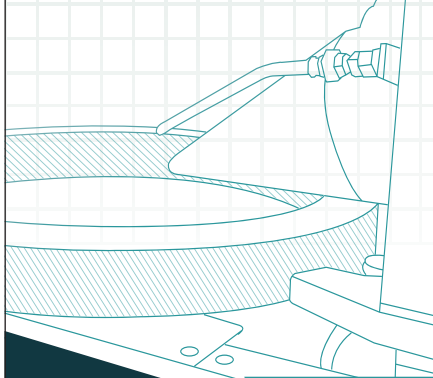
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The latest release of Siemens' NX brings new collaborative tools for mechanical/electronic teams, greater knowledge capture and reuse, and more holistic optimization along with a number of extensions to existing capabilities.

Part of the Siemens *Xcelerator* portfolio of software and services, NX delivers productivity and user-experience enhancements across a broad range of capabilities.

Leveraging leadership and expertise in the electronics/electrical engineering space with Siemens EDA (formerly Mentor Graphics), NX extends its electronic design collaboration capabilities further with a robust workflow for rigid and rigid-flex PCB designs. These are especially important given increased product complexity and packaging constraints.

Users will notice a new codeless approach to Feature Templates that enables the reuse of the knowledge embedded into NX data during design. This elevates user-defined features to the next level, extending data reuse from pure parametric geometry features to include PMI, requirements checks and more. The key benefit is a jump start of efficient knowledge reuse and greater collaboration amongst design and engineering teams.

The latest release of NX brings new tools to help develop the forms designers need and their customers demand, whether that's updates to curve creation and editing with parametric features or to *NX Algorithmic Modeling* which better support convergent modeling workflows enabling more efficient ways to complex patterns and shapes.

NX Topology Optimizer now fully replaces and surpasses previous solution capabilities. Part optimization within the context of an assembly now considers design and manufacturing

constraints and makes simultaneous optimization of multiple design spaces with independent materials possible.

The recently introduced *NX Design Space Explorer* for multi-objective optimization also now offers multirun support to fine tune ranges and refine searches and *Simcenter HEEDS* software run options are now fully integrated and cover baseline, random seed, and normalization factors. This will enable customers to benefit from both cost and time savings through automation of complex optimization tasks helping them to achieve faster time to market during the design engineering phase of product development.

"Today's mechanical products are complex, and engineers need to integrate mechanical, electrical and electronics. Bringing the data from each of these disciplines can create design friction, which needs to be resolved quickly," said Arvind Krishnan, industry analyst, Lifecycle Insights. "A good example is the placement of a cooling fan in an electronic housing. The engineers benefit by working in a collaborative environment. So, when there is a change in the electronic board design, the mechanical engineer responsible for the fan and housing design can respond, and vice versa. NX provides best-in-class electromechanical design tools, smoothly weaving together the different needs of the mechanical, electrical, and electronic disciplines into exactly that tightly integrated collaborative environment."

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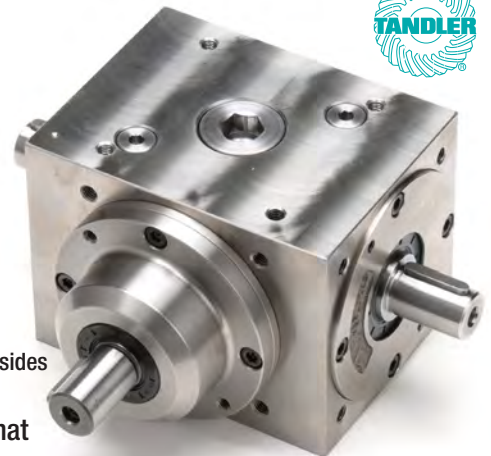


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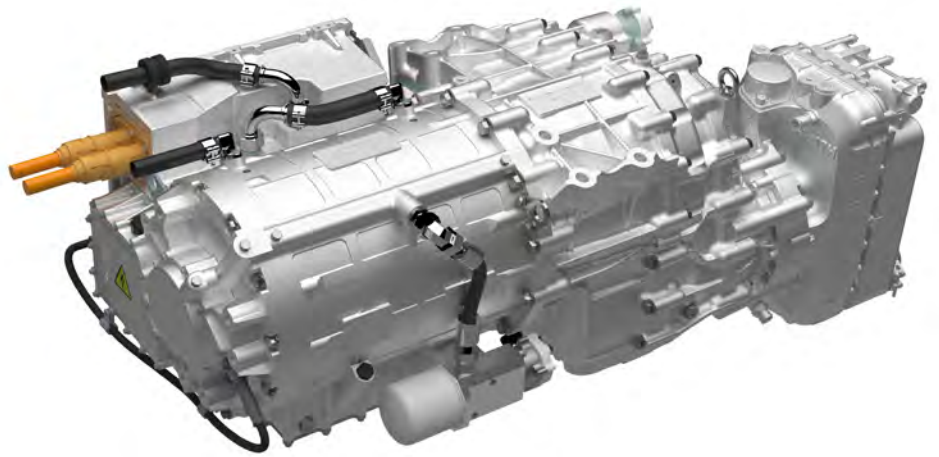
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Voith

EXPANDS EXPERTISE IN E-MOBILITY SECTOR

Voith is further expanding its expertise in the e-mobility sector. With the VEDS HD+, the company is presenting its first drive concept for heavy-duty trucks. Special configurations for waste collection vehicles, inner-city logistics or long-distance transport applications ensure efficient driving with every use.

The core of the system is a new innovative automated four-gear electric transmission. This makes optimal traction available for every driving situation and under any load condition. At the same time, it ensures that the electric motor is operated at optimum efficiency. The Automated Manual Transmission (AMT) developed by Voith automatically selects the best gear for the relevant situation, thus enabling the optimal driving mode—one that is gentle on the engine and has low energy consumption. The transmission is designed to work with superior efficiency at high torque as well as at high speeds. This also makes the transmission ideal for long-distance driving, and it can deliver sufficient power to the axles even on steep inclines. Furthermore, the patented coupling structure ensures maximum efficiency of up to 99 percent. The driver also has the option of selecting a manual shift mode if this is preferable for the driving situation. Different shifting programs are available for the various vehicle applications. A newly developed smart actuator enables short shifting times and thus greater driving comfort every time.

For the drive system of the VEDS HD+, customers can choose between two Evo-named electric motors with top outputs of 390 and 330 kW respectively. “We mainly see the Evo 390 being used in the traditional long-distance heavy-duty transport sector, which means in commercial vehicle types with more than 15 tons of total weight. For the Evo 330, the focus is on typical waste collection vehicles and comparable applications in urban areas with frequent start-stop operations. For both motors, we opted for a sufficiently large power output,” said Alexander Denk, vice president product management E-Mobility at Voith. The power reserves form the basis for good thermal reserves. Therefore, the motor’s internal temperature is significantly lower on average than that of other products, which ultimately extends the service life.

Voith has also designed the inverter of the VEDS HD+ specifically for use in heavy-duty commercial vehicles. The design is modular so that several performance levels are possible. “This allows us to offer the most efficient solution for every OEM application,” Denk said. This is also the first time that directly cooled power semiconductors are being used, which significantly boost the power density and service life.

Just like the VEDS HD and MD, the VEDS HD+ meets the requirements of ISO 26262 (Automotive Functional Safety). The new requirements of Automotive Cyber Security (ISO 21434) are also being met.

voith.com

FANUC

PROVIDES PREDICTIVE MAINTENANCE SOFTWARE FOR DRIVE SYSTEMS

Downtime is the enemy of profitability in manufacturing, which is why FANUC has introduced a new Industrial Internet of Things (IIOT) software designed to prevent production problems before they happen. *AI Servo Monitor* uses artificial intelligence to predict possible failures of the drive systems for FANUC servomotors and spindle motors.

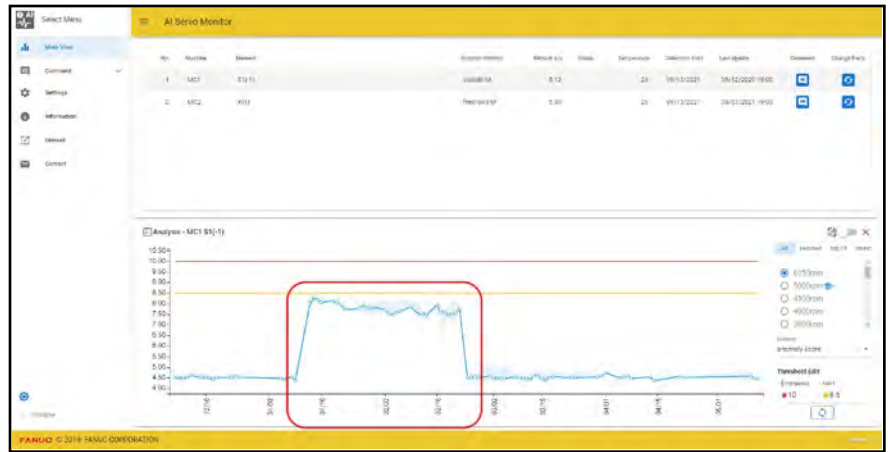
AI Servo Monitor, in conjunction with *MT-LINKi* through machine learning, analyzes the daily performance of machines equipped with FANUC CNCs. Daily data is displayed in intuitive graphs which allows users to easily monitor abnormalities on these machines. Artificial intelligence automatically creates a baseline model of the machine while running in a normal state. An “anomaly score” developed expresses a difference in the baseline model and the daily recorded values. On a web interface, users can easily see the anomaly scores in a graph. Plus, email notifications can be issued if this value exceeds the pre-defined thresholds.

“The power of IIOT software is that it detects a failure before it happens, not after,” says Jon Heddleson, general manager of factory automation for FANUC America. “Predictive maintenance is key in preventing unexpected downtime. FANUC’s *AI Servo Monitor* helps ensure that production keeps running smoothly.”

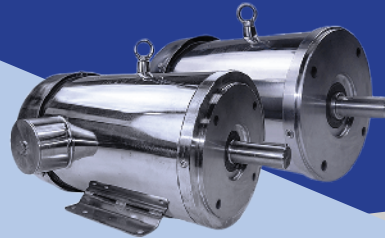
MT-Linki is FANUC’s machine status monitoring and data collection software that connects shop floor equipment, including machine tools, robots and PLCs. *MT-Linki* monitors, collects, and presents data in color-coded graphical representations of the factory floor to provide more information about manufacturing processes as well as historical data. Non-FANUC CNCs, PLCs and various sensors can be connected using MTConnect or OPC-UA protocol.

Information presented via *MT-Linki* enables data-driven business decisions to optimize operations through enhanced maintenance capabilities.

fanucamerica.com



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A Preview of the 2022 Turbomachinery & Pump Symposia

A vital industry event for rotating-equipment engineers and technicians worldwide

Aaron Fagan, Senior Editor

The Houston Turbomachinery & Pump Symposia (TPS) began as a 200-person Turbomachinery Symposium on the campus of Texas A&M University in 1972. The Pump Symposium was founded in 1984 and joined with Turbo for a singular event in 2011.

TPS is a vital industry event that offers a forum for the exchange of ideas between rotating equipment engineers and technicians worldwide. For nearly 50 years, TPS is known for its impact on turbomachinery, pump, oil & gas, petrochemical, power, aerospace, chemical, and water industries through two pathways: the technical program and the exhibition.

The TPS technical program is hand-selected by advisory committees made up of key industry players, and led by highly respected practitioners and leaders in their

fields. Topics cover maintenance, reliability, troubleshooting, instruction on emerging designs, technology, and best practices that include case studies with real-world relevance on problems solved and lessons learned.

The TPS Exhibit Hall is a forum—composed of nearly 5,000 attendees from close to 50 countries—for exploring innovation and forging new relationships. Visit the booths of more than 350 leading turbomachinery and pump companies that will feature full-size equipment, new technology, and emerging industry trends. Power Transmission Engineering reached out to a select few exhibitors for a preview of what they will be bringing to TPS, September 13–15, at the George R. Brown Convention Center in Houston.

ABB (Booth #2617)

ABB offers a full range of high-performance, energy-efficient motors for the pumping industry. Our products are engineered with industry-proven designs that reach the highest levels of efficiency under the most demanding conditions.

ABB delivers a wide offering of explosion proof and severe duty motors including the Baldor-Reliance IEE 841XL with patented positive lubrication system (PLS), extending motor life in contaminated areas.

The Severe Duty 841XL P-base vertical motor with IP55 sealing and winding insulation, suitable for inverter use, is ideal for harsh pumping applications.

For next-generation efficiency, ABB offers the Baldor-Reliance EC Titanium integrated motor/drive. These motors are suitable for constant or variable torque applications while still offering excellent performance across a wide speed load range.

baldor.com





Altra Motion (Booth #1926)

Ameridrives, along with other well-recognized Altra Motion brands, including Bibby Turboflex and TB Wood’s, provide technically advanced coupling solutions for a range of critical turbomachinery and petrochemical applications. These industry-leading global manufacturers offer a complete line of engineered and standard flexible couplings widely utilized for general purpose, ANSI, API-610 and API-671 turbomachinery driveline connections.



Popular Ameriflex diaphragm couplings, Turboflex Plus, Torsiflex and Form-Flex disc couplings and Amerigear gear couplings provide exceptional reliability and accuracy to help avoid costly downtime and enhance operational efficiency and productivity.



Two leading international flexible coupling manufacturers, Ameridrives International and Bibby Turboflex introduce a new series of high-performance disc couplings designed to meet the stringent requirements of today’s turbomachinery market. The Turboflex Plus combines the proven Turboflex and Ameridisc disc couplings together with the experience of the Ameriflex diaphragm producing a coupling as ideally suited to sensitive high-speed turbo compressors as it is to low-speed load couplings whilst offering an economical solution and being fully compliant API-671/ISO10441 for critical oil and gas, energy, and petrochemical applications.

altramotion.com

Sumitomo Drive Technologies (Booth #2647)

Sumitomo Drive Technologies is pleased to once again exhibit at the Turbomachinery & Pump Symposia. This year, they will showcase their N-series high-speed gear units. These units are optimally designed for every application, with a high and advanced load capacity and cast-iron casing—integrated with the bearing housing.



In addition to their large industrial gearbox display, they have invited their product and support sister company—LUFTEX Gears, Manufacturing & Services, to join them. LUFTEX representatives will be available to discuss industrial gearbox repair and support.

us.sumitomodrive.com

Voith (Booth #2703)

The VoreconNX is located in the driveline, between the drive motor and the driven machine. The input shaft is connected to the planet carrier of the planetary gear. This means that a large proportion of the input power is therefore transmitted to the planetary gear directly, mechanically and almost loss-free.

Additionally, the pump wheel of a hydrodynamic torque converter is coupled to the input shaft and diverts just a small portion of the input power. A liquid flow transmits this power from the pump wheel to the turbine wheel of the torque converter. The diverted power is transmitted to the sun gear of the planetary gear. The power from the planet carrier and from the sun gear is combined in the planetary gear, where ring gear transmits the accumulated power to the output gear stage.



The required specified output speed is achieved by the gear ratio of the parallel shaft gear. Adjustable guide vanes at the pump wheel control the liquid flow in the torque converter and determine the speed of the turbine wheel. This allows the speed of the driven machine to be infinitely adjusted.

The VECO-Drive is the ideal solution for speed regulation of high-speed rotating equipment, achieving a record efficiency of more than 97 %. This is attained by operating an electrical superimposing planetary gear in combination with frequency-controlled servo motors that transmit a small amount of rated power. This saves energy and reduces CO2 emissions. Operators are assured of the lowest possible operating cost through increased efficiency while running rotating equipment in a power range of between 4 and 15 MW.



The VECO-Drive requires 50 % less space and has 30 % less overall footprint when compared to a conventional variable frequency drive. Only a small portion of the rated power is needed as control power which results in less space being occupied by VFD cabinets. The VECO-Drive is perfect wherever space and weight are important, e.g., offshore oil & gas production.

voith.com

Regal Rexnord (Booth #2335)

Regal Rexnord converts power into motion with energy-efficient solutions. The company's flagship Kop-Flex, Euroflex, Thomas and Addax brands of couplings have amassed billions of hours of reliable operation in API 671 and API 610 applications and are well-known throughout the industry for their high quality. The Regal Rexnord combined portfolio of couplings delivers the best value and performance for customers' turbomachinery equipment. Optimized designs pro-

vide reliable, low weight to torque density ratios, for general purpose to highly specialized application criteria. The combined history of Regal Rexnord Disc couplings offers 100+ years of application, operational, and engineering expertise.

These couplings are backed by an expert class of monitoring solutions, making it possible to move from reactive to proactive maintenance using Regal Rexnord's hard-



ware, software and humanware. This includes the Powerlight Torque Monitoring system powered by Perceptiv intelligence for long term trending of torque, power and speed to diagnose the source of performance and efficiency loss. The Perceptiv team has extensive experience with strain gauge methods of measuring torque that can be applied to VFD start-up, turbine power verification or general troubleshooting with motor or turbine driven trains. Regal Rexnord is the only source for a complete package that includes the coupling, torquemeter, data collection and analysis.

In addition, Regal Rexnord offers Coupling Recertification services for Kop-Flex and Rexnord high performance couplings, worldwide. Regal Rexnord couplings are engineered per API 671 and designed to last the lifetime of the connected equipment. However, equipment is often operated beyond its design, reducing the effective service life of the couplings. Recertification resets the damage that couplings accumulate due to severe conditions. Regal Rexnord stands behind its recertification by offering a same-as-new warranty, giving customers the peace of mind of knowing that their recertified coupling will continue to perform for many years.

regalrexnord.com

Cincinnati Gearing Systems Inc. (Booth #2243)

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

or a standard design, CGS is the single source to satisfy your specific gearbox requirements.

Fracking Unit

Gas Turbine to Pump Drive

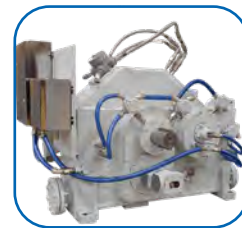
- Double helical gearing, epicyclic configuration
- 16,000/1,455 rpm @ 5,500 hp
- High efficiency, low noise replacement for traditional diesel engine pumping solutions



Expander to Generator Drives

Parallel Shaft Single Helical API 617 Integral Gear Unit

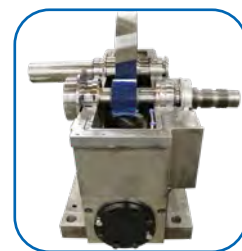
- Expander casing flange mounted to gearbox
- Expander wheel integrally mounted to pinion shaft with hirth connection
- Input speed 33,000 rpm, output speed 3,000 rpm, rated power 1,300 hp
- Used in the plastics production process



Integral Gears

Single Pinion Series

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- Powers to 5,000 hp
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IMTS 2022

It will be smaller than past shows, but North America's largest industrial trade show will still pack a lot of technology into a single week

Randy Stott, Publisher & Editor-in-Chief



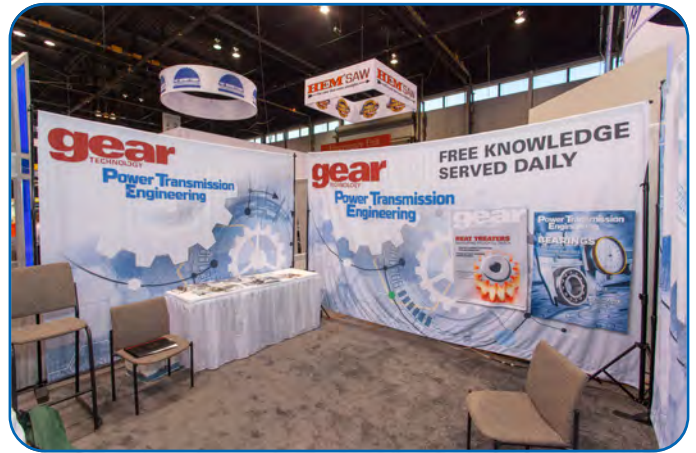
Yeah, there are going to be fewer exhibitors than typical IMTS shows. You'll probably even see some unclaimed booth space. But that doesn't mean you shouldn't go. In fact, this might be the best IMTS you'll ever have the chance to attend, especially if you have an interest in automation technology, motion control and precision mechanical components.

As in years past, Hannover Messe USA will be co-located with IMTS. The Hannover Messe pavilion will be located in the East (Lakeside) building of Chicago's McCormick Place, along with the IMTS Mechanical Components pavilion. Power transmission and motion control with a view: what could be better?

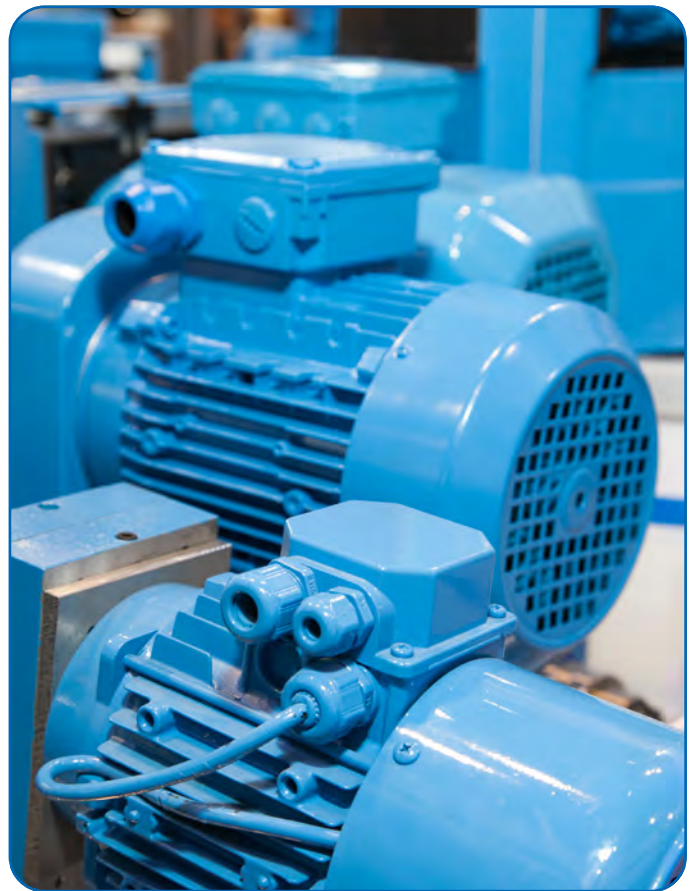
In order to help you better plan for the upcoming show, we've put together a brief list of exhibitors that should be of interest to *Power Transmission Engineering* readers. This list is by no means comprehensive, but it will give you a great idea of what you can expect to see in Chicago this year:

Company	Booth #
Andantex USA	236016
Beckhoff Automation	134417
Bishop Wisecarver Corporation	134825
Cone Drive	134435
Dontyne Gears Ltd.	237227
Dynatect Manufacturing, Inc.	121012
EZO SPB USA Precision Ball Bearings	134725

Gleason Corporation	236909
GMN USA	236658
Heidenhain Corporation	215600, 339449
Hiwin Corporation	134514
igus Inc.	134812
IKO International	134869
J.W. Winco Inc.	432394
Korea Coupling Co., Ltd.	134976
Lenze Americas	134552
Misumi	134841
Mitsubishi Electric Automation	124102
Nachi America	432024
NB Corporation of America	134829
Neugart USA Corp.	134639
Nidec Shimpo America Corp.	134034
Nippon Gear Co. Ltd.	237311
NSK Americas	134438
Ringspann Corporation	431968
Schneeberger Inc.	134837
Six Star Machinery Industry Co., Ltd.	134148
SKF USA Inc.	121903, 121803
Steinmeyer Inc.	134544
Suhner Industrial Products Corp.	431205
THK America Inc.	134802, 134803
Transmission Machinery Co. Ltd.	134136
Von Ruden Manufacturing Inc.	431306



Come and meet our editors and staff in booth #237314



A wide variety of motors, bearings, linear motion, gearboxes and other mechanical power transmission technology will be on display at IMTS and Hannover Messe USA.

Stay tuned to the September 2022 issue of *Power Transmission Engineering* for booth previews and information about some of the technology that will be on display at IMTS and Hannover Messe USA. **PTE**

imts.com
hannovermesseusa.com



Helpline Operator

Keeping components up and running in heavy industrial applications

Matthew Jaster, Senior Editor

How do gearbox and gear drive providers navigate the interesting challenges found in steel, cement, paper, and construction applications? Apparently, one application at a time. Thanks to condition monitoring technology, IoT solutions and the flexibility of engineering teams today, plant downtime is not as problematic as it has been in the past. The secret to success in heavy industrial markets comes down to staying ahead of component failures.

Bonfiglioli Pushes Efficiency Gains in Heavy-Duty Drives and Gearboxes

“The focus today is on complete packages; gearmotors and high-power inverters. Customers in heavy industrial applications are looking for partners that can be a solution provider. They are also sensitive to new IoT solutions,” said Leonardo Sgarzi, heavy duty sectors, sales, and development.

This kind of product modularity and flexibility is found in Bonfiglioli’s Planetary Series (300). The 300 series is compact and powerful, excelling in areas where shock loads and impacts are more the rule than the exception.



Bonfiglioli’s Planetary Series (300)



The product configuration is highly versatile, due to several options for mounting, gear layout, output shaft and motor interface.

Sgarzi believes customer’s needs in the heavy-duty sector are related to personalized services and solutions for every application.

“They require the highest flexibility and reactivity mainly due to market volatility and uncertainty, as well as to match even tighter time-frame in project developments,” Sgarzi said. “Bonfiglioli is continuously improving and developing tailor-made processes for product lines and solutions, also investing on new and focused production plants and hubs in the aim of a higher verticalization.”

This verticalization concept brings all the Bonfiglioli teams together to focus on the organization’s technological advantage and strong specialization that greatly benefits end users.

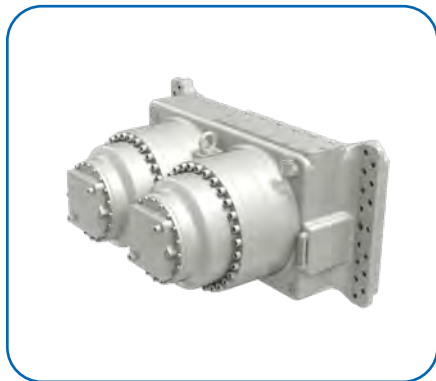
The most fascinating challenge in providing solutions for the heavy-duty industry is the commitment to supply customers with perfectly balanced drives packages that are maximized—in terms of efficiency—to increase the profitability of the entire process.

So, why are customization and reverse engineering so vital in applications like construction, steel, cement, cranes, shredders and screw conveyors?

“We’re highly focused on providing solutions suited to customers’ needs to have full control and knowledge of their machine usage and lifecycle. IoT and predictive maintenance are the keys to technological improvements and utilized to minimize the maintenance/failure cost impacts,” Sgarzi said.

Condition monitoring strategies have led the company to develop dedicated solutions that are in-line with every customer/end-user expectation.

“Customers will also benefit from higher efficiency gains, scheduled



Bonfiglioli's R3-EVOX gearbox

maintenance, and a reduction of cost of ownership," he added.

From a design point of view, the strategy Bonfiglioli pursues is to increase the power density of gearboxes through the optimization of structural components.

"In this sense, we use the most modern software tools, trying to reduce the weight without compromising performance. From a technological point of view, the introduction of new gear finishing processes and high-level components and materials, allows us to increase the efficiency of our products. Our customers obtain a reduction in energy consumption to be more compliant with market demands," Sgarzi said.

The future of heavy-duty drive and gearboxes will be linked to efficiency.

"The real machine/plant lifecycles settled by specific sector/application rules will drive this change," Sgarzi said. "Proper longevity and minimized energy dispersion, operating downtime and cost of ownership will be the pillars for the future of our business. Advanced solutions such as sensors, predictive maintenance, augmented reality and IoT will be the keys to this important switch."

bonfiglioli.com

Xtek Focuses on Engineering Expertise

Xtek products can be found anywhere durability is needed for the most demanding applications in industries ranging from steel and aluminum production, to mining and energy, and more. The company, headquartered in Sharonville,



Xtek applies its metallurgical techniques in areas like steel mills in order to reverse engineer components.

Ohio, provides high-quality custom machined and heat-treated parts and component assemblies for heavy-duty industrial processes.

Founded in 1909, Xtek was known as the Tool Steel Gear & Pinion Company. A young inventor, Russell Bloomfield, was seeking a way to make cup and cone bearings for bicycles that could take the harsh pounding of the period's cobblestone streets. Bloomfield's work led to the development of a steel hardening process that eventually became known as the Tool Steel Process (TSP) because the metallurgical properties that it imparted to gears and bearings made them "as hard and as durable as tool steel."

The original focus of the organization was on gears for traction cars. Later, the company applied its metallurgical techniques to heavy-duty equipment applications in railroads, mines, and steel mills.

Through the decades, Xtek has evolved into a manufacturer of custom engineered components for a wide range of industrial applications. A recent blog on the company's website detailed the variety of engineering expertise that makes the organization better with materials, customized heat treatment options, and finish machining techniques.

Xtek boasts a diverse lineup of engineering expertise with backgrounds in mechanical, manufacturing, materials science, electrical, aerospace, biomedical and industrial engineering.

Application engineering: providing analysis (FEA, etc.) on parts and assemblies, analyzing application requirements, and offering design recommendations.

Design engineering: applying industry standards to product development, and creation of manufacturing and detail drawings.

Manufacturing engineering: developing manufacturing processes and programming for all CNC equipment.

Service engineering: reverse engineering application components, offering upgrade recommendations and determining repair specifications.

Metallurgical engineering: conducting material failure analysis and specifying material composition and heat treat process selection.

With such diverse expertise, it's not surprising to hear that the company recently retired a mill pinion after 58 years of service. This set of carburized mill pinions for a major European hot strip steel mill was manufactured in 1964. Although it had some minor surface wear, it was still in great condition considering the timeframe.

xtek.com

Altra Highlights Heavy-Duty Upgrades

Engineers at Nuttall Gear and Delroyd Worm Gear spend many shifts reverse-engineering equipment in harsh, heavy-duty environments. Whether it's a gearbox or gear drive, maintenance managers meet with application engineers to determine the best course of action to keep steel mills running optimally to avoid downtime.

Nuttall Gear Rebuilds Enclosed Reducer for Steel Processing Line

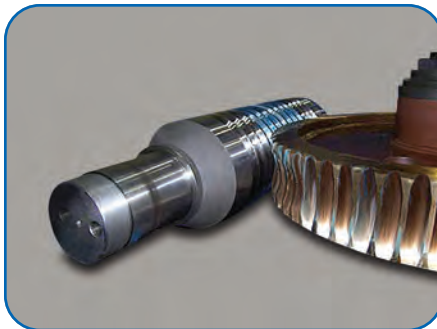
A major steel producer needed an upgrade to a straightener gear drive. The service requirement on the existing drive was increased which caused the heavily loaded gear in the train to fail due to overload. Driven by a 500 hp motor, the straightener pulls strip steel through two sets of rollers that relieve stresses while straightening the coil.

Nuttall Gear provided the upgraded gear drive based on their long-standing working relationship with the customer and their reputation for designing and manufacturing robust steel mill gear drive solutions.

The rebuilt drive featured a reduction ratio of 1:1, a 1.25 service factor with a 160 rpm input and 160 rpm output. The gearing upgrade to the affected components was changed from through-hardened gears to carburized and ground gears for enhanced wear resistance and improved shock load capacity.

Delroyd Worm Gear Solves Drive Failure for Screwdown Mill Stands

The gear drives for screwdown mill stands at a major steel mill in Ohio were failing prematurely causing extensive downtime. The worm gear



A Delroyd reverse-engineered worm and worm gear for a screwdown mill.

teeth were wearing and breaking down at an accelerated rate due to improper meshing at the contact zone. The problem created excessive pressure at the gear's pitch line/contact zone.

Delroyd engineers met with the hot mill managers to conduct an on-site inspection and short-term mill stand monitoring period. Through these efforts, it was determined that the cause of the drive failures was that three different gearing manufacturers had supplied gearing, all with different thread designs, which were being mixed and matched over time.

A spare worm and gear sample was sent to the Delroyd facility so that a new gearing solution could be reverse engineered to ensure that all gear sets installed on the hot mill stands would have a matching thread/tooth design. The new Delroyd gearing solution extended the gearing life from six months to more than six years.

Delroyd Worm Gear Develops New Gear Set for Steel Mill Charging Crane

Gearboxes for a charging crane hoist drive were failing prematurely at a large steel mill in Northeastern U.S.

HELPLINE OPERATOR

The failures were causing unfavorable outages and expensive periods of downtime.

Due to their desire and reputation to solve problems, Delroyd was called in to help analyze the situation and develop a solution. A meeting was held at the mill with various parties including an outside service group, mill engineers, maintenance managers and Delroyd engineers. All aspects of the ongoing issues were reviewed and an on-site inspection of a failed gearbox was performed.

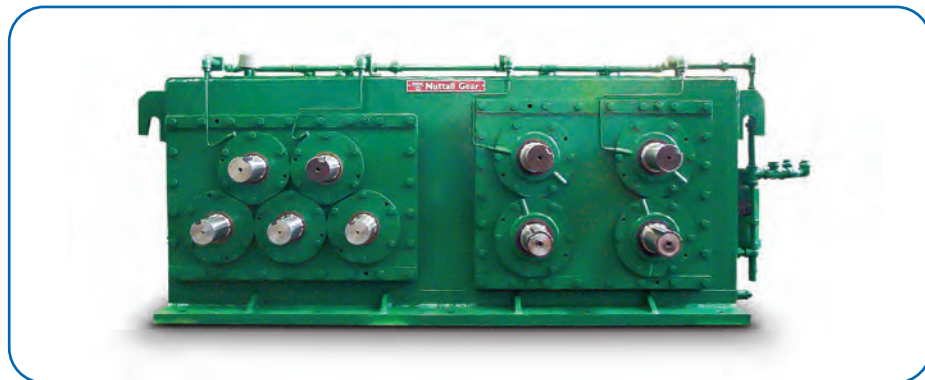
Based on their findings, Delroyd engineering developed new worm gear sets utilizing aluminum bronze gears and redesigned the bearing mountings to enhance strength and durability. A carburize hardened, ground, and polished alloy steel worm develops a smooth, work-hardened surface on the aluminum bronze gear. Extra-heavy side plates were used to connect the worm and gear shaft bearing supports, assuring proper meshing of the gear under all conditions of load. A more rigid fabricated steel housing design was utilized to reduce bending moment stresses. A redesigned, more efficient lubrication system was also incorporated.

The Delroyd design changes resulted in extending the gearbox life by over five years. The charging crane gearbox success prompted the mill to utilize Delroyd's expertise by providing gearboxes for their gantry cranes as well.

altramotion.com PTE



Upgrades to a charging crane hoist gearbox resulted in extending the gearbox life by more than five years.



A rebuilt Nuttall gear drive from a steel processing line.

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Better Condition Monitoring Techniques

SKF Axios Platform Improves Reliability of Rotating Equipment

SKF recently launched SKF Axios, a solution that reinvents the fields of industrial machine reliability and predictive maintenance based on a collaboration between SKF and Amazon Web Services, Inc. (AWS). SKF showcased Axios during Hannover Messe 2022.

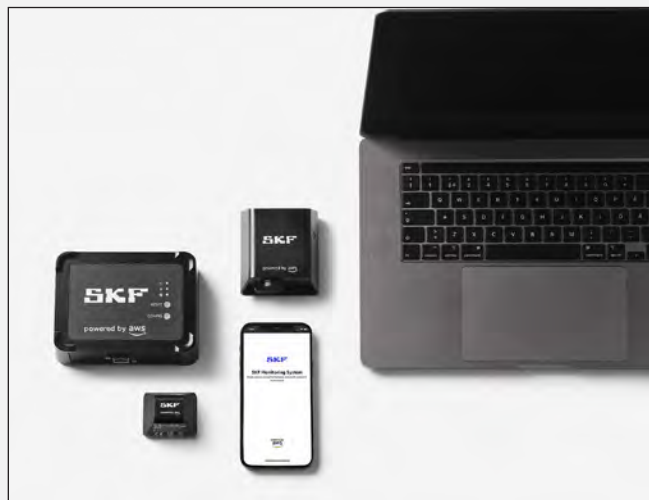
SKF Axios is a fully automated condition monitoring solution which fulfills this need. It is comprised of sensors, gateways and a machine learning service that is easy to install, commission, and scale with no experience necessary, allowing sensors and apps to be operational within minutes. It detects anomalies and pushes notifications allowing for quick action to avoid unexpected machine failures.

SKF's team of vibration analysts and engineers will continue to be an integral part of helping customers improve the reliability of their equipment. SKF Axios complements SKF's current portfolio of sophisticated condition monitoring products and now provides industrial companies with a simple solution to broaden their rotating asset predictive maintenance programs.

"With SKF Axios, we can provide a larger portion of the industrial market with actionable insights leading to improved decision making and more efficient maintenance planning and scheduling. Through leveraging these insights and SKF's knowledge of rotating equipment, customers can improve machine performance and overall reliability of their operations," said John Schmidt, president, Industrial Region Americas of SKF.

"SKF Axios represents a tremendous opportunity for industrial customers of all sizes to benefit from scalable, data-driven, machine-learning technologies offered by AWS. These solutions enable industrial customers to make better decisions faster, increasing operational efficiency, and reducing the costs associated with unplanned equipment downtime. We remain committed to offering our expertise in cloud solutions, IoT systems, and machine learning to enable SKF to constantly innovate and enhance their industrial products and services," added Vasi Philomin, vice president of AI Services at AWS.

SKF Axios collects and analyzes vibration and temperature data to detect equipment anomalies and provide notifications on the health of your machinery. When abnormal machine conditions are detected, users are alerted so they can respond with proper maintenance.



Start small and scale up as needed with this cost-effective, end-to-end predictive maintenance system from SKF and AWS. SKF Axios is simple to use right out of the box. Many sensors can be added.

When SKF Axios detects abnormal machine conditions, users are alerted so they can respond with proper maintenance. Historical trend data is the basis for machine learning. The more data collected, the smarter and more accurate the machine anomaly detection becomes.

The predictive maintenance solution requires no previous vibration experience or expertise and will continue to provide new monitoring technologies for power transmission components.

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The Optimization of 70 Tons of Scrap

Electric pre-shredder provides energy efficient option with MAV shrink discs

Matthew Jaster, Senior Editor

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shrink discs

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The engineering community is fascinated with big, shiny, yellow machines. Walk into any manufacturing facility around the globe and you'll find guests huddled around the biggest, loudest, and most intimidating equipment on the shop floor. These large machines must play by the same rules as everybody else—they need to reduce energy consumption, lower plant costs, and increase productivity. Many power transmission component suppliers are tasked with optimizing this equipment.

Big Yellow Machines

Wendt Corporation, Buffalo, N.Y., is an independently owned and operated family business serving the scrap metal recycling industry for 40+ years. The company is the North American distributor for MTB, a provider of metal recycling pre-shredding, shredding and sorting equipment based in France.

"The pre-shredder offers our customers a simple way to grow their business by maximizing the use of existing assets," says Ethan Willard, Wendt's business development manager. "I believe pre-shredders will revolutionize existing grinding operations with their ability to increase production and reduce operating costs and downtime."

Wendt sold the MTB EZR Electric—a pre-shredding machine with an electric drive—to Rochester Iron and Metal, a recycling operation located in Rochester, Ind. The EZR Electric is the first U.S. electric pre-shredder, providing 92% drive efficiency thanks to its synchronous high-torque electric motors. MTB machine designers turned to electric power over hydraulics, reducing energy consumption while developing a more circular economy.

Combining this with a mechanical design that allows the adjustment of output density and throughput of the machine after installation, MTB can tailor the EZR's operation to meet specific customer needs at a lower energy cost.

These upgrades allow nongrindable material to be stopped or disposed of without risk of damage to the EZR pre-shredder. Slow shaft speeds, for example, significantly reduce the risk of explosions or mill damage that could cause critical machine downtime. Shrink discs made by MAV S.p.A., a product line of Fenner Drives, are right at the heart of the 70-ton-per-hour pre-shredder, the EZR Electric.

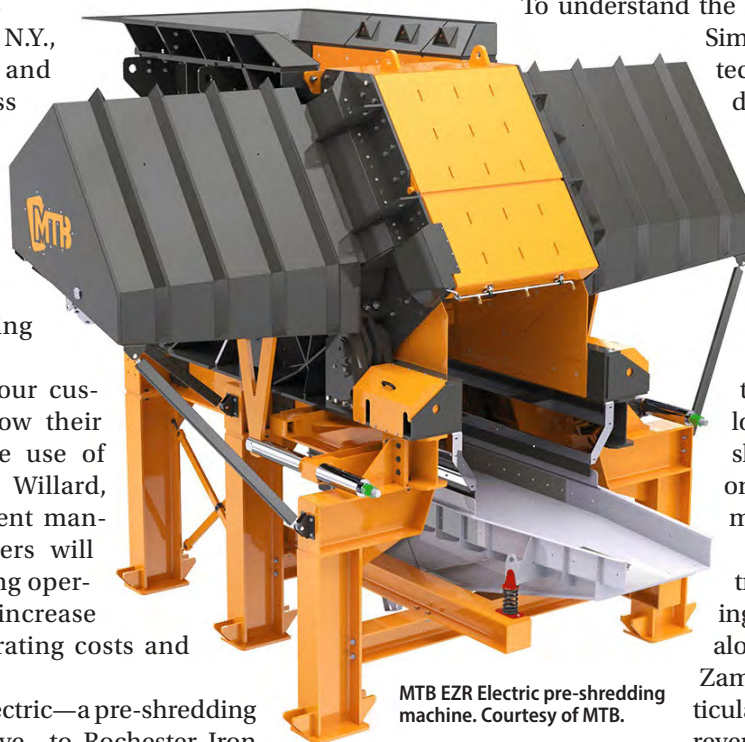
Shrink Disc Analysis

To understand the importance of shrink discs, Simone Zambanini, engineer, technical department at MAV, discussed the components history and application advantages.

The shrink disc is a mechanical assembly composed of conical rings and a set of screws. They provide a rigid, backlash-free, frictional keyless connection between an outer hollow shaft (hub) and an inner shaft. This is installed directly onto the hub which is then mounted onto the shaft.

"Shrink discs allow the transmission of torque, bending, thrust loads, etc., either alone or in combination," Zambanini said. "They are particularly suitable for shock and reversing loads. These components provide high contact pressure between the hub and shaft, offering high load capacity in combination with ease of installation and removal."

The MAV 3208 shrink discs—used for this application—are mounted on the extraction and feeding rotors. They are extremely important in achieving the electrification of the unit. The shrink discs connect to the gearbox's hub to the rotor's shaft, allowing MTB to use gearboxes with hollow, low-speed shafts and a compact design, saving weight and space in the EZR Electric pre-shredder.



MTB EZR Electric pre-shredding machine. Courtesy of MTB.

Zambanini said that the two-part design of the MAV 3208 is less conditioned by installation accuracy than the three-parts design shrink disc, since the single outer ring is guided during tightening operations by the long shallow taper of the inner ring, leading to extremely low runout error.

“Wear and fretting corrosion in the parts or in other locking elements (typ. keyed and splined connections) are eliminated, due to high contact pressure and absence of play (backlash-free).

Clearance fit mounting makes installation and removal much easier than in case of interference-fit or keyed connections,” Zambanini added.

In addition, the high contact pressure between the parts creates a stronger connection and a longer useful lifetime, especially in applications, like shredders, with shock or reversing loads.

Previous generations of pre-shredders relied on hydraulics because of the large amount of power required. In addition, the electric units will have a smaller footprint and be less complex than a hydraulics model.

A History of Application Requirements

The shrink disc has provided 40+ years of proven technology for light, normal and heavy-duty applications. Fenner/MAV engineers utilize 3D CAD and calculation software, including FEM Analysis to provide its customer base with the necessary tools to select the proper components.

“Project files are stored in a PLM software,” Zambanini said. “This grants safe and quick traceability of all pertaining documents.”

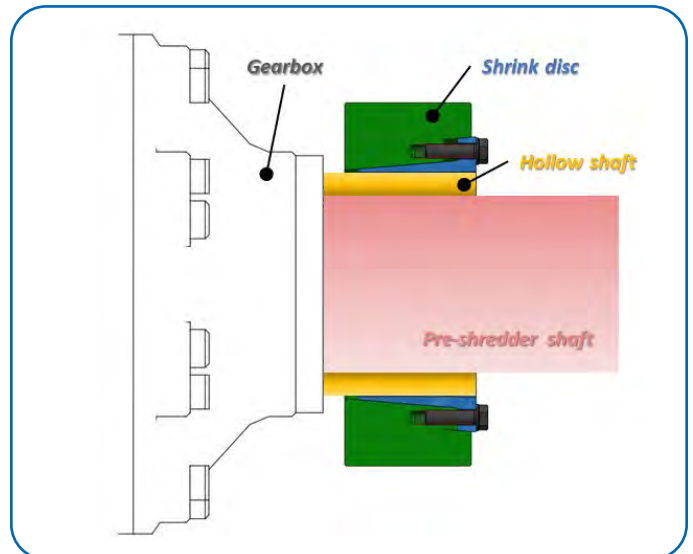
MAV specializes in designing and manufacturing special items according to customer application and design requirements. The company manufactures keyless locking devices, external shrink discs, and rigid couplings for shafts ranging from 5 mm to more than 1 meter. This includes more than 40 series available in both metric and imperial bores.

MAV locking assemblies use tapers that generate high radial forces when pushed together, creating high contact pressure and a zero-backlash connection. The locking assemblies mount gears, pulleys, cams, levers, rotors, and similar devices onto shafts, while the rigid couplings connect two shafts. These products are adjustable both radially and axially, allowing machine designers and users to achieve perfect timing, making installation and removal easier.

“Shrink discs are very versatile. You can position the connecting elements as you want—as they are required—so you’re not constrained by keyways or splines, etc. You can reach any position with these components,” said Sebastien Collignon, international sales manager, Fenner Drives.

Collignon added that the next step in the shrink discs versatility is a brake-integrated shrink disc.

“Attaching a brake directly to the shrink disc is advantageous if the gearbox needs a braking system for service or for a parking brake. This is a unique and special application where it locks the gearbox to the machine shaft. We are using this technology in areas such as mining, oil and gas and other heavy industrial applications,” he said.



The shrink discs connect the gearbox’s hub to the rotor’s shaft, allowing MTB to use gearboxes with hollow, low-speed shafts.

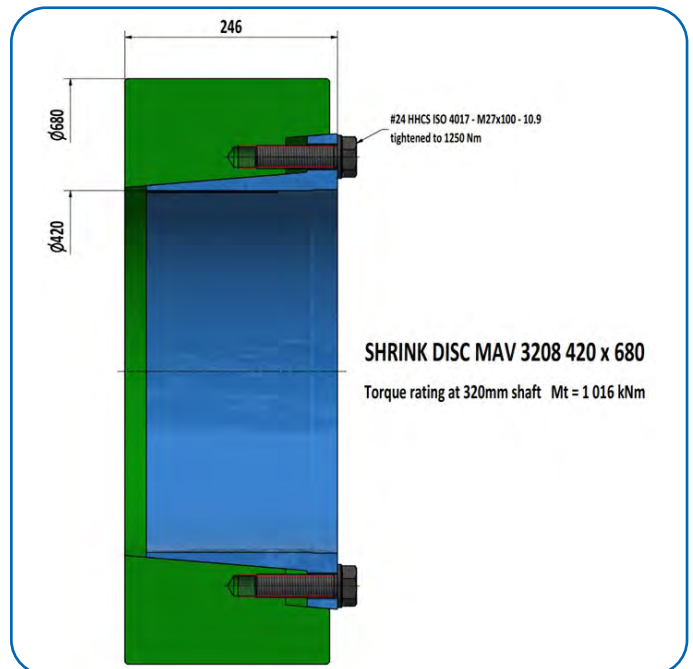


Diagram of the MAV 3208 series shrink disc.

Increased Throughput and Efficiency

The addition of the MTB EZR Electric pre-shredder will make the Rochester facility a safer, more efficient operation. In effect, the pre-shredder prepares the waste stream for the company’s large Wendt M6090 shredding machine. The pre-shredder uses low-speed, high-torque technology to allow Rochester to increase the throughput and cut the wear on its primary shredder. It also removes unshreddable material, greatly reducing the chance of catastrophic failure at the mill.

“We are basically going to become an 80-inch mill without the installation costs,” said Dan Zeiger, controller for Rochester Iron and Metal. “From a financial perspective, the payback estimations are in months, not years.” **PTE**

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Design Takes On a More Holistic Scope

George Holling

In the past, we designed motors and drives separately from the mechanical system, and then we integrated suitable components to make a system work. Increasingly, though, the design focuses more on the overall system aspect and system integration, which makes the design of customized components more challenging.

In this article, we will use examples of specific software tools, and it should be noted that these are just that: examples. For many of these tools, multiple similar and good software packages exist that can be used.

As we closed out the 1990s, we had already observed a change where computer design tools were experiencing more widespread use for mechanical, electronic, magnetic motor and overall system design.

Mechanical CAD packages and 3D models started to cement their role in the design process to ensure that all of the components would fit in the final design. These tools also could generate all the information for the CNC machines so that prototype and production parts and molds could be made directly to avoid errors when transitioning from the design to the build phase. Examples are *Solidworks*, *AutoCAD*, *Inventor*, *CATIA*, *CREO* and others.

Since then these mechanical design suites have become more powerful, and they allow for many additional design functionalities, such as strength analysis where weaknesses and stress points in the design are analyzed and flagged to ensure that the design yields a reliable solution. While some of the above packages, i.e., *Solidworks*, have added features to help analyzing strength, etc., a new generation of simulation tools has evolved to model the whole system, such as *ANSYS*. These software packages do not only analyze the mechanical system, e.g., strength, vibration, critical frequencies, fatigue, but they can also analyze the heat transfer, magnetics and even fluid dynamics for the design of fans, propellers and airflow analysis (heatsink design).

In automotive and military designs, we must use such integrated design tools for thermal management, strength analysis and critical frequencies prior to even prototyping to maintain fast, efficient and cost effective design cycles.

The main drawback is that these integrated software packages are expensive to purchase and maintain and that they require extensive training and knowledge to ensure accurate results.

For motor design (magnetics), we started out with two parallel approaches that are still used today: the finite element software (FEA) which was introduced in the 1980s by Cedrat, Infolytica and A.O. Smith, and in-parallel macro modelers,

which break down the magnetic circuit and iteratively solve simplified equations. *SPEED* software was widely popular and is used by several of our customers, and *SPEED* also has an integrated FEA option that allows for fine tuning of the magnetic curves, which can yield improved accuracy of the results.

In the past, we used *SPEED* software almost exclusively for our motor designs, and we found that the actual motor prototype delivered less efficiency than what the *SPEED* software had predicted, especially when designing high-rpm motors and those with low phase inductances even when we used the internal FEA module that *SPEED* offers to adjust the BH curves. When designing synchronous reluctance motors, *SPEED* appears to greatly overstate both the projected power output and efficiency.

We also noticed discrepancies in the projected motor efficiencies when using FEA software packages, especially when the excitation waveforms are generated via pulse width modulation (PWM). In many cases FEA-based design tools only describe the waveform, and they often rely on an AC analysis which allows solving the FEA much faster compared to a full transient analysis.

However, we have found it necessary to model the current waveform generation and its interaction with the motor magnetics in much greater detail and to perform a full transient analysis to accurately predict all the projected motor losses. We have found the use of broader system modeling tools, i.e., *MATLAB*, to be advantageous. They allow for us to easily and accurately model and co-simulate our control system and power switches, and we can also design the required control algorithms and automatically convert these into software for our embedded microcontrollers and digital signal processors.

Ever since we incorporated the accurate modeling of the PWM motor controller and excitation waveforms, we have been able to accurately predict the actual motor performance and, most importantly, its efficiency, which has been validated by testing over many motor designs. Thus, we consider co-simulation a key requirement for accurate motor design and performance prediction. Fortunately, most FEA and system analysis software packages offer a *MATLAB* interface to allow for easy co-simulation.

For the design of the power electronics, we use lower-level circuit analysis tools such as *SPICE*, giving us valuable insight into the inner workings of the controller and how we can efficiently drive the main power switches, which has become significantly more important as we are shifting from standard silicon-based technologies to wide-bandgap devices: silicon

carbon (SiC) and gallium nitride (GaN). Furthermore, we are increasingly designing controllers that can operate in high ambient temperatures (up to 160°C/320°F) for military applications and for motor controllers integrated into the motor housing. Using these tools, we have developed our own driver stages that can switch wide-bandgap devices in the nanosecond range to design drives with almost 99% operating efficiency.

We can now use the co-simulation to solve very complex problems, such as magnetic bearing stabilization, acoustic noise control of electric motors and vibration-free propulsion, which involves integrating the electronic controls with the motor, the power electronics and the mechanical structure. Thus, we can be assured that the system will function as specified once we build the actual hardware.

In some cases, the use of this holistic approach also impacts design decisions. One such example was a traction drive with integral gears where a selection needed to be made between two different gear ratios: X and Y. There were some low-speed

efficiency advantages for using ratio Y, but a full mechanical analysis revealed that ratio X would require less internal support and offer higher safety margins. Based on this analysis, ratio X was chosen. While such an analysis is not inherently novel, the use of an integrated analysis tool suite allowed us to construct and optimize a single model and simultaneously gain all the relevant information about magnetic performance, thermal management, critical frequencies and the mechanical strength. Any optimizations could be made quickly and simultaneously using a single model to obtain the desired magnetic performance, weight reduction and optimized cooling channels while assuring strength and thermal management. In the past, the model may have been bounced back and forth between different engineers, which would add significant amounts of design time and expenses.

Below we will give some examples of data obtained for a series of different analyses. One important aspect is the accuracy of modern FEA analysis. In Figure 1 we show the comparison of a static torque curve that was obtained from two

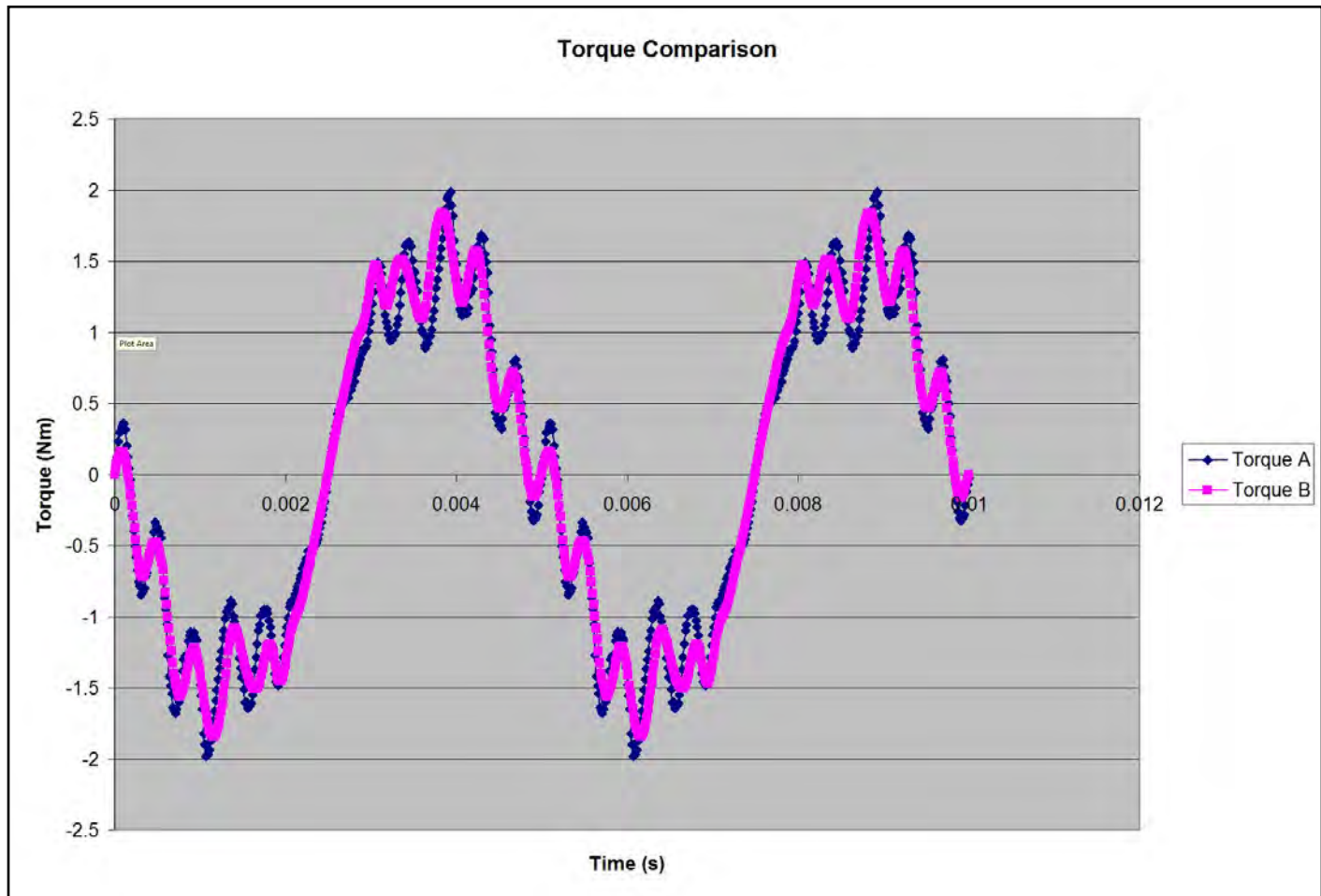


Figure 1 Comparison of static torque curves from two different FEA softwares.

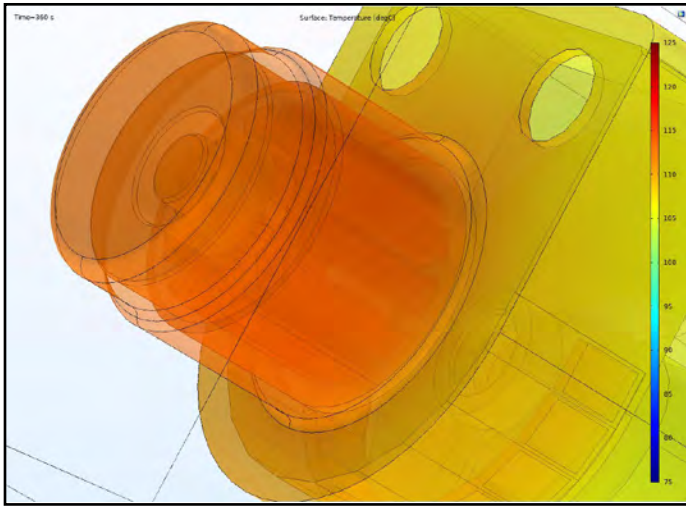


Figure 2 Thermal analysis of an automotive brushless motor water pump.

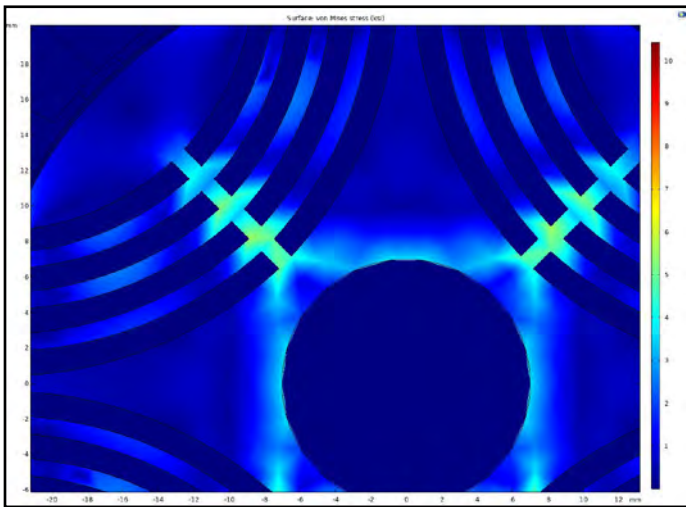


Figure 3 Rotor stresses at 15,000 rpm.

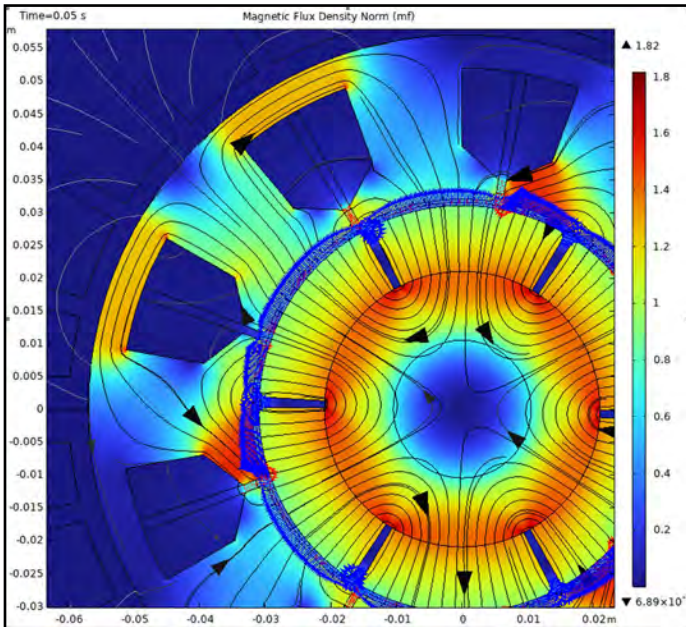


Figure 4 Surface stresses in brushless motor due to magnetic forces.

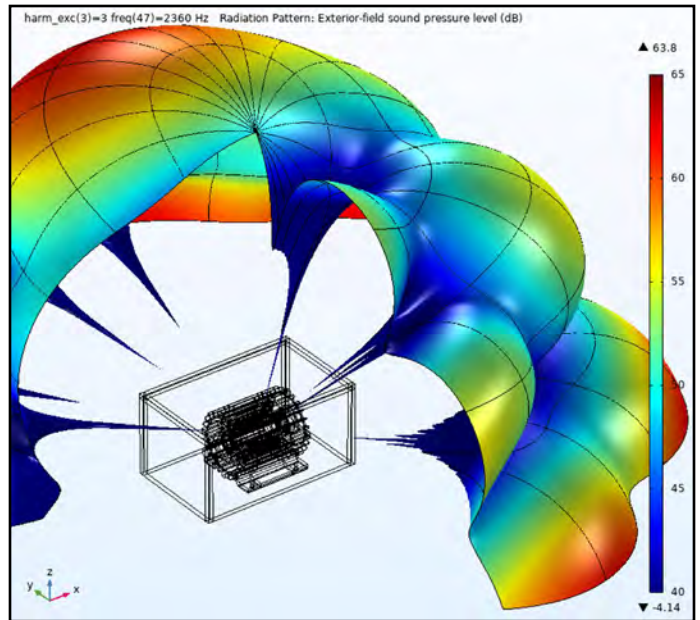


Figure 5 Radiated sound pressure at $f=2,360$ Hz due to magnetic forces.

different FEA software packages and how closely the results from the different software packages match.

In Figure 2, we show the results of the internal operating temperatures of an automotive water pump. In this analysis we model all: the motor, the integral drive and the coolant flow. We analyzed the transient thermal behavior at 85°C ambient temperature. The picture in Figure 2 was taken after six minutes of operation.

In Figure 3, we show the internal rotor stresses in a synchronous reluctance motor at 15,000 rpm.

In Figure 4, we show the surface stresses due to the magnetic fields in a brushless PM motor.

Figure 5 shows the resulting sound pressure at the outside of the motor enclosure that these surface stresses generate at certain harmonic frequencies. A more complex analysis will also consider shaft displacements and vibrations.

All of the above examples are based on the simultaneous analysis of a common model for magnetic performance (torque, efficiency); thermal analysis, which feeds back into the copper losses; mechanical analysis (strength), which takes into consideration the forces between the stator and the rotor and also the acoustic noise and many other important data points of the system performance, e.g., critical frequencies, bending moments, etc.

After the initial learning curve, it requires little extra effort to simultaneously solve for a multitude of physical characteristics of a given design far beyond the basics of torque and efficiency. In a modern design environment, we must take a more holistic view of the design task and analyze a multitude of physics simultaneously to quickly generate accurate and optimized designs for our applications. **PTE**

George Holling is Technical Director of Rocky Mountain Technologies (george.holling@rockymountaintechnologies.com).

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The need for flexibility and ease of maintenance drove additional design features. We include bolted diodes to eliminate the need for soldering when inspecting rotating diodes in the field. Brushless excitation system and seal-for-life bearing structure also makes it easier to maintain. Standard SAE adapters for most engine connections and standard 12 lead for 3-Phase (4 lead for 1-Phase) design allows for a wide range voltage and frequency demands. We can also provide special auxiliary winding design to increase motor starting ability. Our models are available in one- or two-bearing configurations. WorldWide Electric is committed to continued investments in technology for new product development.

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Closed Loop Control of Hybrid Motors— When Is It a Servo?

Donald Labriola

A quick search of the patents issued, as well as a review of recent articles, shows a wide range of what authors call “servo stepper motors,” “closed-loop step motors,” “hybrid servo motors” and the

like. Although the names may sound similar, the performance can vary quite substantially. Most of the “closed-loop stepper motors” are not actually servo motors!

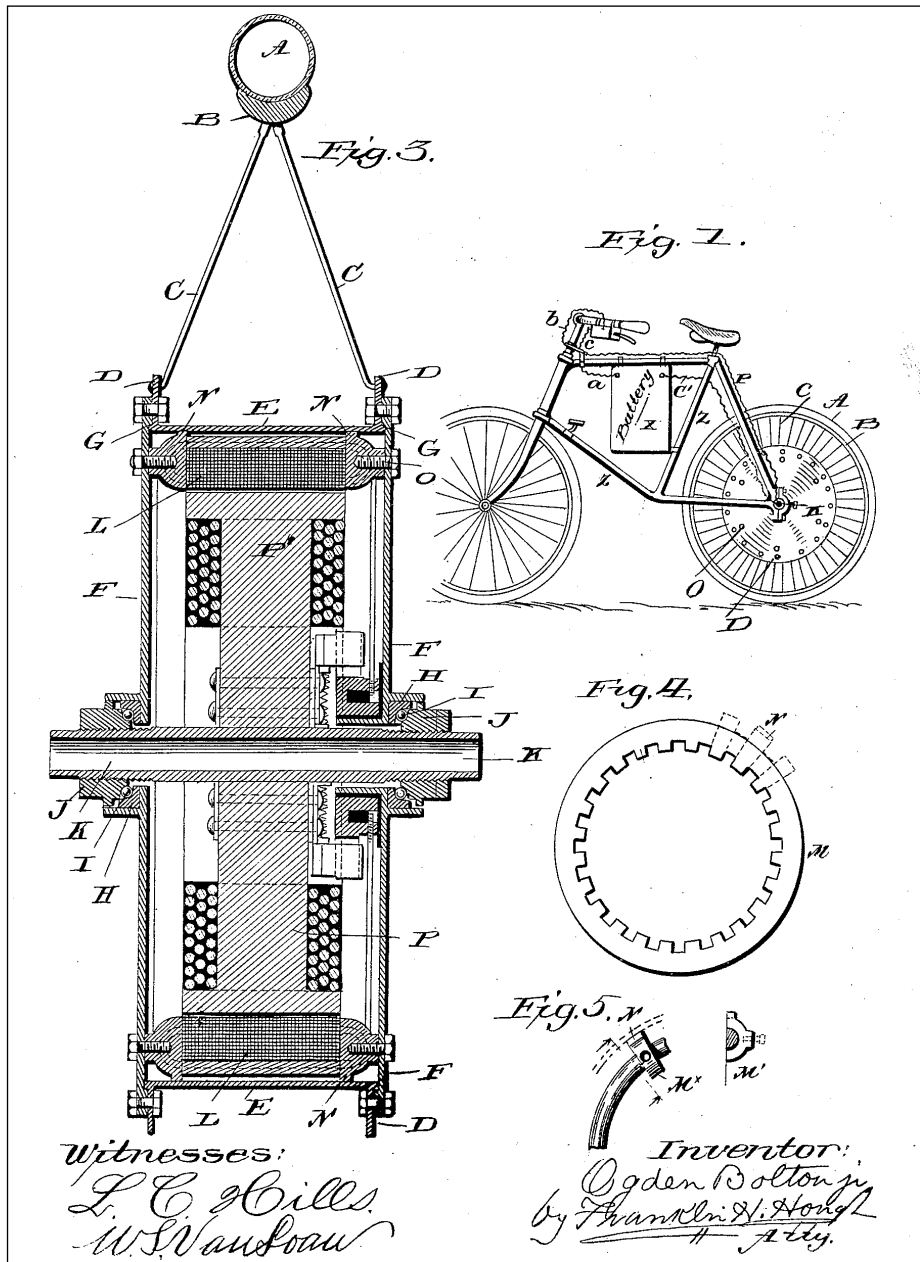
A Quick History:

Hybrid motors actually started out as high-torque DC brush motors for bicycles back in the 1890s, and later as 2-phase split-phase motors running from 60 Hz to run 78 rpm record players before eventually ending up as the 1.8-degree steppers—first full step and later microstep commonly now seen in machine tools.

The vast majority of hybrid motors are used as open-loop step motors. The simplest and lowest cost and also lowest performance versions are the 6-wire motors driven from a power source to the center tap of each winding with four transistors to drive each winding half to the ground. Adding a series resistor to the center tap increases the ability to make the current change more quickly and allows the motor to operate from a higher voltage, improving the power at higher speeds, but the constant current through the resistor also generates significant heat. Also, the typical six-wire configurations are using only 50% of the copper at any one time. Bipolar motors—typically four-wire configurations—use all the copper in the motor, which reduces the resistance of the motor with the same windings by 50%, allowing 1.41 times the current rating for the same number of turns and gauge of wire. The higher current increases the available torque of the motor with bipolar windings. The Bipolar motors use more transistors, but the additional transistors also improve the ability to both drive current into the winding and to pull current back out of the winding in a controlled manner, useful when decelerating the motor.

Closed Loop Stepper:

As stated earlier, the original application for hybrid (transverse flux) motors used brushes to commutate the motor to keep the torque angle of the motor at

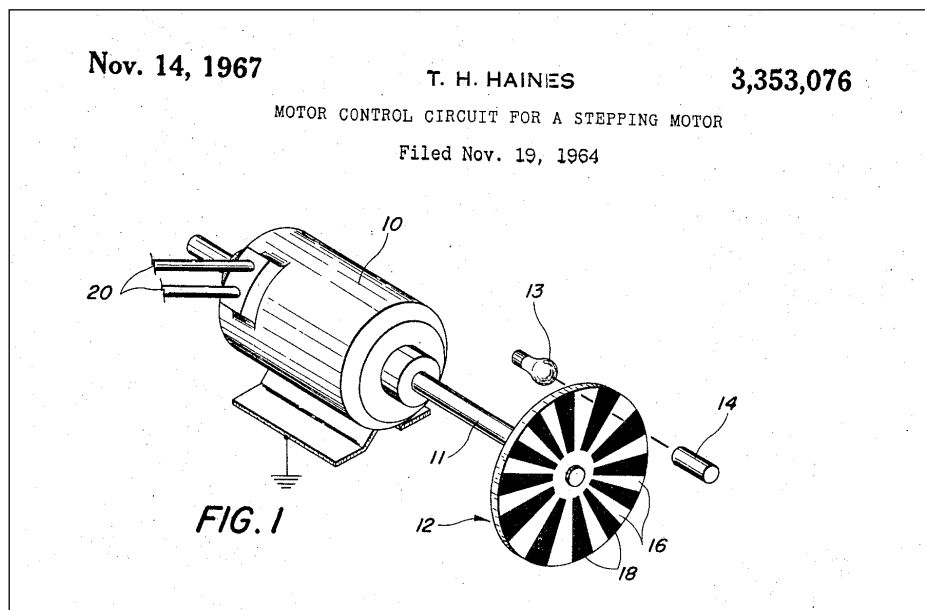


The first electric bicycles used a transverse flux motor, among the earliest forms of hybrid motors (U.S. Patent No. 552,271, from 1895).

an optimal angle. The first closed-loop step motor designs emulated this operation while going brushless by adding encoders with 200 counts per revolution, corresponding to 200 full steps in a common 1.8-degree step motor. The “closed-loop stepper” uses a step generation circuit that limits the step rate to prevent the step drive angle from getting more than 1 or 1.5 full steps (according to the patent) ahead of or behind the measured rotor position. This operation prevents the motor from losing synchronization and improves available torque when accelerating or decelerating.

However, for portions of the move that are not maxing out the motor, the motor operates as a standard open-loop step motor. Although these motors do not require tuning, do not dither, and do not lose steps, they still have strong vibrations at resonance frequencies with the attendant torque reductions typical of open-loop step motor operation. The accuracy at a stop is dependent upon the holding current versus the load on the motor when stopped, and with friction, an error will remain. Trying to reduce the error requires keeping the current higher, which leads to motor heating. As the motor spends most of its time in open-loop mode, the efficiency of the motor is basically the same as for open-loop steppers—which is fairly low.

An improved version of the closed-loop step motor design increases the encoder resolution and microsteps the hybrid motors to reduce vibration. This helps but does not eliminate resonance issues, which arise from the rotary inertia of the rotor interacting with the magnetic “spring” of the rotor interacting with the stator. It is also common for the closed-loop step motors to use current control loops more optimized for the first and third quadrants—that is for driving power into inertia and do not have as fine of control for the second and fourth quadrants where the motor is acting as a generator. Although higher resolutions are available with the use of microstepping drives, the heating and accuracy problems still remain for these higher resolution versions. Another common issue with microstepping drivers is that they require changing the stepping resolution at different speeds as the processors may not



Among the earliest closed-loop steppers was this encoder-controlled motor (U.S. Patent No. 3,353,076, from 1967).

be able to keep up with the full microstepping rates at higher speeds.

Commonly, the various closed-loop stepper configurations are open loop whenever the error angle is less than a full step. They do not have the ability to dampen the final ringing of the motor. This ringing can both delay settling and can double the final settling uncertainty as the friction can lock the final position on either the positive or negative half of the ringing waveform. Ringing is also not just an issue when stopping but is also a significant issue when rotating and can persist for tens of seconds or more while rotating, causing the speed of the motor to continue to vary even though the step rate is constant.

Stall Prevention Closed Loop:

A variant of the closed-loop stepper motor uses “stall prevention.” This method uses a variant of a Kalman filter to estimate the motor phase using a measurement of the motor winding voltages and currents. The Kalman filter needs a minimum motor speed—typically around a hundred rpm—to generate enough back-EMF to get a good rotor angle estimate. For lower speeds, these again operate as an open loop. Some of these designs are also able to vary the motor current as a function of load to improve motor efficiency—reducing the heating of the motor.

True Hybrid Servos:

The hybrid motor may also be operated as a true servo motor. The hybrid motor is a two-phase AC synchronous motor. With the addition of a position feedback element, the difference between the measured position and the actual position may be determined, with the error being used to calculate and adjust the needed torque for the motor, to reduce the error of the system. The phasing of the current to the motor is optimized by the controller to minimize motor heating for a given torque requirement and motor speed. Further, the winding currents can be adjusted to produce for field weakening of the motor, which can typically double or triple the available motor speed available for a given power supply voltage, which flattens the efficiency curves for the motors—and 4,000 rpm operation becomes possible.

Eliminating Resonance:

The open-loop stepper has a second-order system from the rotor inertia interacting with the effective rotary spring of the rotor magnet interacting with the stator magnetic field, which gives rise to low-speed resonance issues. The hybrid servo system commutates the stator field to keep the rotor-stator angle nearly constant, which essentially eliminates torque variation with angle. Without the spring, the rotary pendu-

Table 1 Advantages and Disadvantages of Various Motor Types

Issue	Open Loop Stepper	Closed Loop Stepper	Hybrid Servo	Conventional Servo
Low-Speed Operation, Speed Passing Through Resonance	Lost steps from low-speed resonance, greatly reduced torque at resonance	Rough operation from low-speed resonance, reduced torque at low-speed resonance, but no lost steps	No low-speed resonance. No torque drop out. No lost steps	No low-speed resonance. No torque drop out
High Continuous Torque Holding	Large error, possible lost steps. Current margin for torque may cause significant heating	Large error. Current margin for torque may cause significant heating	Control loop minimizes error. High “motor quality” reduces heating—only current necessary for holding the load will be used	Control loop minimizes error, low motor quality factor (Kq) can cause substantial heating. May cause motor to thermal out. Continuous torque commonly 1/3 to 1/10 of peak torque
Direct Driving Lead Screws, Belt Drives	May lose steps if going through resonance	Will not lose steps, but may have strong oscillations at different speeds	Easily tuned to cover speed range of lead screw. Torque curve well matched. Speed curve well matched without gearhead.	Speed limitation of leadscrews typically not well matched to high efficiency portion of speed-torque curve, so limited torque and higher heating unless a gearhead is used
High-Speed Operation	Low torque at high speed, likely to lose steps or drop out completely.	Low torque at high speed, may not reach needed speed	Torque available at 2,000–4,000 RPM top. Field weakening increases speed ranges with good efficiency	Low pole count servos have high speed (5,000–8,000 RPM is common). Best efficiency at near top speed
High Inertia Loads	Very easy to lose steps. Long settling time	Won't lose steps but may have long oscillation period. Resonance speeds may be rough.	Damping is easily handled by proper control systems. 30:1 inertial mismatch is routine. 200:1 with relative ease	Many conventional servos use PID without additional damping, limiting inertial mismatch to about 10:1
Tuning Complexity	No closed loop tuning, but step profile may need to be carefully adjusted to not lose steps and to minimize ringing.	No closed loop tuning. Will not lose steps, but motion may be shaky unless step profile carefully chosen.	Requires tuning, but motion profile is easily accomplished	Requires tuning, but motion profile is easily accomplished
Cost	Very low	Mid	Mid	Higher
Power Density	Lowest. Typically only using 1/3 to 1/2 of motor torque for margin to avoid missing steps.	Low torque at high speed, may not reach needed speed. Torque margin usually needed for settling.	Field weakening produces significant nearly constant power over 2x to 4x speed region. Good efficiency over a similar speed region.	According to motor, power density is greatest near top of speed range, as is efficiency. Both typically poor when only running 1,000 RPM and less typical of lead screws and belts. Often requires a gearhead to utilize higher power capability
Acoustical Noise	Significant noise	Significant noise	Low noise	Low noise at lower speeds, high-speed whine at higher end speeds

lum does not exist, and the low-speed resonance is eliminated. The motor can be used over the full range of speeds without torque dropouts normally seen with step motors.

The servo system tuning adds damping to the system. This damping allows for very rapid motions with very rapid settling and minimal overshoot. As only the current actually needed to produce torque is applied to the motor, motor heating is minimized, and efficiency is significantly improved. With full four-quadrant control of the current through the windings, tight control is maintained both when accelerating and decelerating the load. Integral control reduces

the error, even in the presence of an offset force or friction.

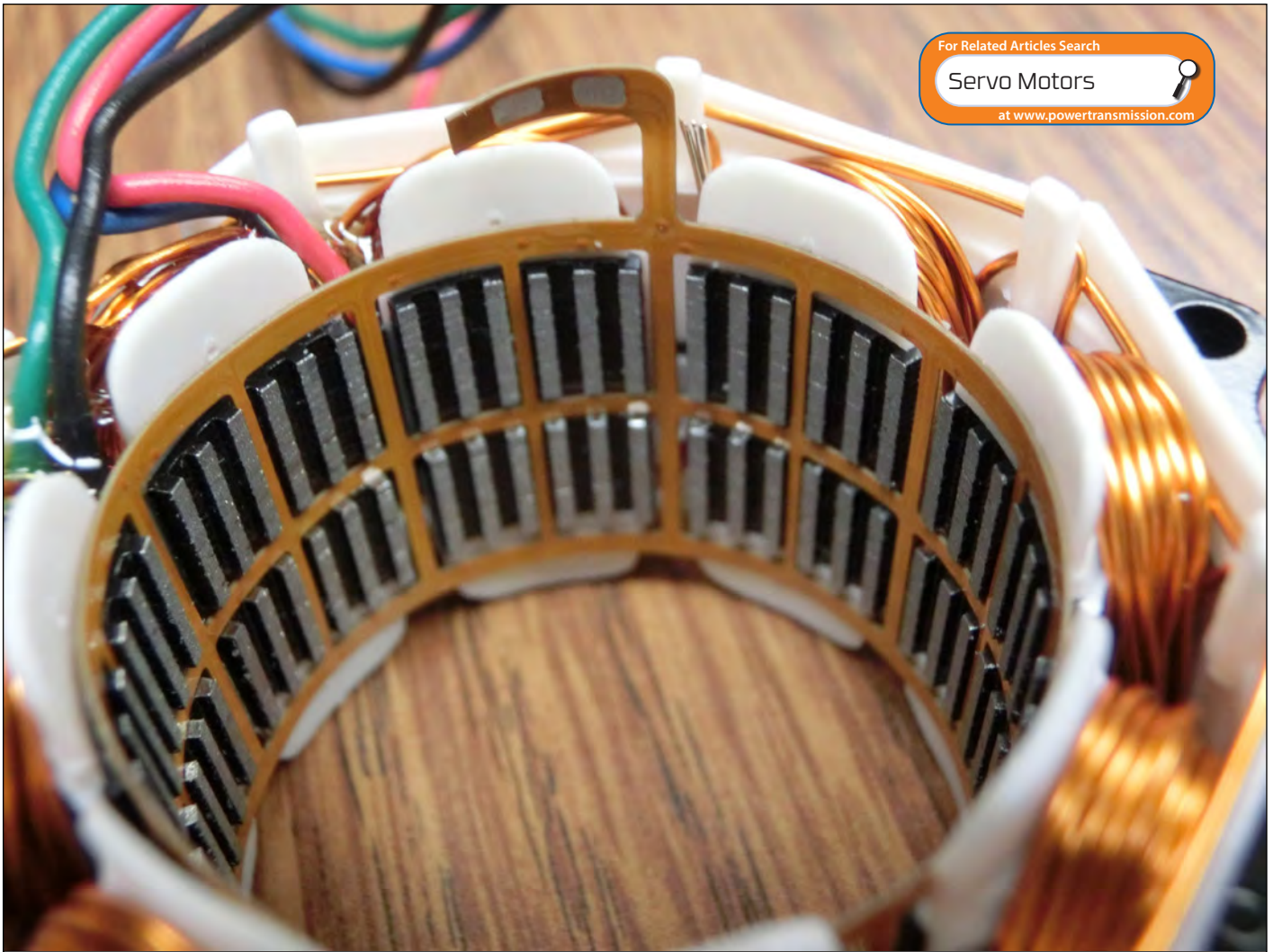
Servo control of these motors produces a controlled-to-limit torque, which can be useful in applications such as tightening caps. Servo systems also allow the designer to add a secondary feedback device to allow the load position to be directly measured. Such a dual-loop system helps compensate for backlash and other distortions in the drive path, including leadscrew inaccuracies and pulley eccentricities.

A servo system may be made very rigid when stopped, while the current to the motor may be minimized to that actually necessary to counteract the load encountered. The positioning error

can thus be significantly less than when these same motors are operated as step motors, while simultaneously reducing the motor heating. Operating these high torque density hybrid motors as servos also reduces the required torque margins, effectively allowing 2x to 3x more power out of the same-sized motors. Damping allows significant load inertia mismatch levels while still having stable and smooth operation.

Hybrid Servo versus Traditional Servo

The pole count of a motor times the number of turns in the winding times the flux density in the gap sets the torque constant for a motor. Traditional



The Mosolver from Quicksilver Controls is an example of a full hybrid servo motor.

servo motors have low pole counts—typically one to 16 pole pairs, as each pole normally requires its own magnets, and the related stator slots are normally individually wound. Due to the lower pole count, traditional servo motors typically have a lower back-EMF and the resulting lower torque constant. Traditional servo motors typically also have significant end windings, which raises the winding resistance without adding to the motor torque. While the low back-EMF allows these motors to run at high speeds, the low torque constant also limits the continuous torque of the motor due to $I^2 \cdot R$ heating of the stator coils. Efficiency generally peaks near the upper speed limits of the motor, resulting in low efficiency at low speeds.

Hybrid servo motors have a much higher pole count—typically 50 (1.8 degree) or 100 pairs (0.9 degree). The

design of the hybrid servo allows rotor magnets to be shared with many poles, enabling the high pole count while still having a simple design. The stator windings have a small end winding factor, so most of the copper is torque producing. The resulting structure results in a remarkably high motor quality factor (torque per square-root of power), allowing for high continuous torque. The trade-off is a lower top speed capability. This low speed limitation is often offset by not needing gearheads or in other cases as many stages of speed reduction for a given application.

What is Servo?

Original use of the word *servo* (from Latin for slave or keeper) was related to water clocks (aka clepsydras) of ancient times, which kept the flow of water constant by keeping the height of the water nearly constant. These mechanisms

sensed the water height in a reservoir and allowed more water in when it started to drop below a threshold. Think of the floats in a modern toilet. So, to answer the original question: To be properly be called a “servo,” the mechanism must vary its operation in response to a measurement so as to reduce the variation in the measured parameter. Thus “closed loop” does not always equate to “servo”! **PTE**

You can read more about ancient water clocks at https://aljaribook.com/en/2018/09/04/castle-clock_en/

Don Labriola, P.E., is President of QuickSilver Controls Inc., a producer of servo motors and controllers. (www.quicksilvercontrols.com).



Mars Helicopter Team

RECEIVES COLLIER TROPHY

The Mars helicopter team was recently awarded the Collier Trophy for being the first aircraft to achieve powered, controlled flight on another planet. NASA's Ingenuity helicopter flies with electric motors from the Swiss company maxon, a provider of precision drives. This award was presented on June 9th in Washington D.C. by the U.S. National Aeronautic Association (NAA).

NASA's Mars helicopter is the first controlled aircraft in history to be used on a planet other than Earth, laying the way for future airborne exploratory missions to other planets. The pioneer project has been developed by a team of engineers, including from NASA's Jet Propulsion Laboratory (JPL), AeroVironment and maxon. The more than a century old Robert J. Collier Trophy is awarded by the NAA each year marking major achievements in the timeline of aviation, including one of the Wright brothers in the 1910s and the Apollo missions to the moon in the late 1960s.

For maxon, the Mars expedition is a special highlight in its space sector experience. Both the Perseverance rover as well as the Ingenuity helicopter are equipped with maxon

motors. "It wasn't easy to meet the incredibly strict requirements of the mission. These successful flights exceeded all our expectations," says maxon CEO Eugen Elmiger.

The helicopter is manufactured by AeroVironment, an unmanned air vehicle (UAV) specialist, under contract from JPL. maxon's "SpaceLab" engineers have been working closely with their counterparts at AeroVironment. Six precision micro motors (DCX10 S) with a diameter of 10 millimeters are installed to move the swashplates. Swashplates are found on all helicopters and are made to adjust the angle of the rotor blades and thereby to control the helicopter's flight path.

It took intense development work for NASA's Mars missions. For the small helicopter to fly, it takes an incredible engineering effort. The thin air on Mars is comparable to the conditions on Earth at an altitude of 30 kilometers. This means that the helicopter must be extremely light (1.8 kilograms) and can only carry small batteries that must be highly energy-efficient, a requirement that also applies to maxon's DC motors.

"We're very proud to have joined the team of AeroVironment and JPL at the Collier Trophy award ceremony and share this great honor," says Florbela Costa, maxon's SpaceLab project



From left to right: Matt Keennon, Florbela Costa (maxon), Sara Langberg, Ben Pipenberg, AeroVironment, Inc.

manager. The SpaceLab is an organization within maxon that specializes in developing high risk new technologies for space missions, as well as supporting the growing commercial space market with high reliability actuators that are suitable for the harsh space environment.

maxongroup.com

Sulzer

BREAKS GROUND ON ELECTROMECHANICAL SERVICE CENTER IN TEXAS

Sulzer has begun the expansion of its Orange, Texas, Service Center, a project which will enhance its 24/7 electromechanical service capabilities and provide expanded capacity.

“We are delighted to begin this landmark expansion, which will further improve our industry-leading repair and upgrade services for critical electrical equipment operating in the U.S. Gulf Coast,” said Jim Mugford, president and global head of electromechanical services at Sulzer.

“This expansion and future growth is only possible because of our dedicated team, which works hard to support repair and maintenance projects around the clock. It is also important to thank our loyal customers for continuing to partner with us to help solve their most pressing maintenance and equipment problems.”

Sulzer is an independent service provider (ISP) for electromechanical equipment. Supporting its customers from a global network of local service centers, the investment at Orange ensures access to increased workshop capacity, new state-of-the-art equipment, and a large team of Sulzer experts—all of which will ensure it continues to deliver rapid response with best-in-class engineering and repair.

The Orange Service Center provides turnkey support for electromechanical equipment including all brands of motors, generators, drives and gearboxes. Furthermore, responsive field services teams are ready to rapidly respond to any on-site requirement. With this unrivalled capability, the Orange Service Center ensures that customers will benefit from exceptional equipment reliability, availability, response time and reduced lead times.

The groundbreaking ceremony was attended by local representatives, including members of the Greater Orange Area Chamber of Commerce and The City of Orange, who welcomed the new expansion.

Ida Schossow, president of the Greater Orange Area Chamber of Commerce, said: “We are excited that Sulzer has chosen to put their investment in our community. Sulzer’s sustainability and growth even during the pandemic shows the strength of the company’s business strategy.”

“The City of Orange Economic Development Corporation strives to greet new or expanding businesses with a business-friendly approach. If you’re willing to invest your time, effort, and hard-earned money into Orange, we want you to know that we are invested in you as well. We appreciate Sulzer’s decision to expand their current operation here,” added Leigh Anne Dallas, assistant director of the City of Orange Economic Development Corporation.



Sulzer’s expansion of its Orange, Texas Service Center, will enhance its 24/7 electromechanical service capabilities and provide expanded capacity.

Another benefit of the expansion is that it will further expand Sulzer’s Gulf Coast hurricane recovery services. Along with the Pasadena Service Center, Orange provides 24/7 emergency response to get customer equipment fixed as fast as possible after severe weather events. Increased capacity will ensure even more equipment can be repaired simultaneously, with the facility having the personnel, supplies and on-site generation required to meet challenging circumstances.

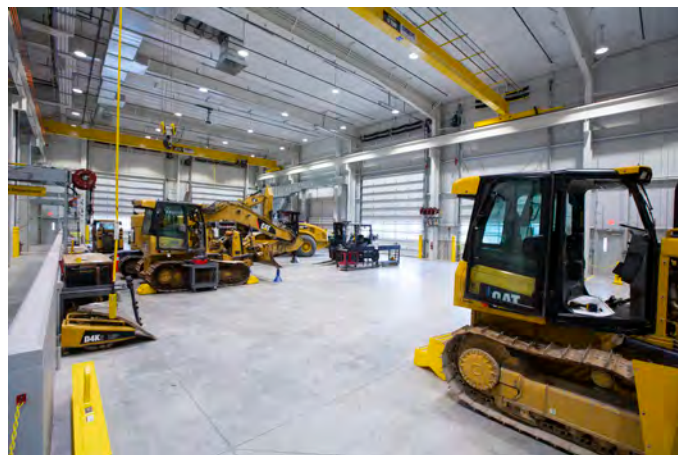
sulzer.com

Milton Cat

OPENS NEW YORK LOCATION

Milton CAT, the Northeast’s Caterpillar (CAT) equipment dealer, has opened its 13th location, a 40,000 sq. ft. purpose-built, Tonawanda, N.Y., facility. Every feature of the facility is in place to improve safety and efficiency so Milton CAT can support western New York equipment owners with machine sales, machine service, CAT parts, CAT work tools, hydraulic hose repair, and Trimble technology from SITECH Northeast. The location also offers generator rentals, CAT merchandise and has a two-acre machine operation and demonstration area.

The Wheeler Street site is the former home of the Spaulding Fibre Company, which was a pillar of the Tonawanda



community for over 80 years. “We are extremely excited to serve and support the Buffalo area with equipment, machine control technology, and timely service from our new state-of-the-art and strategically located facility. We are proud to call this historic site our new home and we look forward to carrying on Spaulding’s legacy as an involved member of Tonawanda’s business community,” commented Machine Sales Manager Jason Pierce.

The facility’s 10,000 sq. ft safety-oriented earthmoving machine service shop features heated floors to keep technicians comfortable and to dry equipment, three in-floor scissor lifts with 12,000lb capacity each for compact machines, four cranes from Simmers Crane Design & Services of Tonawanda, five oil reels that dispense triple-filtered oil, and all the tools and equipment required for a wide range of service tasks.

The parts department features a fully stocked hydraulic hose repair center with most repairs being done in under 30 minutes and an automated vertical lift parts stocking system (VLM) that stores 22,000 different line items on revolving tracks that automatically come down when a part is sourced by the system. 96% of parts orders can be fulfilled from Tonawanda’s inventory. If a part is not in stock, it will come on the nightly shuttle from Milton CAT headquarters in Milford, Mass., or CAT’s parts depot in York, PA, and be available as soon as the next business day. Customers can also pick their parts up at one of several conveniently located drop boxes throughout western New York. The drop boxes are accessible 24 hours a day.

Tonawanda is the first Milton CAT location with a SITECH Northeast presence. SITECH Northeast is an authorized, independent provider of Trimble site positioning, machine control technology, training, support, and service. The facility’s demo area will be used for CAT machine and Trimble technology sales and training demonstrations.

miltoncat.com

Applied Nano Surfaces

BECOMES TRIBONEX AB

Applied Nano Surfaces (ANS) was founded 14 years ago as an advanced surface finishing and coating technology innovator. The company offers its technologies as a commercially viable and cost-effective solution to reduce component wear and friction on many of the critical parts that are produced within the industrial and mobility component manufacturing segment.

The new company name, Tribonex, reflects its technological advancements and positions and provides dedicated solutions for solving problematic wear and friction issues experienced across many component applications. The strategic focus also included a new ownership position by First Venture Sweden AB, a technology fund listed on the Nasdaq Nordic stock exchange.

The company’s flagship technology, known as Triboconditioning, is a patented mechano-chemical surface treatment process, which has been successfully applied to both inner and outer diameters of various components



used within the mobility powertrain, hydraulics, and industrial sectors.

Applications span from automotive drivetrain components, such as transmission gears, drive shafts and differentials, to engine components such as cylinder bores, blocks, liners cam/crankshafts, to industrial components used within hydraulic motors, pumps, compressors, rock drills, and specialized gears and bearings. All areas where reduced friction and wear are important elements for efficient and reliable performance.

The need for increased wear and friction reduction technologies is ever evolving and demanding with much interest being generated by market shifts towards electromobility and the use of alternate fuels such as hydrogen being used in the mobility sector.

To meet these new demands for tougher wear resistance and improved efficiency, the company will also accelerate its development and implementation of one of its proprietary solutions referred to as Triboconditioning complex geometries (TCG). This novel mechano-chemical surface treatment is built upon the principles of Triboconditioning but is applicable for use on components with complex geometries, such as gears used within EV/hybrid transmissions, differentials as well as industrial applications including components used within hydraulic and compressor products.

tribonex.com

Automate 2022

EXCEEDS EXPECTATIONS IN DETROIT

The Automate 2022 Show and Conference celebrated the most successful event in its history, setting new records for registrants, exhibit booths and online engagement during its four-day run June 6–9, 2022, in Detroit. The show organizer, the Association for Advancing Automation (A3), expects next year to be even bigger with nearly three-quarters of an



Automate 2022, held June 6-9, set new records for registrants, exhibit booths and online engagement.

expanded show floor already booked for Automate’s return to Detroit, May 22–25, 2023.

“Automate 2022 exceeded our most optimistic expectations,” said Jeff Burnstein, president of A3. “The excitement in the hall was like nothing I’ve ever experienced. People loved being back in person and seeing all of the latest advances in robotics, machine vision, AI, motion control and more. This was the largest and best attended trade show we’ve ever had.”

Automate, North America’s largest robotics and automation tradeshow, featured more than 24,000 registrants, 600 exhibitor booths, over 250,000 square feet of exhibit space, and two million virtual views of its digital content. Exhibitors showcased the latest innovations in robotics, artificial intelligence (AI), machine vision, motion control and smart automation, and nearly 200 expert speakers from many of the biggest names in the industry offered insights on the trends and best practices behind the emerging technology in keynotes and conference sessions.

According to exhibitors, attendees at Automate came armed with a list of automation projects in need of solutions.

“Exhibitors told us that virtually everyone they met at the show has plans to automate, and some exhibitors reported selling robots right off the floor,” Burnstein added.

automateshow.com

Voith

ACQUIRES ARGO-HYTOS GROUP

Voith has acquired Argo-Hytos. Based in Baar, Switzerland, the company develops and produces components for hydraulics and system solutions with a focus on the off-highway sector (agricultural tractors, construction equipment and material handling vehicles).

“Voith is the technology leader in drive technology in many industries. We have defined the off-highway sector as an additional growth area for Voith Turbo. With its more than 70 years of experience, focus on technology and innovation as well as a clear customer orientation, the family business Argo-Hytos is a perfect fit for Voith. This makes Argo-Hytos the ideal entry point for Voith into this promising market,” says Cornelius Weitzmann, member of the Voith Corporate board of management and president and CEO of Voith Turbo.

“By combining the competencies and resources of Argo-Hytos and Voith, we want to offer our customers significant added value. In addition to the successful continuation of the previous growth strategy of Argo-Hytos, our primary focus is on the joint development of customer solutions in the megatrend areas of electrification, digitalization, and sustainability,” adds Erich Hofer, CEO of Argo-Hytos. The company will



be continued as an independent brand with the addition “a Voith Company.”

Voith is acquiring 79.5% of the Argo-Hytos shares. The further participation of the two previous owners Christian Kienzle and FSP Capcellence sends a strong signal that Argo-Hytos will consistently and continuously pursue its successful path in a new ownership structure.

“Argo-Hytos has found its new home as a strategic platform for off-highway applications at Voith Turbo,” says Christian Kienzle, former majority shareholder of the Argo-Hytos Group. “Voith will enable Argo-Hytos to continue and accelerate its long-term growth strategy, thus also offering a secure perspective to all our employees,” adds Dr. Spyros Chaveles, managing partner of Capcellence.

voith.com

Gates

PUBLISHES ANNUAL SUSTAINABILITY REPORT

Gates recently published its 2021 corporate sustainability report highlighting progress toward goals, transparency, and Eco-Innovation.

The 2021 report details their continued significant commitment and progress toward goals established through the company’s sustainability framework. Encompassing four key pillars—Governance, Technology, the Environment, and Stewardship (GTES)—the framework was developed to codify the company’s focus on sustainability.

Already aligned with the United Nations’ Sustainable Development Goals (SDGs) and grounded in the company’s core values, Gates’ sustainability efforts advanced during 2021, making significant progress against metrics in all four areas of the GTES framework focus. Gates now also reports in accordance with Global Reporting Initiative (GRI) Standards, the world’s most widely used standards for sustainability reporting, creating even more transparency into the progress the company is making.

gates.com/us/en/aboutus/sustainability.html



September 13–15—Turbomachinery and Pump Symposium



TPS (Houston) offers a forum for the exchange of ideas between rotating equipment engineers and technicians worldwide. Now surpassing 49 years, TPS is known for its impact on turbomachinery, pump, oil and gas, petrochemical, power, aerospace, chemical and water industries through an exhibition and a technical program. The TPS technical program is hand-selected by advisory committees. Topics cover maintenance, reliability, troubleshooting, instruction on emerging designs, technology, and best practices that include case studies with real-world relevance on problems solved and lessons learned.

tps.tamu.edu/

September 12–17—IMTS 2022

The International Manufacturing Technology Show (IMTS) is the largest manufacturing technology show in the Western Hemisphere. The IMTS conference brings the industry together to discuss new opportunities and network with the manufacturing community. Other highlights include the Smartforce Student Summit, Exhibitor Workshops, the Emerging Technology Center and IMTSTV. Pavilions include additive, gear generation, machining, tooling, quality, controls and more. IMTS is co-located with Hannover Messe USA where cobots, digital twins, and smart factory solutions come together under one roof. See the latest industrial automation, motion and drive technologies in the East Building.

imts.com

September 12–14—International Conference on Gear Production 2022

The requirements in gear manufacturing are increasing dramatically which delivers a dilemma between productivity (scale) and flexibility (scope) of today's technical solutions. Lead times need to be shortened in order to increase productivity while batch sizes are getting smaller and individual geometric features (topological modifications) push the need for intelligent support by manufacturing simulation and closed-loop approaches. The digitalization of the gear manufacturing processes promises high potential but also raises some challenges. In addition, new technologies evolve, that challenge the conventional manufacturing chain for gears. Topics in Garching, Germany, include manufacturing of internal gears, manufacturing processes, gear soft machining,

new concepts for machine and manufacturing processes, advances in special gearings, modeling in gear production, measurement technology and gear hard machining.

vdiconference.com/event/gear-production/

September 28–30—EPTDA Annual Convention 2022

EPTDA's Annual Convention attracts 350–400 power transmission/motion control entrepreneurs and leaders of distributor and manufacturer companies, together with their guests. Offering invaluable opportunities to network with peers and potential contacts, both formally and informally, this renowned event also presents inspiring and thought-provoking educational programs and business case studies for the member and nonmember attendees. This year's convention takes place in Warsaw, Poland.

eptda.org/event/eptda-2022-abc-warsaw/

October 17–19—AGMA Fall Technical Meeting 2022

The gear industry is faced with emerging trends and innovations challenging engineers to stay course with the latest design, quality, materials, and analysis technology. It is imperative that researchers and gear engineers communicate ideas with fellow experts in the field. AGMA's annual Fall Technical Meeting (FTM) is the forum to share research and disperse knowledge for the benefit of the global gear industry. Each year, authors selected by AGMA write peer-reviewed technical papers on gear topics such as design and analysis; manufacturing and quality; materials, metallurgy, and heat treatment; operation, maintenance, and efficiency; and gear failure. The authors will present their work at the 2022 FTM in Rosemont, Ill., (outside of Chicago). All papers presented at FTM will be indexed in Scopus, the international database of peer-reviewed literature.

agma.org/events/fall-technical-meeting-ftm/

October 24–30—Bauma 2022



Bauma 2022 (Munich) will focus on five key topics including: Zero emissions, the digital construction site, tomorrow's construction techniques and materials, autonomous machines and mining—sustainable, efficient, reliable. The show examines the latest products and technology for construction machinery, building material machines, mining machines, construction vehicles and construction equipment. Bauma features more than 3,500 exhibitors and nearly 630,000 visitors. Product groups include components, systems, services, safety, security, handling machines, drilling, mining equipment and more.

powertransmission.com/events/903-bauma-2022



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Always Fit to Print

What would trade magazines be without a healthy low-ratio, high-speed gearing system?

Matthew Jaster, Senior Editor

Print is not dead. While reading magazines cover-to-cover is a lost art—thanks to work responsibilities, 24-hour sports/entertainment coverage, and the universal time suck known as Instagram—someone, somewhere still prefers the printed word to the shiny, unfriendly artificial light of tablets and smartphones.

This publication (hopefully) provides information engineers can discuss, debate, or collaborate on for future manufacturing endeavors. There would be no words, no photographs, no advertising without the paper used to print this very magazine.

At the heart of paper mill production is the large industrial gearbox, a component that rarely gets the credit it wholeheartedly deserves for providing the right amount of torque, reduction ratios and overall efficiency gains to keep paper mills moving. The very same gearboxes that appear in *PTE* case studies, technical articles and product news items could be responsible for the paper this magazine is printed on.

The papermaking process starts by grinding wooden chips or other fibrous material into pulp. Paper mills in North America, Europe and Asia go through forming, pressing, drying, and calendaring processes to create some 400 million tons of paper every year.

Gearbox providers are tasked with maintaining the equipment for pulpers, paper machines, and vacuum pumps. These gearboxes help convert logs into building material, turn barking drums, and provide the low-ratio, high-speed gearing needed between low- and high-pressure stage compressors. They are also essential in paper recycling efforts.

Valmet, headquartered in Espoo, Finland, for example, is a supplier of process technologies, automation and services for the pulp, paper, and energy industries. The company has more than 220 years of industrial experience, cooperating with customers in more than 700 board machine and 900 paper machine deliveries worldwide.

Paper production at Valmet includes complicated machines with dryers, siphons, motors, and ventilation systems that produce paper around 3,200 feet per minute. Operating conditions are typically unkind, offering hot, dusty, grimy, and wet conditions requiring consistent machine maintenance.

There's a global field engineering team tasked with troubleshooting these gearboxes. Annual inspection visits to paper mills can become "Agatha Christie" mysteries as engineers attempt to figure out what killed the gearbox and how they can make it right to avoid plant downtime. Miraculously, these engineers can sometimes rebuild or repurpose a gearbox in one day to keep the paper rolling across the assembly line.

According to paper machine supplier Voith, the modern paper mill uses an efficient and complex series of processes and control technology for papermaking. The company is working to create the most sustainable manufacturing solutions by focusing on water management and reducing fiber consumption.

Ultimately, the technophiles of the world sometimes forget the engineering that goes into something as simple as producing a

blank sheet of paper. And the manufacturing/engineering community continues to innovate paper production lines for the future to create maintenance-free, eco-friendly products.

"Our annual statistics are proof of the resilience of this industry and its unique attributes," said Jori Ringman, director general of the Confederation of the European Paper Industries. "The pulp and paper sector remains in a leading position for its recycling performance, use of renewable energy, energy efficiency and sustainable sourcing. These are key to our capacity to develop rapidly in new markets."

Furthermore, books and magazines just smell better, it's a scientific fact!

Long live Print! **PTE**



Goodbye complex automation. Hello MOVI-C.



The MOVI-C modular automation system from SEW-EURODRIVE is a one-software, one-hardware automation platform that combines fully integrated drive components, control electronics and automation software – all from one source. The key to the MOVI-C platform is that each of those components is designed to work together perfectly.

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MOVI-C works with decentralized control architectures as well as centralized approaches, from the controller and inverter all the way to the gearbox. MOVI-C components can be fully integrated into all network standards and fieldbus topologies such as Ethernet IP, PROFINET®, PROFIBus®, Modbus®, and EtherCAT®.

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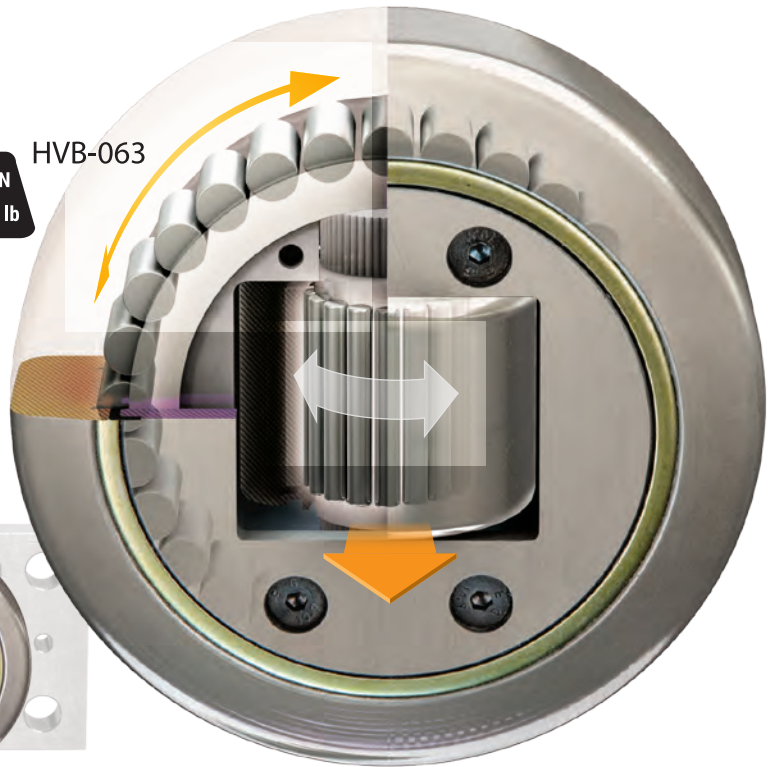
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