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IFPE PREVIEW



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March 24-26: AGMA Steels for Gear Application, Alexandria, Virginia

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Schaeffler Goes Big in Bearing Applications.





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Stearns: 87 Series SAB Brake

Avoid excessive downtimes and keep production moving with this self-help video resource. This step-based tutorial explains how-to reset the self-adjust lever arm position on Stearns 87,000 series brakes using comprehensive 3D modeling animation. Watch these methods carefully before installing, operating or self-servicing your Stearns brake. The concepts in this video can also be applied to other standard models of Stearns 81, 82 and 86 series brakes.

www.powertransmission.com/videos/Stearns-How-To-Series-3-Methods-to-Adjust-the-Lever-Arm-Position-on-Your-87-Series-SAB-Brake---



Klingelberg: Roller Bearing Measurements

The complete solution for GD&T, Form, Contour & Surface Roughness Measurement — Dr. Christof Gorgels, director precision metrology at Klingelberg presents solutions for roller bearing measurements.

www.powertransmission.com/videos/Klingelberg-Roller-Bearing-Measurements-



Editor's Choice: Condition Monitoring with SKF

Advances in condition monitoring technology means maintenance and operations teams can spend less time collecting data, and more time acting on it, says Chris James, product line manager for permanently installed condition monitoring at SKF. Learn more here:

www.powertransmission.com/blog/from-walkarounds-to-wireless-monitoring/

Event Spotlight: International Fluid Power Conference 2020

The 12th International Fluid Power Conference (Dresden, Germany) offers future trends and innovations in the field of fluid-mechatronic systems. Throughout a series of technical lectures and during the accompanying exhibition, there will be many opportunities to discuss ideas with scientists, end-users and manufacturers from all over the world.

www.powertransmission.com/news/10192/International-Fluid-Power-Conference-2020-



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Cast Your Ballot



It's presidential primary season here in the United States, and we thought we'd get in on the action by encouraging you to take part.

No, this is not a message about politics. We don't care whether you're Republican or Democrat. But we do want you to vote. We want you to vote for us.

The ballot appears on page 55, and it looks suspiciously like a subscription form.

Please fill it out. We need your support.

A vote for **Power Transmission Engineering** helps us better understand who you are, what you do and how we can provide you with the information you need. In addition, your support helps us in a number of very tangible business-related ways :

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Of course, no stump speech would be complete without telling you what we've done for you lately. However, unlike what you often hear from politicians, every word that follows is 100% true!

Every issue we try to give you a blend of mechanical power transmission articles, and this issue is no exception. We start it off with our focus on fluid power. Alex Cannella's article (page 20) touches on increasing power density in fluid power systems as well as ways to extend the service life of fluid cylinders. Also, the IFPE trade show—held in conjunction with CONEXPO (March 10-14 in Las Vegas)—only comes once every three years. So don't miss Senior Editor Jack McGuinn's IFPE preview on page 40.

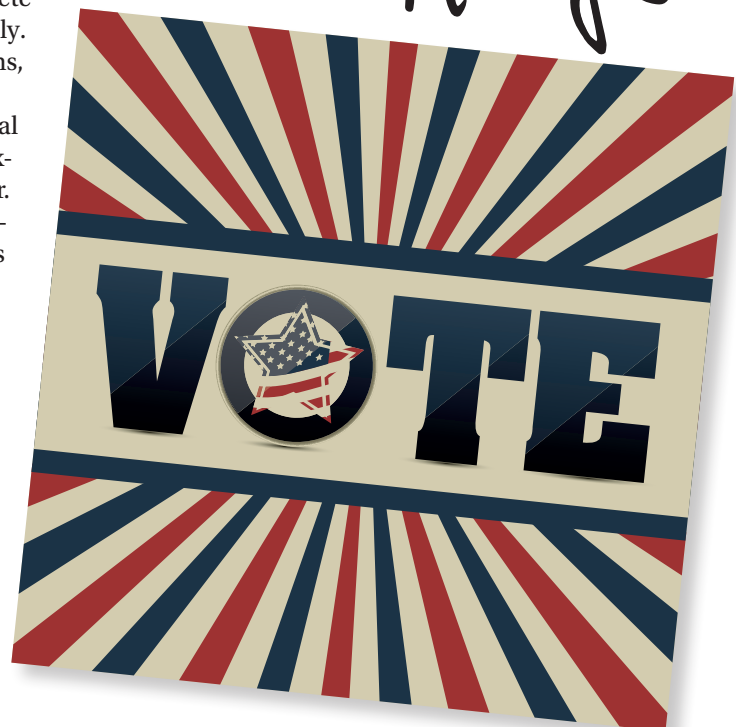
Senior Editor Matt Jaster's in-depth feature on mechatronics (p.24) delves into the flexible, intelligent drive systems being offered by many of the leading suppliers, and his article on gearmotors talks about harsh environments, digitalization, customization and improved service life.

For something on the lighter side, we have an interesting case study on an agricultural application you may not have heard of: automated brush systems for cows (p.36). Our technical articles this issue focus on computing gear sliding losses (p.42) and motor sizing for unusual loads (p.46).

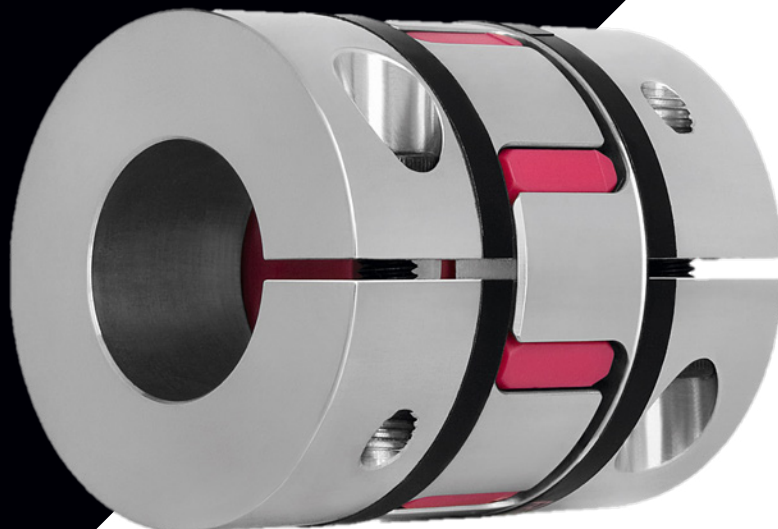
And our Power Play this issue tops it all off with some really big bearings (p.56).

We're proud of the issue, and we believe you'll find a lot of great articles to read. So please turn to page 55 and cast your ballot for **Power Transmission Engineering**.

Randy Stott



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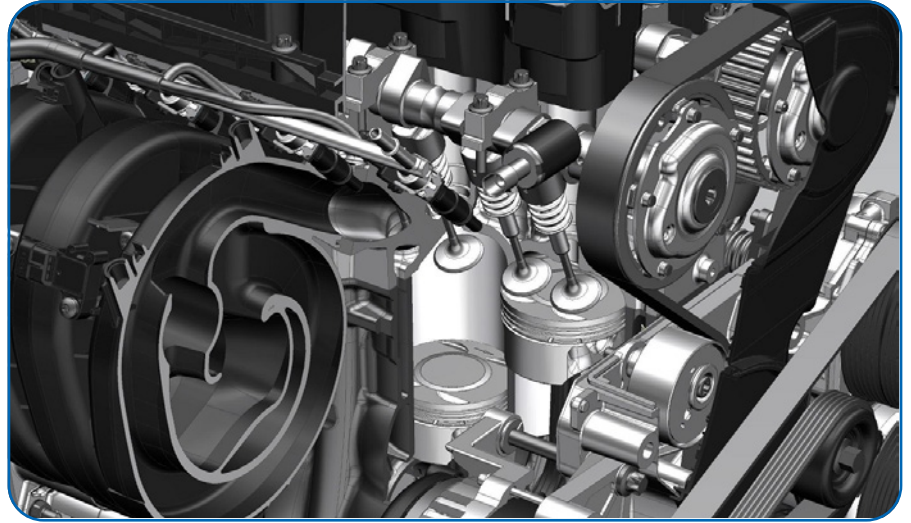
Siemens Digital Industries Software

RELEASES LATEST VERSION OF PARASOLID AND UPDATES SIMCENTER PORTFOLIO

The latest version of *Parasolid* software is now available from Siemens Digital Industries Software. The updates to *Parasolid* include enhancements to Convergent Modeling technology, which can now operate on models containing a mix of facet B-rep surfaces and classic B-rep surfaces, helping to enable more efficient workflows in a wide range of applications. For example, in generative design, where new products are autonomously developed to satisfy design constraints, Convergent Modeling can restore precise, classic mating surfaces to a model that has undergone facet-based topology optimization. In reverse engineering processes, the new technology can be used to add precise analytic surfaces to scanned data of parts for re-manufacture.

The *Parasolid* geometric modelling kernel is used in Siemens' own *Solid Edge* software and *NX* software and is at the core of the *Xcelerator* portfolio's open and flexible ecosystem. *Parasolid* is also used by over 350 other products including many world-leading CAD/CAM/CAE/AEC software applications.

The company also announced new releases of Siemens *Simcenter MAGNET* software and *Simcenter Motorsolve* software for simulating electric motor design and electromagnetic fields at any stage of the design process. Electric traction motors must be durable and NVH-compliant, however, electromagnetic forces induce mechanical vibrations which may lead to failure. The



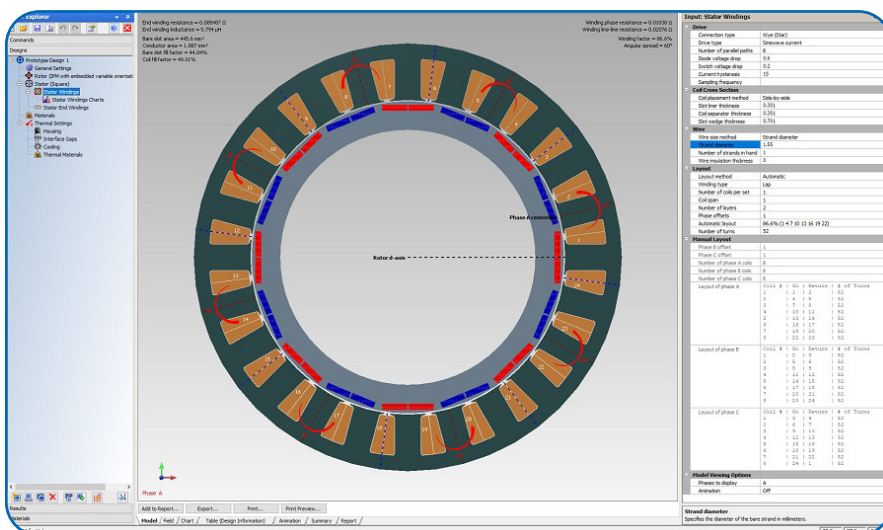
Simcenter MAGNET and *Simcenter Motorsolve* solution calculates the behavior of electromagnetic forces on individual components, providing examination of the structure and materials integrities under multiple operating conditions during any phase of the design process. These new capabilities are important for implementing a realistic digital twin of electric and hybrid electric vehicle powertrains or for any application where NVH constraints are critical, such as aerospace, industrial and medical equipment.

Siemens' approach to NVH analysis is unique since the *Simcenter Motorsolve* tool uses smart 2.5D technology to generate a 3D nodal force mesh model based on 2D simulations, significantly accelerating analysis with accurate

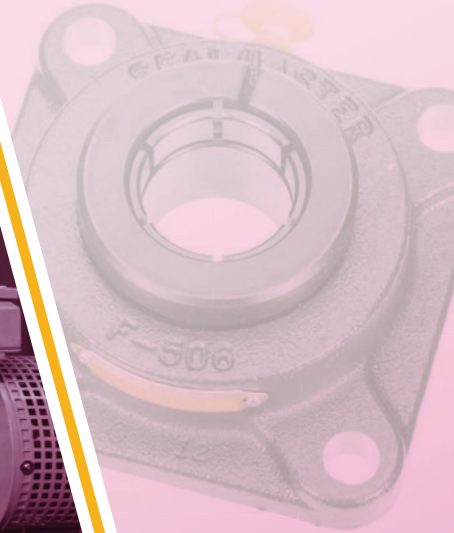
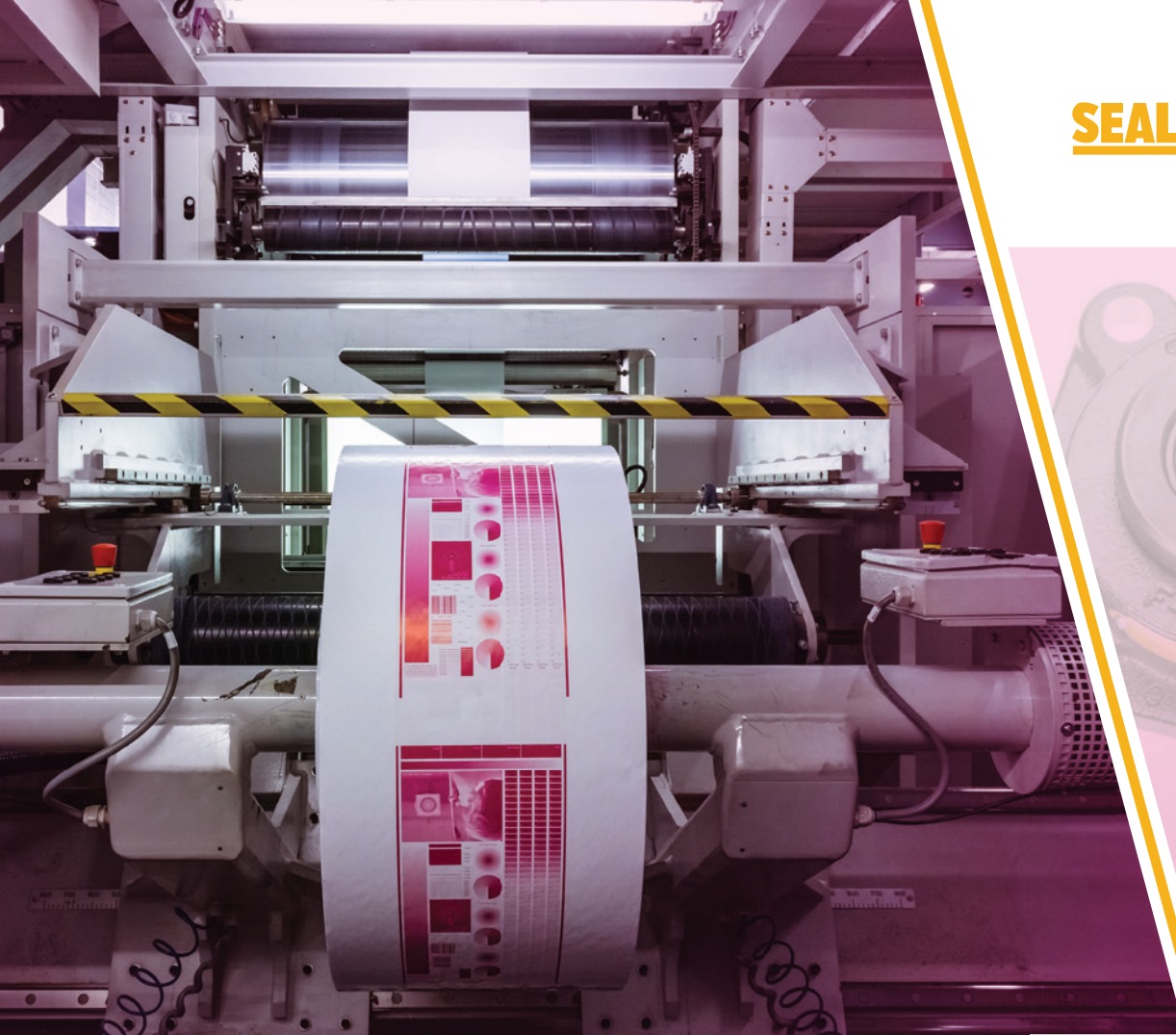
results. Net forces on components can be determined using *Simcenter MAGNET* software, even when they are in contact, including artificial component grouping. *Simcenter SPEED* PC-BDC models can be seamlessly imported into *Simcenter Motorsolve* software for higher-resolution finite element simulations, and *Simcenter 3D* electromagnetic software integration can provide optimal electric motor simulation performance results. Now, design engineers can apply a wider range of real-world conditions in their electro-vibro-acoustic simulation analysis.

Siemens provides the most comprehensive automotive and transportation software portfolio in the industry, combined with an application development platform to accelerate the efforts of engineering teams to innovate with confidence. Automotive manufacturers, suppliers, technology startups and industry leaders apply Siemens comprehensive digital twin to create the most robust digital representation of automotive systems and real-world environments, blurring the boundaries between engineering domains, and between the digital and physical worlds.

"Our *Simcenter MAGNET* and *Simcenter Motorsolve* solution addresses the key challenges electric motor designers face for NVH compliance," stated Roland Feldhinkel, vice president simulation and test solutions,



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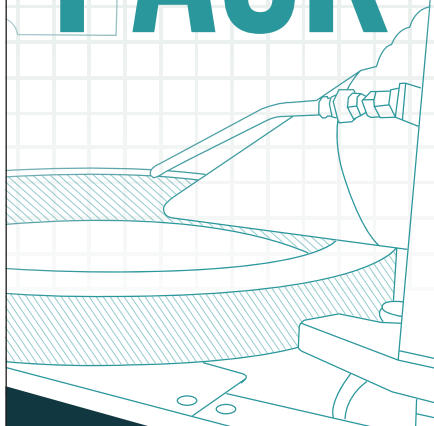
For improved lock reliability compared to older and competitive designs, the new redesigned Sealmaster® Skwezloc® concentric collar locking design achieves improvement through an innovative circumferential groove on its inner ring bore that reduces stress on the inner ring when properly clamped to the shaft. A larger cap screw and collar also improves the clamping force.

By reducing the stress on the inner ring and adding a groove that decouples from the inner ring to improve elasticity, Sealmaster Skwezloc locking collar has a design that accommodates commercial (turned & polished) shaft tolerances. This allows OEM's and end users to specify a lower cost shaft depending on application requirements.

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R+W

INTRODUCES INTELLIGENT COUPLINGS FOR PROCESS RELIABILITY

SASCHA MARKERT, DEVELOPMENT MANAGER, R+W ANTRIEBSELEMENTE GMBH

Accurate measurement of torque and other parameters can be a challenge in machinery applications, as measurements taken at the drive and motor only tell part of the story. To address this challenge, R+W is launching a completely new measurement device in its Intelligent Coupling. This specialized coupling creates entirely new possibilities, providing wireless transmission of mechanical data from directly within the drive train.

The objectives of the Industrial Internet of Things (IIoT) include optimizing operational efficiency, reducing production costs and monitoring equipment condition. Various production processes can be better adapted to given requirements with better data. With modern methods, such as predictive maintenance and artificial intelligence in machines, process reliability

has been significantly increasing in new plants and production facilities. This serves to reduce cycle times and increase product quality.

Collecting accurate data in the field of drive technology is not always a simple task. Data monitoring in a rotating drive train is difficult because a direct networking cable connection is often impossible, or the machine lacks sufficient installation space for the necessary instrumentation. R+W now offers a user-friendly and widely applicable hardware and software solution in its Intelligent Coupling.

Coupling with smart measurement system

The Intelligent Coupling is an upgraded standard coupling with integral sensors to provide additional measurement functions. The system

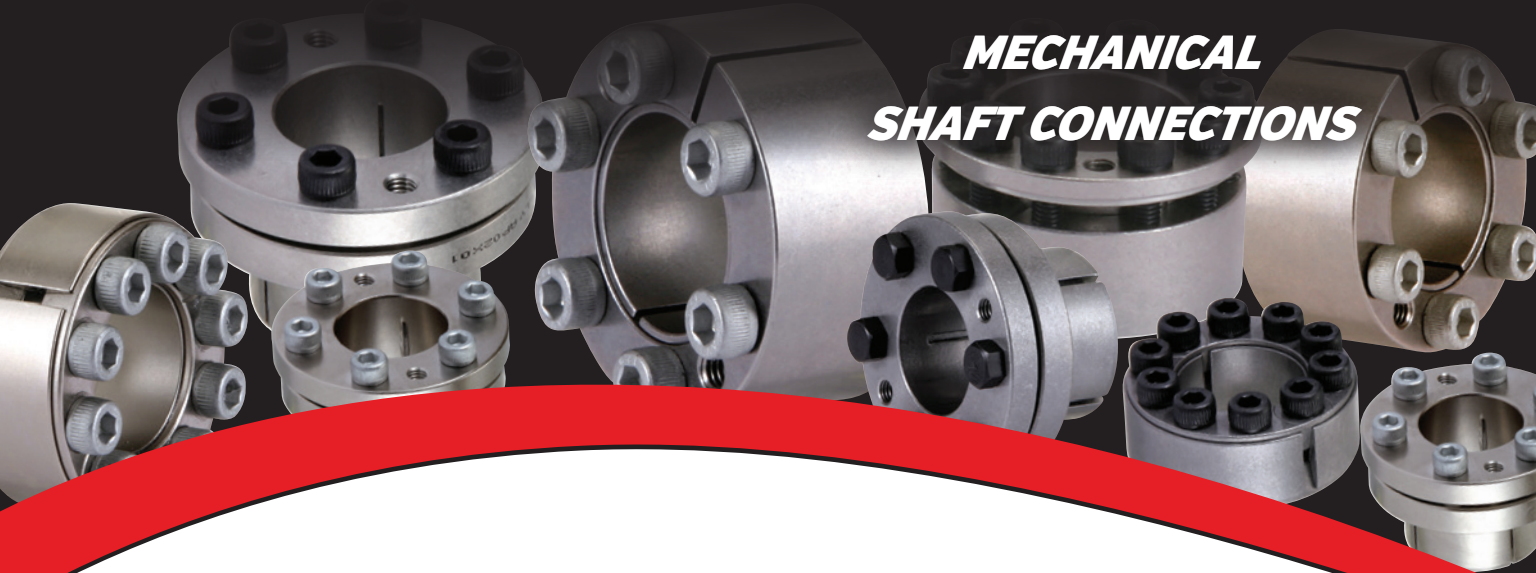


The R+W App displays the data on the dashboard in large views and a variety of other diagrams.

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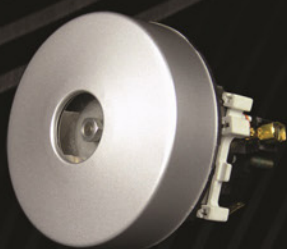
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measures torque, rotational speed and vibration as well as axial forces, at a sample rate of 500 Hz. The data is processed directly within the electronics package and displayed on a wirelessly connected smartphone, tablet, computer or PLC. On the R+W App for mobile devices the data can be monitored graphically in clearly arranged windows. A recording and export function provides the opportunity for further analysis. The mechanical properties of the intelligent coupling are not affected by the integrated electronics. It can continue to compensate for axial, lateral and angular misalignment and transmit torque as any other flexible coupling can.

Measurement directly in the drivetrain

Like the purely mechanical version, the Intelligent Coupling can be easily integrated into most drivetrains. The installation options are not limited by a permanent cable connection. The use in confined spaces or in mobile applications is made possible via an integrated rechargeable battery, with an inductive power supply also possible. Data can be sent to the connected device in near real time using a Bluetooth Low Energy connection. The R+W App displays the data as an average value with min/max memory on the dashboard. Various scalable chart types track the detailed progress of the data. Data from multiple couplings can also be illustrated simultaneously. For

further analysis, the data can be saved and downloaded as a CSV file.

Quick and easy data acquisition

With the Intelligent Coupling R+W offers a smart alternative to a torque transducer, with reasonable accuracy and a comparatively low cost. Another advantage is the relatively small space required for installation of the coupling, since no complex auxiliary construction is needed for installation, beyond the coupling itself. The intelligent coupling can be quickly and easily mounted into driveline designs or integrated into existing systems.

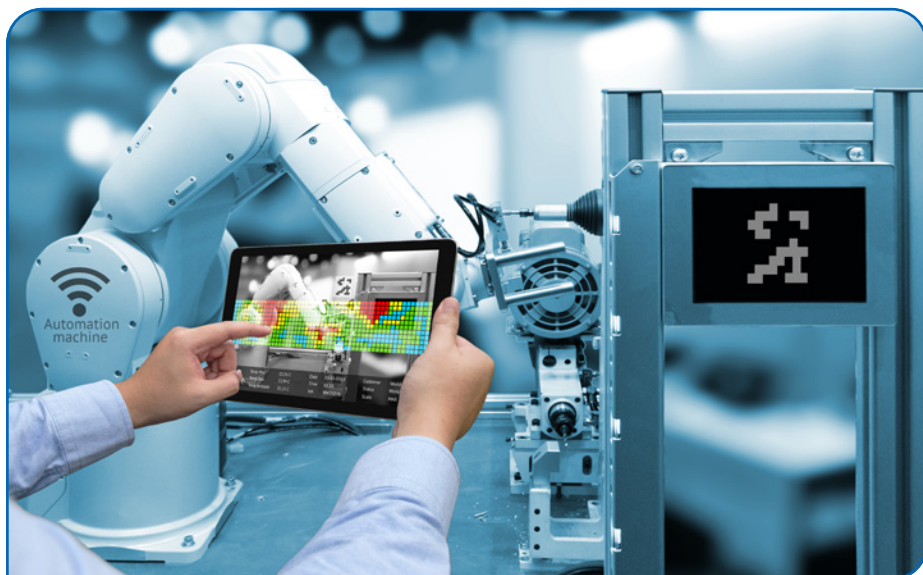
Enhanced transparency in the drivetrain

The combinable, time-dependent measurements can be used, among other things, to achieve a better assessment of the dynamic behavior of rotating drive components. By determining torques and axial forces, failure and downtime can be reduced or prevented entirely, increasing plant availability and reliability.

The entire potential for this development is far from fully realized. New functions and various algorithms for evaluating the data ensure that the intelligent coupling becomes even smarter and sets new standards in the drive technology market.

For more information:

R+W America
Phone: (630) 521-9911
www.rw-america.com



Measurement of torque and speed directly in the drivetrain by an already integral component: the coupling.

Regal

INTRODUCES KLAMPLOC ADAPTER LOCK FOR SEALMASTER SPHERICAL BEARINGS

Regal Beloit Corporation has announced the release of the new Klamploc adapter lock for Sealmaster mounted unitized spherical roller bearings (USRB). The Klamploc adapter lock was designed to simplify the installation process while improving shaft lock reliability. It accomplishes these goals with two unique design features.

The first feature includes key installation steps that are written on the lock collar. Regal always recommends fully reading the installation instructions prior to attempting an installation. Often, after bearings are removed from their boxes prior to installation, the boxes and the installation sheets get discarded by users. Or, the sheets might be reviewed ahead of time, but the installation specifications do not get memorized or are unavailable when needed at a job site. Because the Klamploc adapter has installation steps clearly marked on its collar, the installer can simply read the specs from the bearing itself.

The second key design feature is a split collar with a cap screw to close the split. With the Klamploc adapter, there are neither parts to remove and then install nor parts to bend on the bearing. Other market options require one or more parts to be removed before installation. This not only introduces additional non-value-added steps, but it also creates a situation where these parts, often small, can be lost.

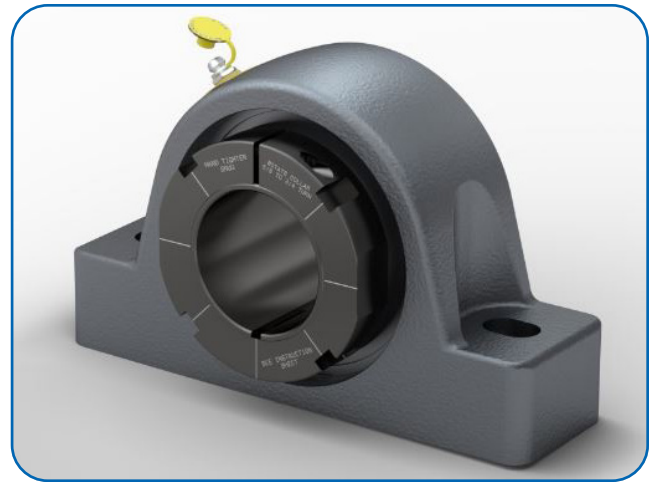
“Other market options require a tab to be bent down to achieve the final lock, but bent tabs can be subjective,” said Jason Annes, senior product manager, Regal Beloit. “With the Klamploc adapter, the final lock of the collar is achieved by simply tightening the screw to the specified torque, eliminating the competition’s several steps.”

In addition to offering simplified final locking, the split Klamploc collar has a benefit unique to the industry. When tightening the collar cap screw,

the split collar compresses and grips the adapter sleeve, which can provide additional clamp force to the shaft when combined with the properly set adapter lock.

Sealmaster USRB bearings with the Klamploc adapter lock have launched in bore sizes of 5 inches and below. Sizes above 5 inches will be launched in 2020. Additionally, a spanner installation tool is available. This tool, when used with a half-inch drive breaker bar, speeds up the installation process further by tightening the collar in one step, rather than using several blows from a hammer and drift.

USRB bearings with Klamploc adapter lock include the Sealmaster



sealing, which helps to keep contaminants out of the bearing in the toughest and dirtiest situations. USRB bearings can be found in aggregate process, unit material handling, air handling, agriculture, metals and mining, and other industrial applications.

For more information:

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SKF

INDUCTION HEATER MAKES HOT-MOUNTING BEARINGS FASTER AND SAFER

The TWIM 15 induction heater has been designed to simplify the hot-mounting process. Alberto Herrera, product development manager at SKF, says: "All the operator has to do is to place the bearing in the center of the heater and connect a temperature probe to the top of inner ring or workpiece bore. With the push of a button, the TWIM 15 will heat the bearing to the target temperature for hot-mounting."

Induction heaters introduce heat into a component using alternating magnetic fields. These fields create currents in the bearing or workpiece, which heats up owing to its natural resistance to electric currents (the so-called Joule effect). The resulting increase in temperature causes the material to expand, allowing the bearing to be mounted without any friction or force. As soon as the bearing is



correctly positioned and the temperature decreases, it contracts to its original form and creates the right interference fit on the shaft.

This process reduces risks of damage to the bearing, shaft and operator compared with other methods for heating bearings such as oil baths or open flame. However, some induction heaters can cause overheating, which can damage the bearing.

The TWIM 15 is fitted with a temperature probe, smart electronics and an advanced operating software, enabling the heater to optimize the heating process accordingly, ensuring that the bearing is heated safely and reliably.

The TWIM 15 is more versatile and convenient to use than other bearing heaters. It features a flat induction plate that does not require the use of a support yoke and it can heat a wide variety of bearings and components, including sensitive parts such as bearings with reduced clearance.

Brian Jagmohan, product marketing manager at SKF, says: "Bearings can fail prematurely if they are not installed correctly. Getting the temperature right during hot-mounting is a key part of avoiding untimely failures. What sets the TWIM 15 apart from other induction heaters is its performance and versatility. It is simple to use yet offers superior safety and reliability."

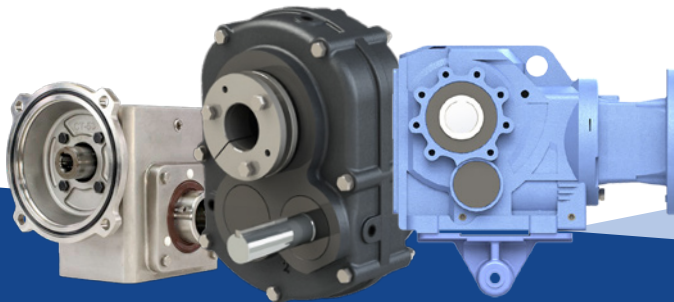
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Miki Pulley has introduced its “Paraflex” Pin-Hub Couplings for direct sale to OEM’s in North America. Key features of these couplings include high allowable misalignment, extremely low backlash and resonance dampening.

With a pin-bushing type design, these Paraflex Couplings are available in two models. The CPU model has a maximum torque of 25 Nm and allows angular misalignment up to 4°. The CPE model has a maximum torque of 10 Nm and allows angular misalignment up to 1°. Available bore sizes range from 3.0 mm to 22 mm.

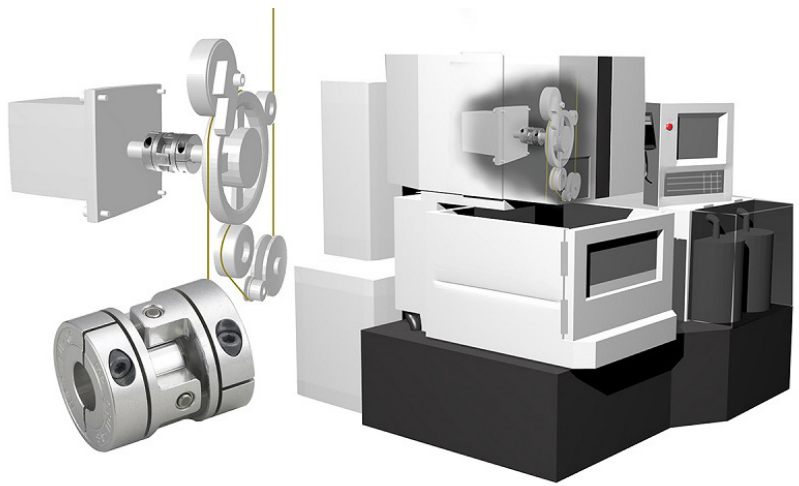
An important feature of these Paraflex Couplings from Miki Pulley is ease of installation. Clamp style hubs made of sintered aluminum slip easily onto two connecting shafts with the coupling locked into position with recessed tightening screws.

Handling system speeds up to 6,000 rpm depending on model, Paraflex Couplings are RoHS compliant. They operate in temperature environments from -30°C to +100°C. They are ideal for automated packaging systems, chip mounters, electric discharge machines and similar applications.

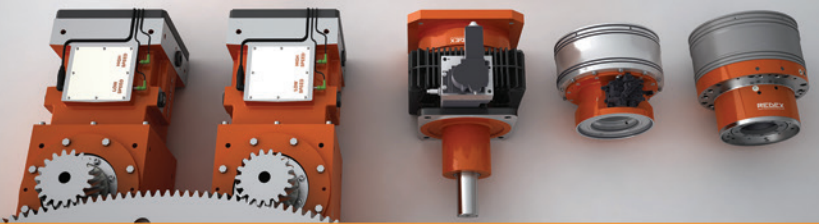
In addition to the Paraflex Coupling line, Miki Pulley designs and manufactures a complete line of motion control components. These include clutches, brakes, flexible shaft couplings, shaft hub locking devices and speed control devices.

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Applied Motion Products

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Applied Motion Products offers an extended line of stepper motors with IP65 ratings that are dustproof and resistant to water pressure impact, making them ideal for use in wet and dusty applications.

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These IP65-rated step motors are available in NEMA sizes 23, 24 and 34. A double-shaft version is available with an optional IP65-rated encoder



for applications requiring feedback. The step motors operate with Applied Motion Products stepper drives that offer advanced current control for optimal smoothness and torque. In addition to communication options including EtherNet/IP and Modbus, the stepper drives offer stored program execution using the Q programming language.

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Forest City Gear

ADDS FINISH GRINDING CAPACITY

Forest City Gear has expanded its capacity for very high precision finish grinding of external, internal, straight and helical gears and special profiles with the addition of its second Kapp VUS 55P Form Grinding Machine.

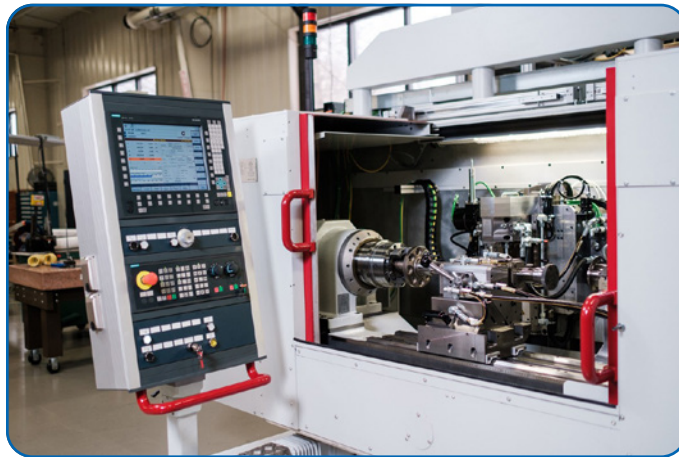
The new Kapp Form Grinder gives Forest City Gear the ability to rough and finish grind internal gears with an ID grinding diameter as small as 1.250", and external gears with an OD grinding diameter as large as 19.685". Additionally, the new machine is equipped with a high speed, 35,000 rpm external grinding spindle, so it can use smaller diameter grinding wheels to more productively grind gears positioned close to shoulders where an interference condition might exist for larger wheels.

In addition, the new machine is equipped with a specific wheel dressing unit, enabling Forest City Gear to run dressable Ceramic and VitCBN grinding wheels for both internal and external gears to meet all types of profile requirements. The combination of on-board dressing and optional on-board measuring systems both speeds and automates the entire grinding process.

"While our first Kapp VUS 55P continues to be a dependable grinding workhorse, this new model gives us more versatility to meet the requirements of our increasingly diverse mix of high precision projects," says Forest City Gear Grinding Lead Person Kevin Chatfield. "With quality and delivery standards higher than ever across all the industries we serve, this machine is a great addition."

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ABB

OFFERS BALDOR-RELIANCE EC TITANIUM INTEGRATED MOTOR DRIVE

Motor standards have been in place for decades, yet there is a growing demand to achieve greater efficiencies as regulations continue to tighten on the total system for fans, pumps and compressors. Equipment manufacturers are turning to new motor technologies to achieve the highest system efficiency possible from wire to air while using sustainable materials.

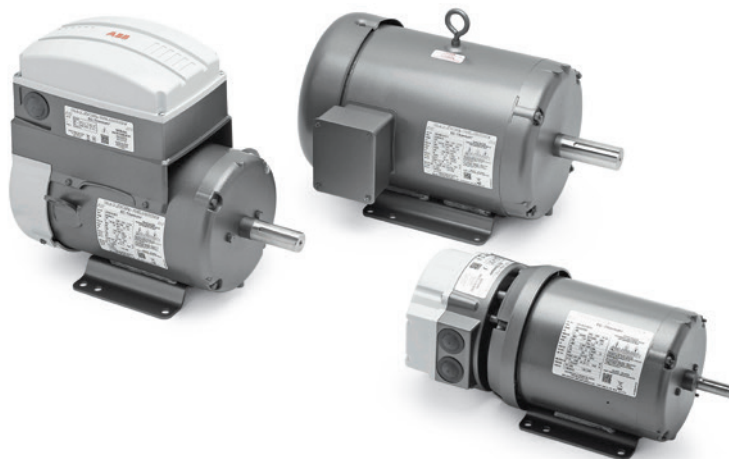
ABB's Baldor-Reliance EC Titanium product line utilizes Ferrite Assisted Synchronous Reluctance (FASR) technology with non-rare earth magnet materials to meet and exceed IE5 efficiency. Suitable for constant and variable torque applications, the EC Titanium offers excellent performance across a wide speed load range and above base speed conditions.

"The EC Titanium product line is economic and efficient, even at partial loads where most fans operate," says Mark Gmitro, global product manager for variable speed motors, ABB. "The real advantage is that efficiency stays high at any speed; including operation above base speed, allowing for greater

fan design optimization."

The near unity power factor of the EC Titanium enables the use of smaller drives, reducing the footprint and weight of the integrated system. Additionally, the integrated motor drive solution saves considerable control panel space and reduces wiring costs by placing the drive on top of or on the opposite drive end of the motor.

Integrated motor drive models are ABB Ability ready with built in capability allowing building operators to have greater connectivity and transparency of their equipment.



The Baldor-Reliance EC Titanium product line is offered in standard NEMA dimensions and can be provided with IEC mounting compatibility. Ratings are available as a motor only option from 1 to 20hp (0.75-15 kW), as an integrated motor with a top mount drive in ratings of 1 to 10hp (0.75-7.5 kW), or axial mounted drive in ratings 1 to 7.5 hp (0.75-5.5 kW).

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Gates

RELEASES SUPER FLEX POLAR BELT FOR EXTREME CONDITIONS

Gates has expanded its thermoplastic polyurethane (TPU) drive belt product line with the introduction of the Super Flex Polar belt. Designed specifically for indoor and outdoor applications operating in temperatures as low as -30°C and -22°F, the Super Flex Polar is the optimal conveying solution. The belt is available in a wide range of lengths and widths to accommodate the requirements of most original equipment manufacturers (OEMs) and distributors. Using the extrusion

process, the new belt has helically-wound steel cords that allow for improved flexibility and work efficiently in tight, confined, temperature-specific spaces where small pulley diameters are critical.

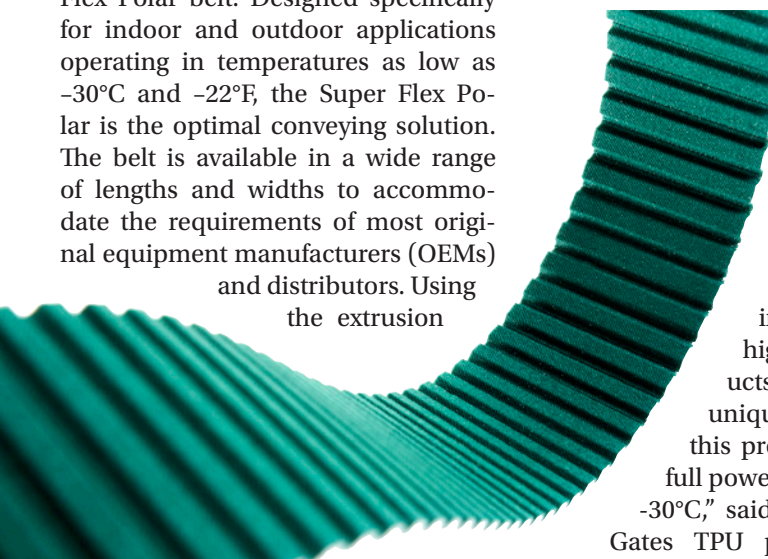
"Through our passion to continually develop innovative and high-quality products, we've added a unique TPU resin to this product line to offer full power capacity down to -30°C," said Heinz Watzinger, Gates TPU product manager.

"This belt can be used with new equipment, or as a replacement, in any extreme cold working environment to meet a wide variety of needs. And, our product doesn't require a special order, which is novel in the marketplace."

All Gates TPU belts are made from an abrasion-resistant polyurethane material providing thermoplastic flexibility, as well as long-lasting and energy efficient belt system solutions for the most demanding applications. The Super Flex Polar is designed for a diverse range of industries and markets, including offshore plants, glass, ceramics, packaging and textiles.

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Tackling Fluid Power Challenges

Increasing power density and improving cylinder lifespan are key issues.

Alex Cannella, Associate Editor

A focus on power density is a growing part of life no matter the industry you're in. No matter where I go or who I ask, it comes up time and time again: Customers want everything in a smaller package, but that doesn't make the torque required for a job magically any less demanding. And so power density becomes the buzzword of the day, with component manufacturers working to either shrink down existing designs without compromising on power or beef up models without getting bigger.

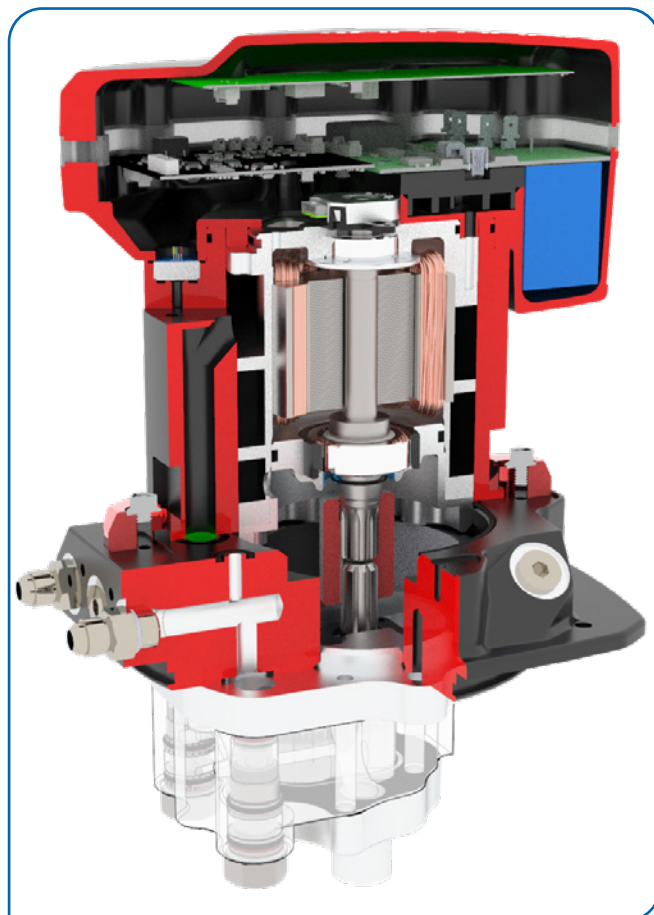
Depending on who you ask, the fluid power industry isn't immune to this surge in demand, either. For some components, it's more important than others, but as with any other industry that somehow ends up using common components like motors, downsizing is an inevitable drive.

Which brings us to Hydrapulse, a package that sells itself on its downsizing benefits.

Hydrapulse has a pretty straightforward pitch. What if you just took a hydraulic power unit with all of its varying components—induction motor, pump, valving, etc.—and just sold those ancillary components pre-attached in a single, cohesive unit?

There's a little more to it than just that, of course. Hydrapulse is also a hybrid power solution. Its PCP board inverter and other electronics also come pre-installed, giving users the ability to control both the pressure and flow of the system, out of the box.

But the main selling point is the assembly's, well, pre-assembled nature. No need to hunt down and acquire a dozen different components, or hash out how you're going to make it all fit inside your own product's parameters. Everything's



Hydrapulse from Terzo Power Systems combines electronic, fluid power and mechanical components in one compact system.

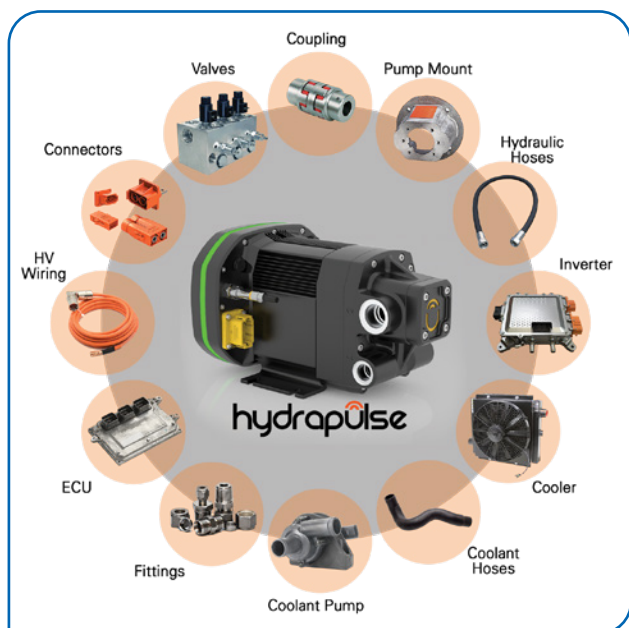
already together and, perhaps most importantly, already guaranteed to work together.

"The idea is that by having that integration already done, that that will reduce installation costs, troubleshooting costs, and it will be a lot more efficient," Rich DiGirolamo, VP of sales, distribution, and business development at Terzo Power Systems, which developed the Hydrapulse, said.

In addition, having everything pre-installed has kept the entire package as small as possible, which is perhaps Hydrapulse's biggest boon. With the manufacturing sector increasingly pressured by power density demands in general, smaller is almost always going to be better.

It's a different approach to improving power density. Usually, doing so would involve looking at different materials and often hiking up costs in the process. But "what if we pre-Tetris'd most of the system's components into one optimized package" tackles the same issue from another angle that often goes overlooked: efficiency. In this case, space-conscious efficiency.

And according to DiGirolamo, the advantage in efficiency and power density that Hydrapulse enjoys doesn't just come down to its smaller package. Sometimes, it can have as much



By combining a wide variety of component technologies, the Hydrapulse system aims to provide smart, flexible systems in a small package.

to do with the existing legacy systems it replaces, which may not always be as efficient as they could be due to a lack of proper diagnostics on hand to inform an OEM's decisions.

"What we're finding when we're going to certain places is a lot of times, they're not exactly sure. They didn't use diagnostic information when they developed the equipment," DiGirolamo said. "A lot of hydraulics is sort of like a black art. People go out and there and say 'ok, we're going to build this and this is kind of what we think it is.' But the diagnostic information is typically not completely dialed in to what specifically pressure or flow you need."

DiGirolamo related how, without the right tools or diagnostics, they'd occasionally find some OEMs who were missing that mark and oversizing their equipment. Hydrapulse manages to tackle that issue head on with built in diagnostics to give those OEMs that information they didn't have last time they designed their hydraulic system.

"If they had a Hydrapulse on their unit — if [oversizing] was even a question for them — they could just go in immediately, reset the pressure and flow on that, and see if they could push the load at a lower power output requirement," DiGirolamo said. "And they could do it right then and there. It

wouldn't even require them to go and plug in diagnostic information. They would be able to see that immediately."

And just as importantly, they'd be able to act on that information, thanks to Hydrapulse's aforementioned ability to adjust the system's pressure and flow. That's not just shaving down on a product's size — that's also energy savings, and energy savings mean monetary savings.

But even beyond Hydrapulse's primary pitch, a whole bevy of additional, compounding benefits spiral out from design decisions made to keep the entire installation small. One notable example: customers can get a Hydrapulse unit without any manifold valving, perhaps the device's greatest space-saving trick of all.

How do they get away with being able to just discard such an important component? Hydrapulse's hybrid design means that for a vast majority of the time, only the battery is



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required for it to run. The only time the motor actually activates is to recharge that battery, and when the motor only needs to turn on intermittently, the overall system produces significantly less heat. And with a primary source of heat removed, manifold valving becomes superfluous, especially in non-continuous duty applications.

This is what I mean about compounding benefits. One decision naturally improves performance in other metrics, which in turn unlocks additional options for Hydrapulse to further improve their product.

Of course, it's still possible to get Hydrapulse with attached manifold valving if the application demands it, which admittedly in some cases, it does. Terzo's got plenty of different ways to implement their system depending on the demands of the application.

"It's sort of what you want to do," DiGirolamo said. "You can have one Hydrapulse that meets an overall power requirement for multiple different functions and use a valve selector and run several functions simultaneously. You could also have a Hydrapulse that is run directly to each individual function and that would completely eliminate all the valving. Or you could take the Hydrapulse and you could plug it into a traditional directional/proportional control valving system and have it just function in the same way that an induction motor would or a VFD servo drive/servomotor would, but it would just be a power on demand system overall."

Hydrapulse works across a wide range of industries: agriculture, construction, hybrid utility vehicles, buses, lifts, doors—the list of applications Terzo is marketing Hydrapulse to is extensive, with its only limiting factor being its intended for use with hydraulic systems.

Perhaps most interestingly for the purposes of this article, Terzo finds itself straddling both sides of the power density question. On the one hand, power density is a major bullet point for products they sell like Hydrapulse. On the other, they have to consider the power density of the components they include in their own designs with Hydrapulse, as well. Not all of the assembly's various components are manufactured in-house—a fair number of them are outsourced. And for a product that sells itself on power density gains, it's only natural that the power density of the components they outsource for also be a top consideration.

"Our value is in our integration," DiGirolamo said. "Being able to integrate all those components of a traditional hydraulic system into a single power-dense unit, so power density is critical."

For others, however, power density isn't quite as critical. The technicians at Peninsular Cylinder experience a similar impetus to do more with the same size components, but according to Jim Czegledi, engineering manager at Peninsular Cylinders, that pressure from customers manifests differently with cylinders.

"Most of the time, [customers] just ask to increase the psi rating of the cylinder so they can achieve more work in the same amount of space," Czegledi said.

Achieving higher psi rating usually comes down to using better materials—a straightforward solution that leaves Peninsular Cylinders with plenty of energy to focus on other,

higher priorities for their products. Instead, the ever-present drive for innovation is to lengthen their cylinders' lifespan, a constant concern that Peninsular Cylinders' Senior Marketing Strategist Chadwick Conte notes they're "constantly making strides" towards addressing.

And according to Conte and Czegledi, if you want to talk about improving cylinder life, it all comes down to the seals, the most common fail point on a cylinder.

For improving seal life, once again the first step is to look at materials. In Peninsular's case, they use heavy urethane for their seals, which improves tensile strength. They don't stop there, however. In addition, they also tweak their designs so that the seal can be pushed further before it critically fails in the first place. While the most straightforward place to put an o-ring is just at the end of a cylinder's tube, Czegledi noted that Peninsular installs their o-rings underneath and inside the tube, which allows the ring to stretch further before the seal is broken and begins leaking.

"We think we have a better mousetrap than everybody else," Czegledi said.

But according to Conte, a big part of improving a cylinder's lifespan is also about designing specifically for its intended application.

"A lot of it comes down to the information that's being gathered initially," Conte said. "A lot of [considerations] that come into play: environment, heat is definitely an issue, the type of fluid that's going to be used inside the cylinder."

As a general rule, the more information you can give a component manufacturer about your application, the better they'll be able to help you design the best part for that application. But in this case, Peninsular Cylinder considers it to be a vital part of the process — so vital that they even have a 50-question data sheet for customers to fill out. According to Conte, the sheet usually doesn't get filled out point by point, but it does usually inform Peninsular on what special needs might need to be addressed in a particular application.

And it's perhaps unsurprising that the list of questions has to be so long when you see the equally long list of industries Peninsular serves, which translates to numerous unique conditions they have to account for. Much like Terzo's Hydrapulse, Peninsular products find their way into applications in machine tooling, oil and gas, the lumber industry, automation, and steel plants, just to name a few.

Flexibility does seem to be the common denominator between the two companies, and when casting a wide net of different industries to serve, they've adopted different strategies. One presents a universally appealing model with additional features, while the other dives into full-on custom tailoring their components to account for application.

Honestly, both probably work. **PTE**

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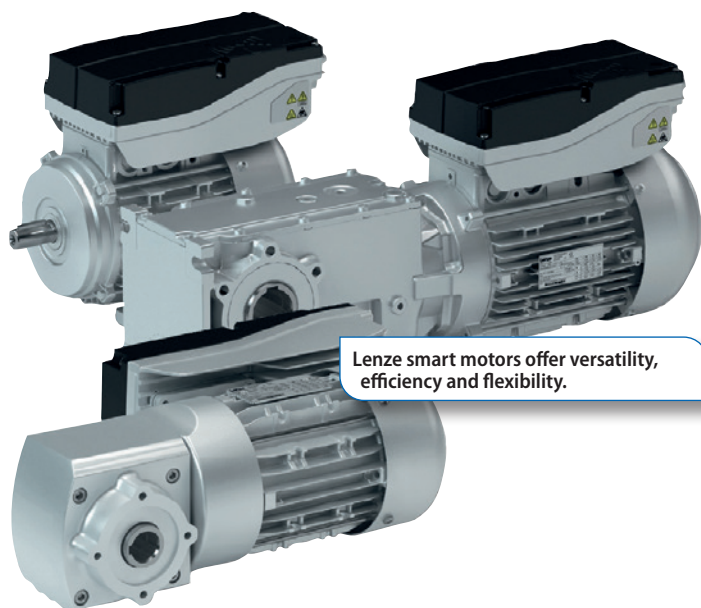
Matthew Jaster, Senior Editor

In 2019, Lenze America relocated its electromechanical operations and logistics center from Glendale Heights, Illinois to its headquarters in Uxbridge, Massachusetts. Nothing mind boggling to report here as relocations in the manufacturing sector happen all the time, but the reason why the move was made is very telling as it illustrates a shift that's taking place across the mechanical power transmission industry.

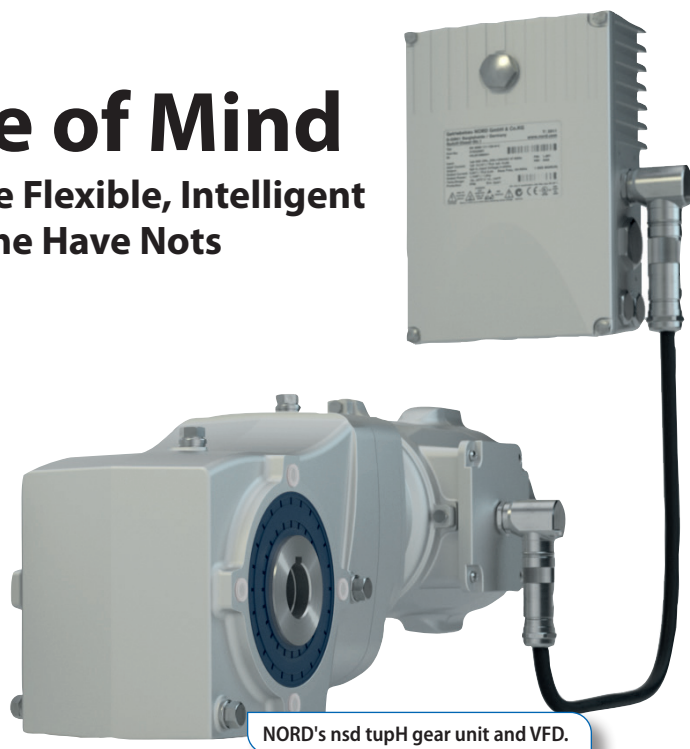
Lenze made this move to bring its core operation, supply chain teams and management under one roof. This allowed the organization to incorporate its lean initiatives to its new electromechanical production lines. The move also helps serve Lenze's customers faster and more efficiently and gives the company an opportunity to expand its electromechanical product offerings.

In simpler terms, the relocation of business segments at Lenze reminds me of the change that's happening inside the mechanical components they sell. Versatility, efficiency, safety, and flexibility are all terms used to describe the changes happening in the gear drives, motors and electronics we cover in the pages of this magazine. Call it Mechatronics 101. This is the future of machining. It's what an economy driven by technology *should* look like.

How is mechatronics changing the market on the PT component level? What does it *truly* mean to be a provider of a complete drive package? This article will examine these questions while also digging deeper into the application-focus that comes with mechatronic concepts as well as the push for more education and training in these areas today.



Lenze smart motors offer versatility, efficiency and flexibility.



NORD's nsd tupH gear unit and VFD.

The Drive Package

Mechatronics involves electrical and mechanical systems living in harmony, but there's much more taking place at the design level. Complete drive packages today include control systems, computer data, robotics, sensors, system engineering and more.

Dan Breitbarth, engineering manager, control products at NORD Gear Corp, said that the ability to provide a complete drive package — gearbox, motor and centralized/decentralized VFD, including networking capabilities — can greatly reduce installation costs for the end user and provide them with the peace of mind knowing everything will work in unison. It also provides the added benefit of there being a single point of contact in the unlikely event something goes wrong or when replacement parts are needed.

“Our goal is to provide flexible, intelligent drive systems that are pre-engineered for compatibility and adaptability. Our drive systems are powering hundreds of different applications around the globe, so it is vitally important to create intelligent drive solutions that are not only versatile, but easy to install, use, and maintain, regardless of the industry or application,” Breitbarth said.

Bonfiglioli is another organization offering all-in-one mechatronic drive systems because its customer-base demands optimal machine design and performance.

“Systems—like DGM and iBMD—provide benefits such as streamlined and simplified design, system compactness, plant scalability, lower costs, as well as high remote-control potential thanks to the digitalization of communication,” said Matteo Canepa, global product marketing and project management manager at Bonfiglioli.

At Lenze, the information and real-time data available from its components allows companies the ability to monitor areas like energy, service costs, production quality and safety. The ease of attaining this data is imperative for remote

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diagnosis and maintenance and can be stored in order to provide predictive services in the future.

SEW Eurodrive continues to offer mechatronic solutions. By combining the motor, gear unit and electronics into a single system, SEW's MOVIGEAR brand focuses on optimizing power, storage reduction, lowering noise emissions and reducing the operating costs of material handling systems.

What do all these organizations have in common when it comes to mechatronic drive systems? They offer an opportunity to deal with a single supplier for system configuration, sales, troubleshooting, maintenance, and replacement parts.

"The power transmission industry values many of the same things as other industries. They want quality products in terms of reliability, durability, and performance. They want the ability to customize solutions to their specific requirements. They want integrated solutions that are easy to install, operate, and maintain. The reason they want these things is because their business depends on it. Manufacturers that can't deliver on these items won't find much success," said Tom Koren, director of engineering, NORD Gear Corp.

"Our role is crucial," said Canepa at Bonfiglioli. "Mechatronics is the way to optimize machines and their performances. In addition, when drives are selected, they influence all the characteristics and the degrees of freedom of the electro-mechanic powertrain applied. So, the opportunity to have a unique supplier for a mechatronic solution is vital for the customer experience."

Application Intelligence

For everyone interviewed in this article, mechatronics is shifting from product centricity to an application perspective. Canepa calls these 'all-in-one solutions' where systems like DGM and iBMD can cover 0.25 to 22 kW in a compact design. Both solutions are sensorless, with a dedicated vector control algorithm able to determine speed, torque and position of the application. The technology trends are to increase performances in a reduced dimension, enhance modularity and expand connectivity.

"The main players in our industry are changing electromechanical products through new mechatronic solutions—reshaping the PT market and accelerating the pace of change along the way," Canepa added.

This is happening at Bonfiglioli by merely looking at a traditional geared motor in the company's catalog. "Mechatronic drives are extending the lifetime of our traditional geared motors by reducing the mechanical stress of each component," Canepa said. "Ideally an additional benefit for our customers is the ability to gather data to finally improve both design and performances of their machines, meanwhile customers of our customers are driven by all the opportunities of Industry 4.0 an IIoT (remote monitoring, predictive and proactive maintenance, etc.)"

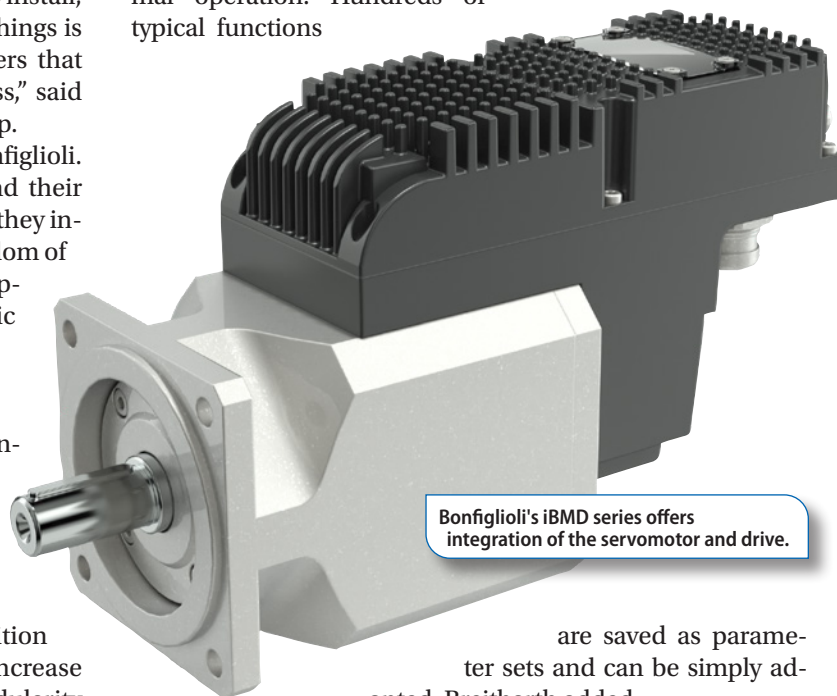
Smart manufacturing and IIoT puts actionable data front and center. It's something NORD anticipated and started working toward years ago when rumors of the 4th Industrial Revolution began to surface.

"As a result, NORD drive units are networked, autonomous,

and scalable. The key components are the VFD units with their powerful processors and comprehensive equipment, interfaces, and functions. They not only monitor themselves and the motor, but also the effect on the load situation in plant segments and beyond," Breitbarth said.

The integrated PLC processes data from sensors and actuators. If necessary, it initiates a control sequence and communicates drive and application data to the control center and other networked components.

For example, intelligent sequence controls can enable the drive unit to independently decide on a branch position and act accordingly. The drive units can also communicate with each other: "Attention, I am sending a package in your direction. Start your conveyor belt." A follower drive can synchronize to a master for a particular task and then return to normal operation. Hundreds of typical functions



Bonfiglioli's iBMD series offers integration of the servomotor and drive.

are saved as parameter sets and can be simply adopted, Breitbarth added.

"In terms of specific gear units, we're seeing an increasingly strong preference from our intralogistics customers for helical bevel units, which provide gear efficiency ratings in the 95%+ range, over the traditional worm gearboxes, whose gear efficiency ratings can dip as low as 40%," said Koren.

For companies replacing worm units with helical bevels, the tremendous boost in efficiency they'll receive could allow them to reduce the physical size of their gearboxes and power demand of their motors for the same power output of the system.

"For example, if you have a 45% efficient worm unit with a 10 hp motor input you're only getting 4.5 hp on the output side of the gearbox. You could use a 95% efficient helical product at 5 hp and produce the same ratings on the output. When multiplied by hundreds or thousands of gearboxes, there's the potential to realize significant savings in electrical costs and equipment costs using the smaller units," Koren added.

SEW's MOVIGEAR combines the gear unit, electronics and motor into a single drive system for the customer. This

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essentially reduces the number of variants in a material handling system, for example, and gives the company the ability to create and develop standard modules and systems the customer can incorporate to optimize the application. The result is a 50+ percent energy savings on the equipment.

Combining optimally matched components into one product reduces project planning to a small number of interfaces. In addition, pre-prepared system information and optimized logistics ensure faster delivery times. The minimized connection outlay and preset control electronics enable exceptionally fast production startup. Manufacturing at the push of a button thanks to a network of components that are in constant communication with each other provides a series of practical engineering benefits.

Education & the Flexible, Autonomous Employee

In addition to the company's move in the United States, Lenze broke ground in 2018 on a Mechatronic Competence Campus (MCC) in Extertal, Germany. Lenze is particularly determined to improve collaboration—from brainstorming to product development, prototype construction and pilot series, through to series production. A central element of the development site is a technical center where various departments will come together to collaborate on mechatronic solutions.

Industry 4.0 will be reflected in practice at the MCC. Networking and control are redesigned from the ground up, based on an SAP environment. Driverless transport systems will be used in production itself, while a modern high-bay storage facility with space for more than 16,000 pallets and over 15,000 containers will be directly connected. Around 300 Lenze drives will be mounted in logistics. It's a future that combines electrical and mechanical engineering solutions with automation, smart tools and production innovations.

Along with mechatronic campuses, companies like Siemens are providing certification programs to encourage a new way of thinking about mechanical engineering.

The Siemens Mechatronic Systems Certification Program (SMSCP) combines the German dual education system with Siemens' in-house know-how. It prepares students to work their way into the mechatronics field.

Students with an SMSCP certification are employees who are flexible, autonomous, and professional in his or her dealings with such complex systems. This system has been used in-house in Germany to train Siemens very own engineers. All SMSCP courses are designed to be integrated within a high school, college, or university curriculum, or to be implemented as continuing education.

Mechatronics is not only the marriage of electrical, mechanical, and computer technologies; it is also a philosophy for looking at systems. Under the systems approach, students learn about the complexities of the system in a holistic fashion. This allows them to easily transfer their knowledge to other systems, resulting in flexible and autonomous employees.

Watch closely as mechatronics courses and training programs continue to pop-up in the coming years at manufacturing facilities and universities here in the United States.

Putting it All Together

Although it's impossible to discuss mechatronics in depth in a few pages of a trade magazine, the main takeaway here is that many successful companies in the PT market are following the global electromechanical trends taking place in manufacturing today. A systematic approach to components is paving the way for the vast innovations and technologies to come.

"We think we'll see both an evolution and a revolution over the next decade. Features that our customers value today—energy efficiency, safety, configurability, versatility—will still be extremely important. We'll also see a strong push for more compact, lightweight products with smaller footprints. Developments with safety over Ethernet networks and dedicated safety systems will continue to have strong appeal," Koren said. "But the biggest change will likely revolve around new capabilities for continuous condition monitoring and predictive maintenance enabled by intelligent, digitally networked design for the Industrial Internet of Things including sensors, communication interfaces and integrated PLCs."

"The next generation of mechatronics will likely have some degree of learning capability and be able to automatically adjust to correct themselves. Other topics that will come to light in the future are RFID recognition and settings, single-cable solutions, and the ability to network bus via power cabling," Breitbarth added.

Canepa at Bonfiglioli believes their solutions will be more software centric.

"Nowadays the trend is from electro-mechanic to electronic, but we envision that tomorrow the challenge will be from electronics to software that enables value creation," he said. "The gearboxes and gear drives will be smarter having decentralized logic, sensors for interconnections. The efficiency will increase due to innovative materials and they will be smaller. All those new features will have a positive impact on both, performances and cost." **PTE**

For more information:

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www.bonfiglioli.com

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www.lenze.com

NORD Gear Corporation
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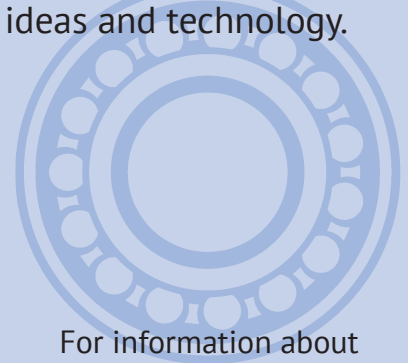
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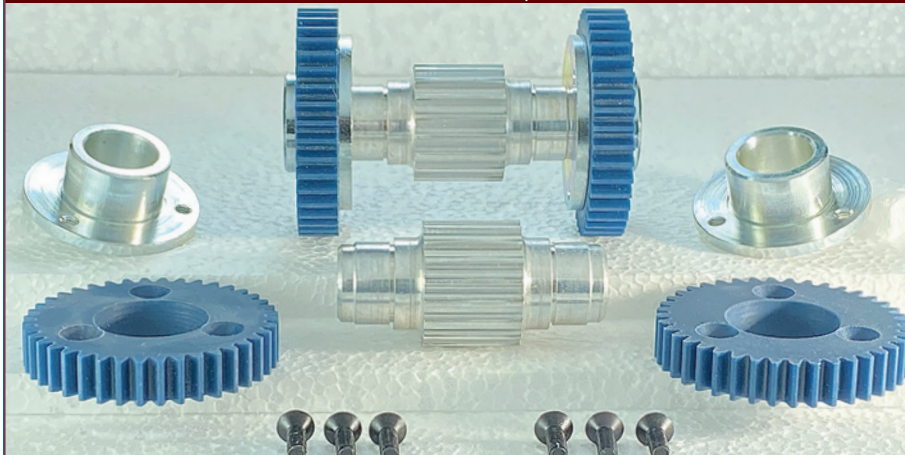


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Integration Nation

Gearmotors handle harsh environments with digitalization, customization and improved service life

Matthew Jaster, Senior Editor

It's 2020, so it comes as no surprise that mechanical components are smart, sophisticated and built to handle a variety of custom specifications.

For example, gearmotors for applications in material handling, food & beverage, packaging and industrial equipment are efficient, smaller, and more durable than their previous counterparts. Here's some gearmotor highlights from recent exhibitions and trade shows:

EZ Series — Stober Drives

SPS — Smart Production Solutions (Germany, November 2019) featured a new generation of servo planetary gear units from Stober. These drives are compact, and any motor series can be directly attached in any available size. This variability allows Stober to create the right drive solution for any application. In contrast to the prior generation, Stober also equips the new planetary geared motors with an electronic nameplate, which makes commissioning controllers and drive controllers much faster. All Stober motors, such as the EZ series or sensorless lean motors, can be directly attached without an adapter, in any desired size.

Thanks to this compactness, the user benefits from a smaller installation space, lower weight, greater torque and a resulting power density that is increased by up to 65%. The mass moment of inertia is lower because the motor adapter is no longer needed, which allows the full dynamics of the drive to be used. This is a real advantage for the customer, particularly noticeable with small and medium sizes in shorter cycle times.

The new generation also features high backlash stability and ruggedness. The housing and gearing quality ensure high acceleration torques as well as high running accuracy and precision. Users benefit from acceleration torques increased by 60%, a speed increase of 45% and an increase of the torsional stiffness by up to 50%.

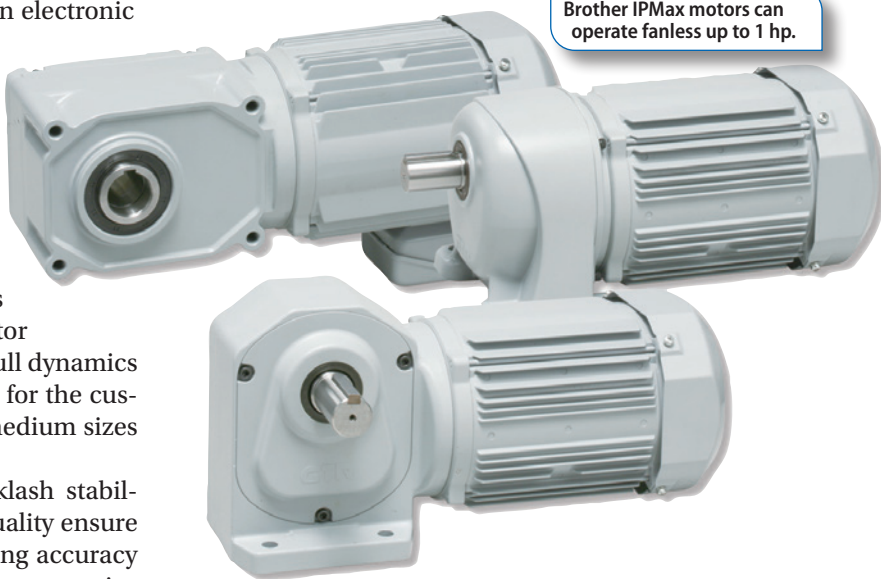
A noteworthy feature to this new generation of planetary gear units is its enormous variability. This means that not only are the gear units able to be combined with different Stober motors via direct attachment, they can also be attached to all third-party motors in any size using variable adapters. The drive specialist offers a one-of-a-kind interface technology for this purpose. Stober motor adapters are available with different couplings as well as in the ServoStop variant with an integrated brake. The adapters can also be combined with standard or reduced-play gear units. In particular, the large design of the Stober adapter with an extra-large motor plate makes it possible to connect the most

compact Stober gear units with motors of very large sizes—a truly unique selling point.

Another advantage is that the right bearing can be selected, whether deep-groove ball, cylindrical roller or angular contact bearing. These low-friction bearings enable generally higher speeds. Thanks to this enormous variety, engineers have all the options in the design phase to put together exactly the right drive solution for any application.

Additionally, thanks to Stober electronics, every geared motor automatically sends its electronic, mechanically relevant data by plug and play to the corresponding drive controller upon commissioning. As a result, the geared motors are uniquely identified. This eliminates high-effort, error-prone parameterization, which shortens the total system configuration significantly.

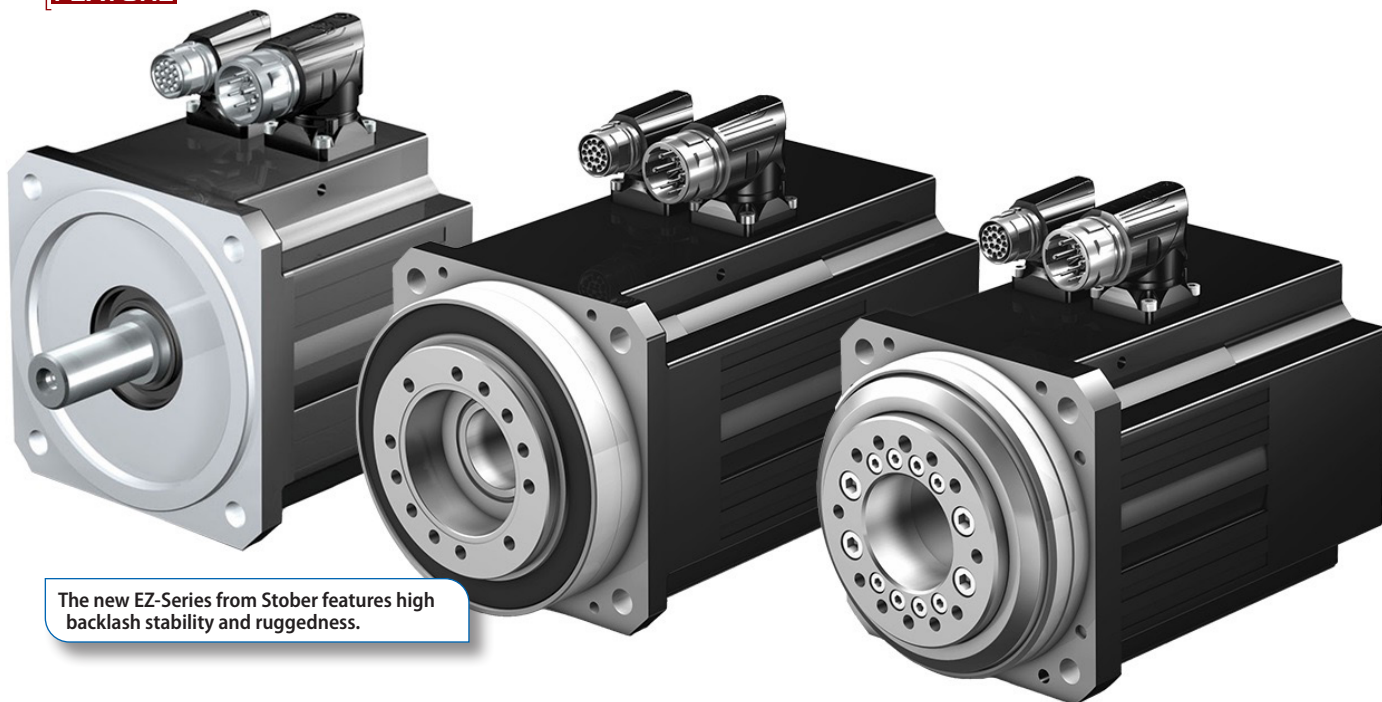
Brother IPMax motors can operate fanless up to 1 hp.



IPMax Series — Brother Gearmotors

Matthew Roberson, vice president of Brother Gearmotors, discussed how the IPMax series ran at specified frequency commands regardless of load, making them highly reliable in demanding manufacturing environments. "IPMax offers near-constant power over a broad speed range and a magnet-retaining design."

Brother Gearmotors IPMax series incorporate magnets embedded within the rotor, as opposed to on the surface. No copper losses are experienced in the rotor, and considerably less copper losses occur in stator winding. The gearmotors can operate fanless up to 1 hp, and do not require encoders for sensor control. When stopped, a servo lock feature holds the motor in position.



The new EZ-Series from Stober features high backlash stability and ruggedness.

This line of lightweight, compact interior permanent magnet (IPM) gearmotors that are highly efficient with a wide synchronous speed range.

Brother's IPMax gearmotors are 23% smaller than comparable ie3 motors, and run 24% cooler for longer lifespan. They employ brake sequential—which sets motor operations when the mechanical brake is turned on or off—as well as a torque limit solution that protects the mechanical system. Various functions of their programmable I/O terminals may be changed according to external circuits or applications. RS485 is included as standard.

Interior permanent magnet motors are ideally suited for conveyors, fans, and pumps, and are frequently used for factory automation, material handling, packaging, and food processing.

In addition to reduced size and weight, Brother's IPMax gearmotors offer an ingress protection rating of 65 (IP65), meaning they are protected from total dust ingress as well as from low pressure water jets from any direction. Additionally, compared with a brushless DC gearmotor, the IPMax gearmotors feature simple wiring and are easier to connect. They also offer similar high efficiency without requiring any extra signal cable.

Quantis - ABB

The Dodge Quantis Product Line from ABB is a modular gear drive engineered for flexibility and power density in a compact housing design. Common applications include belt conveyors, slide bed conveyors, mixer drives and general industrial machinery. They provide high torque density in a compact housing configuration. These reducers are available as gearmotors or B5 flanged input, and ship ready to install with factory-filled lubrication. A wide variety of mounting configurations and accessories make the Quantis an ideal solution for many industrial applications.

The Quantis product family includes four and five stages of gear reduction for all three types of gear arrangements; in-line helical (ILH), offset parallel (MSM) and right-angle helical bevel (RHB). Quantis reducers feature up to 98% efficient gearing and are available with integrated or flange mounted IE3 or NEMA Premium Efficient motors for an energy-saving package.

Quantis gearmotors are manufactured for long-lasting reliability with wear-free gear designs that are finish-ground with an ellipsoid tooth form. Standard units feature class 30



Euronorm has 100+ years of drive system experience.

gray iron gearcase housings, and all units are available with a two-piece harsh-duty output sealing system that provide industry-leading protection against contamination. E-Z Kleen corrosion-resistant, and Ultra Kleen all-stainless-steel units are available for the food and beverage industry.

Clamp style or 3-piece coupled inputs are available for easy motor installation and removal. For shaft-mounted applications, RHB and MSM styles feature the patented twin-tapered bushing system that makes it simple to install and remove the reducer from the driven shaft with no damage.

Whether the application requires the compactness of an integral gearmotor, the durability of a 3-piece coupling, or a separate shaft input for direct-coupled equipment, Quantis offers thousands of reducer configurations and bolt-on accessories to meet any need.

Stainless Steel Gearmotors - Euronorm

Euronorm, located in the Netherlands, has more than 100-years-experience in the drive system industry. Starting out as a manufacturer of belts, the company continues to develop technologies in the fields of electric motors and various types of transmissions such as gearboxes, geared motors, linear actuators and planetary gearboxes. They recently exhibited some of these products and technologies during SPS - Smart Production Systems in (Germany, November 2019). Here are some examples of their gearmotor portfolio:

Stainless Steel: The stainless steel gearmotor from Euronorm is designed to meet HACCP and EHEDG guidelines. As a result, they withstand a thorough cleaning regimen and are made of hygienic components. Blind spots and horizontal surfaces are as much as possible avoided.

ATEX: Special measures are required for the use of a gearmotor in an ATEX environment (areas with potentially explosive air/gas or air/dust mixtures). These measures are defined in the ATEX 114 Directive (formerly ATEX 95). Euronorm has a wide offer of ATEX gearmotor types. Euronorm itself is ATEX certified for gearmotor types. Due to this, the gearmotor can be assembled from stock and combined with selected ATEX electric motors. Euronorm offers the full range (from 30 Nm up to 4,300 Nm) in ATEX from stock. The ATEX gearmotor is suitable for ATEX categories II2G, II2D, II3G-D, II3D and for use in zones 1, 21, 2 and 22.

Helical: The Euronorm helical gearmotor JRT R series is competitively priced, high quality and assembled from stock conform customer demands. The JRTR follows the industry standard for helical/coaxial gear. The JRT R helical gearmotor series are well compatible with other major brands, are assembled from stock and are competitively priced.

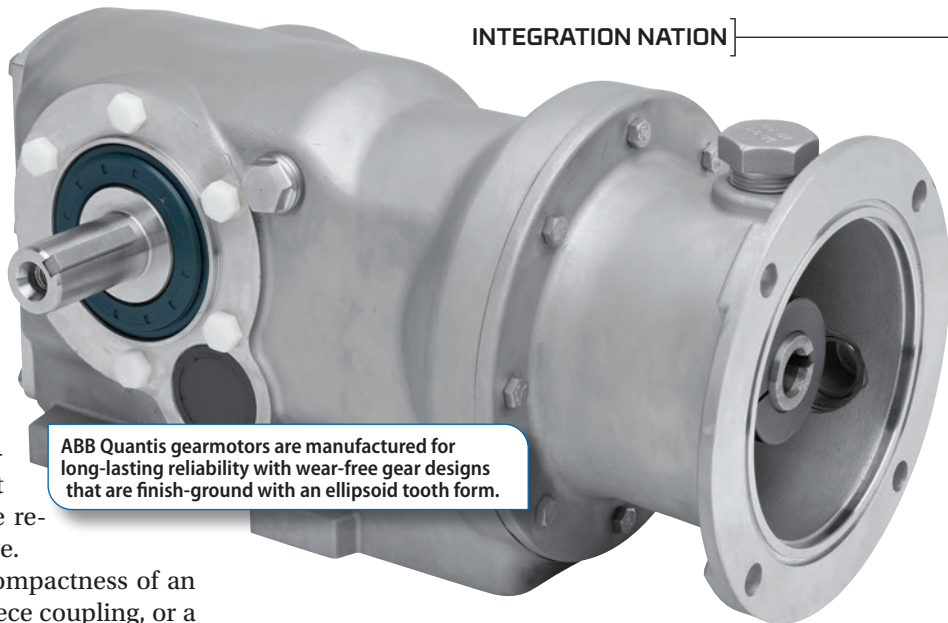


ABB Quantis gearmotors are manufactured for long-lasting reliability with wear-free gear designs that are finish-ground with an ellipsoid tooth form.

Euronorm offers different versions of helical gearmotor types, which are 1 on 1 interchangeable with SEW and other manufacturers.

Parallel-Shaft: The Euronorm parallel-shaft gearmotor types JRT F series are competitively priced, high quality and assembled from stock conform customer demands. The JRTF follows the industry standard for parallel-shafted gearmotor types. The JRT F series are well compatible with other major brands, are assembled from stock and are competitively priced. Euronorm offers different versions of parallel-shaft gearmotors, which are 1 on 1 interchangeable with SEW and other manufacturers. **PTE**

For more information:

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Back to Basics: Gearmotors

Since 1986, Power Electric has provided custom motor and gearmotor design, engineering and sourcing services to organizations in a wide range of industries. Here is some general information from Power Electric on gearmotors for those starting out in the mechanical power transmission market:

What is a Gearmotor?

Gearmotors are basic in design, using some combination of plastic and/or metal. One of their greatest benefits is that they eliminate the need of having a separate gearbox and electric motor. The motor powers the gearbox, turning the box and creating energy. As a packaged set, they work together to increase torque (force) while keeping rpms (speed) low.

In most cases, the addition of a gearbox is intended to limit the speed of the motor's shaft and increase the motor's ability to output torque. Gears transform shaft speed into torque at specific ratios, with minimum efficiency losses, making it possible to create the ideal torque output and speed by adding the appropriately sized and configured gearbox.

What Are the Different Gear Motor Types?

The two most common gearmotor types are right-angle gearmotors and inline gearmotors:

- Right-angle gearmotors use worm, bevel or hypoid gearing.
- Inline gearmotors typically use spur gears or planetary gear sets.

Of these five gear sets or gearings, the most common are worm, spur and planetary.

Gearmotors can be purchased with a variety of AC (alternating current) or DC (direct current) motor types. They also come in many reduction ratios to accommodate a vast number of applications such as automatic door operators, food & beverage equipment, and robotics.

Gearmotors are used in applications that require lower shaft speed and higher torque output. This describes a wide range of applications and scenarios, including many of the machines and equipment we interact with daily. From ATV wipers to hospital beds, servo mechanisms to packaging equipment, paint mixers to juice dispensers, gearmotors are used to power a significant number of machines and applications.

What Applications DO NOT Use Gear Motors?

Due to the flexibility and widespread use of electric gearmotors, it is easier to explore applications that do not use them. Any application that requires high shaft speed will not benefit from the use of a gearmotor. This includes fans, pumps and engine starters. In these cases, the speed of the motor's shaft rotation is the most important factor. (www.powerelectric.com)

For Additional Information

To learn more Back to Basic articles on Product Selection & Sizing, Specifying Components, Electric Motors, Linear Motion, Bearings, Drives, Lubrication and more, be sure to visit our Back to Basics section on the PTE website at www.powertransmission.com/subjects/basics/. **PTE**

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Creature Comfort

Intelligent drive technology in the cowshed

NORD Drivesystems

The Danish company Celi Invest has specialized in the production of electrically powered cow brushes. Since the Danes incorporated drive technology from NORD DRIVESYSTEMS, their intelligent and robust drives ensure reliable, safe and efficient operation. The result speaks for itself: happy cows and satisfied farmers.

To clean their hide, cows like to rub themselves against trees or on the ground. In addition to cleanliness, this scratching has another important effect. It stimulates the blood circulation in the skin as well as the metabolism and improves the health and wellbeing of the animals. In the cowshed, so-called cow brushes take over the role of the trees. “Cow brushes are a genuine revolution in cow care,” says Carsten Papuga, Managing Director of Celi Invest ApS, a Danish cow brush manufacturer. “It has been scientifically demonstrated that healthy cows produce more milk. Our brushes enable thorough hide care and beneficial massages to ensure that the cows are more comfortable. This has a positive effect on milk production.”

A Lucky Start

The fact that Celi now produces cow brushes is something of a coincidence. Actually, the company has been well known for its mobile bus and truck washing systems for more than 30 years. “Several years ago one of our customers — a company which transports pigs and cattle — told us about a new law which obliges Danish farmers to install a cow brush for every 50 cows in the cowshed and said: You should produce cow brushes,” recalls Papuga. “We laughed about that. However, the customer remained adamant and so we started to work on this idea.” What followed was a large number of discussions with farmers and the conclusion: Robustness and reliability are essential. “Cows are very strong. As well as this, the brushes are in operation for 15 to 18 hours per day. Cow brushes have to stand a lot of strain and must be strongly constructed,” explains Papuga.

In September 2015 Celi Invest launched the first cow brush, initially with different drive technology — which

turned out to be a mistake. “We had several broken shafts,” reports Papuga. “Because of this we soon changed to Nord. We have used the drives for many years for our bus and truck brushes and are familiar with their first class quality. However, when we started with cow brushes, Nord could not yet meet our control and price requirements.” Nord development and application engineers worked intensively on a solution and since the beginning of 2017 Celi Invest has sold its cow brushes exclusively with technology from Northern

For the cow brushes from Celi Invest, Nord Drivesystems supplied a powerful combination consisting of a two-stage NORDBLOC.1 helical geared motor and a NORDAC BASE frequency inverter.





The Danish company Celi Invest ApS specializes in the production of cow brushes.



Cow brushes enable thorough hide care and beneficial massages to ensure that the cows are more comfortable. This has a positive effect on milk production.

Germany. “We now have more than 400 Nord gear units in use. Since then there have been no more complaints, and all drive units operate perfectly. We and our customers are very satisfied,” Papuga says. “The service is also excellent. Nord takes good care of us.”

Reliable drive technology from Nord

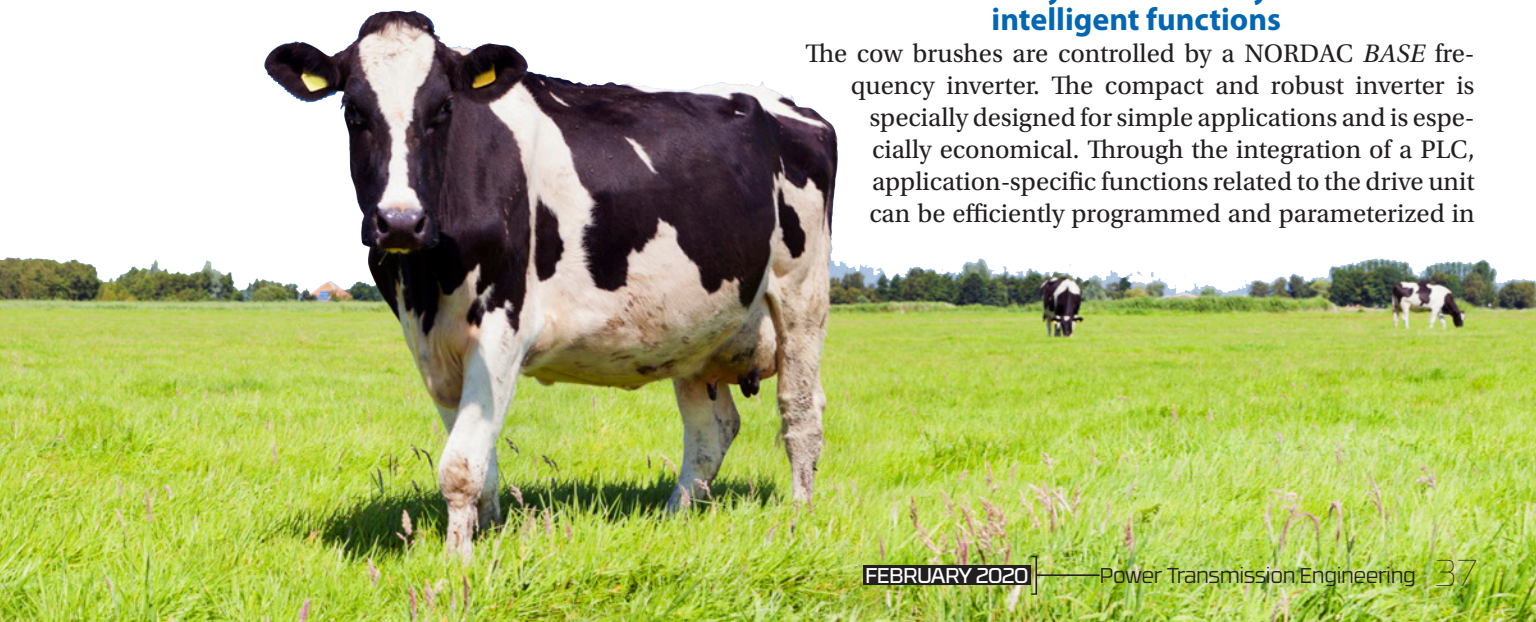
Nord Drivesystems supplies fully matched drive systems consisting of gear units, motors and frequency inverters for more than 100 branches of industry. For the Danish cow brushes, the drive specialist supplied a powerful combina-

tion consisting of a two-stage NORDBLOC.1 helical geared motor and a NORDAC *BASE* frequency inverter. The motor, the controller and the gear unit form a unit attached to the cow brush, which does not move with the rotation of the brush but rather remains rigid. “With the products from our competitors, the motor and the gear units move together with the brush. Faults and wear are therefore inevitable,” explains Papuga. “Our cow brushes are the only ones on the market with a strong drive construction. This rules out cable breaks.” A universal joint between the motor and the brush as well as 40 mm stainless steel bearings in front of the motor also ensure maximum durability. Both components absorb the torques and reduce the load on the motor.

In addition, the Nord drives are energy-efficient in operation, have a compact design, great reliability and a long service life. The innovative design of the NORDBLOC.1 helical geared motors guarantee quiet running and safe operation. Thanks to their wash-down design, they meet even the most stringent hygiene requirements. The gear units do not have any separating joints or closing caps. This increases the stability of the product and at the same time provides a smoother surface on which neither liquids nor solid materials can accumulate. A Certonal coating protects the electronics against condensation.

Greater safety and efficiency thanks to intelligent functions

The cow brushes are controlled by a NORDAC *BASE* frequency inverter. The compact and robust inverter is specially designed for simple applications and is especially economical. Through the integration of a PLC, application-specific functions related to the drive unit can be efficiently programmed and parameterized in



the same way as other functions of the NORDAC BASE – SK 180E. The brush starts to rotate as soon as a cow rubs against it. If there is too much resistance—for example if the tail gets trapped—the brush stops and then turns in the opposite direction. In addition, the direction of rotation changes on each start and at intervals of five minutes. This ensures even wear of the brush elements. “This intelligence is very important for us. We also like the fact that we can make minor changes to the program,” says Papuga. “For example, we can reduce the torque if we use the same brush for smaller cows—because smaller cows have shorter tails.” Another advantage is the energy saving function for the partial load range: The motor power adapts to load changes automatically according to actual requirements. This ensures energy-efficient operation. This is also helped by the use of gear drives. These can achieve an efficiency of up to 98 percent—and therefore use at least 50 percent less power than comparable cow brushes. Most manufacturers use single-phase motors with worm gear units, whose efficiency can be as low as 60 percent in the worst case. With regard to service life, they are also inferior to the helical gear units used by Celi Invest.

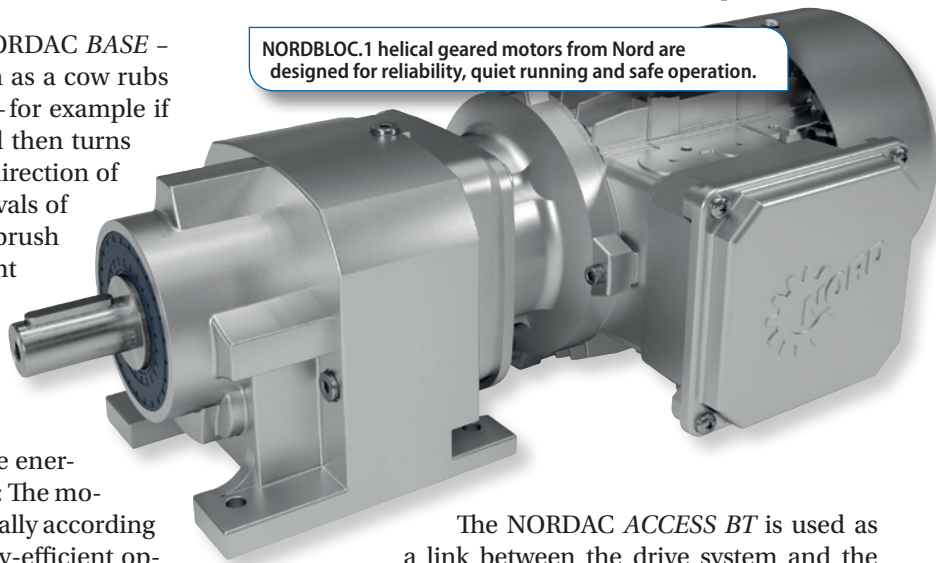
The NORDAC BASE frequency inverter by Nord Drivesystems offers an economic variant for simple drive applications.



Easy commissioning

Celi Invest uses the new Bluetooth stick NORDAC ACCESS BT with the NORDCON APP to parameterize the drives of the cow brushes. The mobile solution enables a temporary wireless connection and offers users completely new options for the control and optimisation of their Nord drive units. Thanks to the help function and rapid access to parameters, parameterization is quick and simple, and commissioning can be carried out very rapidly. In addition, the app has further practical features such as a backup and recovery function for simple handling of the frequency inverter drive parameters, as well as an individually configurable oscilloscope function for analysis of the drive. Video tutorials and the possibility of direct contact with Nord support additionally assist users in their work.

NORDBLOC.1 helical geared motors from Nord are designed for reliability, quiet running and safe operation.



The NORDAC ACCESS BT is used as a link between the drive system and the app. Users therefore have practical access to drive data and retain full access control. The stick can also be used without the app for transferring parameters between individual frequency inverters.

Fully satisfied

The customers of Celi Invest ApS include Sjoerd Ydema. The farmer operates a farm with 450 cows and cultivates grass, corn and cereals on an area of 600 hectares. A total of twelve cow brushes are available for the cattle. “We have used brushes from Celi Invest for about two and a half years and are very satisfied with them. The drives function well and at the moment there are no problems,” explains Ydema, who adds: “We used to have several brushes from another company. However, we have now replaced all of these with Celi Invest brushes with Nord motors. We think that these are the best.” **PTE**

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IFPE 2020 Shapes Expectations and Technology for the 2020s — and Beyond

Jack McGuinn, Senior Editor

The International Fluid Power Exposition (IFPE) is a one-stop exhibition where you'll find just about everything to help maintain your company's leading edge in the ever-expanding fluid power industry.

From sensor technology and data analytics to robotics and automation—it's all here under one roof. The show presents every three years and is co-located with CONEXPO-CON/AGG — the largest international gathering place for the construction industries.

Indeed, on display are the latest products and systems from over 400 exhibitors. What's more, IFPE 2020 also features product concentration areas, thus facilitating attendees' ability to locate specific products, services and exhibitors of most specific interest.

"There's really no show quite like the International Fluid Power Exposition (IFPE)," says John Rozum, IFPE show director. "That's because no other show brings as many sectors of the fluid power, power transmission and motion control industries together in one place at the same time. The show brings together a truly unique combination of engineers and executives — both in booths and aisles — to share ideas, educate one another, and ultimately shape the future of the construction industry through collaboration and consensus."

Also, in keeping with the growing trend at trade shows to incorporate educational presentations and venues for attendees, IFPE 2020 also offers the type of learning and networking opportunities that help make attending and exhibiting a quality experience.

"In addition to the great education sessions and the over 400 exhibitors, IFPE will be hosting an all-new networking reception for engineers and executives, right on the show floor," Rozum adds. "IFPE's Fluid Power Hour, presented by Bosch Rexroth, will be held on March 11, from 4 p.m. to 6 p.m. on the IFPE show floor. The event includes a bonus hour on the IFPE show floor, complimentary hors d'oeuvres and cocktails and entertainment."

About IFPE 2020

IFPE is considered the leading international exposition and educational resource dedicated to the integration of the latest fluid power and other technologies for power transmission and motion control applications. More than 180 sessions on industry trends, technologies, and solutions will be presented.

For example, the show will offer college course-styled speaker sessions. These hands-on sessions will help attendees get the most out of their IFPE experience.

Other examples of the educational opportunities include:

- IFPE 2020 Expert Q&A: Fundamentals of Hydraulic Systems

- IFPE 2020 Expert Q&A: How Hydraulic Fluid Impacts Machine Performance
- Systems — Thinking and Diagnostic Skills for Today's Hydraulic Technicians

IFPE is targeted for design engineers and other decision-makers from these industries:

- Off-Highway Vehicles (includes Construction, Mining, Forestry, Agriculture, Lawn & Garden, and Airport Support vehicles)
- Fluid Power/Power Transmission Products, Electrical Machinery, Instruments/Controls
- Distribution
- Material Handling (includes overhead/straddle cranes, industrial trucks, tractors and stackers)
- Manufacturing/Production Automation/Machine Tools (includes chemical, petroleum, metal, plastics, and rubber processing)
- Automotive/Commercial Vehicles (includes Class 8 trucks, vocational trucks, and trucks for other applications)
- Engineering Services
- Defense/Aerospace
- Amusement/Entertainment Technology
- Other Products/Services

A partial list of exhibitors related to mechanical power transmission:

ASCO Sintering Company, Auburn Gear, B&R Industrial Automation, Bonfiglioli Riduttori, Bosch Rexroth, Carlisle Brake and Friction, Comer Industries, CW Bearing, Eaton, Eskridge, Gates Corporation, Geartek, KTR Corporation, Logan Clutch, Moog Inc., Motion Industries, Nachi America, Omni Gear, Optibelt, Posi Lock Puller, QA1 Precision Products, Rotor Clip Company, Schaeffler Group, Smalley Steel Rings

Much More on Education Topics and Activities:

Education session topics will include:

- Electric vs. Hydraulic Transmission
- Variable Speed Technology of Fluid Power (Industrial)
- Hydraulic Transmission Control Methods
- Mobile Hydraulic Robotics
- Industry of the Future
- Economic Outlook
- Additive Manufacturing
- Workforce Development
- Assessing Your Hydraulic System Efficiency
- Integration of Site Management
- Digital Displacement Pumps
- Machine Control Automation of Functions on the Machine

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IFPE Research Symposium — Hosted by the National Fluid Power Association

When mapping out your IFPE schedule be sure to keep the lunch hours on March 11, 12 and 13 open for the IFPE Research Symposium. Over these three days, the National Fluid Power Association will be presenting a program that showcases the latest fluid power research being performed at U.S. universities with funding provided by a new program within the U.S. Department of Energy to improve the energy efficiency of hydraulic systems on off-road vehicles.

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- Hydraulic Fluid Properties, Efficiency and Contamination Control
- Digital Design

More educational specifics:

- Wednesday, March 11 |11:30 AM to 12:30 PM
Individual Electro-Hydraulic Actuators for Off Road Machines
Andrea Vacca, Purdue University
- Thursday, March 12 |11:30 AM to 12:30 PM
Efficient, Compact, and Smooth Variable Propulsion Motor
James Van de Ven, University of Minnesota
- Friday, March 13 |11:30 AM to 12:30 PM
Hybrid Hydraulic-Electric Architecture for Mobile Machines
Perry Li, University of Minnesota

And finally, in the spirit of it's not just what you know but who you know, Rozum emphasizes: "We encourage all exhibitors to bring their top engineers and executives to take advantage of a great networking experience and interact with industry peers."

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Computing Gear Sliding Losses

Caleb Gurd, Carlos Wink, John Bair, and Claudia Fajardo

Introduction

As concerns surrounding the environmental impact of fossil fuels continue to grow, so does the need to produce vehicles with higher overall efficiency. The importance of enhanced vehicles has spurred drivetrain component manufacturers to study every aspect of efficiency loss in their products. The gearbox is a key contributor to the overall drivetrain efficiency.

There are several factors that make up inefficiencies in gearboxes. These can be divided into two categories: load-dependent and load-independent. Load-dependent losses (mechanical losses), which include factors such as gear sliding and frictional bearing losses, occur while transmitting a load through the gearbox. Load-independent (spin losses) are due to factors such as bearing, seal, and synchronizer drag, oil churning and gear windage (Ref. 1). It is well known that mechanical losses are the predominant sources of lost efficiency. At rated load, empirical studies have shown that gear sliding losses dominate all other sources of mechanical loss — especially at higher speeds (Ref. 2).

Accurately predicting gear sliding losses is critical for increasing gearbox efficiency. The parameters that govern the losses, such as surface finish and sliding velocity, can be effectively optimized for performance and cost if an accurate analytical method is available to predict the effects of these controlling parameters. Significant effort has been devoted to this issue in recent years. Some focused their efforts on the impact that gear geometries played on efficiency, assuming constant coefficient of friction (μ) (Ref. 3). Others studied the impact of geometric differences using a more refined approach by utilizing existing experimental formulae to calculate μ (Ref. 4). A benefit

of this second approach is that each of the formulae was determined via experimental methods rather than pure theory. On the other hand, the derived equations are only valid within the experimental evaluation parameters, which may limit their application to certain operating conditions, lubricant types and temperatures in practical applications. Finally, some researchers used an elastohydrodynamic lubrication (EHL) approach for improving the prediction of μ (Ref. 5).

An extension of past work, this paper documents an effort to enumerate and evaluate the impact of existing formulae of μ on the prediction of gear sliding losses. This is done by establishing the accuracy of each evaluated method

against experimental results of various gear sets over a range of operating conditions.

Existing Formulae

The overall calculation of lost power due to gear sliding as defined in ISO 14179-1 (Ref. 6):

$$P = \frac{\mu \times T \times n_1 \times (\cos \beta_w)^2}{9549 \times M} \quad (1)$$

where

- P is lost power
- μ is coefficient of friction
- T is pinion torque
- n_1 is pinion speed
- β_w is operating helix angle
- M is mesh mechanical advantage

Table 1 Existing formulae for μ	Applicable ranges	Specific units
Formulae and Authors Drozdov and Gavrikov [7] $\mu = [0.8 \sqrt{v_k V_s + V_r \phi + 13.4}]^{-1}$ $\phi = 0.47 - 0.13(10)^{-4} P_{max} - 0.4(10)^{-3} v_k$	$v_k \in [4.500]$ $V_r \leq 15, V_r \in [3.20]$ $P_{max} \in [4000, 20000]$	$V_s, V_r: m/s$ $P_{max}: kg/cm^2$
O'Donoghue and Cameron [8] $\mu = 0.6 \left[\frac{S+22}{35} \right] \left[v^{1/6} V_s^{1/3} V_r^{1/6} R^{1/2} \right]^{-1}$		$S: \mu in, CLA$ $V_s, V_r: in/s$ $R: in$
Misharin [9] $\mu = 0.325 [V_s V_r v_k]^{-0.25}$	$V_s/V_r \in [0.4, 1.3]$ $P \geq 2.500 kg/cm^2$ $\mu \in [0.02, 0.08]$	$V_s, V_r: m/s$
ISO TC 60 [10] $\mu = 0.12 \left[\frac{W'S}{RVv} \right]^{0.25}$		$V_r: m/s$ $R: mm$ $S: \mu m, RMS$ $W': N/mm$
Benedict and Kelley [11] $\mu = 0.0127 \left[\frac{50}{50-S} \right] \text{Log}_{10} \left[\frac{3.17(10)^8 W'}{v V_s V_r^2} \right]$	$\frac{50}{50-S} \leq 3$	$S: \mu in, RMS$ $W': lbf/in$ $V_s, V_r: in/s$
ISO 14179-1 [6] $\mu = \frac{\gamma^{-0.223} K^{-0.4}}{3.239 V^{0.70}}$	$V \in [2.25]$ $K \in [1.4, 14]$	$V: mm/s$ $K: N/mm^2$
ISO 14179-1 (with surface roughness) [12] $\mu = \frac{\gamma^{-0.223} K^{-0.4}}{3.239 V^{0.70}} \frac{1.25}{1.25-S}$	$V \in [2.25]$ $K \in [1.4, 14]$	$V: m/s$ $K: N/mm^2$
ISO 14179-2 [13] $\mu = 0.048 \left(\frac{F/b}{v_{sp}} \right)^{0.2} \eta_{oil}^{-0.05} Ra^{0.25} X_L$	$v_i \leq 50$ $F/b \geq 150$	$v_i: m/s$ $F/b: N/mm$
ISO 14179-2 (with Hohn's modification) [14] $\mu = 0.048 \left(\frac{F/b}{v_{sp}} \right)^{0.2} \eta_{oil}^{-0.05} Ra^{0.25} \left(\frac{1}{(F/b)^{0.0651}} \right)$	$v_i \leq 50$ $F/b \geq 150$	$v_i: m/s$ $F/b: N/mm$

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Formulae Observations

Drozdov and Gavrikov and ISO 14179 predict that μ decreases with increased contact pressure, while Benedict and Kelley and ISO TC60 propose that μ increases with increased contact pressure. Misharin and O'Donoghue and Cameron suggest that load and contact pressure have a negligible effect on μ . The formulae that include surface finish show a proportional relationship with the friction coefficient, while those that incorporate sliding velocity show an inverse relationship with friction coefficient.

All equations were empirically formulated: experiments, such as the twin-disk were performed, and a curve was then fit to the results to determine model coefficient values. The disadvantage of this approach is that each equation is only valid within the parameters captured by the experiment, such as lubricant type, temperatures, speed, load, and surface roughness (Ref. 15).

Experimental Procedure

This paper focuses on the realistic application of existing formulae to predict sliding losses using commercially available software. This was accomplished by implementing each of the existing coefficient of friction formulae into Eq. 1 and comparing the results against the measured test stand results. To cover a large spectrum of possible gearbox applications the gearboxes chosen for comparison were a mixture of spur and helical gear sets with various arrangements, the simplest of which was a common FZG type-c spur gear, measured at The Ohio State University Gear Lab (Ref. 16). The evaluation then evolved to encapsulate commercially available gearboxes operating with both single- and twin-countershaft layouts. Note that Commercial 2a and 2b represent two power paths within the

same gearbox. Each was measured in a controlled test cell environment. The basic parameters of the gearboxes used in this study are shown in Table 2.

Measurements and Lost Power Calculations

The test cells measured input and output power. To compare the analytical results with measured data, some post-processing of the measurements was required to isolate the experimental sliding losses. The measured spin loss (Input torque = 0) was subtracted from the loaded power loss, leaving gear sliding losses and load-dependent bearing losses. The load-dependent bearing losses were calculated following ISO 14179-1 and then subtracted, leaving only gear sliding losses. This methodology is outlined in equation 2.

$$P_{Sliding} = P_{Load} - P_{Spin} - P_{Bearing} \quad (2)$$

where

P_{Load} is loaded measured power loss;

P_{Spin} is unloaded measured power loss;

$P_{Bearing}$ is calculated loaded bearing loss via ISO 14179-1 (Ref. 6).

Table 3 shows the normalized results of the testing at 100 N-m over the range of speed tested as an example of the measurements and calculations used to determine the power loss due to gear sliding. The normalized value is calculated as the power loss divided by an arbitrarily selected value.

Finally, the sliding losses were calculated for each of the previously presented empirical formulae corresponding to the measured operating conditions, making a direct comparison between all formulae and measurements possible. For the remainder of this report the term 'Power Loss' will refer to sliding losses. Likewise, experimental losses refer to the values as calculated above.

Parameters	FZG Type-C	Commercial 1		Commercial 2a		Commercial 2b	
Gearbox Layout		Twin Countershaft		Single Countershaft		Single Countershaft	
Center Distance (mm)	91.5	155		85		85	
Gear Set	1	1	2	1	2	1	3
Module	4.5	3.1	3.156	2.4	2.6	2.4	1.53
Gear Ratio	1.5	0.731	1.047	1.280	3.143	1.28	0.459
Pressure Angle (°)	22	20	20	14.5	14.5	14.5	14.5
Helix Angle	-	26	29	33	19	33	32
Effective Face Width(mm)	14.0	26.7	26.8	27.0	28.0	27.0	26.0
Finish Method	Ground	Ground	Ground	Shaved	Shaved	Shaved	Shaved
Operating Temperature(°C)	80	90		90		90	
Viscosity @40°C (cSt)	95.1	95.1		30.67		30.67	
Viscosity @100°C (cSt)	14.8	14.8		6		6	
Input Torque Range (N-m)	100–300	971–2500		220–330		220–330	
Input Speed Range (rpm)	1785–2975	900–1500		1600–3200		1600–2350	

Input Torque [N-m]	Pinion Speed [RPM]	Pinion Speed [rad/s]	P _{Load}	P _{Spin}	P _{Bearing}	P _{Sliding}
100	1785	186.92	30.49	14.47	1.57	33.49
100	2380	249.23	43.16	21.99	2.10	49.15
100	2975	311.54	32.02	32.02	2.63	66.82

Results and Discussion

Figure 1 is an example plot of the power loss prediction of each empirical formulae versus pinion speed. Also shown are the experimental data over a range of input speeds and a steady-state torque of 300 N-m. All the predictions follow the same general trend, as input speed increases, the sliding losses also increase. Some, such as ISO TC60 and ISO 14179-2 have a significant vertical offset, indicating over-prediction of losses. Others, such as Drozdov and Gavrikov and ISO 14179-2 (Hohn's Modification), align more closely with the experimental data.

The large number of operating conditions and case studies drove the need for a more concise and numerical assessment of each predictive method. The same dataset shown in Figure 1, along with the remaining operating conditions, were plotted as experimental versus predicted. A linear regression equation was then fit to each for a numerical evaluation of the linear correlation and absolute value relationship between each of the empirical formulae and the experimental data.

Figure 2 shows all operating conditions (3 pinion speeds and torque conditions: 9 total), and re-evaluation of ISO TC60 and ISO 14179-2, both of which largely deviated from experimental data in Figure 1. Figure 2 shows that a strong linear relationship exists for each, R^2 of 0.971 and 0.991 respectively, signifying that the predictive variation is not random. A significant offset still exists, $5.89\times$ and $4.37\times$, indicating that the difference is due to some systematic variation (such as a coefficient) within the empirical formulae, shifting the expected losses well above the actual losses. Others, such as ISO 14179-1 (with and without surface roughness), show an extremely weak linear relationship with the experimental data, suggesting that the variation is more random. Overall, none of these predictive methods are adequate for this dataset.

The same procedure was followed to graph the remaining gearboxes. To accurately evaluate each formula over a large spectrum of gearsets and operating conditions, all results were plotted on the same graph. The linear

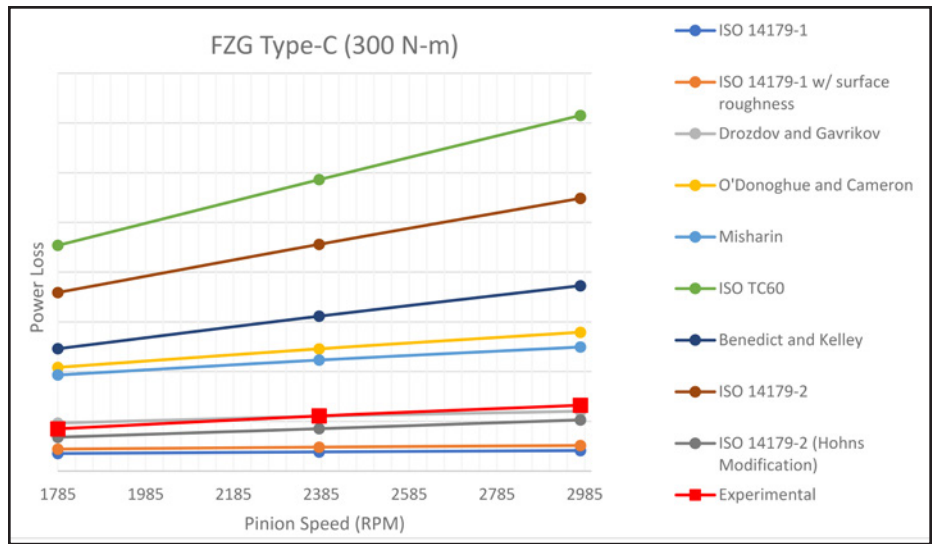


Figure 1 FZG type-C power loss example.

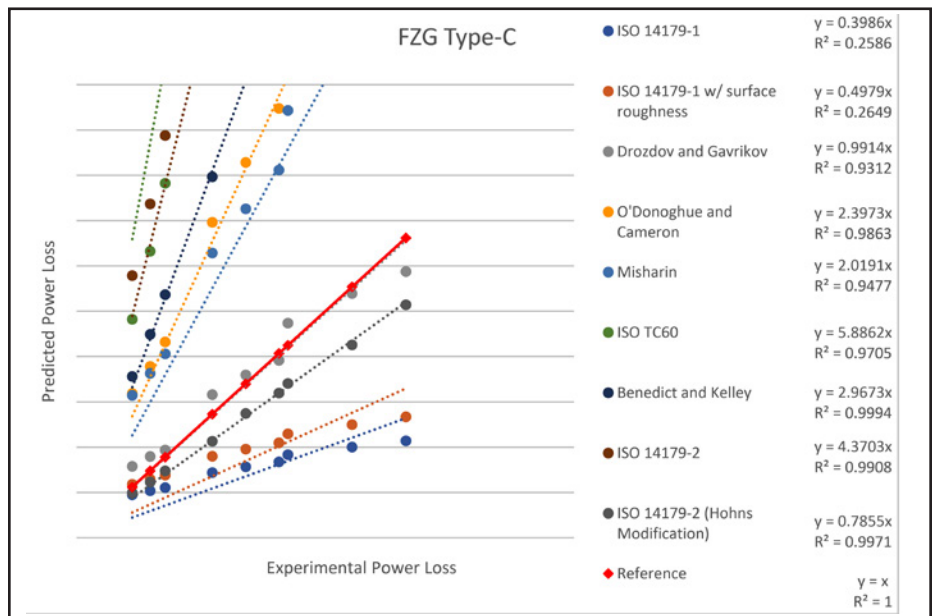


Figure 2 FZG type-C linear regression plot.

Table 4 Linear regression equation of all data					
	ISO 14179-1	ISO 14179-1 (w/ surface roughness)	Drozdov and Gavrikov	O'Donoghue and Cameron	Misharin
Linear Regression Equation	$y = 0.369x$ $R^2 = 0.8696$	$y = 0.656x$ $R^2 = 0.6917$	$y = 0.896x$ $R^2 = 0.9395$	$y = 2.281x$ $R^2 = 0.7369$	$y = 1.888x$ $R^2 = 0.9461$
	ISO TC60	Benedict and Kelley	ISO 14179-2	ISO 14179-2 (Hohn's Modification)	
Linear Regression Equation	$y = 4.002x$ $R^2 = 0.8402$	$y = 2.652x$ $R^2 = 0.9273$	$y = 2.954$ $R^2 = 0.8896$	$y = 0.594x$ $R^2 = 0.9285$	

regression equations of each of the formulae are represented in Table 4.

Table 4 shows the regression equations of the predicted power loss versus the experimental power loss for each of the 26 data points measured from a variety of gearboxes and operating conditions. All the empirical formulae represent the experimental data reasonably well, with a minimum R^2 of 0.69. This suggests that although some may over or under predict, all the methods follow a linear trend that correlates with the experimental results. The best-predicting model for the datasets in this study was Drozdov and Gavrikov, followed by ISO 14179-2 (Hohn's modification). Both have a strong linear correlation and moderate offset coefficient.

Conclusions and Future Work

This paper is focused on the realistic application and evaluation of the nine different existing formulae to predict sliding losses using commercially available software. Power losses of an FZG gearset and two different commercial gear boxes were measured over a variety of operating conditions, consisting of 26 total data points. The sliding losses were then isolated by subtracting the spin losses and the calculated load-dependent bearing losses following the methodology of Equation 2. These experimental losses were compared to the losses predicted by the nine coefficient of friction formulae via linear regression plots. All nine empirical methods show a moderate to strong linear correlation with the experimental data, indicating that any choice of a friction coefficient calculation formula will not drive random variation of predicted results. All equations have an offset and/or multiplier coefficient to directly predict power losses. The equation that best fits the measured data of this study is Drozdov and Gavrikov, followed by the formulation proposed by ISO 14179-2 (Hohn's modification), although both underpredicted the actual losses.

In a realistic application, the Drozdov and Gavrikov model may be limited due to the simplicity of the equation. The equation only accounts for oil viscosity, maximum contact pressure, sliding and rolling velocity, whereas ISO 14179-2 (Hohn's modification) accounts for more of the factors that are known contributors to inefficiency such as face width and surface finish. The inclusion of these important parameters makes the gear design process more effective. The sliding loss equation presented in ISO 14179-2 rather than Equation 1 (ISO 14179-1) was not evaluated but may have provided different results.

Overall, the empirical formulae present relationships between gear design and operating parameters that may be used to calculate the lost power. The specific time-varying effect of these parameters is complex for gearing. The friction varies with changing normal force, rolling velocity, sliding velocity and radius of curvature over the mesh cycle, for which a simple formula may not adequately capture. More detailed analysis of these parameters and their time-varying effect on friction may be needed. In addition to the factors previously cited, the specific parameters which might be included in a more sophisticated analysis are the time-varying effects of contact pressure and temperature on lubricant viscosity and the instantaneous values of these factors: average contact pressure, contact area, film thickness, film temperature, and lubrication shear limiting. Future work may entail the creation of a new coefficient of friction calculation method that incorporates these additional parameters. Additionally, a future study may be needed to evaluate the accuracy of the power loss equations from ISO 14179-1 vs ISO 14179-2. **PTE**

For more information. Questions or comments regarding his paper? Contact Caleb Gurd at CalebLGurd@eaton.com.

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Power Transmission Engineering

Motor Sizing Unusual Loads

Don Labriola

One of the fun parts of the motion industry is involvement in popular movies! Motor specifications can be a bit rough: “I need to spin a 120-pound actor (and chair) 180 degrees in one-half second. He will be sitting upright. This was the requirements for rotation portion of the half human, half CGI android bartender in “Passengers”

So how do you go about calculating what is needed? My daughter had laughed that her Physics Professor used to say — oh, you need to model a cow, a sphere should be close enough for most applications. Sometimes you can get a bit closer. I decided that a 120lb cylinder about 14 inches in diameter would be a reasonable first order approximation. And of course, I automatically went to metric for the calculations! So mass is 54.4 kg, Diameter is .356 meters, inertia calculates to $.86 \text{ kg}\cdot\text{m}^2$ ($\frac{1}{2} \text{ m}\cdot\text{r}^2$).

Now, for a .5 second motion with smooth transitions, splitting the motion into ramping time and slew time. A normal starting point is $\frac{1}{3}$ accelerating, $\frac{1}{3}$ slewing, $\frac{1}{3}$ deceleration. The average slewing rate can be calculated as distance / (total time — ramp time) = $\frac{1}{2}$ revolution / (.5-.1667) seconds. Radians are more useful here, so $\frac{1}{2}$ revolution is pi radians. Peak velocity is distance divided by the “average time” which is total time minus one ramp time. Peak rotational velocity = pi radians / .333 sec = 3 pi radians/sec = 9.425 rad/sec.

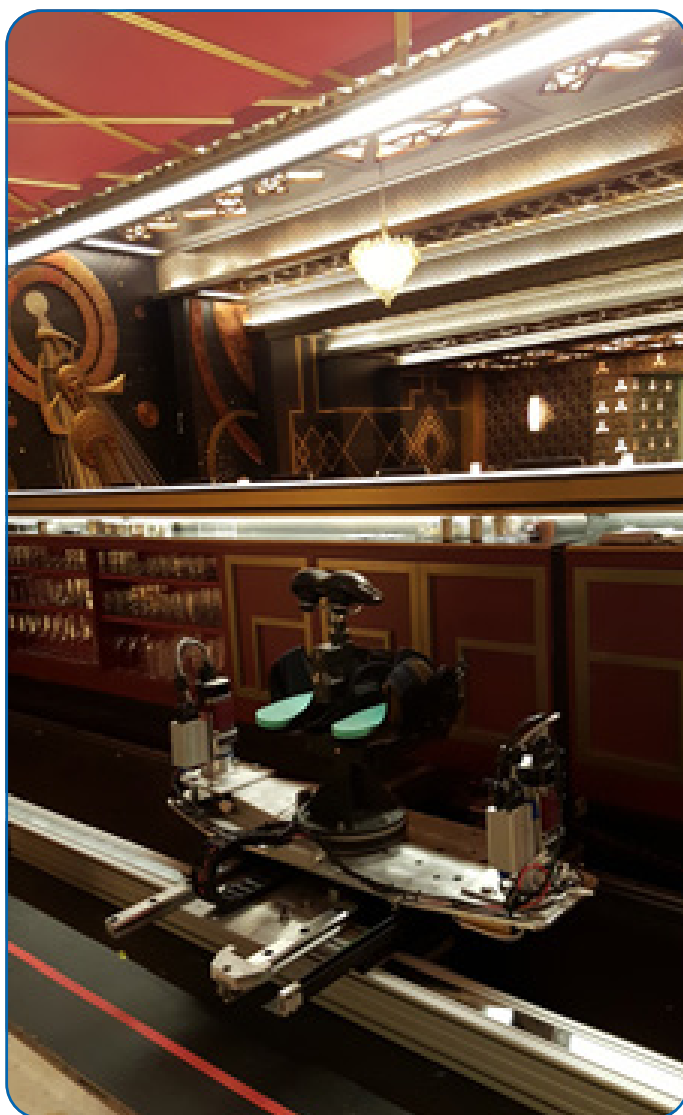
Now we need the acceleration. Assuming a trapezoidal shape, this is peak velocity / ramp time: Rotational Acceleration = maximum rotational velocity / ramp time = $9.425 / 0.1667$ = 56.54 rad/sec^2

Peak power will be torque \times angular velocity = Acceleration \times inertia \times peak velocity = $56.54 \times .859 \times 9.425$ (Nm \times rad/sec) = 458W (Note that 1 Nm \times 1 radian/sec = 1 W)

Looking at our range of motors, the 34HC-2 can provide that power level with some to spare at about 700 rpm. The nearest a pulley ratio was 8:1 which moves the peak speed to 716 rpm.

Checking the inertia levels, the motor inertia is $2.7\text{e-}4 \text{ kg}\cdot\text{m}^2$. This appears to the load to be 64 times larger due to the 8:1 pulley ratio, corresponding to $1.73 \text{ e-}2 \text{ kg}\cdot\text{m}^2$. This is a factor of ~50 less than the “load”. 50:1 is normally fairly easily tuned by our control system.

The chair was assembled, with the belt drive, big pulley on the chair, and a person wearing a back brace so they would not be thrown if they got off balance. Testing showed they were able to get the motion down to about 300 ms, so we had some margin. The final motions were smoothed and coordinated together for the shoot using a CANopen stage controller. The actual motion was closer to the original .5 second. We were told that the director liked the deep sound of the servo motor — it was a “new” sound for an android of the future — and so they recorded it separately and combined it back into the final soundtrack! **PTE**



Note: www.youtube.com/watch?v=eUevWgyQ0kQ&vl=en “Behind the scenes on Passengers” — about 1:50 into the video shows the mechanism and how they blended it in.

Questions or comments regarding this article? Contact Don Labriola at don_labriola@quicksilvercontrols.com.

Donald P. Labriola II, president and founder of QuickSilver Controls, Inc., specializes in servo controllers and motors, with a special focus on cost-effective motion control. He has been granted eleven US patents as well as numerous international patents. His background includes over 40 years of motion control including 20 years in medical instrument design. He enjoys gardening, camping and Ham radio - and motion control!



Romax

ACCELERATES INNOVATION TO COMBAT CLIMATE CHANGE
MIRELLE BALL, ROMAX TECHNOLOGY

Climate change and the ongoing effects of CO₂ on our environment is a hot topic with good reason. Opinions as to the magnitude and the immediacy of the climate crisis may vary, as do the solutions, but the acceptance of man-made climate change being due to CO₂, and the need for action, is near universal.

Many companies are signalling their commitment to reducing climate change. However, closer inspection will reveal who is really committed to making a material change to our society. Romax Technology is proud to have contributed in many ways and across many industries to global material reductions in CO₂ emissions. We believe that the answer to tackling this issue is in collaborating, sharing, innovating and adopting new technologies and applying this approach globally.

Whether it is for the generation of energy to power society or the consumption of energy for personal or public transport, the 'engineering of energy' always returns to a familiar theme — rotating machines. It can be the gearbox and generator that sit behind the blades in a wind turbine, the gearbox and motor which drive an electric vehicle, or the super-advanced aero engine power gearbox which has the potential to achieve a step-change in the energy efficiency of commercial air-travel. Rotating machines, and the optimization of their performance, is central to industry's fight against global warming.

For over 30 years Romax has been assisting the industry in optimizing the performance of these machines. Our ethos is built on creating next generation innovation that supports businesses optimising the manufacturing of drive systems/propulsions, and in doing it Right First Time with an aim that by doing so we are enabling design and developers.

Over our business' lifetime we have been committed to our collaboration with leading industrial companies globally through the supply of advanced technology for performance improvement. We don't just consider the design and development process and its impact on optimizing faster-designs-to-market. We work on creating holistic design solutions that are; eco-savvy, consider the designers creating them, work within a CAE community, adhere to safety and quality measures and are efficient, whilst reducing CO₂.

We believe the encouragement of more efficient practices enables a greater transfer of zero emissions electric vehicle capability worldwide, solutions offered through our eDrive Design Centre.

Emission-free generation of electricity is important for EVs to be truly 'green', and for the electricity to also come from a 'green' source or with consideration of how it gets converted. Our approach to EV design is multi-faceted. We combine our engineering capability on both mechanical and electrical aspects with our patents for hybrid powertrains,

holistic approaches to reducing the noise in addition to other considerations to create a more accessible and desirable EV that is designed to increase up take in society.

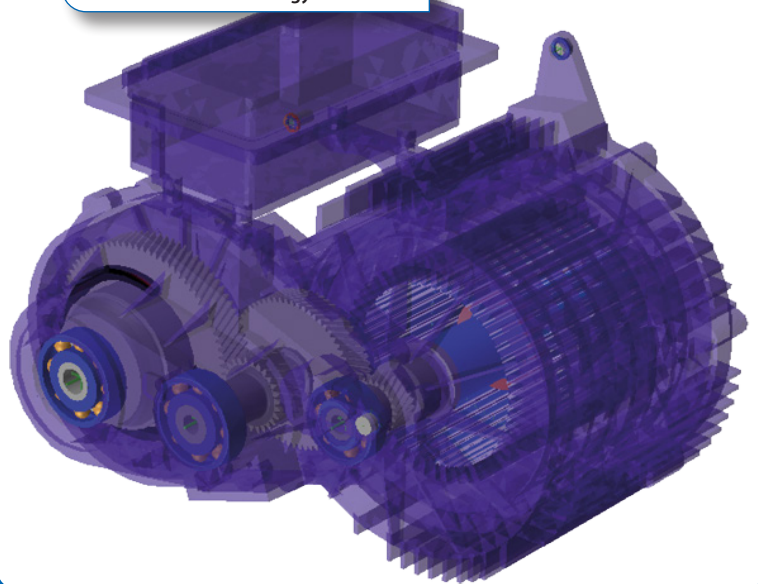
In parallel we also consider the socio-economic and political environment we live in, from our day-to-day living to how CO₂ reduction is set within global initiatives such as the UK Governments' 'Road to Zero Strategy' - the Government's ambition for at least half of new cars to be ultra-low emission by 2030.

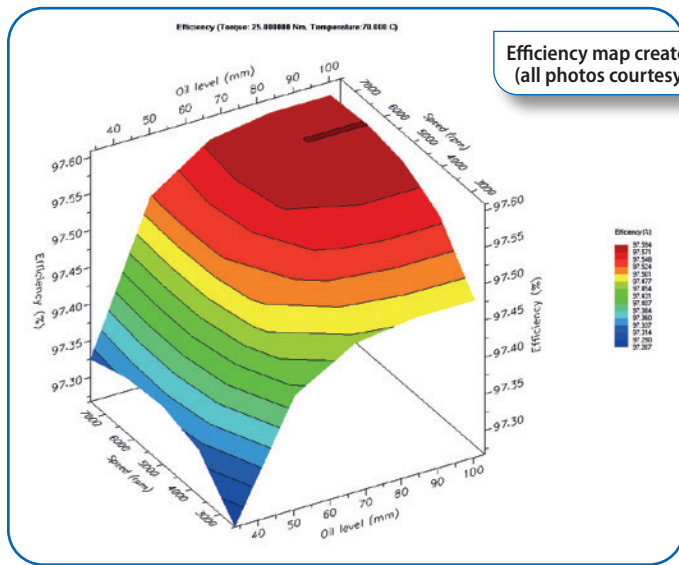
Romax is doing its bit to actively support ambitious targets through combining its practical engineering expertise across all sectors and aligning this with its software creation and unique ability to understand both mechanical and electrical systems. Across the industries, we have been working with the greater aim of increasing efficiency in mind.

In the automotive industry we have been actively supporting technology transfer as traditional engines convert to hybrid and all-electric vehicles, through optimised design and development for over thirty years. In fact, Romax software and engineering experts have had a huge impact in this sector having supported the design and development for over 70% of cars worldwide. We have patent applications looking at improving electric vehicle noise, and hybrid design in addition to improving the efficiency of drivelines.

Streamlining the design and development process with our software had led to more efficient powertrains that produce less CO₂. Some of our projects have seen huge benefits, for example, we have redesigned the gears of a production electric vehicle gearbox with a 20% efficiency improvement confirmed in testing. Another of our project has seen a 2% improvement in the overall efficiency achieved, and an ETI (Energy Technologies Institute) project which reduced power losses in the axle by 60%.

An electromechanical system modelled in Romax Energy software.





Efficiency map created in Romax Energy (all photos courtesy of Romax).

In recent years, using our IET award-winning understanding of electrical systems and their interactions with mechanical drive systems has led to the development of our eDrives business and the development of our software which have been pivotal in the creation of a new wave of electric vehicles including cars, buses, vans and tractors.

At the pinnacle of this activity and in addition to our expertise, Romax has recently launched Romax Energy, a global efficiency prediction tool for electro-mechanical transmissions. An efficiency software product, Romax Energy offers the ability to quickly generate efficiency maps, and accurately calculate fuel consumption and CO₂ emissions.

Encompassing advanced tribological models and backed-up by continuous internal R&D efforts, Romax Energy empowers users with advanced methods to predict transmission power losses and pinpoint where improvements can be made to optimize efficiency performance.

Numerous customer projects have proven that Romax's efficiency simulation methods and tools can improve powertrain efficiency and reduce fuel consumption and emissions. Romax Energy works with the rest of the Romax Nexus family of products, enabling collaboration across multi-disciplinary engineering functions.

In the wind industry we have made an impact in the development of bearings and drivetrain technology for wind turbines, both on shore and offshore. Our focus in the wind industry was to increase gearbox and bearing reliability to extend the life of the components and provide technological solutions. Within this we created software capability to monitor the wind turbines effectiveness and provide detailed durability analysis to those OEMs operating and maintaining them. This resulted in operators being able to use this analysis to plan and even schedule in maintenance on multiple turbines and look closely at the components reliability which saved millions in time, transport and component costs.

Back in 2008, there were major concerns that the UK wouldn't meet the renewable energy targets set for 2020. 10-15 years on from the explosion of onshore and offshore wind turbine development, we have seen an actual improvement in the design methods due to our role in providing a

better understanding of the reliability of drivetrains. Romax' software simulated what was happening inside the drivetrain and provided an emerging industry with accessibility to understand the constraints, bring about innovations and make huge reliability improvements. Such improvements have paved the way for a transformation in the outlook for electricity generation. In addition, Romax analysis services have been used by over 8 GW of assets (wind turbines). This is akin to powering 16.7 million homes in the UK for a year.

Much of its ability to provide such leading innovation comes from the business' investment in its technology advancement which has always been a key part of Romax. Last year alone Romax invested £3.7 million in its Research and New Product Development with a dedicated team of people who work globally with partners on Romax-led or as part of collaborative projects to develop new technologies. This is in addition to a product development team who take the ideas from research to fruition.

In the aerospace industry, airlines have a challenge on their hands to remain acceptable to younger generations as a result of the emergence of 'flight shaming' and the realisation that air travel emits far more CO₂ per passenger km than other forms of travel. The aerospace industry must change, and is changing, with assistance from Romax.

Here, Romax is using its understanding of holistically considered electric and mechanical drive systems to create changes in technology that will benefit future generations through the innovation of electric aircraft and ultra-light — efficient aeroplanes.

Our projects have included working on the design and development of next generation Geared Turbofans where the industry has plans to reduce CO₂ by as much as 25% when compared to current aircraft engines.

Our expert engineers understand the importance of applying safe, quality-controlled parameters to our design work when considering the development goals for the next generation of propulsion systems.

We believe that in the same way as setting an annual CSR strategy, considering the fundamentals of our place, the global ambitions and the environmental impact we have on the world, or our contribution to reducing CO₂, is key.

Without the combination of sharing, partnering and collaboration in technology advancement we cannot change the world in which we live for the better. One small cog within a whole gearbox, we strive to work with others collaboratively, to come together in powering this type of change, to showcase the importance of sustainable engineering in everyday life, as part of the company's values to engineer a better world by creating new industry standards. (www.romaxtech.com)

Mirelle Ball is corporate communications manager at Romax Technology. She can be contacted at mirelle.ball@romaxtech.com.



Altra Industrial Motion

LAUNCHES EXPANDED VIRTUAL TRADE SHOW

Altra has recently extended the scope and functionality of its virtual exhibit. The immersive and interactive trade show environment provides visitors around the world with convenient 24/7 access to browse the extensive portfolio of motion control and power transmission products offered by Altra's 27 global brands.



Visitors can quickly and easily navigate through the intuitive virtual exhibit area by clicking on various primary hotspots, including clutches & brakes, couplings, gearing, automation & specialty, PT components, brand websites and a media tower.

Interactive product category kiosks are located within each major section of the exhibit. Users can select specific Altra brands on each kiosk which reveal a series of product family hotspots that link to specific product screens where related literature pdfs can be downloaded. The media tower features links to various videos as well as the Altra literature portal. (www.altraex.com)

Motion Industries

NAMES PACER TO VICE PRESIDENT – CENTRAL GROUP

Motion Industries, Inc. has named **Chris Pacer** to vice president of the company's Central Group — effective January 1, 2020.

A graduate of the University of Toledo with a bachelor's degree in engineering technology (electrical and electronics engineering, 1994), Pacer has more than 24 years of experience within the industry. He has spent the last 22 years with Motion Industries, which were dedicated to various key roles throughout the organization.



Pacer joined Motion Industries as a certified fluid power specialist in 1997, working his way up to branch manager throughout the various markets within Northern Ohio. He then joined the company's Corporate Accounts Team in 2011, before being promoted to his latest position of Detroit Division vice president and general manager in 2014. In that role, Pacer was responsible for the further development and overall growth of 22 branch operations and one service center, creating a positive experience for customers through a

multi-faceted approach to strategic value.

Pacer will report to Mark Stoneburner, Motion Industries senior vice president Eastern Sales & Branch Operations, Mergers & Acquisitions.

"Chris's experience and drive will provide the perfect foundation for his next challenge of leading the Central Group to success," said Stoneburner. "The promotion is well-deserved and we are excited to see him start this new decade in a new leadership role."

Motion Industries President, Randy Breaux, said, "I'm very proud of Chris and his accomplishments to date. Over the years, Chris's acumen for the business, dedication to success, and persistent drive for superior customer service makes him the right person to fill this leadership role. I look forward to seeing accelerated growth and success for the Central Group under his direction." (motionindustries.com)

Siemens Digital Industries Software

PARTNERS WITH ARM ON AUTOMOTIVE TECHNOLOGY

Siemens Digital Industries Software has announced a partnership with global semiconductor IP leader Arm, that will bring leading edge IP, methodologies, processes and tools together to help automakers, integrators and suppliers collaborate, design and bring to market their next-generation platforms much faster. This partnership was formed to address the increasingly complex challenges facing the industry in developing platforms to realize active-safety, advanced driver assistance, in-vehicle infotainment, digital cockpits, vehicle-to-vehicle/vehicle-to-infrastructure and self-driving vehicles. Key advances in computing and sensor technology are enabling companies to redefine mobility beginning with the integrated circuits and software within automotive electronics systems. The combination of Siemens' and Arm's innovative technologies can help automakers and suppliers deliver tomorrow's electronic design and automotive solutions, today.

Siemens' PAVE360 digital twin environment, featuring Arm IP, applies high-fidelity modeling techniques from sensors and ICs to vehicle dynamics and the environment within which a vehicle operates. Using Arm IP, including



Arm Automotive Enhanced (AE) products with functional safety support, digital twin models can run entire software stacks providing early metrics of power and performance while operating in the context of a high-fidelity model of the vehicle and its environment, helping deliver a new future of mobility.

“Developing future transportation solutions requires collaboration across complex ecosystems,” said Dipti Vachani, senior vice president and general manager, Automotive and IoT Line of Business, Arm. “Arm technology has been deployed in applications across the whole vehicle for more than two decades, and our collaboration with Siemens redefines what is possible in terms of safety-capable, scalable heterogeneous compute. We see this as an important catalyst for the next wave of automotive semiconductor innovation.”

Using Siemens’ PAVE360 with Arm automotive IP, automakers and suppliers can simulate and verify sub-system and system on chip (SoC) designs, and better understand how they perform within a vehicle design from the silicon level up, long before the vehicle is built. Arm’s automotive IP is helping to democratize the ability to create safety-enabled silicon, bringing it within reach of the entire automotive supply chain. By rethinking IC design for the automotive industry, manufacturers can consolidate electronic control units (ECUs), leading to thousands of dollars in savings per vehicle by reducing the number of circuit boards and meters of wire within the vehicle design. This in turn reduces vehicle weight which can promote longer range electric vehicles.

“In all we do at Siemens, our goal is to provide transportation companies and suppliers the most comprehensive digital twin solutions, from the design and development of semiconductors, to advanced manufacturing and deployment of vehicles and services within cities,” said Tony Hemmelgarn, president and CEO at Siemens Digital Industries Software. “Siemens believes collaboration with Arm is a win for the entire industry. Carmakers, their suppliers, and IC design companies all can benefit from the collaboration, new methodologies and insight now sparking new innovations.” (www.su.siemens.com)

Dana

OPENS LOUISIANA GEARBOX REPAIR AND SERVICE CENTER

Dana Incorporated has announced that it has opened the doors to a nearly 32,000 square-foot (3,000 square-meter) facility in Slidell, Louisiana, for the repair, service, and assembly of industrial gearboxes, including the ability to custom-make gears up to 6.5 feet (2 meters).

Located in the Fremaux Park development, the new facility replaces the company’s current operations in Slidell, offering a larger footprint to meet the growing demand for industrial gearbox service, repair, and refurbishment. Dana has also invested in gear grinding and hobbing equipment and skilled personnel to increase the ability to quickly turn-around gearboxes for customers.

In addition to the facility in Slidell, Dana has 26 service



and assembly centers around the world that provide custom solutions for gearboxes used in a variety of applications such as mining, steel and metal, pulp and paper, power generation, food processing, marine, cement, wind power, water treatment and much more.

“The additional square footage in this new facility combined with the increased ability to rapidly make gears gives Dana the capacity we need to further support our industrial gearbox customers who come to us for custom, highly engineered solutions,” said Aziz Aghili, president of Dana’s off-highway drive and motion technologies. “Dana’s service and assembly centers provide critical support for our global customers throughout the lifecycle of their machinery, whether they’re building something completely new for a one-off application or maintaining current equipment to ensure maximum performance and uptime.”

With the expanded capabilities in this facility, Dana in Slidell now offers customized open-gearing solutions for

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multiple applications, as well as drop-in replacements gearing and full assemblies for obsolete units. From upgrading customer gearboxes to increasing the quality and capacity, Dana's service and assembly centers are equipped to address each of the challenges faced by its customers, including updating legacy products.

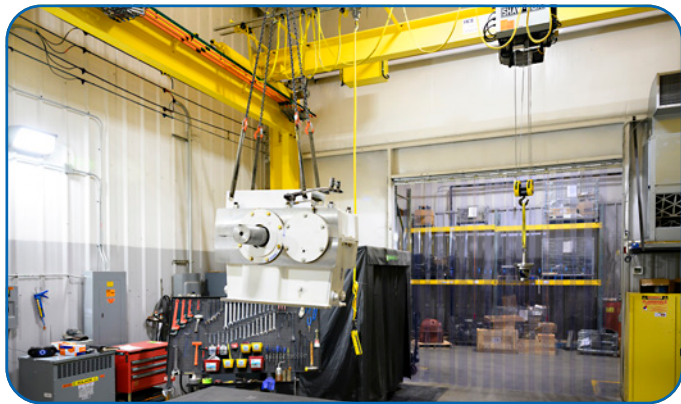
Within its global network, Dana has an extensive inventory of service components, including bearings, seals, shafts, and gearing for its original-equipment brands – Brevini and PIV. The company also provides repair services for a broad range of industrial gearbox brands ranging from small applications to large, 40,000-pound (18,000-kg) industrial gearboxes.

In addition to its service and repair capabilities, Dana partners with customers to offer on-site maintenance training to its to address the importance of maintaining equipment to extend the life of the gearbox. (dana.com)

Timken

EXPANDS MANUFACTURING CAPABILITY OF SOUTHWEST REGIONAL GEAR REPAIR FACILITY

The Timken Company has announced that renovations are complete and new services operational at the Philadelphia Gear Southeast Regional gear repair facility in Birmingham, Ala. The project includes an isolated assembly bay, the addition of a retractable paint booth and a large industrial parts washer, all designed to facilitate a “clean assembly” environment. “We evaluated our operation from the ground up,” said Jay Alexander, manager of the Philadelphia Gear manufacturing and service center. “Our renovated facility is streamlined to simplify production and improve efficiency, and more importantly, expand our service offering.”



The newly renovated assembly bay features 3,500 square feet of isolated assembly space, new floors and a crane system capable of handling up to 5-tons. The portable, retractable paint booth includes an integrated air filtration system that can expand to 400 square feet to accommodate all sizes of gearboxes. The paint booth addition is an environmental and quality improvement in the painting process. The other major investment was a large industrial parts washer that can hold gearboxes and components up to 7,000 lbs. It features a 72-inch turntable, 150 psi of washing pressure and 180 degree washing temperature. This unit will reduce cleaning time by four hours per gearbox over manual methods

and eliminate the need for outsourced sand or bead blasting. “We’re excited about the improvements in our Birmingham location,” said Alexander. “This upgrade will fill a niche in the paper mill industry and provide even better, “cleaner” services for customers across all markets. We are committed to our goal of becoming the trusted, full-service advisor for gearbox repair and service in the Southeast.” (www.timken.com)

Velodyne Lidar

ANNOUNCES NEW CHIEF TECHNOLOGY OFFICER

Velodyne Lidar, Inc. announced **Mathew Rekow** as its new chief technology officer (CTO). Rekow assumes the CTO role following Anand Gopalan, who was recently named Velodyne's chief executive officer (CEO). As CTO, Rekow leads Velodyne's customer-focused advanced research and development team. The group designs state-of-the-art lidar solutions for high performance, cost optimization and high-volume production to address a wide range of market needs. Since joining the company in 2015, he has had a significant impact on Velodyne engineering and solution success, including the development of lidar products, such as the Alpha Prime, Vellarray, Velabit and VelaDome.



Rekow was previously a senior director of optical engineering at Velodyne. With 30 years of experience in the development of macro and micro optical systems, semiconductor lasers and detectors, Rekow has proven an effective engineering team and project leader, building and fostering a dynamic research team. Rekow is an accomplished engineer whose work has contributed to numerous U.S. and European patents and successful commercial products and processes. He has written numerous technical articles for leading industry publications.

“Mathew is passionate about addressing customer needs and driving innovation in advanced, cost-effective lidar technology,” said Gopalan. “He has been a powerful asset to Velodyne in developing game-changing lidar solutions that help our customers bring to market new products with greater autonomy and safety. Mathew is an outstanding engineering team leader who will guide us in continuing to develop outstanding products and managing a great technical team recognized for invention and growth opportunities.”

“As CTO, I will ensure Velodyne's technology and product roadmap remains closely aligned with the needs and vision of our customers as we usher in the autonomous future. Of equal priority is growing our technical talent and mentoring the engineering architects and leaders that will take autonomous technology to the next level. Velodyne has built a diverse and capable engineering team and I will do everything I can to ensure our continued growth and industry leadership,” said Rekow. (velodynelidar.com)

March 7–14—IEEE Aerospace Conference 2020 Big Sky, Montana. The International IEEE Aerospace Conference, with AIAA and PHM Society as technical co-sponsors, is organized to promote interdisciplinary understanding of aerospace systems, their underlying science and technology, and their application to government and commercial endeavors. The annual, week-long conference, set in a stimulating and thought-provoking environment, is designed for aerospace experts, academics, military personnel, and industry leaders. The 2020 conference is the 41st in the series. Conference topics include aerospace systems, military, civilian or commercial aerospace endeavors, government policies, aerospace engineering and management, and more. The event features over 175 hours of technical sessions and 20 hours of networking events. For more information, visit aeroconf.org.

March 9–11—International Fluid Power Conference 2020 Dresden, Germany. The 12th International Fluid Power Conference offers future trends and innovations in the field of fluid-mechatronic systems. Throughout a series of technical lectures and during the accompanying exhibition, there will be many opportunities to discuss ideas with scientists, end-users and manufacturers from all over the world. In over 100 international scientific and technical lectures spread over three days, the participants will get an overview of current developments, novel applications and research work in the field of fluid power technology. Sessions include fundamental topics, such as fluid properties, to challenges related to digitalization and automation, such as predictive maintenance or digital systems. The diversity of fluid power technology is reflected in the program. For more information, www.ifk2020.com.

March 10–14—IFPE 2020 Las Vegas, Nevada. IFPE is the leading international exposition and educational resource dedicated to the integration of fluid power with other technologies for power transmission and motion control applications. IFPE exhibits showcase the latest technologies and innovations in equipment, products and services for fluid power/motion control/power transmission. The show also features product-focused exhibit pavilions and international exhibit pavilions. IFPE is owned by the National Fluid Power Association (NFPA) and the Association of Equipment Manufacturers (AEM). AEM is show producer. For many attendees, part of the IFPE show experience includes participation in IFPE's education program, including college courses and timely sessions to help them stay on top of their game. New this year, attendees will be able to mix and match sessions between both IFPE and CONEXPO-CON/AGG. Attendees will be able to pay one price and select education from both shows. Presenters for IFPE's education sessions come from across the United States from distinguished universities. For more information, visit www.ifpe.com.

March 16–19—AeroDef 2020 Fort Worth, Texas. AeroDef Manufacturing is an aerospace manufacturing and defense manufacturing conference and trade show for the aerospace and defense manufacturing industry. Produced by SME, in partnership with industry OEMs, the show's mission is to foster innovation across the extended enterprise to reduce costs, expedite production times and maintain manufacturing competitiveness in the global economy. Conference topics

include additive, automation, composites, assembly, coatings, quality, smart manufacturing and more. For additional information, visit www.aerodefevent.com.

March 19–21—2020 AGMA/ABMA Annual Meeting Lake Buena Vista, Florida. Join 300 of your industry peers to grow every aspect of your company while staying up on the latest technologies and innovations in the gear and bearing industries. Along with technical meetings, committee meetings and special luncheons and dinners, the Annual Meeting will feature a diverse group of speakers including A.B. Stoddard (Real Clear Politics), Dave Hataj (Edgerton Gear, Inc.), Dominique Dawes (Olympic gymnast and public speaker), Jim Meil (ACT Research), Peter Zeihan (Zeihan on Geopolitics) and Todd Palmer (Diversified Industrial Staffing). For more information, visit www.agma.org/events/agma-abma-annual-meeting/.

March 24–26—AGMA Steels for Gear Application Alexandria, Virginia. Attendees will gain a basic understanding of steel and its properties. They will learn to make use of steel properties in an application and understand the potential that different steel and heat treatment options can offer. They will explore how performance of the material depends on how the steel is produced. Class will take place at AGMA Headquarters from 8:00 am–5:00 pm each day. The course will be taught by Goran Nystrom, executive vice president, Ovako. For more information, visit www.agma.org.

March 25–27—PTDA Spring Meetings and Leadership Development Conference Pittsburgh, PA. PTDA 2020 Spring Meetings combine the Leadership Development Conference and governance meetings. The Leadership Development Conference offers networking opportunities along with powerful education for those looking to enhance their leadership skills. Up-and-coming leaders, including Next Genners (40 or under) or established leaders who are seeking to improve on this important skill will benefit from attending this conference. The governance meetings include PTDA's board, council and committees as well as the PTDA Foundation Board of Trustees. More than 100 volunteers come together to work on programs and services to achieve the goals set forth in the PTDA and PTDA Foundation Strategic Plans. For more information, visit www.ptda.org.

March 31–April 1—Bearing World by FVA Hannover, Germany. This is the third expert forum “Industrial Research and Science in Dialogue with Practical Application,” focusing on the topic of bearings in theory and application. Bearing World focuses on all facets of bearings and all involved components, with special emphasis on rolling bearings in combination with or comparison to plain or magnetic bearings. The conference examines everything from life and durability to lubrication, NVH and smart bearings. Participants include Schaeffler, SKF, FVA, Klingelberg, SEW Eurodrive, Thyssenkrupp, Tsubaki, ZF Wind Power, and more. Keynote topics include mechatronics and bearings, using AI to predict performance, and flexible grinding manufacturing. For additional information, visit bearingworld.org.

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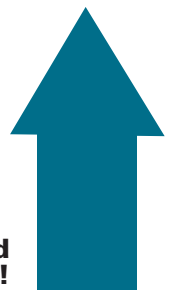
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Schaeffler Goes Big in Bearing Applications

Matthew Jaster, Senior Editor

One of the largest components manufactured by Schaeffler last year was a double-row tapered roller bearing featuring an outer diameter measuring 3.6 meters and a weight just over nine tons. This bearing is used to support the main shaft in an offshore wind turbine. Although this bearing is currently used in overseas markets, it is expected to be installed in North America-based applications later this decade.

Wind turbines equipped with bearings of this size certainly present some interesting challenges for application engineers and designers, according to Anant Bhat, business unit manager—railway and renewable energy, Schaeffler Group USA Inc.

“It is important to meet or even exceed several critical requirements such as contact pressure, rating life, safety factor as well as the actual reliability of the bearing and its components. This is where Schaeffler’s specially designed in-house calculation and simulation tools are invaluable: they assist our engineering and design team with the ability to provide comprehensive analysis support to help ensure optimum bearing design.”

Bhat said that Schaeffler’s production team can rely on several key manufacturing competencies including forging, soft machining, specially designed heat treatment, hard machining and final assembly for components like this.

As a final manufacturing step, Schaeffler undertakes some of the industry’s most stringent quality inspections and measurements of the finished bearing that enable the company to ensure the highest quality and reliability for its customers throughout the world.



In-house design validation and testing of the massive bearing was performed on Schaeffler’s proprietary ASTRAIOS test stand, one of the largest, most modern and highest-performing bearing test rigs in existence.

“In-house design validation and testing was performed on Schaeffler’s proprietary ASTRAIOS test stand, one of the largest, most modern and highest performing bearing test rigs in existence,” Bhat said. “ASTRAIOS simulates the real loads and moments that occur in a wind turbine, which enables Schaeffler to make a major contribution toward reducing development times for wind turbines. In doing so, ASTRAIOS facilitates a more reliable design process while also increasing the cost-effectiveness and safety of these massive power-generating machines.”

Along with projects in other industrial sectors, Schaeffler is currently working on additional bearings of similar size for main shaft applications in offshore wind turbines. In recent years, the company has gained a great deal of experience producing large components.

“In 2016, Schaeffler introduced the world’s first sealed ultra-large 241/1250 spherical roller bearing, which was specifically designed for the highest-capacity High Pressure Grinding Roll Crushers (HPGRs) used by the mining industry. The seal inside this massive roll support bearing is designed to prevent the crushing materials from contaminating its internal components,” Bhat said.

In 2019, Schaeffler produced the largest spherical plain bearing in the company’s history (to date). “Featuring an outside diameter of 1.9 meters, a bore diameter of 1.5 meters and a height of 60 centimeters, this special bearing weighs approximately 4.7 tons. It will be installed in a cutter suction dredger that is used in offshore oil & gas drilling applications,” Bhat added.

With each new bearing application, Schaeffler’s engineering and design team gains valuable experience and the tools necessary to provide reliable products for the areas like wind, mining and oil & gas no matter the size or scope.

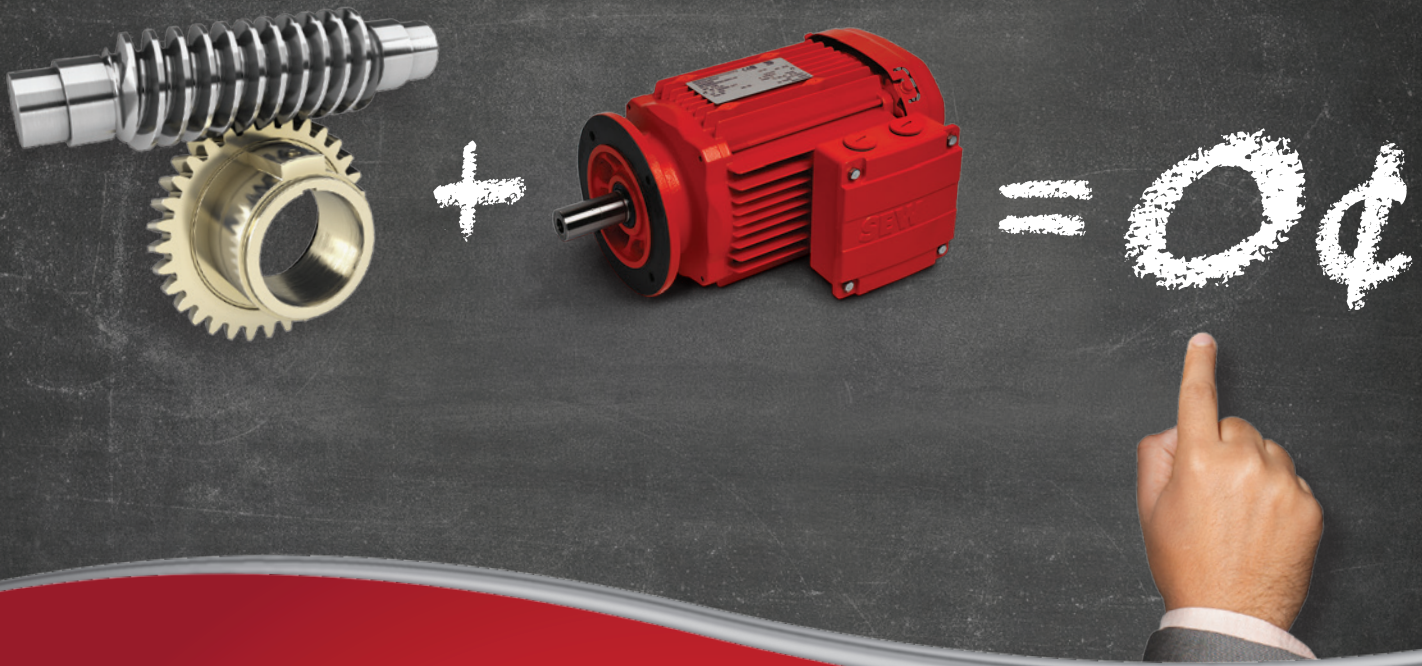
The big business of bearings continues... **PTE**

For more information:

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Schaeffler’s double-row tapered roller bearing — currently used in offshore wind turbine applications — features an outer diameter measuring 3.6 meters and a weight of just over nine tons.

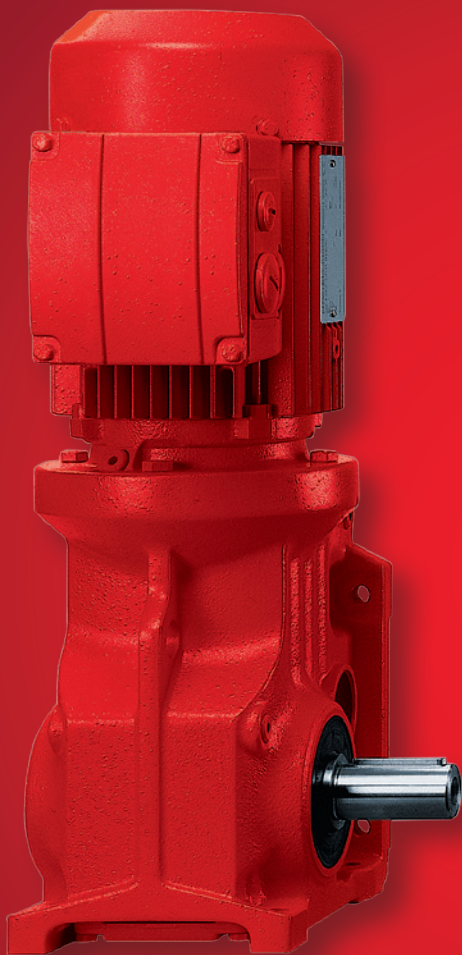


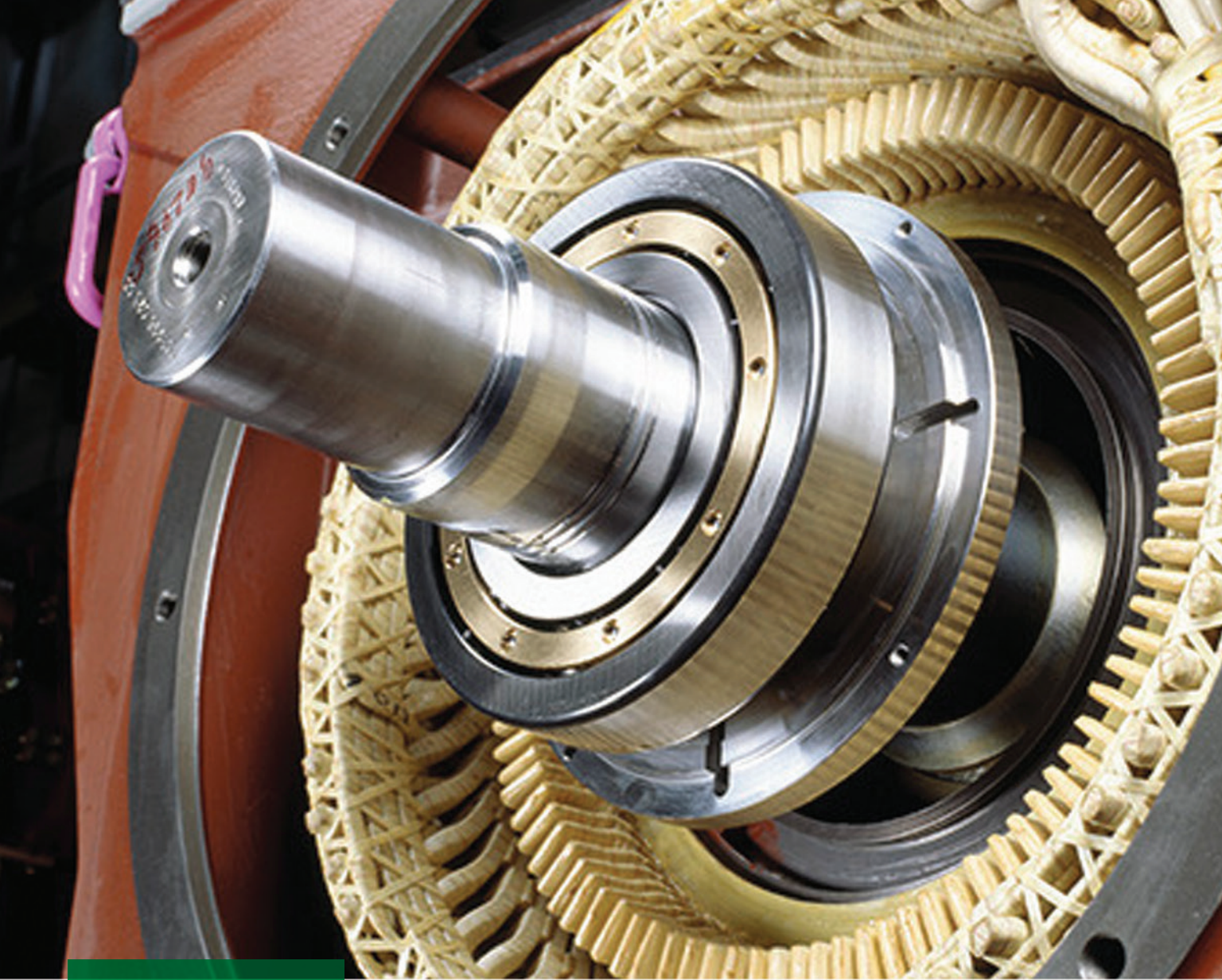
Makes no cents!

Adding an inefficient single-stage worm gearbox to a premium efficient motor doesn't make sense if you are trying to save money.

Why gain 2-3% energy savings with a more efficient motor and then lose 50% or more through the worm gear?

Solution: Use a helical-bevel gearmotor from SEW-EURODRIVE and obtain 96% efficiency. Now that makes a lot of cents!





Stray Electric Current: Meet Your Match

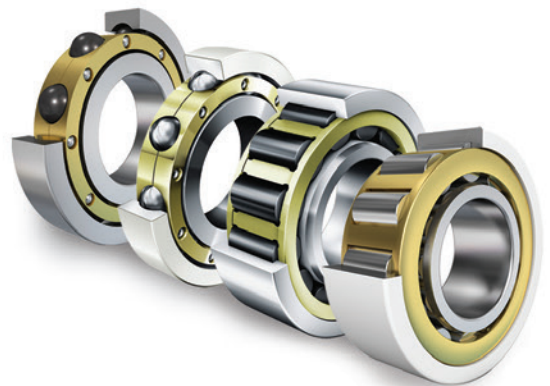
The problem: Damage caused by electrical current passing through bearings in electric motors.

The solution: Current-insulated bearings from Schaeffler — including hybrid ceramic or ceramic-coated versions featuring our proprietary Insutect™ coating — that have been engineered to stop stray electric current in its tracks.

Now that's electrifying!

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