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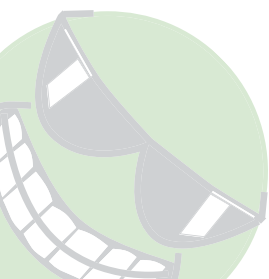
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Power Transmission Engineering®

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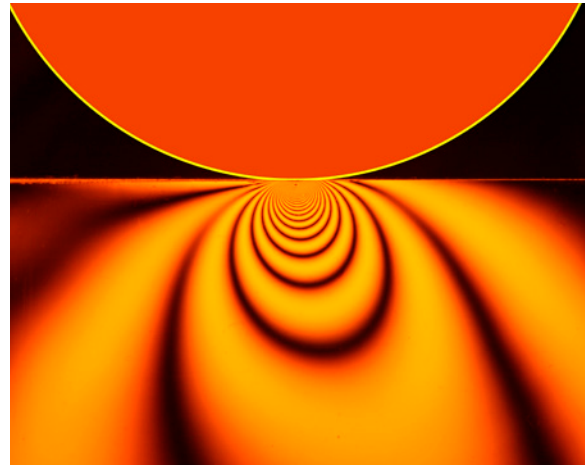
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Are you looking to stay ahead in the ever-evolving world of mechanical power transmission and motion control? Look no further than *PTE* magazine!

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powertransmission.com/blogs/1-revolutions/post/9970-dual-loop-motion-control-with-only-one-encoder

Engineering Legacy: Maxon (1961)



Our next legacy entry is maxon, a global leading provider of electric drive systems. The company provides single-source DC and BLDC motors, gearheads, sensors, control electronics, mechatronic drive systems and more—from individual prototypes to large-scale production. The history of maxon begins with Interelectric AG in Frankfurt.

powertransmission.com/blogs/1-revolutions/post/9993-engineering-legacy-maxon-1961

AS SEEN IN GEAR TECHNOLOGY

Mission to Mars



If all goes as planned, NASA will launch its Sample Retrieval Lander (SRL) Mars mission from Florida's Space Coast in June 2028, the start of its latest, and greatest, mission to Mars. Read Southern Gear's role in the SRL mission here:

geartechnology.com/articles/30763-mission-to-mars

powertransmission.com



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Feedback Loops

Recently I've had a number of people tell me how much they enjoy our work here at *PTE*. While it's always nice to receive "attaboys," these recent unsolicited compliments have been both thoughtful and specific, which is especially gratifying because they validate many of the choices we make as publishers.

For example, one reader, a process engineering manager, wrote to compliment us on our technical content. He noted in particular how we keep our technical articles separate from advertising. We do this quite deliberately to avoid any hint of commercialism or bias, knowing full well that not everybody notices. That same reader made it clear that he wasn't advertising averse. In fact, he specifically recognized its importance, which is a relief, since many of the technological innovations we present are, in fact, in the advertisements.

It's extremely rare for us to receive such feedback. Think about it. How many times have you been so moved by the content of a trade magazine that you're inspired to write to the editors and tell them? Trust me, it just doesn't happen that often. But when it does, it means a lot to me and my team.

Another example comes from a nice conversation I had with an engineer at IMTS. He told me how much he enjoys our publication, and he looks forward to every issue. He works in the bearings industry, and he especially values the articles in that area, specifically mentioning the articles from our longtime contributor Norm Parker. You can read Norm's latest insights on ball bearing efficiency in his article on page 48.

I don't have to tell you how important feedback is. For many of you, it's part of your job every day.

At IMTS, we saw many examples of closed-loop systems, where feedback from measurements (either of actual parts or process parameters) is being used to

inform and improve manufacturing operations to reduce scrap and improve uptime. In fact, the closed-loop system is considered the Holy Grail of process improvement for machine tools. You don't have to stop the machine to take a part off, inspect it and figure out if your process is on track. You can measure and correct on the fly.

The same is true of modern condition monitoring, which we write about nearly every issue. For example, the importance of condition monitoring is highlighted in this issue's article on best practices for lubrication excellence in the food and beverage industry (p. 16). Constant feedback on the performance of your machinery is how you stay ahead of problems—before they become bigger problems. It's also reassuring to know that systems are running smoothly.

Unfortunately, we don't have the same kind of capability in publishing. You could say we're the ultimate in high-mix, low volume production, because everything we produce is original. So when we *do* get feedback, it's appreciated more than you can know.

We strive to be unique among trade publications, and our success is dependent on the hard work, intelligence and creativity of our two senior editors, Matt Jaster (p. 30) and Aaron Fagan (p. 24, p. 56). So please read their stuff and let them know how they're doing.

PTE



Randy Stott

Publisher & Editor-in-Chief



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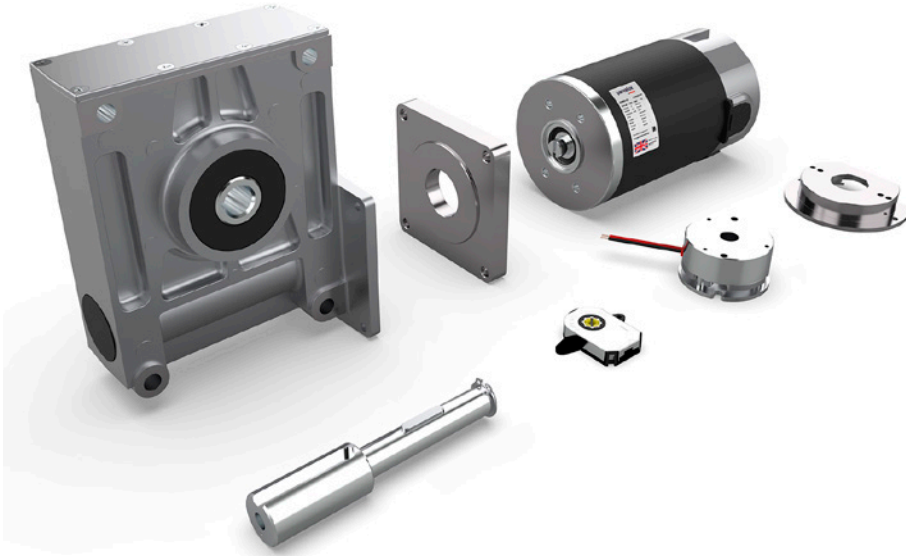
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PARVALUX BY MAXON

Offers Rapid Prototyping Capabilities for Motors



The latest innovation by Parvalux is their ability to provide prototype motors at a rapid pace. The company has designed and manufactured a series of modular components that are easily mixed and matched so that users get a paired system from one manufacturer rather than piecing together components such as motors, gearheads, brakes and encoders from various manufacturers. The ability to create a near optimal motor drive for your application just became faster and easier. In a three-step selection process, designers can purchase a motor that is built to order using the company's online configurator.

Although every application can be different, designers need to focus on voltage, speed, and torque in every case. Using a modular system provides a range of options that allow designers to determine their required output performance and make a quick selection. Once this is done, users of the online configurator can fine tune their selection using a range of accessories including brakes, encoders, shaft extension kits, and controllers.

As part of the company's modular drive systems, Parvalux offers a line of motors that includes PMDC (permanent magnet DC) motors,

BLDC (brushless DC) motors, and single-phase or three-phase AC motors, all of which are available with inline or right-angle gearboxes. The company's line of AC/DC motors are available in series-wound or shunt-wound versions. Accessories, such as encoders and brakes are easily selected.

PMDC motors are small motors with impressive output performance, excellent for mobility, patient care, and industrial product designs. BLDC motors require no maintenance and offer high starting torques, excellent power density, and quiet operation. Parvalux also offers their SC 50/15 controller which ensures precise control over speed, torque, and motor efficiency. The company designs and manufactures a complete line of motion products for industry that have become key components in a wide variety of applications. Parvalux also offers recommended combinations of motion systems for building automation that include door automation and access control stations; material handling combinations that include conveyors and AGVs, and mobility combinations that include stairlifts, patient hoists, wheelchair lifts, and more.

parvalux.com/us/modular-range/

ABB

Expands Baldor-Reliance SP4 Technology in Severe Duty Enclosures



The development of the new cast-iron totally enclosed fan cooled (TEFC) severe duty motor marks the second phase of ABB's SP4 technology launch. This model is uniquely designed for applications in hazardous environments with certifications for Division 2 and Class I Groups A, B, C, D, as well as Class II Groups F, and G, making it suitable for areas with explosive gases and combustible dust. The model also features an IP55 rating, ensuring protection against dust and water spray, making it reliable for harsh and dirty conditions. ABB previously introduced two different models with SP4 technology: rolled steel open drip proof and totally enclosed fan cooled motors.

The SP4 product line builds on the simplicity of ABB's proven AC induction motors and features a range of durable motors tailored to meet diverse, severe-duty applications. These motors are compatible with pumps, fans, compressors and conveyors and are ideal for all industries. The new cast-iron motors cover a power range of 25 to 300 hp, and the rolled steel models, which were launched earlier this year, are available in ¼ to 20 hp.

"Reducing electricity consumption benefits communities, businesses and the environment," said Brandon Canclini, ABB NEMA Motors Division global product manager. "The addition of the ABB

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Baldor-Reliance SP4 motors double down on our commitment to advancing our motor technology and maximizing energy savings.”

More than 80 percent of industrial electric motors run direct-on-line (DOL), independent of a drive. As a standalone DOL unit, SP4 achieves NEMA Super Premium (IE4) efficiency. The motors become even more efficient when paired with an ABB variable speed drive. SP4 motors run cooler, reducing heat-based energy losses and extending bearing and other component life. Reducing energy losses also leads to lower electrical energy consumption, which lowers operating costs and total cost of ownership.

Available in 2, 4 or 6-pole configurations, SP4 can seamlessly replace existing units to deliver efficiency upgrades for current applications. All SP4 models come with a standard 48-month warranty and are designed to easily replace existing NEMA motors, whether in simple direct-start setups or more advanced variable speed operations.

SP4 motors comply with current U.S. Department of Energy efficiency standards and anticipated Medium Electric Motor (MEM) regulations which take effect June 1, 2027. These regulations require motors up to 100 hp to meet NEMA Premium efficiency and motors between 100 and 250 hp to achieve NEMA Super Premium efficiency.

abb.com

HBK Offers Optical Solution for Railway Monitoring

To help railway engineers maintain their catenary system—the circulatory system that keeps everything moving—Hottinger Brüel & Kjær (HBK) has created its Fiber Bragg Grating (FBG) Pantograph Measurement System.

Monitoring forces and accelerations under high voltage in a train’s pantograph structure is vital, as it reduces the risk of damage to the catenary of railway networks. The

correct contact between the pantograph and the overhead line is mandatory for efficient train operation; electric trains establish connection to the catenary via their pantographs.



Within this high voltage environment, HBK’s FBG pantograph measurement system provides safe, continuous measurements via its fiber optic and issues instant alerts if a critical condition is detected, which can prevent unexpected delays or system shutdown.

The optical sensor is ideal for this task, as the main requirement for overhead line and pantograph monitoring are accurate measurements within a high-voltage level (15–25 kV). The optical sensor is a passive element, so its measurement principle is based on light and no active excitation of the sensors is required, which means there’s no interferences with other operations during measurement.

The FBG system also ensures compliance with EN 50317 legal standard for measuring the pantograph contact line interaction, which operators must meet to ensure minimal losses, limited wear and tear, as well as a reduced risk of disruption during the current transmission to the power unit of the vehicle.

hbkworld.com

NORD Provides Drive Units for Crane Applications

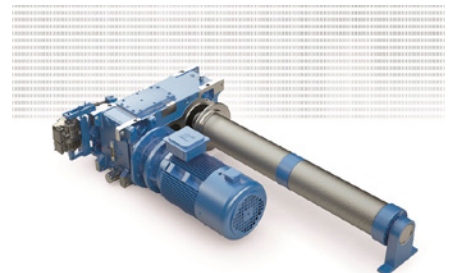
For different types of cranes and load ranges, Nord Drivesystems offers properly dimensioned drive solutions from a single source. For that, the company can rely on locations in

more than 80 countries. In Poland, the specialist for hoisting equipment Protea relies on the crane and cargo competence of the complete supplier from North Germany.

Protea has been relying on drive solutions and services from Nord Drivesystems for years. For its bridge cranes used, among other things, to transport bales of straw in biogas production, the company uses the Maxxdrive industrial gear units. They can cover torque ranges of up to 282,000 Nm.

For the lifting gear, Protea uses a robust Maxxdrive XD with a power of 18.5 kW. These parallel gear units build on the proven Unicase housing principle and have been specially optimized for heavy loads.

Due to the elongated arrangement of gear stages, the housing has a large center distance, enabling a U-shaped drive design. Especially with lifting gear drives, the cable drum and the motor can thus easily be arranged on the same side of the gear unit. The drives for cranes and trolleys also build on the Maxxdrive industrial gear units with powers of 0.55 and 11 kW.



“Our goal is to work in close coordination with our customers to find the optimum drive solution for their crane applications,” says Gernot Zarp, sales manager at Nord. “With our versatile product portfolio, we offer a wide range of drive components.” The drive specialist thus allows for individual system solutions, whose power, weight, size and service life are precisely tailored to the respective application. Over dimensioning the drive is therefore no longer necessary.

Especially for the design of lifting gear, Nord has extended its portfolio and now offers additional Maxxdrive XD sizes. It is now possible to configure the industrial gear unit with center distances of up to 1,281 mm. With this, the economic and tailor-made dimensioning of lift drives for crane applications is further improved. The installation space is used optimally, significantly reducing the weight of the drive. All in all, Nord provides its customers with higher flexibility in crane system design.

"We chose Nord components because the company is a reliable partner with whom we have been working for many years," says Tomasz Poprawa, project manager at Protea. "The products are of high quality and recognized throughout the world." Poprawa highly appreciates the one-piece Unicase housings with their high durability and the low maintenance costs, as well as the double seals ensuring smooth operation without leakage.

nord.com

FREUDENBERG SEALING TECHNOLOGIES Offers Sealing Solutions for Tire Inflation Systems

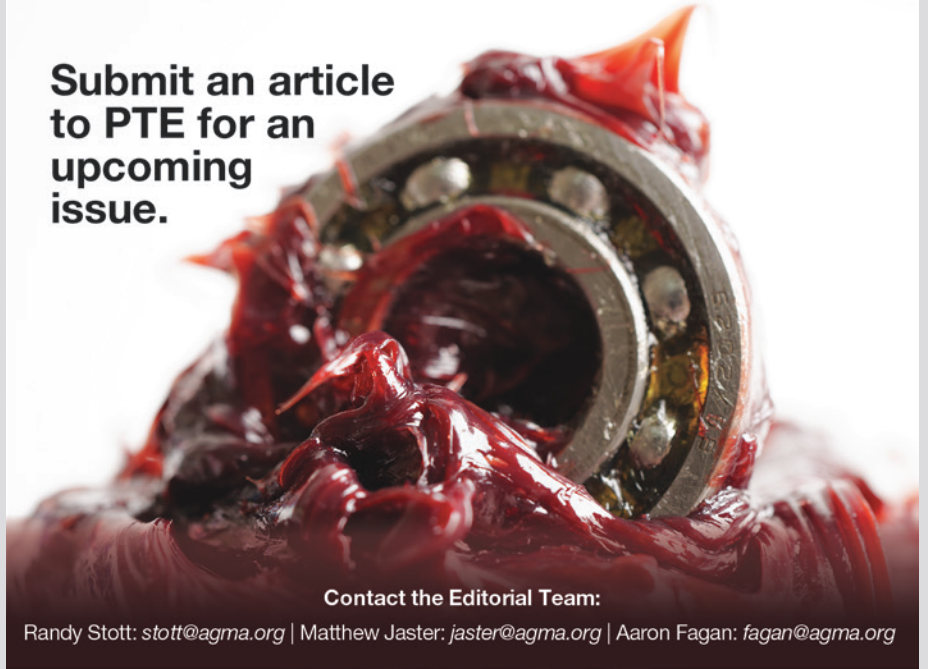
Freudenberg Sealing Technologies has made significant technological improvements to its seals for central tire inflation systems (CTIS) used by construction and agricultural machinery. These seals automatically adjust the tire pressure of off-highway vehicles to varying ground conditions and vehicle loads. Simply by pressing a button, drivers can now save time, reduce CO₂ emissions and simultaneously extend the service life of their tires.

Tilling fields with a tractor for row crops is very different from driving a truck on roads. But at least in one respect, these heavy vehicles have something in common: The tire pressure greatly impacts their performance. Optimally inflated tractor tires conserve fuel, allow farmers to work faster and reduce soil

Has Your Company Solved a Manufacturing Challenge?

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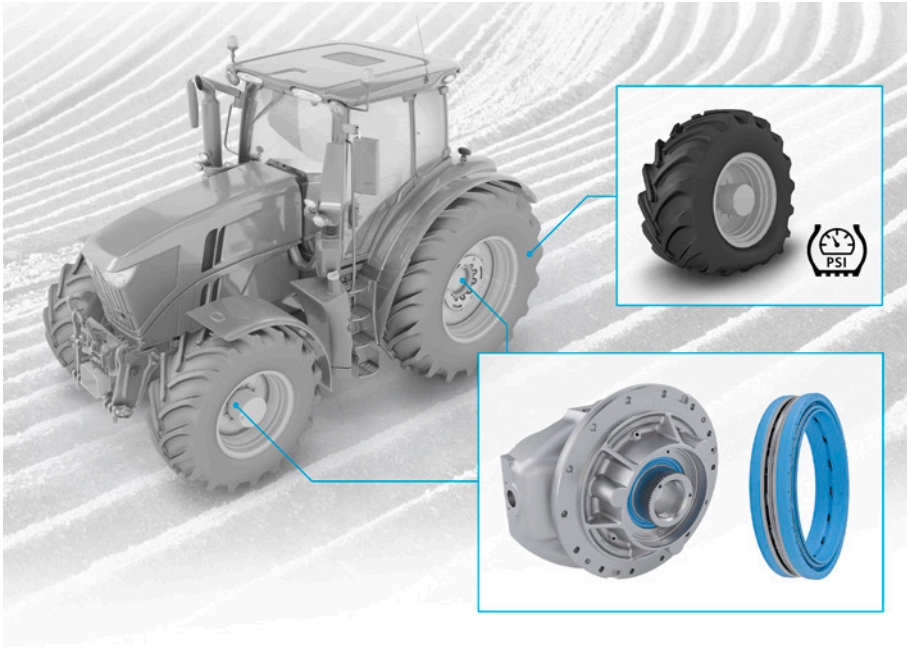
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compaction, whereas over-inflation leads to soil damage and reduced efficiency. Similarly, trucks with correctly inflated tires are safer on the road and can better handle temperature and pressure variations. Incorrect tire pressure results in premature tire wear and dangers at high speeds while making the vehicle less dynamic and more difficult to handle.

To meet these challenges, Freudenberg Sealing Technologies has developed a range of seals for various CTIS applications in heavy-duty vehicles. These systems combine cutting-edge material and design expertise with advanced electronics and sensor technologies, specifically tailored to meet the demands of heavy-duty applications. They offer an automated CTIS function and are installed directly in axle applications on the vehicle manufacturers' assembly lines.

"Freudenberg's seals for central tire inflation systems conveniently adjust the tire pressure to ground conditions, eliminating the need for drivers to leave their cabs to operate manual CTIS systems. This saves time and significantly improves driver safety," says Jens Wolfram, global segment director, mobile machinery agriculture, Freudenberg Sealing Technologies.

"Current systems with external cables are vulnerable to premature failure, as any damage to the system or cables puts their components at risk. Freudenberg's CTIS sealing solutions are housed within the wheel hub, which protects them from external influences during agricultural operations. This is a distinct advantage and unique selling point compared to external systems from competitors."

Key advantages of Freudenberg's CTIS

Central tire pressure control systems must be designed to meet the specific needs of each application—and the systems from Freudenberg Sealing Technologies deliver exactly that. At the same time, they adjust the tire pressure according to road and ground conditions as well as vehicle load. These systems save fuel, reduce excessive vehicle wear and decrease vibrations, offering the drivers a more comfortable ride.

Freudenberg's CTIS technology features an innovative, double-lipped sealing component mounted inside the wheel hub. This design separates the oil in the wheel hub from the compressed air entering the tire, absorbing the compressed air flowing to and from the tire. This eliminates the need for a hose

mounted on the outside of the tire. An air lip ensures stable CTIS operation at pressures up to 8 bar and circumferential speeds up to 4.5 m/s. The seal is pressure- and speed-optimized, which reduces the vehicle's power loss. Freudenberg's system offers the lowest power loss compared to conventional tire inflation systems, as the air pressure is equalized on both sides of the sealing lip. The resulting force minimizes the radial load on the sealing lip.

Freudenberg Sealing Technologies has already supplied CTIS sealing systems in series production for over 15 years, securing additional contracts with renowned manufacturers of agricultural and construction machinery and their suppliers. The CTIS system is manufactured in the company's various production plants worldwide.

"The North American heavy-duty vehicle market in particular has been seeking solutions to system aging caused by high speeds and temperatures in heavy-duty applications," Wolfram noted. "We are the right partner with the right technology to offer our customers the solutions they need. Freudenberg's CTIS solutions save fuel, reduce carbon dioxide emissions and extend service life—all at the push of a button. It's a real benefit to our customers."

fst.com

RED LION Launches Two New Programmable RTUs for Rugged Automation Environments

Red Lion is pleased to announce the launch of two new programmable Remote Terminal Units (RTUs), VT-MIPM-138-D and VT-MIPM-248-D. Equipped with onboard I/O and designed for uncompromising performance in extreme environments, the industrial controllers are ideal for a wide range of rugged, process-oriented applications in water and wastewater processing, oil and gas production and other advanced automation settings.



The new RTUs deliver maximum standalone control over today's toughest industrial processes. Automatic datalogging and timestamping, as well as logging of trends, alarms and sequences of events, give operators full visibility on their applications. A robust IEC 61131 programming and configuration environment in Red Lion Workbench provides extensive programming and troubleshooting capability. The unit also supports ISaGRAF for backward compatibility and has a true open system design, with Ethernet TCP, Modbus, Linux and more.

An ideal platform for water, wastewater and oil and gas processing facilities, the VT RTUs come pre-certified, letting operators add applications as desired, program and configure as needed and scale up easily, from 1 to 1000+ stations. Multi-user connectivity is enabled via 10/100 Ethernet ports, RS232 and RS485 and up to 4 communications ports. Onboard I/O is a mixture of DI, DO, AI and AO. Advanced communication capabilities include report on exception, store and forward and peer-to-peer networking.

"The VT-MIPM-138-D and VT-MIPM-248-D units represent the ultimate RTU upgrade for extreme industrial settings," said Jacob Colegrove, product manager. "For operators moving from an existing Sixnet series, it's the obvious choice.

They share the same footprint, has equivalent I/O count, offer comprehensive data logging and networking functionality, plus programmable features for full flexibility."

Suitable for hazardous areas and extreme temperatures, the controllers are rated for operating temperatures of -40°C to 70°C and have UL Class I, Division 2, CE, and ABS Type certifications.

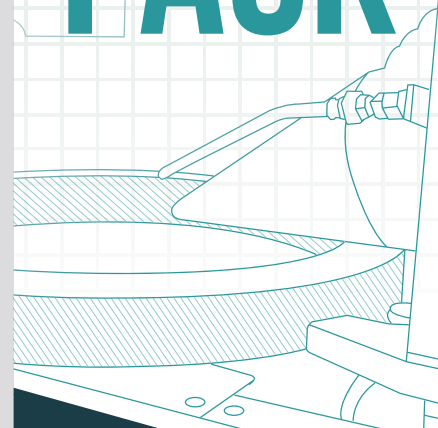
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RINGSPANN CORPORATION Unveils Universal Joint Program

Ringspann Corporation has unveiled its latest innovation—the Universal Joint Program. Designed to provide unparalleled efficiency and durability, the program offers a range of universal joints that promise seamless power transmission and flexibility across multiple industries.



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Universal joints have long been essential in machines with rotating shafts, enabling torque transmission between shafts with high misalignment. Ringspann Corporation's universal joints stand out for their precision, durability, and exceptional performance, making them a game-changer for businesses seeking reliable power transmission solutions.

The newly launched universal joint product line boasts a unique one-piece monolithic yoke design, setting new standards in durability and precision. These universal joints are built to withstand even the harshest environments. The Yokes are made from heat treated alloy steel, telescopic center sections that can accommodate up to 1,524 mm of travel, and up to 1,000 mm swing diameter. The crowned rollers are made from Bearing quality 52100 thru hardened steel to ensure extended bearing life.

"We are excited to introduce our Universal Joint Program to the market," said Keith Sowers, coupling product manager for Ringspann Corporation. "Our commitment to producing a complete, high-quality, power transmission portfolio; with competitive prices and short lead times, has driven us to develop this innovative solution. These universal joints are an excellent addition to our power transmission coupling portfolio, thus giving our customers a complete partner for all their power transmission needs."

Some of the key features of Ringspann Corporation's Universal Joint Program include:

- Metric, SAE, Split Eye, and Closed Eye options
- Special designs tailored to customer requirements
- Minimal lubrication requirements
- Virtually backlash-free operation
- Long bearing life for extended durability
- US-based manufacturing and assembly

- Robust technical support
- Quick turnaround on builds and repairs

The launch of the Universal Joint Program emphasizes Ringspann Corporation's position as a pioneer in providing high-quality power transmission solutions.

ringspann.com

SCHNEIDER ELECTRIC Enhances Enterprise Software Suite

Schneider Electric announces major enhancements to *EcoStruxure Resource Advisor*, a versatile enterprise software suite of solutions designed to empower global companies across efficiency, ESG, energy and risk, and renewables and carbon. This strategic evolution from a platform of stand-alone solutions to an integrated and multifaceted suite addresses the rapidly maturing market and the increasing complexity of corporate sustainability needs. Much of this has been driven in the market by escalating stakeholder demands and stringent reporting requirements, including the European Union's Corporate Sustainability Reporting Directive (CSRD) starting in 2025.

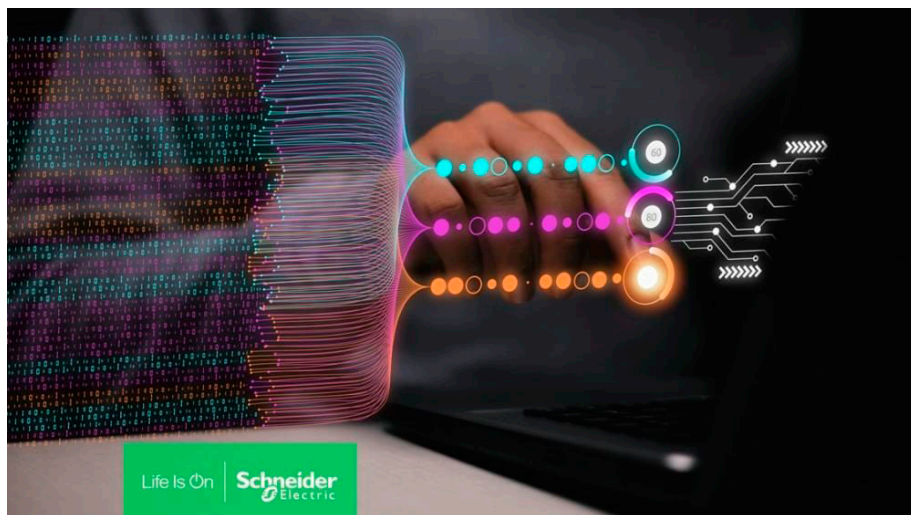
Recent research has highlighted a significant uptick in corporate sustainability programs, evident

in increased resourcing in people, tools, and budget. Companies are increasingly challenged to streamline ESG reporting, implement sustainability initiatives, manage renewable energy projects, reduce carbon footprints, optimize energy procurement, and enhance operational efficiency through targeted energy-saving measures.

The enhanced *Resource Advisor* suite offers specialized solutions that cater to these diverse needs, providing users with flexibility and depth to navigate their unique sustainability paths. Clients can leverage these capabilities individually or collectively, depending on their specific enterprise sustainability goals.

"As our clients and other global enterprise companies scale up their sustainability capabilities, we anticipate a growing need for precision technology and tools required to meet their evolving needs," said Steve Wilhite, president, Schneider Electric Sustainability Business. "We're excited about the targeted capabilities and emphasis on interoperability within *Resource Advisor*. The diverse set of stakeholders that often find themselves in energy, sustainability, or ESG projects—including legal, compliance, sustainability, procurement, operations, and technology teams—can solve even more of their pressing challenges with *Resource Advisor*."

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- PGO-FGL Series is NSF H1 registered and NSF/ISO 21469 certified food grade.

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- 100% Synthetic, ISO 460 grade, polyalphaolefin (PAO)-based worm gear oil.
- Formulated especially for worm gear applications.
- Provides excellent lubricity and oxidation resistance.

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- High-quality, petroleum-oil based, extreme pressure (EP) gear oils.
- Meets military specification MIL-PRF-2105E and MIL-L-2105D.
- Conforms to API categories GL-3, GL-4, GL-5, MT-1.

KLING GEAR OILS HEAVY-DUTY, TACKY RED, PETROLEUM OIL-BASED EXTREME PRESSURE (EP) GEAR OILS

- Heavy-duty, tacky, red, extreme pressure (EP) petroleum-based gear oils.
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Lubrication Excellence

Best practices for safety and uptime in food processing

Brandon Brownlee, Motion

Figure 1—Use color codes and symbols to show which lubricant goes with each equipment piece. Image courtesy of Motion.



The increasing cost of food and beverage machinery makes running equipment to failure not just impractical, but potentially devastating to your bottom line. However, there are solutions that can lead to significant savings, and an often overlooked one is implementing an effective lubrication program. A well-structured program delivers a trifecta of benefits: reduced downtime, a cleaner and safer work environment, and easier compliance with the stringent regulations of the food processing industry.

Moving beyond basic lubrication, many companies find even greater returns by integrating lubrication into a comprehensive reliability-centered maintenance program. This approach, built on measurable goals, timely execution and consistent discipline, provides a framework for continuous improvement and drives significant payback. This focus on lubrication empowers you to achieve optimal asset health, consistent production output and the holy grail of zero downtime.

Myth Busters

More grease does NOT equal better lubrication. Think of it this way: Running through a kiddie pool at your local swimming pool is a breeze, but try that in the deep end, and you'll barely move. The same principle applies to bearings or gearboxes overloaded with oil or grease.

Excess lubricant, just like insufficient lubricant, leads to excessive heat buildup. Overgreasing also forces lubricant past seals, causing messy spills and potential contamination. A compromised seal becomes an entry point for contaminants, a major concern in sanitary environments. In both scenarios—too much or too little grease—component and machinery lifespan is significantly reduced.

To Lube or Not to Lube?

Apologies to William Shakespeare for contorting his line from Hamlet. While the decision “to lube or not to lube” might seem straightforward, developing and maintaining an effective program requires planning, dedication and an initial investment. However, the return on investment is undeniable: Lubrication programs consistently save money and reduce waste. Don’t wait for a contamination incident, regulatory action or equipment failure to force your hand. Protective lubrication is the key to keeping your assets producing, healthy and profitable.

Organizing a Lubrication Team

Once the decision to implement a new lubrication process is made, assembling a cross-functional team is critical. The team should include representatives from maintenance, operations, engineering, and even your lubricant and equipment suppliers. The initial meeting serves as a crucial discovery phase, allowing the team to assess the current state of lubrication practices and define desired outcomes. Remember, clearly defined objectives are essential for achieving success.

This process is key to identifying and training dedicated, full-time lubrication technicians. Lubrication is not a task to be relegated to part-time or light-duty roles. It demands a specialized skillset, honed through comprehensive training and ongoing development, ensuring these technicians can effectively maintain the health of your assets.

Choosing the Best Lubricants and Usage

This is where your cross-functional team shines and third-party partners bring their expertise. Focus on:

- **Consolidation and Standardization:** Collaborate to identify and consolidate the optimal lubricants (including aerosols and oils) for your needs. Determine the most effective lubrication methods

(centralized systems, automatic lubricators, manual lubrication) and establish sanitary dispensing procedures for your food production environment.

- **Equipment-Specific Requirements:** Define lubrication requirements for each machine type and location, consulting equipment manufacturers for recommended lubricants and intervals. Work with bearing and gear reducer manufacturers to specify proper lubrication for those critical components.
- **Optimize Lubrication Delivery:** Explore grease guns and automatic lubricators for optimal grease and oil application, especially in areas with difficult access or safety hazards. Selecting the right dispensers ensures reliable lubricant delivery, a crucial element of a successful program.
- **Creating a Lubrication Legend:** Develop a clear visual legend using color codes and symbols to match lubricants with specific equipment (Figure 1). Your lubricant and equipment provider can be invaluable in this process. Include clear warnings against mixing fluids—debunking the myth that all greases and oils are compatible with mixing. Verifying compatibility upfront prevents costly problems down the line.
- **Implementing an Oil Analysis Program:** Establish a robust oil sampling program to identify potential issues before they impact production. Regular analysis can also enable extended drain intervals, maximizing equipment life and minimizing downtime. This proactive approach, combined with conditioning monitoring, provides insights that visual inspections alone cannot.
- **Prioritizing Food Safety:** Ensure appropriate food-grade lubricants and oils (H1, H2 or H3, along with other relevant subcategories). Food safety is number one.

“Moving beyond basic lubrication, many companies find even greater returns by integrating lubrication into a comprehensive reliability-centered maintenance program. This approach, built on measurable goals, timely execution and consistent discipline, provides a framework for continuous improvement and drives significant payback.”

Storage Best Practices

Proper storage and dispensing are crucial for maintaining lubricant integrity, promoting safety and ensuring efficient application.

- **Dedicated Lubrication Room:** Designate a well-lit, restricted-access lubrication room for storing bulk containers, pails, greases and aerosols. This room should have lockable (and potentially fireproof) cabinets, climate control to prevent moisture buildup and appropriate equipment for storage, dispensing and transportation.
- **Spill Prevention and Control:** Install spill containment decks or pallets beneath all dispensing equipment. Ensure spill kits are readily available in the storage area for immediate cleanup.
- **Designated Transport and Equipment Areas:** Define specific areas for storing lubrication equipment and filter carts, adhering to company policies for safe lubricant transportation within the plant.
- **Clear Identification System:** Implement a consistent identification system that mirrors the usage legend established for equipment and ensure a legend copy is posted in this room. Use color-coded labels and shapes to identify lubricants in storage and at dispensing points throughout the plant. This visual system enables lubrication technicians to quickly and accurately locate the correct lubricant for each application.

Waste Disposal

Protecting the environment and complying with regulations are integral to a successful lubrication program.

- **Designated Disposal Area:** Establish a designated disposal area well away from food production areas. Never dispose of used lubricants in undesignated trash bins or drains.
- **Safe Waste Oil Management:** Implement a system for safely managing waste oil from oil changes, empty grease tubes, pails and bulk containers. Utilize a skid-mounted waste oil unit and avoid mixing different types of lubricants. Adhere to all local and national regulations for proper disposal, documenting all activities for audit and compliance purposes. Consult your lubricant provider or Environmental Health and Safety (EHS) representative for guidance.
- **Exploring Recycling Options:** Investigate the potential for recycling used lubricants. While regulations for food-grade lubricants vary, consult with recycling companies to identify opportunities to reduce waste and enhance sustainability.

Remember, minimizing should be a primary objective of your lubrication program. Following best practices for lubrication selection, application and storage, along

with utilizing tools like automatic lubricators, can significantly reduce waste generation.

Training

Elevate your lubrication program by investing in comprehensive training for your team. Partner with a reputable organization that can tailor a program to your plant's needs and goals. This will empower your team with enhanced skills and credibility, and ultimately deliver a strong ROI.

Strive for comprehensive certification across your lubrication team. Organizations like the International Council for Machinery Lubrication (ICML) and the Society for Maintenance & Reliability Professionals (SMRP) offer valuable certifications in machinery lubrication, oil analysis and best practices for maintenance and reliability. A well-trained team is essential for building a world-class lubrication program.

Changing Needs

Building a successful lubrication program requires ongoing effort and adaptation. Regularly review and adjust your plan to align with your plant's evolving needs. Factors like new equipment installations, upgrades or decommissioning of older assets will necessitate modifications. Stay informed about changing regulations, whether due to plant expansions, relocations or general industry updates, to maintain continuous compliance. Remember, meticulous and consistent documentation is crucial for success.

This comprehensive approach to lubrication will contribute to improved asset health, a cleaner and safer food production environment and increased uptime. Prioritizing food safety benefits both your plant and consumers. By implementing these strategies and collaborating with your qualified lubricant and lubricant-equipment provider, you can establish a robust lubrication program as a cornerstone of your overall plant operations.

[Motionind.biz/47cfEPW](https://www.motionind.biz/47cfEPW)
PTE

Brandon Brownlee, a food and beverage industry specialist for Motion, has been involved with reliability-centered maintenance for 27 years and has served the industry for 40 years.



Environmental Engineering

Renewable Lubricants assists Weedoo Greenboats to power onboard hydraulic equipment

Renewable Lubricants

Clearing the world's waterways of invasive vegetation, algae, refuse, and other pollutants is essential work with enormous impact. Healthy marine environments are a lifeline for so many things—from jobs such as farming, fishing, and shipping; to clean water and wildlife habitats; to property values, tourism, and recreational opportunities. Regular herbicide use, chemical runoff, and basic evolution have caused numerous plant species to develop resistance, leading to clogged waterways and other hazards. Removing the offensive materials mechanically is ideal, but that method poses different challenges. Fortunately, Weedoo Greenboat, Inc. found an environmentally friendly solution that is also cost effective from Renewable Lubricants.

Unique Workboats Offer Mechanical Clearing and Removal

When John Grimes and his father Phil wanted a machine to clear weeds from their lake in an environmentally friendly manner, they took matters into their own hands by inventing one. Twenty years later, Weedoo has grown to make several lines of environmental workboats and amphibious work equipment that can take on the toughest jobs in extreme and challenging aquatic conditions. Their advanced, environmentally friendly shoreline equipment provides a cost-effective way to clean waterways of invasive vegetation, algae, refuse, and other pollutants. Customers ranging from single individuals

to large companies actively seeking to preserve nature and protect natural resources have found these machines effective, without the use of carcinogenic chemicals.

Since no two waterways are the same, Weedoo has developed a range of products and accessories. Their TC-Series workboats are compact and powerful, with a unique hull design that allows for maximum payload and balance. The TC-3012 can clear 500 pounds of weeds a minute, transforming a whole lake in an afternoon. A range of quick-change hydraulic attachments saves valuable time and includes a marine bucket, root rake, silt sucker, skimmer bucket, sediment remover, and pole saw. The Weedoo AmphiKing 6450 performs water maintenance, construction work, and even disaster cleanup in the harshest, most inaccessible environments. A front-mounted, articulating boom features their convenient quick-connect hydraulics and brings well-known power to the front collecting rake, mowing and collecting basket, small auger dredge, weed grapple, and T cutting bar. With no ramp required and a shallow draft for easy access to problem areas, the Weedoo workboats are multifunctional, powerful, and extremely maneuverable.

Mechanical removal of weeds and debris avoids the use of threatening substances, but working in the water with hydraulic equipment poses a new set of challenges. These machines require essential fluids for transmitting power, lubricating the system,



Weedoo Greenboats offer a cost-effective way to clean waterways of invasive vegetation, algae, refuse, and other pollutants.

and dissipating heat. While there are many options available, most are not suitable for use in water. Mineral-based options are not biodegradable, cause long term pollution, and are toxic to aquatic life, so even a small leak, much less a blown hydraulic hose, can have disastrous effects on the environment. Plus, there are potentially high fines for these accidental discharges. Water-based fluids are a logical consideration, but they are only moderately

Minimizing environmental liabilities is a sound operational policy and demonstrates a commitment to sustainability. There are also financial incentives such as grants and tax breaks. By adopting these greener technologies now, companies can future-proof their operations, align with global sustainability goals, and gain a competitive edge in an increasingly eco-conscious market.



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biodegradable, must be replaced frequently, and they tend to wash away. They're also better for low pressure systems and places that are not environmentally sensitive. To make matters even more complicated, regulations for chemical use in waterways become more stringent every year. In 2024, the Environmental Protection Agency (EPA) introduced the toughest clean water legislation so far, with stiff penalties for violators.

Weedoo realized that an environmentally friendly hydraulic fluid was in order. While researching the options, they found that not all eco-conscious choices are the same. Even though they are the same ISO weight, there are significant differences in oxidation process, resulting in critical variances in performance. Oxidation is a complex series of chain reactions common to most hydraulic fluids and consists of three stages: initiation, propagation, and termination. During the initiation phase, hydrocarbon molecules react with various catalysts, such as heat, pressure, or contaminants, which leads to the formation of free radicals (highly reactive molecules that combine to create new products). In propagation, the radicals keep the process going by reacting with oxygen, creating peroxides and other reactive species. Sometimes the byproducts from these reactions also act as propagators, speeding up the process even more. Many factors including high temperatures, moisture, metal contaminants, and agitation can also accelerate the oxidation process, leading to very rapid degradation. Consequences of oxidation include increased oil viscosity and organic acids; the formation of sludge, varnish and deposits; additive depletion (including anti-wear additives, dispersants, and corrosion inhibitors) and the loss of other vital performance properties. The termination phase occurs when stable, nonreactive products have formed, and oxidation has ended.

Hydraulic Fluids Exceed Expectations

Companies and government agencies that buy biobased anti-wear (AW) hydraulic fluids at the lowest bidding cost are assuming all biobased fluids (in the required ISO viscosity) perform the same, which is simply not true. Fortunately, Renewable Lubricants solves the problem with their patented, fully biodegradable options. A recent study conducted on seven brands of biobased hydraulic fluids demonstrated Renewable Lubricants' remarkable performance in resisting oxidation. The ASTM D-2272 Rotary Pressure Vessel Oxidation Test (RPVOT) is a standardized method of comparing the oxidation life of lubricants in similar formulations. In the accelerated life-cycle testing format, all Renewable Lubricants lines significantly outperformed the other biobased and synthetic polyol ester (POE) based AW hydraulic fluids. The longer the time in minutes the greater the stability of the fluid. The US Steel requirement for anti-wear hydraulic fluid is greater than 120 minutes, which equates to 1800 hours of service life. While many brands do not achieve that minimum, every Renewable Lubricants formulation exceeded the requirement by more than double, with some products such as the Bio-Ultimax 2000 providing an impressive 650 minutes of product life (more than five-times the requirement). Bio-Fleet is particularly suitable for the demanding conditions encountered by Weedoo's workboats, which operate in heat and water.

As Bobby O’Shields from Weedoo noted, “We use BioFleet ISO 46 in our machinery. The fact that it is 100 percent biodegradable makes it favorable for use with our Weedoo Boats, as we are running our equipment in fragile ecosystems.”

Superior fluid performance ensures reliable operation, maintaining hydraulic systems’ performance while minimizing environmental impact.

Bio-Fleet Hydraulic Fluids are environmentally accepted lubricants (EALs) that are formulated from renewable biobased resources. Ideal for both high-pressure and low-pressure hydraulic applications, they meet the Environmental Protection Agency (EPA) 2013 Vessel General Permit (VGP) guidelines for Environmentally Acceptable Lubricants (EALs). A direct replacement for mineral oil based hydraulic fluids, they should

be used when low toxicity, biodegradability, and nonbioaccumulation properties are required. They exceed the acute toxicity (LC-50 / EC-50 >1000 ppm) criteria adopted by the U.S. Fish and Wildlife Service and the EPA. Because they meet the environmental requirements, they can also be used where ISO 15380 (HEES/HETG) Hydraulic Fluids are specified.

Highly inhibited against moisture and rusting in both fresh and seawater, Bio-Fleet fluids passed both A and B Sequences of the ASTM D-665 Turbine Oil Rust Test, and they provide excellent water separation as shown in an ASTM D-1401 Demulsibility Test. With a higher viscosity index than synthetics, they provide improved thermal shear stability and increased load capacity, which translates to better performance and longer equipment life.

Green Alternatives Are the Future

Intense OSHA monitoring and new regulations for water supply safety add increased urgency to eco-friendly business efforts. Transitioning to environmentally safe hydraulic fluids ahead of regulatory requirements has benefits for companies. In addition to ensuring compliance, companies can reduce the risk of operational disruptions or expensive fines. Minimizing environmental liabilities is a sound operational policy and demonstrates a commitment to sustainability. There are also financial incentives such as grants and tax breaks. By adopting these greener technologies now, companies can future-proof their operations, align with global sustainability goals, and gain a competitive edge in an increasingly eco-conscious market.

Weedoo uses the Bio-Fleet formulations because “We’ve had positive experiences with the ISO 46 hydraulic fluid from Renewable Lubricants,” O’Shields says. “It was an easy choice for us, because it meets our criteria and it’s readily available for purchase on platforms such as Amazon.”

The product shows excellent performance in both test and real-world applications, ensuring reliable operation even in harsh conditions. Available in various ISO weights, including 22, 32, 46, and 68, the fluids offer anti-wear, anti-rust, anti-oxidation, anti-foam, and demulsibility properties, making them suitable for high-pressure systems, and ideal for marine applications like winches, capstans, dredges, and other workboat applications.

Adds O’Shields: “Ultimately, we like the BioFleet ISO 46 because it performs well, is readily available, and is American made!”

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PTE



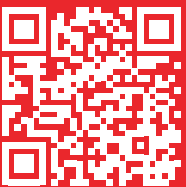
Bio-Fleet Hydraulic Fluids are formulated from renewable biobased resources and ideal for both high-pressure and low-pressure hydraulic applications.

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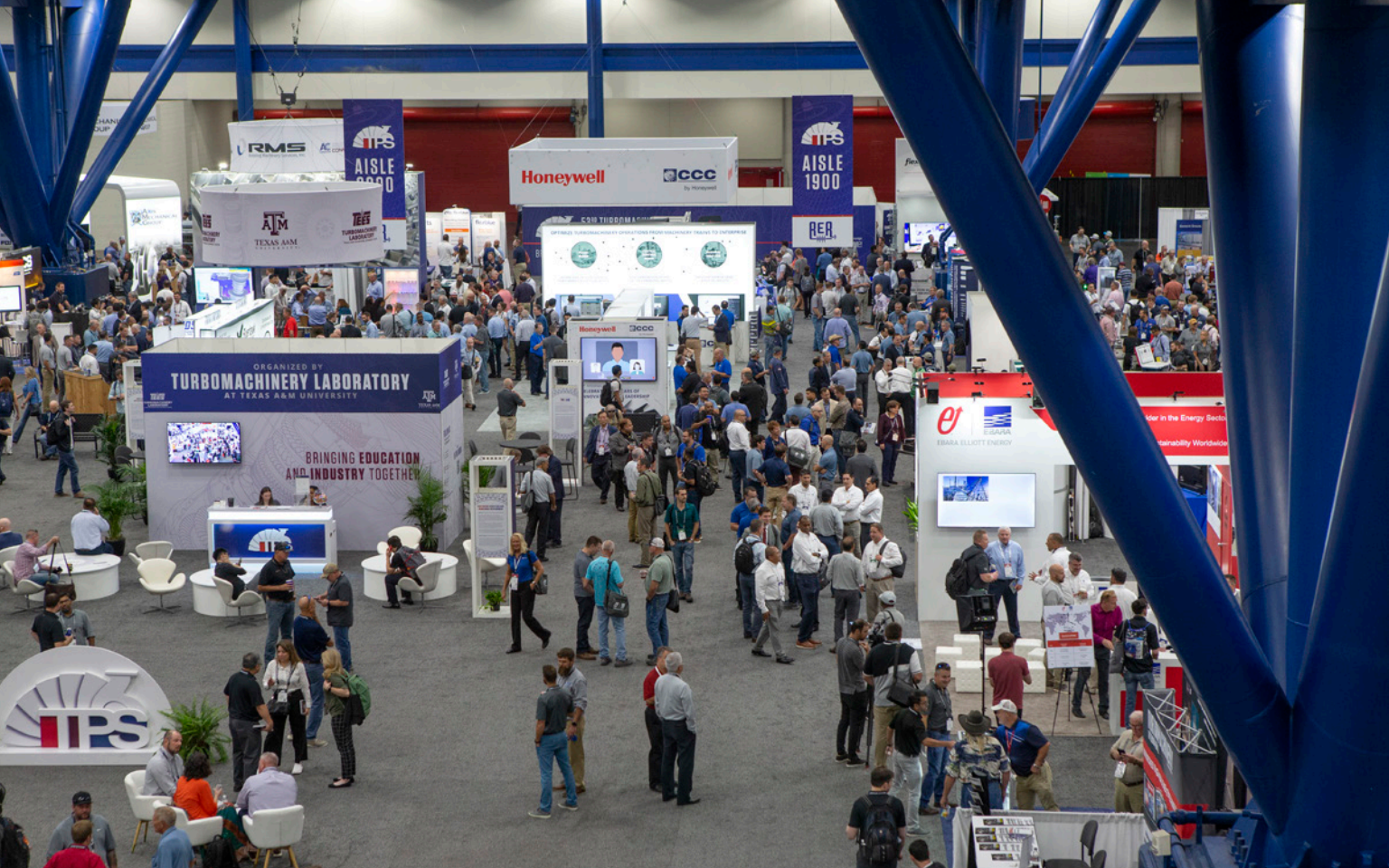
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A Backward Glance at TPS 2024

This industry event offers an integral forum for the free exchange of ideas between rotating equipment engineers and technicians worldwide.

Aaron Fagan, Senior Editor

Organized by the Turbomachinery Laboratory at Texas A&M University, the annual Turbomachinery and Pump Symposia (TPS)—the 53rd Turbomachinery and 40th International Pump Users—event was held August 20–22, at the George R. Brown Convention Center in Houston.

TPS is known for its spirited engagement with turbomachinery, pump, oil and gas, petrochemical, power, aerospace, chemical, and water industries through its peer-reviewed technical program and world-class exhibition, Innovation Presents (formerly Turbo Stage), a tour of the Turbomachinery Lab at Texas A&M University in College Station, and more.



Michelle Jordan of Techmar delivered a talk titled “The Role of Emotional Intelligence in the Workplace” at the Women of TPS luncheon.

The Women of TPS luncheon—with special guests Dena Malloy of Atlas Copco and Michelle Jordan of Techmar, is a forum for women of TPS to share experiences and challenges in the industry. It is also an avenue in which those experiences and challenges can be heard and understood by others, including upper management.

TPS 2024 saw 4,769 attendees, hosted 106 technical sessions and had 308 exhibiting companies. Every year attendees emphasize the invaluable networking, conversation and spirited debate at the show. Below is a taste of our experience from the exhibition hall at TPS 2024!

ABB

Low-voltage motors in equipment such as pumps, fans and compressors account for two-thirds of industrial electricity demand. At ABB Low Voltage IEC motors, we are developing solutions that last longer, run smoother, and are easier to install, service, and specify for use across this diverse mix of industries.

ECP5000 Severe Duty

ABB ECP5000 series of severe-duty motors were specifically designed for the rigors of harsh chemical processing applications. Standard features include heavy-duty paint to withstand corrosion, IP66 for increased protection against dust and water ingress, a large left-hand side (F1) conduit box with terminal blocks for easy installation, space heaters to minimize condensation, industry-standard 5000 frame mounting dimensions to allow simple, drop-in replacement, as well as oversized bearings on both ends with an insulated bearing on the ODE.

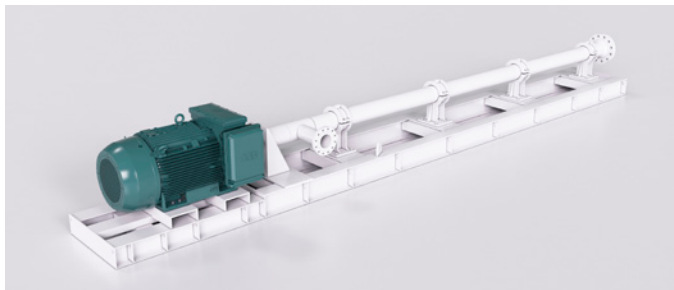


ABB ECP5000 Severe Duty.

These motors quickly found success with H-pump (Horizontal Surface Pump) manufacturers due to design improvements focusing on mitigating vibration. Due to the high speeds (~3600RPM) inherent to these applications, vibration is a typical failure mode. Care was taken to minimize the risk and extend motor life.

Other features added specifically for the H-pump market included supplemental bearing cooling on the drive end and different frame materials for additional vibration dampening. On top of the vibration mitigation developments, bearing and winding RTDs and the ABB Ability Smart Sensor are installed at the factory to assist with predictive maintenance. Also, key to the ECP5000's success in the H-pump market was the local U.S. inventory;

ratings up to 1000HP/460VAC are stocked in warehouses around the country, allowing operators to quickly get back up and running.

This unique combination of features and local availability has allowed users and OEMs to capitalize on the lowered cost of low-voltage drive technology in these tough, high-horsepower applications.

IE6 SynRM

ABB's Synchronous Reluctance motor (SynRM) technology is the first magnet-free motor design to achieve the IE6 hyper-efficiency level, an unofficial but anticipated tier above IE5 motor efficiency standards. In keeping with the logic of previous energy loss reductions of 20 percent from class to class, IE6 motors are deemed to have 20 percent fewer than IE5 motors.



ABB IE6 SynRM.

The SynRM design combines the performance of a permanent magnet motor with the simplicity and service-friendliness of an induction motor, while allowing for safer transport and installation. SynRM motors pair perfectly with ABB drives right out of the box to further simplify operation and are ideal for variable-torque applications such as pumps and fans.

Recent improvements in drive technology have led to increased suitability for constant-torque applications as well, allowing full torque at zero speed if needed. Because there is no current being induced on the rotor (which would typically cause rotor losses as heat), this design enables a significantly cooler running motor with increased bearing lifetimes.

This technology is available in Safe and Hazardous Area designs, as well as other mechanical packages including water-cooled designs for additional power density. The rotor design can even be used in the 5000 frame design discussed above. Ratings are available up to 1,100 hp in voltages up to 1,000 VAC. Because of the diversity of potential applications, these motors are all engineered-to-order to meet the specific requirements of each customer.

abb.com

Cincinnati Gearing Systems

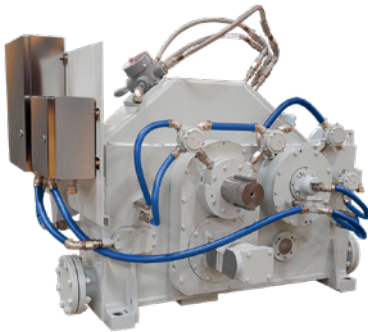
Located in Cincinnati, Cincinnati Gearing Systems (CGS) is a recognized leader in precision component gear man-

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



Fracking Gear Unit

- Gas turbine to pump drive
- Double helical gearing, epicyclic configuration
- 16,000/1,455 rpm @ 5,500 hp
- High efficiency, low noise replacement for traditional diesel engine pumping solutions
- Intermediate shafts
- Integrated bearings for planetary gears



Hydrogen Compression and Expansion Services

- Expander to generator drives
- Parallel shaft single helical API 617 integral gear unit
- Expander casing flange mounted to gearbox
- Expander wheel integrally mounted to pinion shaft with Hirth connection

- 33,000/3,000 rpm @ 2,000 hp
- Used in the plastics production process

Faster Machining Processes

With the installation of our new Liebherr CNC shaper cutter, we have significantly reduced the machining time for double-helical gears. This machine doubled our previous cutting speeds. The correction measurement in the machine substantially increases the quality of the gear; and due to the electronic helical guide, we can shape every helix angle without the need for additional tooling.

Our new Kapp Niles gear grinder has automatic onboard checking and the capability to grind internal gears up to a 30° helix angle both left hand and right hand.

cincinnatigearingsystems.com

Regal Rexnord

A new overrunning clutch technology developed by Regal Rexnord is addressing the gap in the turbomachinery market for high-power, high-speed applications.

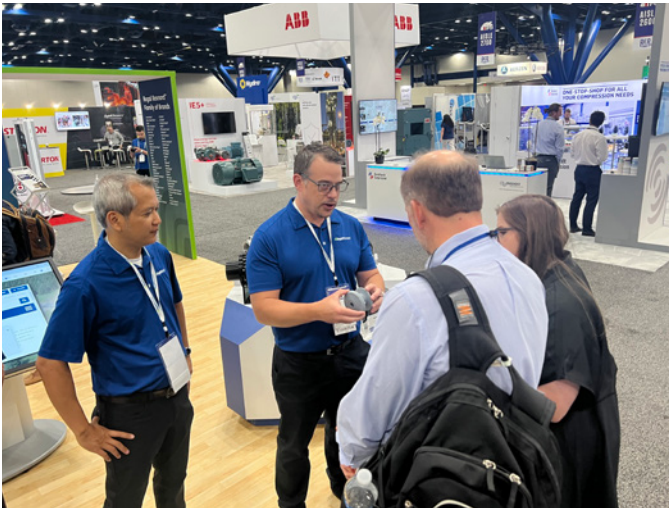


The FSS (Formsprag Self Synchronizing) clutch is a globally patented design.

Unlike traditional overrunning clutches that are limited to either high power or high speed, but not both, the FSS (Formsprag Self Synchronizing) clutch can manage tens of megawatts of power and thousands of RPM. Its patented radial engagement design offers a thin profile assembly, making it suitable for shaft mount options that can be integrated as a mobile clutch/coupling package that does not require a foot mount. The zero-contact clutch mechanism design provides minimal overrunning drag, allowing the driver to come to rest while the driven machine continues rotating at speed. The self-contained lubrication oil management system also simplifies installation and operational requirements.

Regal Rexnord engineer Willem Sullivan said the FSS clutch aligns with the “Green Power Surge” and addressing new shortcomings that the push for electrification is creating, generating new niches in applications like wind/solar integration, energy distribution, mobility solutions, and micro-reactors.

Sullivan and his colleagues were excited to meet potential partners at the 2024 Turbomachinery and Pump Symposium.



Regal Rexnord engineer Willem Sullivan shows an FSS clutch model to Regal Rexnord TPS booth visitors in August 2024.

“By working closely with our partners we’re learning a lot about these various applications and defining the benefits in system efficiency improvements,” Sullivan said. “Fitting a shaft-mounted clutch can be complicated but by considering the effects on rotor dynamics and system response we can engineer the clutch to meet the specific application requirements.”

One of the clutch’s key features is its ability to synchronize equipment at any speed above 100 RPM. In a nutshell, the FSS was designed to allow power companies to address the secondary effect on the grid phase created by the push for renewable energy generation—especially in retrofits.

For example, initially testing on an ongoing retrofit shows the FSS clutch can successfully transmit power over one to two months of operation, with a potential power rating of up to fifty megawatts.

Additional applications include:

- Inverter Generation—Where local grid stability needs to be ensured, aligning with the global push for electrification and the limitations of wind and solar power in providing phase-correcting capabilities.
- Peaker Plants—By using the FSS in power generation applications such as synchronous condensing, it allows existing generators to lock into the grid to provide phase stability, while reducing the non-driving turbine/motor drag and thereby improving system efficiency.
- Dual Drive (Gas/Electric)—The FSS offers seamless transmission in hybrid configurations for power and compression systems, offering flexibility in power source as LNG and electric power prices fluctuate.

Regal Rexnord also has a diverse high-performance coupling portfolio from industry name brands such as Ameridrives, Kopflex, Bibby Turboflex, and Euroflex, Sullivan noted—as well as a trusted coupling recertification program.

“With a global manufacturing and support footprint, we are truly a one-stop-shop for cost-effective, energy-efficient solutions,” he said.

Overall, the FSS clutch represents a significant technological advancement with potential to enable higher efficiency, expansion of grid stabilization offerings, and integration of renewable energy sources into existing power generation systems.

Those interested in learning more about the FSS clutch can get in touch with Regal Rexnord online.

regalrexnord.com

Sealmatic

Sealmatic is a high precision/high performance mechanical seal for rotary equipment in refinery, oil & gas, chemical, petrochemical, chemical, fertilizer, pharmaceutical, power, marine, pulp & paper, food & beverage, aerospace and many more industrial applications.



One among dozens of designs, the Sealmatic SPX is a single seal in split configuration for plain shafts suited to many industrial applications.

They are an OE supplier to KSB, Sulzer, Sundyne, KEPL, Weir, Andritz, KBL, RuhrPumpen, Flowserve, Wilo, SPX, Seepex, Dichtung, ITT (USA), BHEL, IDEX, Egger, PMSL, MSL, Xylem, Metso, Netzsch, Atlas Copco, Burckhardt, Circor and many other renowned OEMs.

Sealmatic is an API Q1 Spec, ISO 19443 (Nuclear), ASME U Stamp, TRCU 010, 012 & 032, ATEX - 2014/34/EU, DSIR, ISO 9000, 14000, 45000 & PED 97/23/EC QA-System, FDA, GMP, RoHS, REACH Certified Company.

Its raw materials are imported from USA, Germany and the UK from approved sources of various international sealing companies:

- Seal faces such as carbon and silicon carbide are imported from USA and Germany.
- Elastomers are imported from Germany.
- Springs and hardware are imported from Germany.

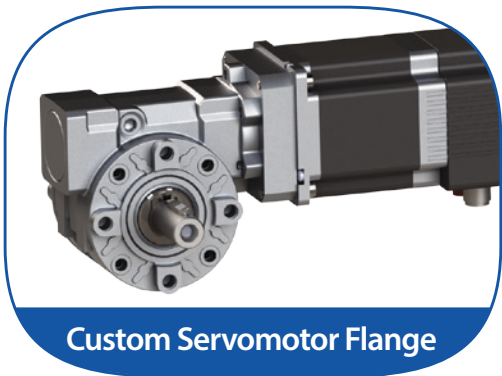
Having worked in the sealing industry since 1989, Sealmatic has more than 50,000 mechanical seals installed globally in more than 53 countries with a primary objective to cater to high-end applications such as API seals, boiler feed pumps, cartridges, split seals and many more sealing applications.

sealmaticindia.com

PTE

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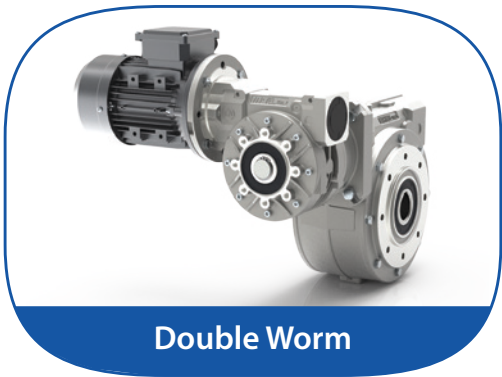
With our extensive range of standard components and custom machining capabilities, a custom-designed and manufactured gearbox for specific applications is something we do all the time.



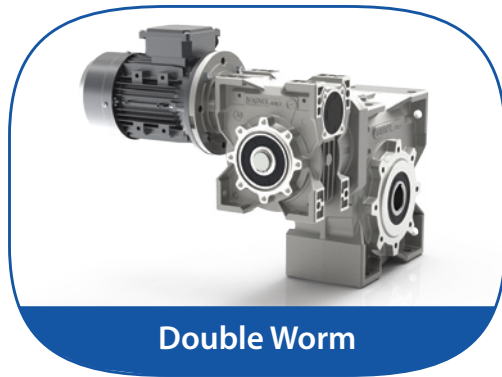
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Pack Expo 2024 Highlights Innovation, Sustainability and Automation

Matthew Jaster, Senior Editor

With over 2,500 exhibitors occupying 1.3 million net square feet, Pack Expo promises solutions catering to over 40 vertical markets. Expectations also forecast a convergence of more than 45,000 attendees from global consumer packaged goods and life sciences companies.

“We’re thrilled to be back in Chicago, offering an event to spotlight numerous solutions for an expanding market, complete with its distinct challenges,” expresses Jim Pittas, president and CEO of PMMI. “Every aspect showcased at our event is grounded in thorough research and listening to our members, ensuring we remain attuned to the evolving needs of our industry both now and in the future.”

The pavilions are a “show within a show,” offering focused solutions in specific industry areas. These pavilions streamline the attendee experience, allowing them to explore a wide array of offerings and easily compare solutions in close proximity on the show floor.

The Processing Zone returns to Pack Expo International with the widest variety of food and beverage processing equipment. In today’s manufacturing environment, processing and packaging are integrated systems, making it critical to bring both technologies under one roof. Search for front-of-the-line solutions such as homogenizing, heat treating, forming/sizing, and coating. Attendees will discover solutions to increase efficiency, achieve total system integration, and ensure safety.

The Containers and Materials Pavilion is the prime destination for companies looking for innovative containers and materials to meet sustainability goals, refresh a brand, or launch new products.

It also houses award-nominated packaging solutions in The Showcase of Packaging Innovations, sponsored by WestRock.

The PACKage Printing Pavilion features digital printing and converting, labeling, coding, and marking technologies.

The Healthcare Packaging Pavilion, a top destination for life sciences companies, is a zone housing innovation in biologicals, medical devices, nutraceuticals, and pharmaceuticals.

The Reusable Packaging Pavilion, sponsored by the Reusable Packaging Association, showcases reusable packaging solutions to help reduce waste, cut costs, and gain supply chain efficiency.

The Confectionery Pavilion, sponsored by the National Confectioners Association (NCA), highlights candy trends and technologies and also houses The Candy Bar Lounge, hosted by NCA and sponsored by Syntegon Packaging Technology, LLC, for casual networking and idea-sharing.

Association Partner Pavilion presents leading organizations dedicated to advancing the packaging and processing industry, offering significant resources, insights, and expertise in one central location.

The Workforce Pavilion is Pack Expo International's one-stop shop for resources to strengthen your current workforce and grow the existing workforce.

Sustainability Central

Making its Pack Expo International debut, Sustainability Central will explore packaging sustainability and what it means to brands. This show floor destination will include expert speakers and a look at actionable, sustainable solutions in manufacturing, materials, recovery, logistics, analytics, and design.

With over 20 educational sessions at Sustainability Central, attendees can gain critical insights on various vital topics from experts at Amazon, Conagra, Clorox, Dow, Nestle, the Consumer Brands Association, Conagra, and other major industry players.

Additionally, Sustainability Central will feature displays from Virginia Tech, the University of Florida, Clemson University, PMMI Business

Intelligence, and AMERIPEN among others, sharing their latest planet-friendly innovations, research, and best practices.

"We've intentionally partnered with companies, exhibitors, and vendors to integrate sustainability into every component of Pack Expo International, including educational programming, show features, and how we do business as the largest packaging and processing event this year," says Laura Thompson, PMMI's vice president of Trade Shows.

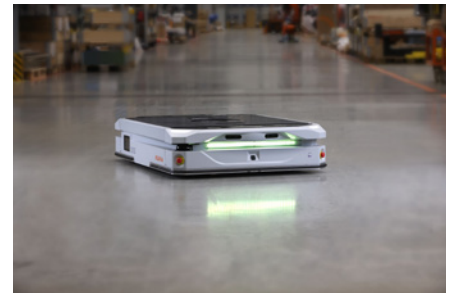
In addition to the new and expanded education and show navigation resources, attendees can expect the return of familiar features and initiatives to support their eco-conscious efforts:

- Sustainability focused educational sessions also will take place at the Innovation Stage, Processing Innovation Stage, and Industry Speaks.
- The Reusable Packaging Pavilion will feature Reusable Packaging Association member companies demonstrating sustainable packaging solutions to help reduce waste, cut costs, and gain supply chain efficiency. Attendees can explore reusable transport packaging products and services and see innovative reuse solutions.
- Sponsored by WestRock, The Showcase of Packaging Innovations, located within the Containers and Materials Pavilion, will display award-winning packaging from around the world.

Booth Preview: KUKA

Booth #N-5414

Highlighting speed, versatility and flexibility for the packaging and processing industry, KUKA Robotics will feature four innovative robotics cells. The live cell demonstrations will include autonomous mobile robot (AMR) solutions for intralogistics, robotic palletizing/depalletizing, a robotic bottle capping operation and a food handling system.



System integrator Stac Material Handling will use a KMP 1500P AMR and KR Cybertech, a compact palletizing cell simulating a palletizing process for cardboard boxes in the food industry. The KMP 1500P is KUKA's latest generation of AMRs for Logistics 4.0 and features intelligence, safety and easy commissioning to navigate complex, dynamic environments with the SLAM (Simultaneous Localization and Mapping) navigation method. The AMR platform automatically identifies loads with QR code readers, and 3D cameras detect obstacles in three-dimensional space.

Automation solution provider Technica International will use a KR Iontec in the booth to demonstrate depalletizing open-top cardboard can trays. The cell's KR 70 R2100 Iontec has a maximum reach of 2,101 mm and a rated payload of 70 kg that can subsequently be adjusted even after mounting. KR Iontec provides users with the highest output with a low total cost of ownership and high life cycle efficiency.

KUKA's Iontec family of robots is an extremely versatile six-axis medium payload robot that can be floor, wall, ceiling or angle mounted, and its optimized design is well-suited to compact cells with a small footprint. Boasting a best-in-class work envelope and equipped with a waterproof and dustproof in-line wrist and protected motors, Iontec is suitable for virtually any application. The HO variant uses food-compatible H1 oil in all axes to eliminate the potential for contamination in the food processing and manufacturing sectors. Refrigerated and freezer packing applications can also be accomplished with KUKA's Quantech PA Arctic, which

does not require a cover or heater while working in temperatures down to -30°F.

KUKA's high-performance SCARA robot family is featured in a bottle capping cell. The ultra-compact KR 6 R500 Z200-2 SCARA will cap small spray bottles with a cycle time of less than 0.36 seconds. With a maximum payload of 6 kg and a 500 mm reach, the four-axis KR 6 R500 Z200-2 has a serial mechanism with rotational joints in the first two axes, and the remaining axes are combined to allow rotation and linear movement in the Z-axis. The KR SCARA industrial robots are available in a variety of payloads, reaches and Z-axis strokes and are also available in an HO variant for safe food and beverage applications.

To demonstrate how KUKA automation provides food-processing companies with increased production control while avoiding failures and reducing costs, KUKA will highlight a primary food

handling solution using a KR DELTA HMhygienic robot. The KR DELTA hygienic robot provides outstanding performance and value for pick-and-place applications in the food, packaging, electronics and pharmaceutical industries. The KR DELTA combines precise grip, corrosion resistance and minimal maintenance requirements to excel in sensitive high-speed production applications. This ceiling-mounted robot offers a reach of 1,200 mm, a maximum payload capacity of 3 kg and cycle times as low as 0.5 seconds.

The robot is made entirely from corrosion-resistant stainless-steel that protects against dust and moisture. The design accepts alkaline or acidic high-pressure cleaning and disinfection up to 100 kPa for simplified upkeep and shorter downtimes. Food-sector certified for material safety, the entire robot carries IP 67 high-protection certification, with IP 69K for axis 4 that is also ISO 3 rated for cleanroom applications.

The KR DELTA is equipped with KUKA's new KR C5 micro robot controller that reduces full load power consumption by 35 percent.

kuka.com

Industry Spotlight: Warehouse Software

According to Interact Analysis, the warehouse software market is facing a rapid growth trajectory. In 2023, the market was valued at \$7.2 billion, and this is expected to soar to \$16.6 billion by 2030.

Overall, the standalone WMS remains the largest software category. The markets for other warehouse automation-related software, such as robotic picking software, multi-fleet orchestration platforms and warehouse control systems (WCS), are expected to grow rapidly and at a higher growth rate than the total warehouse software market. The automation-related software segment will expand at a compound annual



growth rate (CAGR) of approximately 19.5 percent between 2023 and 2030, compared with 12.7 percent for the warehouse software market as a whole. The boundaries between different types of warehouse software vendors have become blurred as vendors expand their software product offering. Many traditional WMS vendors have started to offer WES and WCS solutions, for example.

The deployment of a WES is a strategic choice leading to increased operational warehouse efficiency. Not only does the system provide visibility into warehouse asset operations but it also has the capability to dynamically release orders and assign tasks based on the real-time operation status of assets. As a result, bottlenecks can be avoided, and efficiency is increased. The WES data can also be used to predict future warehouse automation and capacity efficiency, while providing feedback to warehouse managers.

However, the biggest question surrounding the WES market isn't the benefits of the solution, but rather who will be providing it. Historically, automation vendors have been the main provider of WES solutions, given the amount of data they have on throughput rates and system constraints. However, we're seeing strong growth in standalone WES solutions (independent of the WCS and the WMS) and Embedded WES solutions (where the WES is embedded into the WMS).

The next few years will be highly dynamic, as different groups of companies compete to provide orchestration and execution capabilities. This report provides a wealth of information to help companies stay ahead of the curve in the race to own the execution layer.

Irene Zhang, senior analyst at Interact Analysis comments on the warehouse software growth trajectory, "The exponential growth of the warehouse automation-related software segment we have observed is the result of a few key drivers.

"First of all, the growth of warehouse automation has created the

need for software that can be used to control and execute solutions. There is also a need to optimize the overall throughput due to the growth of modular and standardized automation sub-systems which require orchestration and execution of various modules. Finally, the growth of the mobile robot market has driven demand for fleet management systems. As well as this, the availability of the Robotics as a Service (RaaS) model has also

contributed to the widespread adoption of mobile robots."

interactanalysis.com

Booth Preview: Beckhoff Automation

Booth #N-6136

Beckhoff's new EL8601-8411 EtherCAT Terminal offers incredible interface flexibility in a compact, 12-mm-wide design. With up to 12 signal interfaces (8 x DI, 2 x DO, 1 x AI, 1 x AO) and nine signal types in one ter-

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minal, the multi-interface is ideal for numerous applications. These use cases include systems that require only a few complex signals or to enable highly flexible signal configuration on custom machines without adding single-purpose hardware.



The EL8601-8411 offers a large number of configurable combinations to create a compact solution for applications where only a few complex signals are required. For example, it can serve as an ideal complement to microcontrollers, such as the CX7000 Embedded PC, which offer a direct backplane connection to the Beckhoff I/O system.

In addition to the digital inputs and outputs, one analog input and one analog output can be configured as a current or voltage signal. The digital inputs with configurable filter times can also be used for 24 V HTL encoders with A/B track, including latch and gate function, or as an up/down counter with a counting frequency of up to 100 kHz. Two of the digital outputs can be used as a PWM signal that can be modulated in both pulse width and frequency in a range of 20 Hz to 25 kHz.

As such, the EL8601-8411 can operate in an extremely flexible manner. It can provide digital/analog, counter/PWM/analog, or encoder/PWM/analog configuration options for wide-ranging industrial automation applications.

beckhoff.com

Student-Focused Initiatives

Recognizing the acute need to attract and retain a skilled work-

force, Pack Expo International, produced by PMMI, The Association for Packaging and Processing Technologies, prioritizes educational outreach to students. The event will feature a variety of activities aimed at introducing high school and college students to opportunities within the industry:

Girl Scout Event: New to the show, local Chicago Girl Scout Troops will receive credit for their Sustainable Packaging Patch. Scouts will meet in the Student Lounge on Sunday, Nov. 3, at 11:00 a.m. for a hands-on project focusing on sustainability. Lunch will be provided followed by a panel and show floor tour from industry professionals.

Silent Auction: Foundation Fundraiser: New to the show, the Silent Auction will take place Sunday through Wednesday. Notable items up for bid include accommodations at premier Chicago-area hotels, including the Langham, Sheraton Grand Riverwalk, LondonHouse, Loews, and the InterContinental Magnificent Mile. In addition, premium wine and spirits, gift cards, and more are available. All bidding will occur virtually, and items will be displayed on the Grand Concourse, Level 2.5. Proceeds will benefit the PMMI Foundation.

Pack Challenge: Returning for its second year, the Pack Challenge, sponsored by PepsiCo, invites six high school teams to participate in a machine-building competition. Competitors will demonstrate their skills by constructing full-scale material-handling machines capable of denesting and orientating paper coffee cups. Participating schools are Argo Community High School, Crete Monee High School, Elk Grove High School, Legacy Academy/Becker High School Coalition, Rich Township High School, and Waterford Union High School. This event will take place in the West Hall Lobby at Booth W-16005.

Future Innovators Robotics Showcase: In this event, sponsored by Schneider Electric, attendees will be able to witness cutting-edge robotics from high school teams across the country. These students will showcase their design, engineering, and troubleshooting prowess in the West Hall at Booth W-21052.

Amazing Packaging Race: Sponsored by Emerson, this dynamic competition involves college and university students from across North America who will navigate the expo floor, engaging in tasks set by participating exhibitors. This event highlights student creativity and fosters teamwork and practical industry engagement.

Students PACK the EXPO: On Nov. 5, PMMI will host local area students from Indiana, Illinois, and Wisconsin for a comprehensive expo experience. Activities will include a scavenger hunt, student tours, and a lunch-and-learn session to deepen their understanding of the industry.

Student Tours: PMMI staff will conduct tours of the show floor daily at 10:00 a.m. and 2:00 p.m. Tours start at the PMMI U/PMMI Foundation Booth at W-20022 (West Hall). Interested students should meet at the PMMI U Booth 10 minutes prior to the starting time. No pre-registration is required.

Booth Preview: Emerson Discrete Automation Group

Booth #N-5345

Emerson is a global technology, software and engineering company that takes an innovative Floor to Cloud approach to packaging. As the future of automation, a Floor to Cloud approach empowers smarter packaging lines and more efficient processes that make it possible for manufacturers to continuously improve plant productivity, sustainability and safety—and achieve their most ambitious goals.



By leveraging our industry-leading expertise and portfolio of ASCO, AVENTICS, Branson, Movicon, PACEdge and PACSystems solutions, manufacturers can unlock trapped data, connect islands of automation and gain unprecedented visibility and control to solve critical challenges. By transforming packaging applications from Floor to Cloud, companies can improve overall equipment effectiveness (OEE), increase energy efficiency while reducing waste, and create safer operations and digital record keeping.

Emerson's team of experts works closely with companies of all sizes to identify key opportunities and implement distinct solutions based on their specific goals and needs. By taking a Floor to Cloud approach, manufacturers can optimize their existing machines, processes and labor power, no matter where they are in their digital transformation journey.

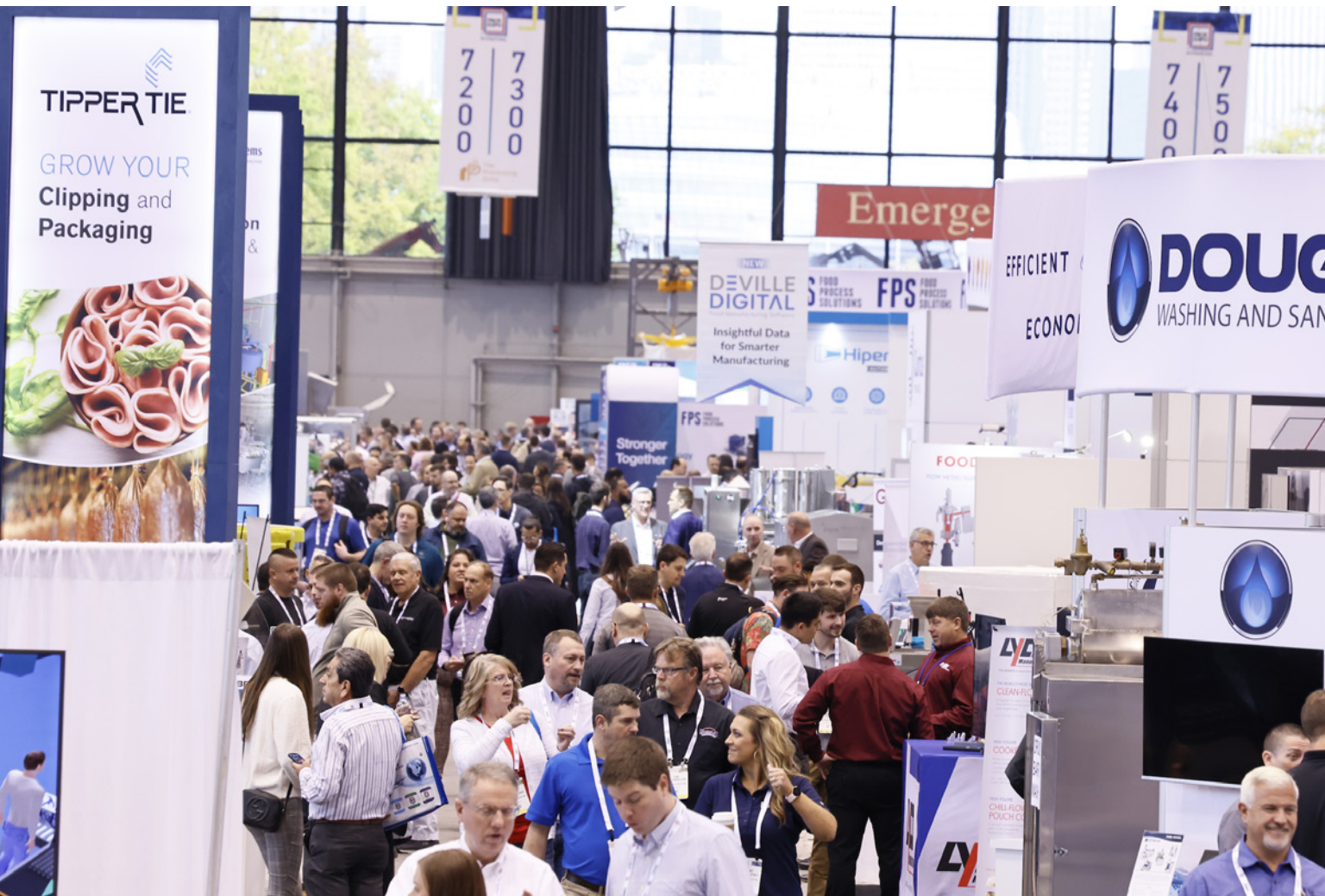
Recent news: Emerson announced the release of the Rosemount 802 Wireless Multi-Discrete Input or Output Transmitter, which has eight discrete input/output (I/O) channels, each one configurable as an input or an output. WirelessHART capability allows the transmitter to connect to a wireless gateway, which can in turn link to a host—such as a control system or asset management system—via a wired connection. This allows the host to monitor and control assets remotely over a WirelessHART network.

The new Rosemount 802 transmitter and its predecessor, the

Rosemount 702 Wireless Discrete Dual Input or Output Transmitter, are the only WirelessHART-enabled remote I/O transmitters available today, supporting Emerson's vision of a "Boundless Automation Intelligent Field" with flexible configuration and ease of deployment via wireless connectivity.

The wireless capabilities of the new Rosemount 802 dramatically reduce the costs associated with monitoring and controlling field-installed assets, such as motors, valves, and pumps, which traditionally require time-consuming field visits from technicians or a hardwired connection. The new Rosemount 802 minimizes these costs and improves safety by removing the field technician from hazardous areas while maintaining the discrete input and output control levels enabled by the host system.

The new Rosemount 802 functions in a similar manner to Rosemount 702 transmitters, but with eight I/O channels instead of two, each one



configurable as a discrete input or output. For installations where multiple assets are in one area and each must be monitored and/or controlled, the 802 transmitter is a more cost-effective solution than the Rosemount 702.

Power options include 10–30-volt direct current external line power or an Emerson SmartPower module. The latter option requires no wiring, provides up to eight years of maintenance-free operation, and can be quickly and easily replaced in the field.

emerson.com

Industry Spotlight: Machine-Integrated Robots

The machine-integrated robot market is expected to grow by 9.2 percent year-on-year in 2024 despite the sluggish growth outlook for the overall industrial automation market, according to new research by Interact Analysis. The market intelligence firm defines a machine-integrated robot as a robot that is controlled by a machine control platform, such as a PLC or Industrial PC. This concept is primarily implemented by eliminating dedicated robot controllers, but there is also the option of retaining robot controllers and programming the robots directly using machine controllers through software platforms.

Beyond 2024, the overall outlook for the industrial automation and manufacturing sectors will improve. Machine-integrated robot unit shipments are expected to grow by 14.7 percent in 2025 and have a predicted compound annual growth rate (CAGR) of 14.6 percent between 2023 and 2029. Although the overall industrial robot market is much larger, the machine-integrated robot segment is emerging, and its growth prospects look promising. Lack of skilled labor has been identified as one of the most important drivers behind this growth.

Due to the shortages of robot programmers and engineers in the Americas and Europe, these regions currently present the

greatest opportunity for the machine-integrated robot market. Unifying the control systems of robots and machines is becoming increasingly attractive to machine builders as a means of addressing the shortage of more specialized programmers and engineers. By 2029, it is expected that over 14,000 units will be shipped by the Americas, more than double the number shipped by the region in 2023. Growth of the machine-integrated robot market will be much slower in the APAC region. As well as labor shortages, price sensitivity also plays a large role in the different growth rates between the United States and Europe, and APAC. The price of machine-integrated robots is currently significantly higher than buying mid to low-end robots and robot controllers in APAC, making the former a less popular choice.

Interact Analysis' new report also provides analysis of the components used within machine-integrated robots, including motors, servo drives, precision gearboxes, encoders in robot arms, teach pendants, robot end effectors and machine vision systems. Revenues for key components used in this type of robot are expected to reach nearly \$500 million in 2029.

Samantha Mou, research analyst at Interact Analysis says, "The market for machine-integrated robots is certainly an interesting one and shows promising growth potential, especially in the Western world.

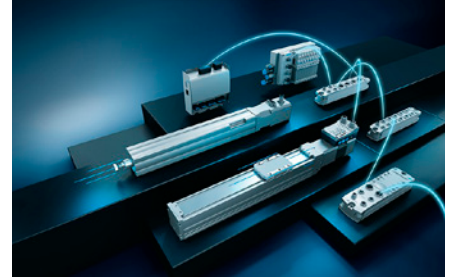
"The delta robot is currently the main type of machine-integrated robot, accounting for 34 percent of total units shipped globally in 2023. The food and beverage and pharma and personal care industries are the largest consumers of these robots, and they are often deployed for packaging processes. There are currently very few collaborative robots used as machine-integrated robots in the market, but we expect the use cases to grow over the next five years as vendors begin to promote them."

interactanalysis.com

Booth Preview: Festo

Booth #N-5927

Festo's exhibition floor is filled with cutting-edge solutions, machinery, and equipment designed to revolutionize packaging processes. Discover the latest trends, network with industry professionals, and gain valuable insights into the future of packaging at Pack Expo.



Considering motion control or remote I/O for your food & packaging operations? It's easy to power up efficiency and connectivity with Festo's extensive portfolio of motion control and remote I/O. Festo's linear and rotary mechanical systems, servo drives and motors, control solutions, and I/O systems can be integrated into your existing automation chain with minimal risk.

Festo's intelligent gripping systems adapt to the unique requirements of your packaging line. From delicate items to heavy loads, these versatile grippers effortlessly handle a wide range of products, providing a reliable and flexible solution for your packaging needs.

Didactic specializes in providing innovative learning solutions for technical education and industrial training. They offer a wide range of training systems, simulators, and educational resources designed to develop practical skills and competencies in various fields, such as automation, mechatronics, robotics, and fluid power.

Fabco-Air is a manufacturer known for high-quality pneumatic components, including the industry-standard Original Pancake cylinder. They offer a wide range of actuators, valves,

and custom-engineered solutions for various industrial applications.

festo.com

Booth Preview: Bosch Rexroth

Booth #S-1548

It's time to streamline how automation works. With more than 225 years of engineering expertise, Bosch Rexroth does more to engineer and deliver the most complete, harmonized, and easy-to-use factory automation solutions today's manufacturers want. With a factory automation portfolio that offers the broadest selection, these comprehensive solutions go beyond advanced components to include digital engineering tools and customized support that enables customers to solve the most intricate engineering challenges. Product highlights include drives, motion control, software, controls, motors, encoders, conveyor components and more.



High throughput rates combined with constantly changing package designs can become a productivity nightmare if the wrong material transport systems trap packaging lines into limited configurations. Bosch Rexroth conveyors and transport systems like ACTIVE Mover and VarioFlow plus are modular systems engineered with maximum flexibility and feature:

- Efficient motors plus modular designs that prevent over-dimensioning and energy loss
- Robust components and innovative technology to ensure high reliability at low maintenance costs.

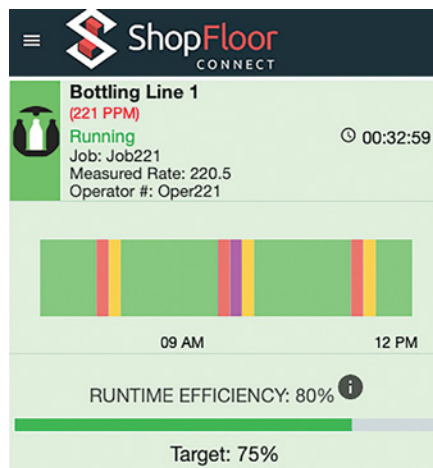
- Linear motor-driven transport systems for ultra-precise endpoints and accelerations up to 4g.
- Consistent modular design combined with our MTpro tool that speeds up planning and allows easy upgrades.

boschrexroth.com

Booth Preview: Wintriss Controls Group

Booth #LU-8431

Wintriss Controls Group has announced it will be demonstrating advanced features in its *ShopFloorConnect OEE* and *Data Collection* software at Pack Expo 2024. The latest functionality in *ShopFloorConnect* gives packaging and processing professionals efficient and easy-to-use software for increased productivity and reduced machine downtime, including when remote monitoring is required. The software can significantly increase manufacturing capacity and profitability by identifying and quantifying excessive production losses and bottlenecks.



Advanced *ShopFloorConnect OEE* and *Data Collection* software collects downtime and production efficiency data from every machine in a variety of industries including packaging, food, beverage, discrete manufacturing, metal forming and metal fabrication. Data are displayed real-time, and indispensable manufacturing reports are

produced, including detailed OEE reports in a variety of formats. At Pack Expo, Wintriss will highlight the *ShopFloorConnect Maintenance Tracker* which enables users to track important machine preventative maintenance (PM) items by run-hours, calendar days or machine cycles, issue targeted alerts when an item requires PM, and track the maintenance work history for all machines.



Wintriss will also demonstrate its new, compact SFC ShopFloor Tracker hardware device, an economical way for its *ShopFloorConnect* software to automatically collect production data from virtually any machine. The SFC Tracker is a wireless machine monitor that can be installed on any machine or production line to track machine parameters such as run time, idle time, production counts, production rate, uptime efficiency, and more without requiring any operator input. The most outstanding trait of the SFC Tracker is its versatility, featuring four inputs that can be configured to accept input from a variety of digital or analog signals.

wintriss.com/
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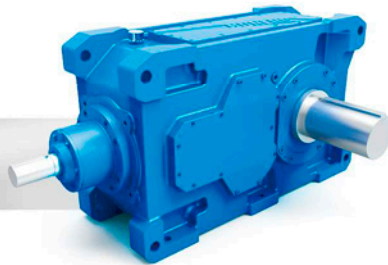
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Control System Techniques— Dampers (Part 1)

Donald Labriola II, PE—QuickSilver Controls

Closed Loop control systems can handle a wide range of motions with a wide range of loads if the control system and mechanics are properly designed for the task. A couple of the more difficult combinations to design for are high inertial mismatches and backlash with hard gearing. The question is not just how to make the system stable, but rather how to also get the desired performance.

Different approaches are needed for rapid motions with a light load versus those required for high inertia loads, especially in the presence of stiction. Additional requirements may include minimizing acoustical noise and having stability in the presence of backlash.

Yet another tuning complexity occurs when encountering variable stiffness especially with variable loads, for example, a coupling with a significant varying load to a motor using a belt drive. In this case, the effective distance between the motor and the load—as seen through the portion of the belt under tension—varies as the position varies, and as the direction of applied force varies. The resonance frequency of such a system varies with a) the position, b) belt tension—which varies with the motor torque, and c) the inertia of the load, which may change if the system is being used to transport materials.

There are also other motion optimizations that are dependent on the application. A precision liquid dispensing application, for example, requires not only that no overshoot occurs, but also requires that the liquid deceleration be kept low enough to avoid cavitation (bubble formation) in the liquid stream. Note that some other liquid dispensing techniques may intentionally shock the flow to dispense drops of liquid through the air without leaving a drop hanging. Overshoot in either of these cases would affect the dispense volume accuracy in an undesired way.

Animatronics also tend to come in two flavors: those that try to look lifelike want the final position to slide into place, while those moving like a robot want the motion to snap into place from a fixed speed and often with as high of acceleration as is reasonable to “stick the landing.”

Another confounder for control engineers is stiction. Stiction is the significant increase in friction as the speed goes below a critical threshold; the friction increase can cause the sliding parts to grab and may completely stop the motion until the force is raised enough to again overcome the low speed friction. The resulting breakaway action is then capable of causing a lurching if not properly handled. A common example is a sealed piston pumping liquid. These may have significant breakaway force and may also studder in the delivery stroke if the servo is not properly tuned to overcome the stiction. Animatronics does not look smooth if the stiction is not properly handled, and machining operation will not be smooth if stiction causes the motion to be jerky.

This material will be covered in a multipart article that goes through these related but different issues. We will first dive into the underlying issues and then how to address them via the control system. I will try to minimize the math and stick to the heuristics to keep this from requiring a master’s or higher in controls systems to follow! I’m also going to focus on rotary motors as they are most common, but the same techniques apply to linear motors.

High Inertia Mismatch Problem

High inertia mismatch describes when the effective inertia of the load (as seen by the motor) is significantly higher than the motor inertia. This is particularly problematic if there is significant compliance (i.e., a springy coupling or backlash) between the motor and the load.

In many cases, the problem can be simplified by use of tooth belts and pulleys or gear heads to gear down the motor to the load. For a gear ratio of $N:1$, the effective inertia is reduced by a factor of N^2 . The load acceleration is N times lower than motor acceleration, and the force/torque to the load is N times greater than the force/torque seen at the motor. The resulting effect is that a 10:1 gear can reduce the reflected inertia by a factor of 100. However, this introduces additional parts into the system that can wear and typically need maintenance, as well as the size and weight effects.

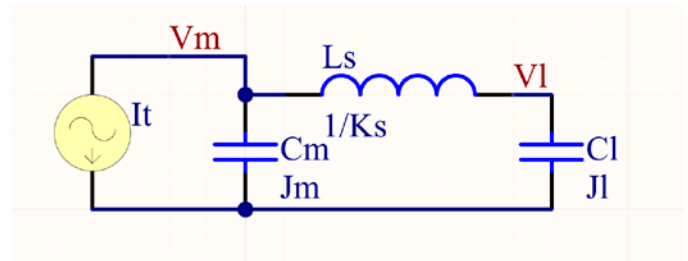
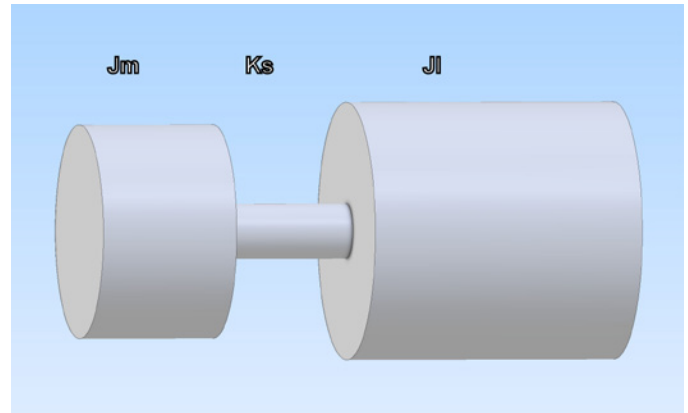
Most PID systems require an inertial mismatch to be below about 8.7:1 for stability, which can require either multiple reduction stages or adjustments to the control system, or other techniques.

Most servo systems measure the position of the motor shaft (and often the back shaft of the motor). For light loads with stiff coupling, the load can appear to just be an extension of the motor inertia, with any resonance frequencies above the bandwidth of the servo. Placing the feedback before any reduction gearing/pulleys gives a higher effective resolution to the measurement, so for simple/light load systems, this works well.

Gears, however, have cost, size, weight, and maintenance impacts. If the gears are not tight or have worn, they may also cause backlash/play in the system. When a servomotor reverses direction, the load decouples from the motor until the motor has moved far enough to have the opposite side of the teeth engage and couple to the load again. On impact, the teeth can bounce sufficiently to cause the system to go into a limit cycle where it buzzes with rapid motion reversals. This oscillation happens due to the system gain (angular acceleration divided by current) greatly increases while the teeth are not coupling the load inertia to the motor. The materials of the teeth can significantly affect the rebound energy when the teeth hit, so careful selection can help mitigate this issue.

When direct drive coupling is used, the system can be very responsive, but more care is needed to keep the system stable. As the inertial mismatch increases, the shaft/couplers between the motor and the load form a spring. Spiral couplers can have real difficulty in servo system due to their lower stiffness.

At low frequencies, the shaft may seem quite stiff, and the inertia seen by the motor is just the motor inertia plus the load inertia: $J_t = J_m + J_l$ (My electrical background uses the letter I for other purposes, but mechanical types may call inertia I !) This just ignores the effects of the shaft.



As the frequency increases, the spring effect of the shaft does not allow the load inertia to accelerate as quickly as the motor which is attached. The shaft starts to twist so that the angle of the load is no longer the same as the angle of the motor. The minimum response will come at an antiresonance frequency where the two masses are moving in opposite directions. The gain of the system then increases with frequency as the main contribution to the load seen by the motor is the torsion of the shaft. This continues up to a resonance at the peak of the curve, after which the inertia of the motor then dominates the load seen by the motor.

Note that this model is simplified, having no damping, whereas real systems have some losses due to material heating when flexing occurs. Adding damping reduces the resonant and antiresonance peaks, but a fairly low loss system will look similar. The electronic model will be a low pass Pi filter, where the torque is modeled as a current, the motor and load inertias are modeled as capacitors, and the spring of the shaft is modeled as an inductor. The value of the inductor is $1/k$ as a zero-value inductor would represent an infinite stiffness shaft. The motor velocity is V_m , while the load velocity is V_l which would be modeled as voltages in the electronic style model.

We calculate the gain in $\text{dB} = 20 * \log_{10}(\text{gain})$, where we are looking at the output velocity versus torque. The frequency scale is plotted on a \log_{10} basis. This allows us to easily look at the gains over a wide range of frequencies.

(These can all be readily modeled in *Excel* using complex math functions. See sidebar.)

Chart 1: Response in dB vs. Frequency in Hz 1:1 Mismatch

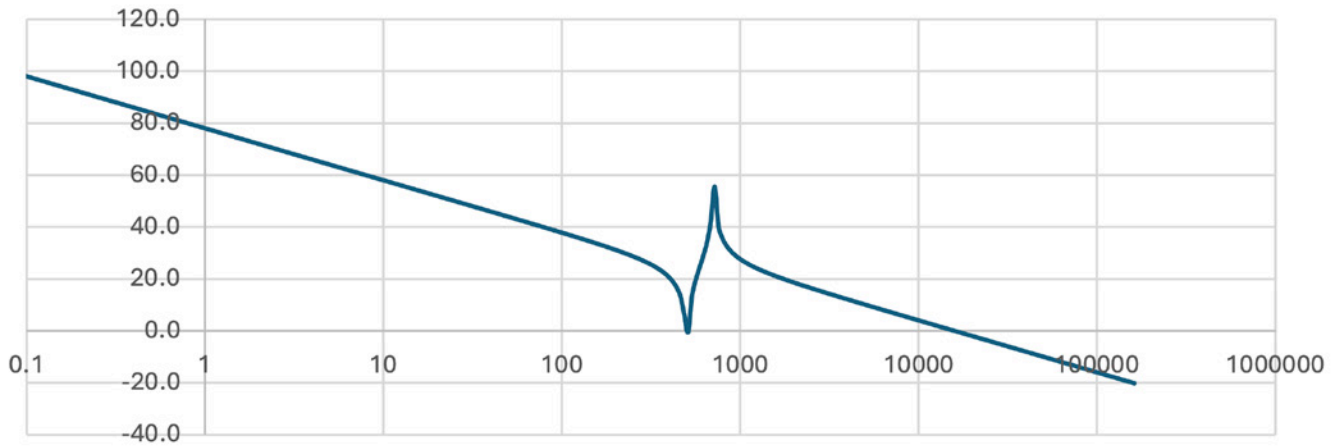


Chart 2: Response in dB vs. Frequency in Hz 10:1 Mismatch

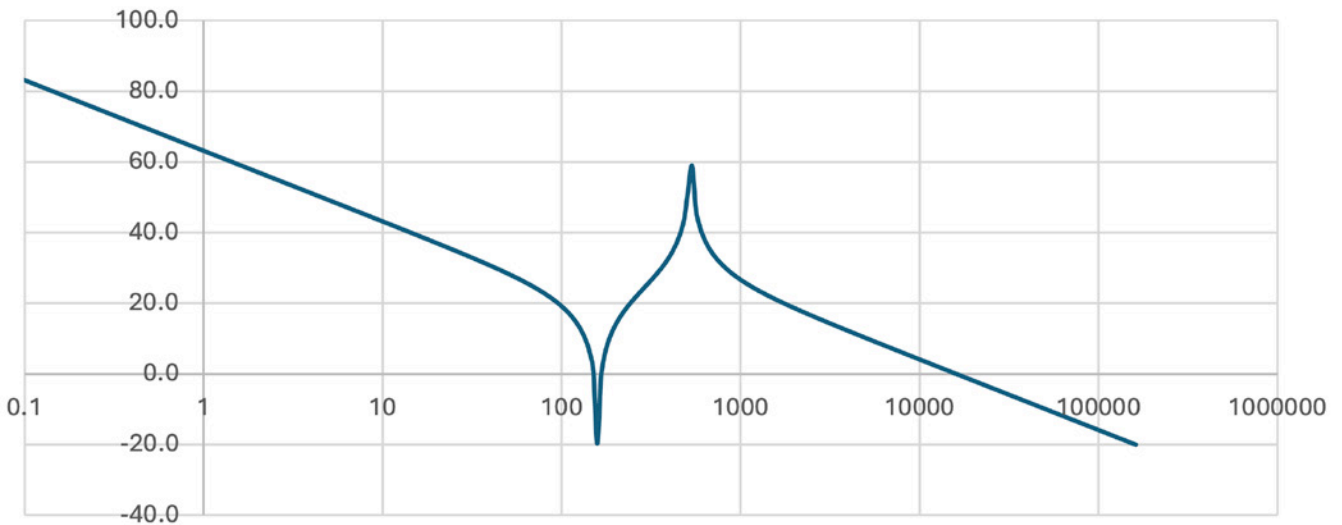


Chart 3: Response in dB vs. Frequency in Hz 100:1 Mismatch

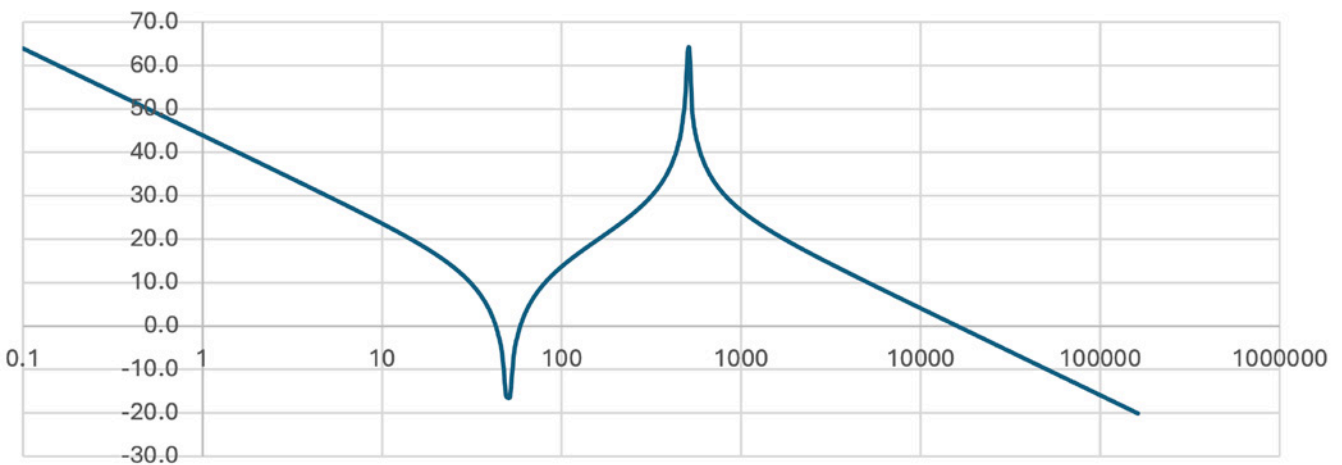


Chart 4: Phase angle for 100:1 Inertial Mismatch

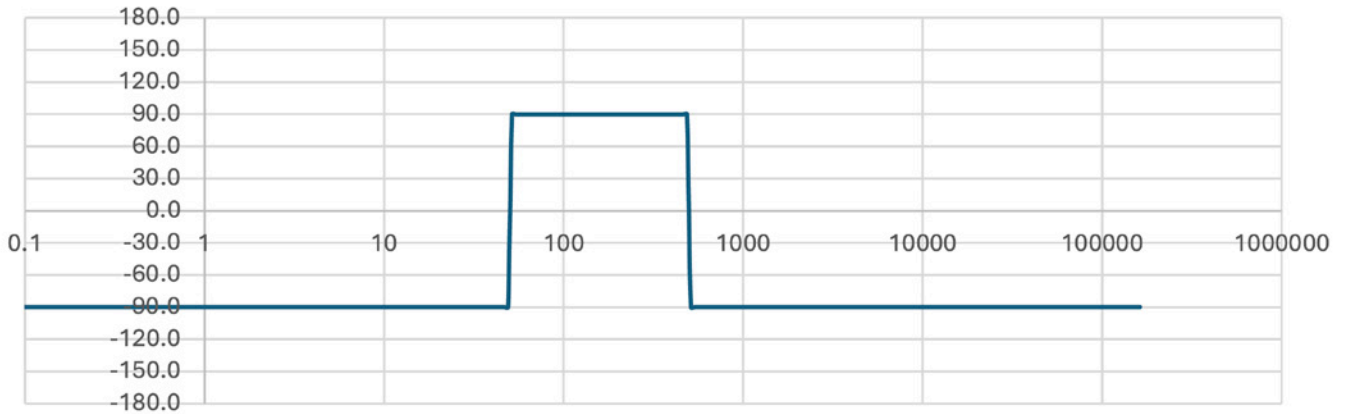


Chart 1 shows the gain for a 1:1 inertial mismatch. The downward peak is the antiresonance. The upward peak is the resonance.

Chart 2 shows the significantly greater gain increase for a 10:1 inertial mismatch

Chart 3 shows the effect for a 100:1 inertia mismatch

Chart 4 shows the resulting phase angle

You will see in each case the maximum gain from the resonance and the resonance frequency does not change much with the mismatch, as this is mostly determined by the motor inertia and the spring constant of the shaft and coupler. However, the anti-resonance frequency goes down by the square root of (1+inertial mismatch), that is by the square root of the motor plus load inertia.

The low frequency gain drops as $1/(J_m + J_l)$ that is as $1/\text{total inertia}$. This is expected as a very large inertial load will accelerate much more slowly than a light inertial load. The control engineer would normally increase the gain of the system to try to make it more responsive.

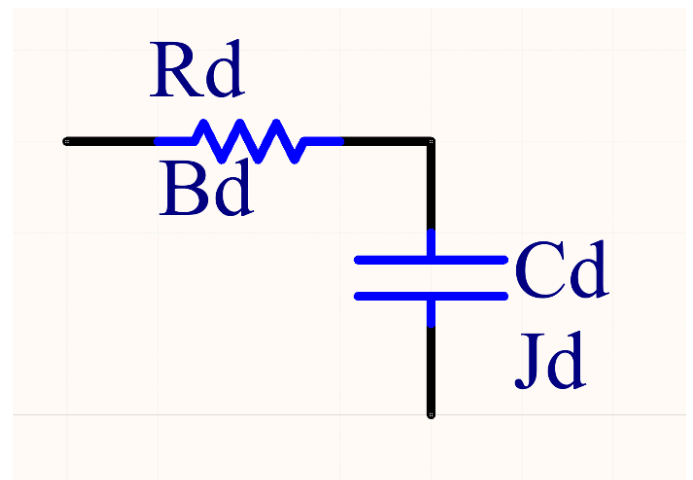
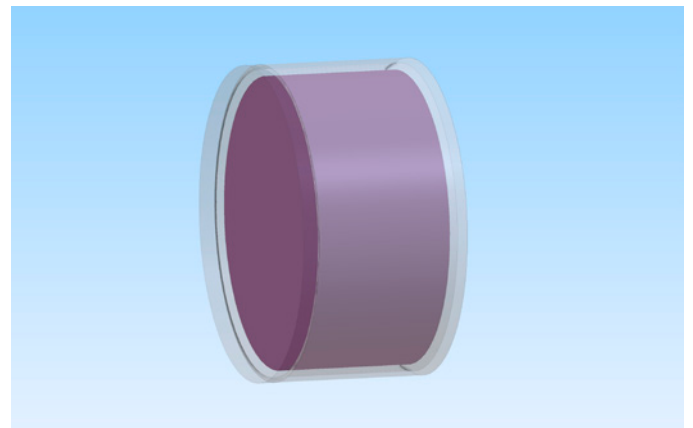
The problem comes in the upward slope portion of the curve. As the inertial mismatch increases, the gain between the low frequency line ($1/(J_m + J_l)$) and the high frequency line ($1/J_m$) gets larger, increasing the chance that the system will go into oscillation.

It is also interesting to note that the phase jumps from -90 when the inertia dominates, to +90 when the spring dominates, and back to -90 when the inertia again dominates.

There are a couple of methods to help stabilize such a high inertial load. The first is to add a low pass filter to the velocity estimator for the control loop. The extra filtering will increase lag in the velocity estimate but will reduce the gain at higher frequencies. This can be considered as making a better estimate of the actual load velocity which continues to reduce with frequency, unlike the sensor on the motor shaft. We can take advantage of the phase boost (+90 degrees) between the antiresonance and resonance

frequencies to counter the lag effect of a 2nd order low pass filter to reduce the gain boost associated with the resonance without losing too much phase margin. We will address this in more detail later in this series of articles.

Another method is to add a viscous inertial damper to the motor.



Load Calculations with Excel

Excel can make easy work of load calculations without brushing up on your complex algebra.

First you need to enable the complex math by adding the Analysis ToolPak to Excel. This varies with your Excel version, so look up your version. This will add the following functions:

COMPLEX: Enter real and imaginary parts of a complex number

IMAGINARY: Extract the Imaginary coefficient

IMREAL: Extract the Real coefficient

IMDIV: Divides complex numbers

IMPRODUCT: Multiplies complex numbers

IMSUB: Subtract complex numbers

IMSUM: Add complex numbers

These few functions allow you to do complex math.

Mechanical loads may be modeled by their electrical analogs.

Torque in N-m => Amps

Rotational velocity in Radians/sec => Volts

Inertia in $\text{kg}\cdot\text{m}^2$ => Farads

Spring stiffness (N-m)/radian => $1/L$ (1/Henry)

Damper (N-m/radian/sec) => Ohms

A frequency in Hz is transformed to $S=j\omega=2\pi$ radians per second

=**COMPLEX(0,(2*PI()*B7))** where B7 holds the frequency in Hz

Motor inertia may be modeled as a capacitor $C1=J1$, $Z1 = 1/(s*C1)$

=**IMDIV(1,IMPRODUCT(C7,E\$1))** where C7 holds s, and E\$1 is the first inertia

A shaft torsion (spring) may be modeled as $Ls = 1/Ks$; $Zk=sL$

=**IMPRODUCT(C7,G\$1)** where C7 holds x, and G\$1 holds L

Load inertia is again modeled as an inertia $C2=Jload$, $Z2= 1/(s*C2)$

=**IMDIV(1,IMPRODUCT(C7,E\$2))** where C7 holds s, and E\$2 holds load inertia

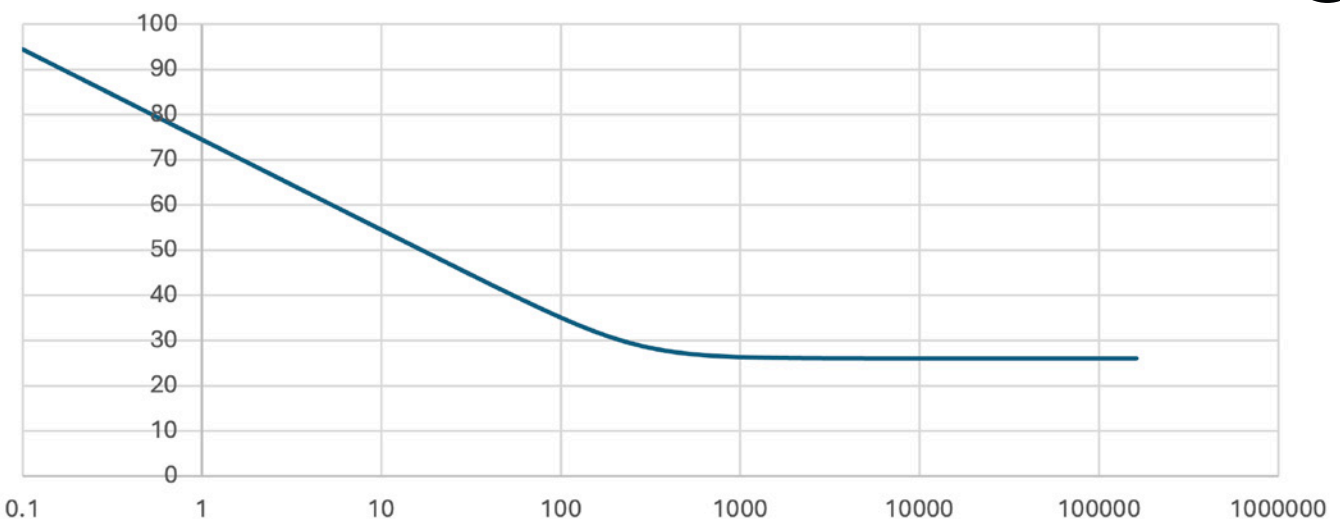
The total impedance is the parallel connection of $Z1$ and $(Zk + Z2)$.

If you have impedances Za and Zb in parallel, $Zt = 1/(1/Za + 1/Zb)$

=**IMDIV(1,IMSUM(IMDIV(1,D7),IMDIV(1,IMSUM(E7,F7))))**

So starting at the right end, we sum $Z2$ and Zk , divide it into 1, add it to $Z1$ divided into 1, and divide this sum into 1. This is the impedance at frequency S in C7, which came from frequency in Hz from B7.

Chart 5 Damper transfer function



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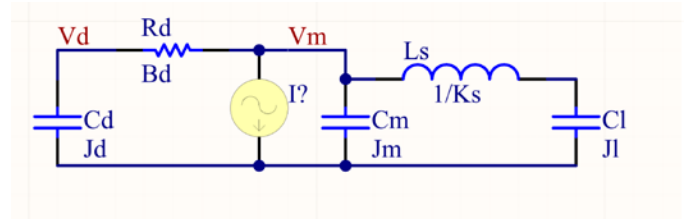
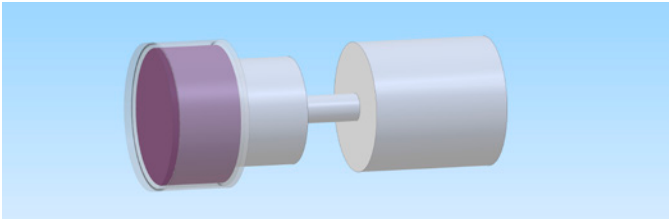
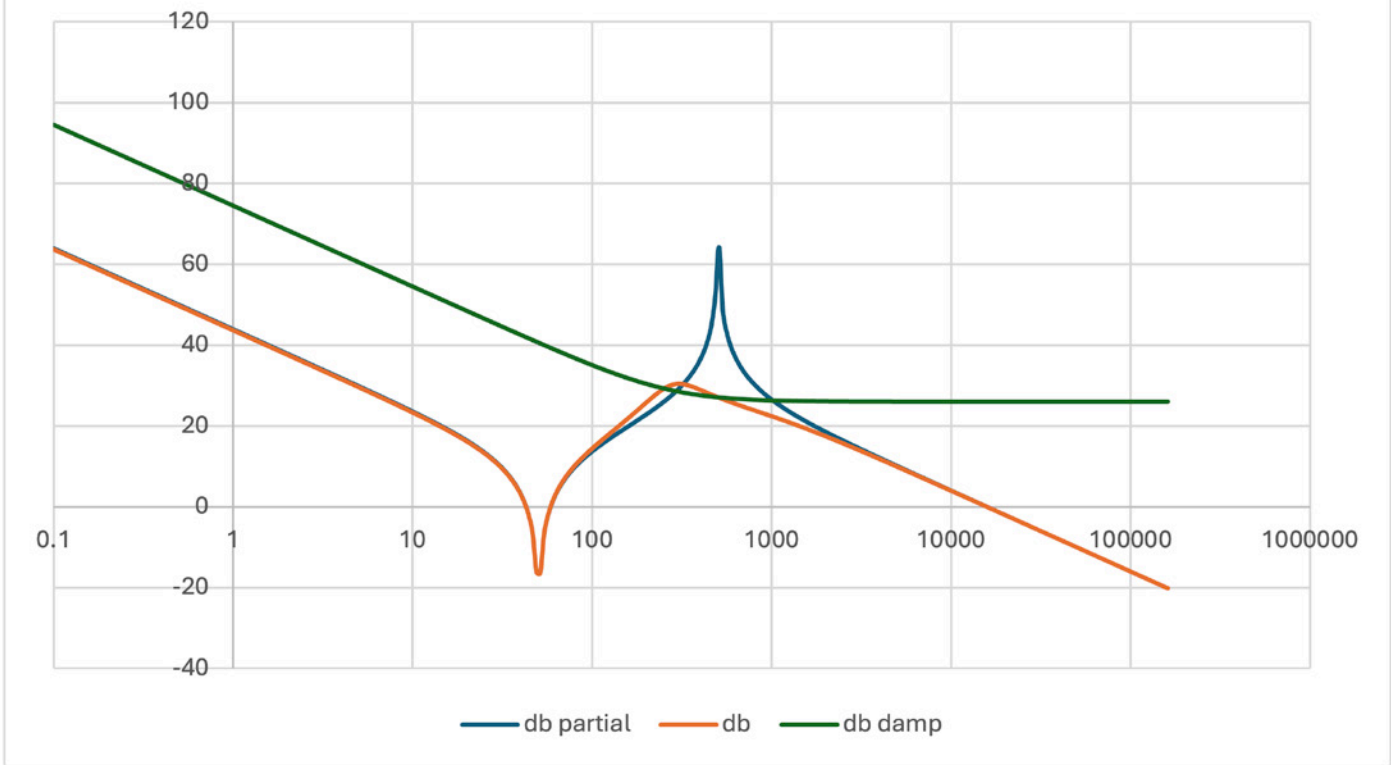


Chart 6: Motor + Load + Damper vs. Frequency



A viscous inertial damper typically has a fairly low inertia housing which contains a higher inertial cylinder which couples to the housing via thick silicone grease. At low accelerations, there is little shear in the grease, and the load looks mostly like a simple inertia. At higher accelerations, the shearing increases, with the inertial damper not significantly moving compared to the input shaft, and the resulting load looking mostly like a like a damper. For a rotary load operating at constant velocity, the inertial load will spin at the same speed as the motor shaft and only a little additional load is introduced. For oscillations in the shaft speed, as the oscillation frequency increases, the shearing of the coupling grease increases, adding damping to the system.

Assuming the housing inertia is low compared to the motor, we can model the shear of the grease as causing a torque to the damper inertia proportional to the difference in radial speed between the case and the damper inertia.

This damper has an inertia about 3x motor inertia, and 1/33 of the load inertia, and the viscous term was adjusted to optimize the shape of the combined curve.

The damper is shown mounted to the motor inertia (stiff compared to the viscous coupling of the grease) with the 100:1 inertia attached to the motor via a shaft

Chart 6 shows the effects when the damper (green) is connected to the motor and 100:1 inertial load (blue) to produce the damped system (orange).

When the damper is placed on the motor shaft, the impedance of the motor with load goes from the dB partial (blue curve) to the dB (orange curve), which has a peak ~ 64 dB down to a peak around 30 dB, almost 64 dB lower. This allows the system gain to be significantly increased while avoiding oscillations.

This reduced gain spike makes for a system that is much easier to control. Later articles in this series will show how we can produce a similar result electronically in the control system without the need for the mechanical damper.

The charts were all produced in *Excel* using the complex math function which may be loaded as an extension. This website: <https://www.exceldeemy.com/learn-excel/math/complex-numbers/> has a nice chart of these functions.

QuickSilverControls.com

PTE

Ball Bearing Efficiency

Norm Parker, Stellantis



I would like to briefly discuss some thoughts on ball bearing efficiency specifically in terms of applied load and resulting stress. I don't want to trivialize this subject; there are textbooks written on the subjects of electrohydrodynamic lubrication (EHL), octahedral subsurface shear stress and friction losses due to elastic hysteresis. This is a just a high-level discussion on the importance of individual bearing stress on efficiency.

Why is this important? On some level, I feel like I have, at times, personally concentrated too much on the size of the bearing regarding efficiency. I was trained in the traditional bearing houses with the notion that smaller was always better in terms of efficiency; however, this is not always the case. One of the major sources of energy losses for roller bearings is elastic deformation of the raceway under the loaded rollers. This might also be described as elastic hysteresis: It is the microscopic wave that is

generated in front of rolling elements as they pass through the load zone. The higher the load on the individual roller, the larger the loss.

As you begin to visualize these losses, you may start to wonder if using a smaller premium bearing

is truly more efficient than a larger non-premium bearing, considering the individual roller stress will be smaller on a larger bearing.

Of course, there are many factors to consider with a larger bearing that need to be included such as mass,

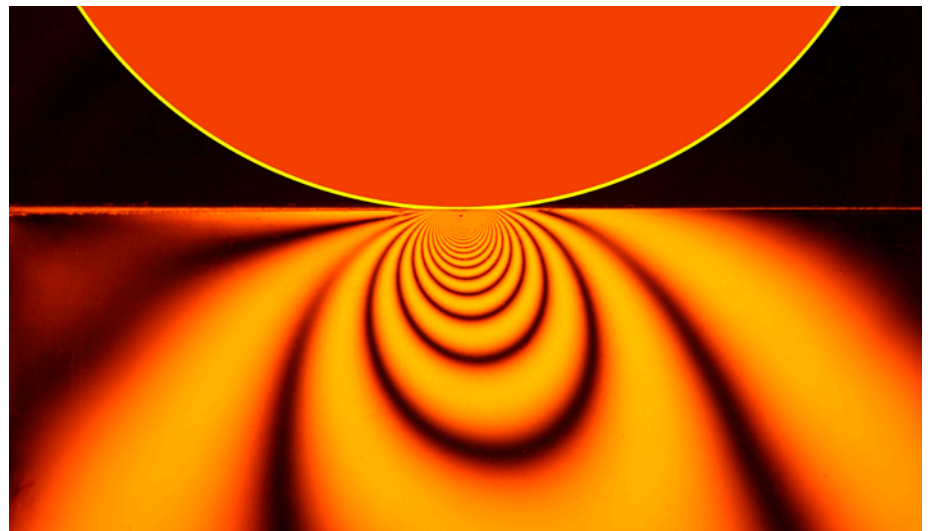


Figure 1—Shear Force Diagram

cost, packaging space, transportation costs, ease of installation, etc. but for the purpose of this example, let's just discuss size vs. efficiency and leave the rest for another day.

As a simple example, I took four ball bearings in the -05 series: a 6005, a 6205, a 6305 and a 6405. I am not suggesting that a 6005 and 6405 would ever be considered interchangeable. This is just for discussion to highlight the differences and get you thinking about stress and efficiency. In the chart below, the four bearings were loaded onto a shaft in *MASTA* with an external applied radial load. The clearances and fits were all identical: C3 clearance, K5 shaft and H7 housing. The lubrication was a lightweight ATF run at 70°C in an oil circulation system where splash and churning have little effect (churning can be a big factor in oil bath/splash systems). The graph is expressed in terms of percent efficiency over five different applied radial loads.

I highlighted in red dashes the interesting finding in this test. The largest bearing, by far, is the 6405. As we would expect, at low loads, the 6405 is the least efficient. There is a lot of rotating mass, a lot of sliding and overall friction. An interesting change happens around 5kN of applied radial load. At this point, this is around 25 percent of the static load rating of the 6405 but just over 100 percent of the static load rating of the 6005. The percentage of static load can be loosely thought of as stress on the bearing as 100 percent of the static load rating is intended to reach 4,200 MPa of individual Hertzian roller stress. This clearly shows that as the individual stress increases, efficiency decreases. This is not an intuitive exercise because the bearing load ratings are discreet and this essentially turns into a comparison of step functions. A simple example like this might help you get started off on the right foot. Certainly though, in this exercise, a 6305 showing better efficiency than a 6205 might be a surprising finding.

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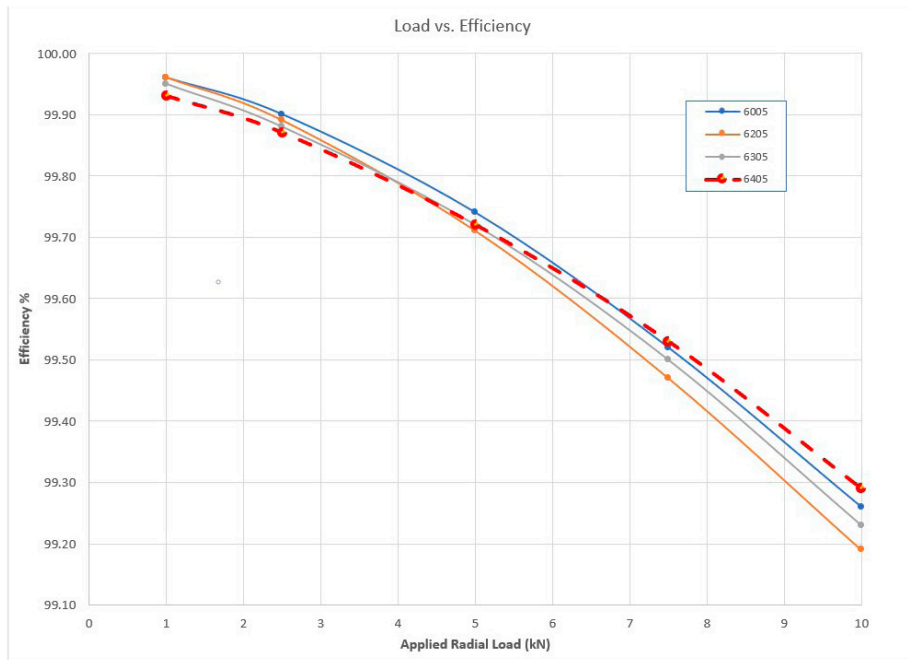


Figure 2—Ball Bearing Load vs. Efficiency for -05 series

Efficiency %	6005	6205	6305	6405
Cr	10.1	14	20.6	36.1
Cor	5.85	7.85	11.2	19.4
1	99.96	99.96	99.95	99.93
2.5	99.90	99.89	99.88	99.87
5	99.74	99.71	99.72	99.72
7.5	99.52	99.47	99.5	99.53
10	99.26	99.19	99.23	99.29



Norm Parker is currently Technical Fellow at Stellantis. He has contributed articles for PTE since 2014.

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SKF Strengthens Lubrication Management Capabilities



SKF has signed an agreement to acquire John Sample Group's (JSG) lubrication and flow management businesses. JSG is a well-established provider of lubrication management systems and services. The acquisition further strengthens SKF's offering in an identified growth segment, as well as its business operations in the expansive India and Southeast Asia (ISEA) region.

More than half of all premature bearing failures are caused by poor lubrication and contamination. This means that lubrication is a critical aspect in machine reliability with a direct and profound impact on production output and quality, costs, and the environment. SKF, through the Lincoln and SKF brand, has a strong position in automatic lubrication systems, and the acquisition provides access to JSG's wide customer base, sales and distribution network, as well as engineering and services capabilities.

JSG had sales of approximately SEK 550 million in their latest fiscal year, is margin accretive and has 86 employees. Following the acquisition, net sales for SKF's lubrication management business will be around SEK 7 billion.

"This acquisition is a good strategic fit as it enables us to become a significant lubrication systems player in the important ISEA region. Lubrication is an important part of SKF's portfolio of offering, enabling us to offer our customers tailored standalone lubrication solutions as well as improved bearing performance. As an essential part

of industrial maintenance, effective lubrication management also contributes to a sustainable business and society," says Thomas Fröst, president, Independent and Emerging Business, at SKF.

"At this stage in my career, transition of the John Sample Group is a natural and positive evolution. It is important for me and my family when making any decision of this kind, to engage with a party whose future vision for JSG is as closely aligned with our purpose, values, and strategies," says John Sample, executive chairman, John Sample Group Pty Ltd.

Founded in 1921, JSG is headquartered in Sydney, Australia, and serves a wide range of industries, including mining, construction and off-highway, pulp and paper, food and beverages, and transportation, across the product verticals Lubrication Systems and Instrumentation & Flow. The acquisition is expected to be completed during Q4 2024.

skf.com

EASA Presents Exceptional Achievement Service Award



The Electrical Apparatus Service Association (EASA) honored John S. Allen, managing director, Sheppard Engineering Limited, with the 2024 EASA Exceptional Achievement Service Award.

Established in 1997, this annual award recognizes individuals who have provided exceptional service to the electrical apparatus sales and service industry over a lifetime. "The EASA award recognizes those who have gone above and beyond in the electrical apparatus sales and service industry, providing exceptional service and demonstrating steadfast dedication," said EASA President & CEO Linda Raynes "It is the highest honor an individual can receive from our association."

In announcing the award, Past EASA Chairman Sid Seymour noted, "This year's recipient is known as a legend

in the industry. His role in the first “EASA/AEMT Study of the Effect of Repair/Rewinding on Motor Efficiency” was instrumental during a critical time for the electric motor repair industry. However, it’s not just this individual’s technical expertise that makes him worthy of this honor. His willingness to share knowledge, provide guidance and offer his insights has been invaluable to peers and newcomers alike.”

In nominating John Allen for this award, one letter from an EASA member firm read, “Many of our members’ employees have undergone training with him in several subjects, but it is in Ex Motor Repair where he has been most involved. This is not only in training and technical advice but also in designing and updating EASA’s Ex repair training course.”

Another read, “His dedication to technical perfection and steady improvement is legendary—and his knowledge is second to none. He has dedicated many days and weekends every year to work for our Association and to support our members in a wide field of technical topics. The spirit of dedication and the willingness to share and train other members is the real spirit of this Association.”

Yet another read, “Through the years, I’ve had multiple encounters with him where his expertise has been used to solve critical matters and develop solutions for keeping motors and generators running.”

And finally, “He has always been enthusiastic about the repair business, and he is always eager to help solve any problem that has occurred, which we could not solve by ourselves.”

easa.com

MOTION Agrees to Purchase Industrial Products Distributor



Motion Industries, Inc., a distributor of maintenance, repair and operation replacement parts, and a premier provider of industrial technology solutions, signed a

definitive purchase agreement to acquire the operating assets of Canadian-based LSI Supply Inc. and its sister company 273 Ontario (which trades as LSI). The transaction is expected to close later this month, subject to customary closing conditions.

Headquartered in Windsor, Ontario, LSI Supply has five area locations and distributes bearings, seals, power transmission and fluid power components, and industrial supplies. Industries served include agriculture, automotive, food & beverage, marine, plastic injection, renewable energy and tool & die. LSI also provides maintenance supplies for the military and wastewater services.

Jordan Sharpe, president of LSI said, “We are thrilled to join the Motion team and look forward to contributing to the company’s growth. With Motion, our offerings will be broader and deeper than ever, raising our customer service to new heights.”

“This acquisition will broaden our leadership position in eastern Canada,” said James Howe, president of Motion. “LSI’s talent, offerings and markets complement Motion’s perfectly. The business culture is an especially good fit, which is critically important when joining forces and providing premier customer service. We look forward to welcoming LSI’s 30+ employees and creating significant opportunities for our teammates and supplier partners, which will increase value for our customers.”

motion.com

FLENDER Receives Global Business Award



Mona Neubaur, deputy prime minister and minister of economic affairs of North Rhine-Westphalia, recently presented the NRW.Global Business Award 2024 to Flender CEO Andreas Evertz. Flender was one of four winners honored at the 20th anniversary of the Award at the K21 Ständehaus in Düsseldorf.

“The innovative and industrial heart of Europe beats in North Rhine-Westphalia. There is no other metropolitan region comparable. This is what makes us stand out in the international competition for the best business conditions. But these conditions are also changing. Creative ideas for climate-friendly, energy-efficient and digital business models, products and production processes are therefore more in demand than ever before. We have many pioneering companies here in North Rhine-Westphalia,” said Neubaur.

Flender receives the NRW.Global Business Award for its strategic foresight in globalization, its innovative strength and its enormous commitment to sustainability and corporate social responsibility (CSR). Thanks to these outstanding achievements, the company is recognized as a global market leader in industrial drive technology and the wind industry. Flender stands for innovative technologies and sustainable solutions that contribute to the energy transition. With its “Winery” brand, Flender is represented with drive components in every third wind turbine worldwide and has already installed more than 350 gigawatts of gearbox and generator capacity today. Figures that underline the company’s global importance and sustainable influence.

“Celebrating our 125th anniversary these days, we are particularly pleased to receive this award. We see it as recognition of our commitment to North Rhine-Westphalia, but also as confirmation of our successful global expansion strategy. It makes me proud to be part of this global team of 9,000 Flender employees. Together we are mastering the challenges of the present and the future. As a leading player in drive technology for wind energy and industry, we are actively and significantly shaping the energy transition worldwide. I am delighted that this course has been confirmed by prestigious awards such as the NRW.Global Business Award,” said Evertz.

The NRW.Global Business Award is presented annually by NRW.Global Business, the state’s own foreign trade promotion organization, together with the Ministry of Economic Affairs of the State of North Rhine-Westphalia. With this award, the state recognizes significant investments by foreign companies in North Rhine-Westphalia as well as particularly successful international expansion activities by North Rhine-Westphalian companies. For Flender, winning the award is confirmation of its many years of work, its contribution to the energy transition and to industrial development in the state of North Rhine-Westphalia and around the world.

flender.com

STLE **Brings Tribology & Lubrication for E-Mobility Conference to Detroit**

The Society of Tribologists and Lubrication Engineers (STLE)—the technical society for individuals in the

field of tribology and lubrication engineering—is hosting the 2024 Tribology & Lubrication for E-Mobility Conference on October 22–25 at the Detroit Marriott at Renaissance Center in Detroit. Registration is now open for the conference.



This event will explore the latest technical challenges and commercial opportunities that will impact the future of electric vehicle technology. Topic areas include electric vehicle hardware, electric vehicle drivetrain efficiency, lubricant formulation, sustainable mobility and electrification.

“The Tribology & Lubrication for E-Mobility Conference offers educational sessions, networking discussions and more with leading experts and companies in the field,” said Rebecca Lintow, CAE, STLE executive director. “It’s a great way for attendees to learn about the latest state-of-the-art developments in e-mobility technologies and lubrication.”

The event will feature expert-led presentations from leading companies and organizations interested in e-mobility, discussions on state-of-the-art electric vehicle technologies and lubrication developments and networking opportunities. New this year, there is an optional education course on Oct. 22 (separate registration required) titled “Electric Vehicle Technologies and Lubrication,” a one-day course featuring expert speakers, including OEMs, tier-one suppliers and additive and lubricant companies discussing state-of-the-art developments in electric vehicle technology and lubrication.

The keynote speakers include:

Kent Wanner, John Deere, presentation titled “John Deere’s Ongoing Electrification Journey: Delivering Customer Value”

Pär Nyman, Scania Group, presentation titled “Tribology Frontiers for Electric Heavy-Duty Vehicles”

Masashi Ogawa, Toyota Motor Corp., presentation titled “The History of Evolution in Toyota’s HEV and BEV Systems and Lubricants for Electric Vehicles.”

stle.org/emobility

November 3–6

Pack Expo International 2024

Pack Expo International (Chicago) is produced by PMMI, the Association for Packaging and Processing Technologies. North America's largest packaging event will bring together the solutions needed to launch new products and solve production issues. Corporate managers, engineers, sales managers, plant managers, manufacturers and production supervisors, brand and marketing managers, quality controllers, purchasers, research/development and package designers from a wide variety of consumer-packaged goods companies (CPGs) will be in attendance. Exhibitors will display state-of-the-art technologies, equipment and materials.

powertransmission.com/events/988-pack-expo-international-2024

See our show preview article on page 30 and check back regularly to powertransmission.com for additional Pack Expo 2024 coverage.

November 18–21

Automation Fair 2024

The Automation Fair (Anaheim, CA) offers an immersive experience showcasing the value and power of Rockwell's IT/OT expertise. This two-day event brings together industrial automation experts and leaders to guide attendees through the latest breakthroughs, strategies, and proven best practices, and to work with you on how to enhance your operation and achieve greater results. From engaging keynote presentations, interactive training and learning, industry-centric discussions, and a signature show floor featuring the latest innovations from Rockwell Automation and members of the company's PartnerNetwork program, this year's event will provide end-to-end insights to expand your business.

powertransmission.com/events/907-automation-fair-2024

November 19–22

Formnext 2024

Formnext (Frankfurt, Germany) is more than an exhibition and conference. It's an entire platform for companies from the world of additive manufacturing. Here, a veritable who's who from the realms of design and product development, industrial tooling, production solutions, quality management, and measurement technology comes together with leading providers in basic materials and component construction. It will also explore clever ways in which AM can be integrated into process chains in industrial production. In addition, top international speakers and other experts will be on hand to engage conference attendees in in-depth discussions at the highest technical level.

powertransmission.com/events/908-formnext-2024

November 12–14

Smart Production Solutions (SPS) 2024



With its unique concept, Smart Production Solutions (SPS) covers the entire spectrum of smart and digital automation – from simple sensors to intelligent solutions, from what is feasible today to the vision of a fully digitalized industrial world. SPS, located in Nuremberg, Germany, is an innovative platform for the automation industry with topics on control technology, electric drive systems, HMIs, software, sensors and mechanical infrastructure. Whether keynote, expert lectures or panel discussions, the SPS 2024 lecture program brings together high-profile speakers across a wide variety of channels, providing additional exchange opportunities beyond physical boundaries.

powertransmission.com/events/905-smart-production-solutions-sps-2024

December 3–4

CTI Symposium Berlin 2024



CTI Symposium Berlin offers keynote speeches, panel discussions and technical presentations on future powertrain technologies. This includes the exchange of experiences, R&D results and opinions with leading representatives of automobile manufacturers, suppliers, engineering consultants as well as officials. Topics include passenger cars, commercial vehicles, electric motors, transmission components, AI in powertrain development, thermal management, supply chain, powder metallurgy and more. While net zero emissions can be achieved with different drive systems and primary energy carriers, all solutions have one thing in common: CO2-neutral mobility based on renewable energy sources.

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Can't Help Myself



Aaron Fagan, Senior Editor

I recently discovered a 2016 exhibition hosted by the Guggenheim Museum that left an indelible mark on the contemporary art scene—Sun Yuan and Peng Yu’s installation titled “Can’t Help Myself.” This piece, a chilling convergence of technology, human emotion, and social commentary, showcased the artistic duo’s ability to transform complex concepts into visceral experiences. Through its profound simplicity, the installation raised questions about control, autonomy, and the human condition in an increasingly automated world.

At the heart of “Can’t Help Myself” was a Kuka robotic arm, caged within a transparent enclosure. This machine, industrial and imposing, was programmed to perform a single task: to continuously shovel hydraulic fluid that perpetually seeped away from it back into a contained space. The liquid, reminiscent of blood or bodily fluids, gradually spread across the floor, only to be painstakingly gathered again by the machine. The arm moved with an unsettlingly organic fluidity, its actions eerily human in their precision and urgency.

The brilliance of the installation lay in the robotic arm’s programmed responses. As the liquid spread further away, the arm became more frantic, more desperate in its attempts to control the spill. The more it worked, the more the liquid spread, creating a futile cycle that resonated deeply with the viewers. The audience, separated by a transparent barrier, could only watch as the machine struggled endlessly, unable to help it, or themselves, from feeling a growing sense of unease and empathy.

This endless cycle of containment and spillage served as a poignant metaphor for the human condition in the 21st century. The robot’s frantic efforts mirrored the struggles of individuals in modern society—trapped in cycles of labor, maintenance, and control, all while dealing with the slow, inevitable spread of entropy. The title, “Can’t Help Myself,” further deepened this connection, suggesting a dual meaning: the machine, bound by its programming, literally could not stop itself from performing its task, just as humans often feel trapped by societal expectations, economic pressures, or psychological compulsions.

Sun Yuan and Peng Yu are known for their provocative and often unsettling works, which frequently explore themes of life, death, and the boundaries of the human body. “Can’t Help Myself” was no exception. It was a masterful example of how they used the cold, mechanical nature of technology to evoke deeply human emotions. The robot, though lifeless, became a symbol of our own existential struggles—an entity engaged in a never-ending task, forever on the edge of completion, yet never quite succeeding.

The use of an industrial robot also raised questions about the relationship between humans and machines. In an era where automation and artificial intelligence are rapidly advancing, “Can’t Help Myself” confronts viewers with the implications of this technology. The robot’s actions, while programmed, were also reactive and unpredictable, blurring the line between machine and sentient being. This ambiguity left the audience questioning where control truly lies—are we the masters of our creations, or do our creations ultimately control us?

In the world of power transmission and automation, the fine line between control and chaos is always in focus—whether on the factory floor or in our broader society. “Can’t Help Myself,” using a robotic arm out of its intended context, sheds light on that very tension. The robot’s relentless, futile task—containing hydraulic fluid spilling around it—becomes a striking metaphor for the struggles faced in industries relying on automation. Just like this robot, always battling entropy, engineers and operators are constantly tasked with optimizing processes, maintaining systems, and innovating in the face of seemingly uncontrollable challenges. At the heart of power transmission and motion control is this same pursuit: balancing precision and efficiency against wear, tear and the unpredictability of real-world applications. The art installation, while a commentary on the human condition, brings into focus the very issues that drive this industry—the pursuit of perfection, and the systems we rely on to maintain it.

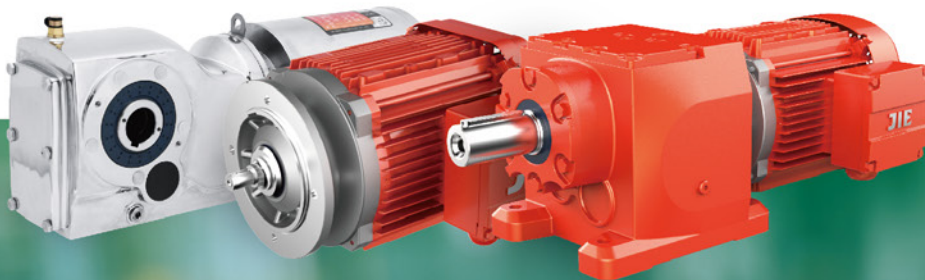
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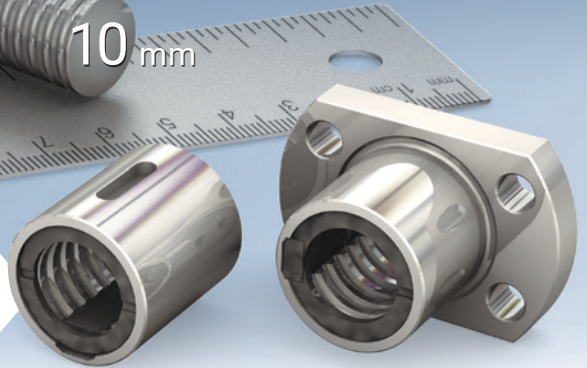
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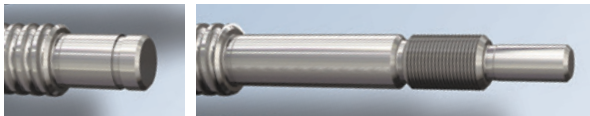
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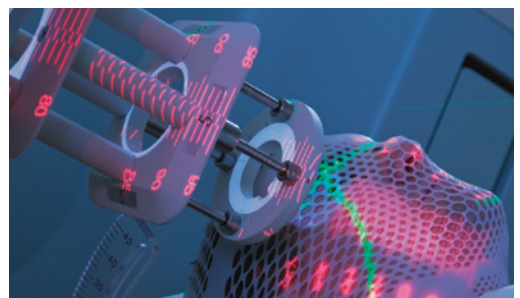
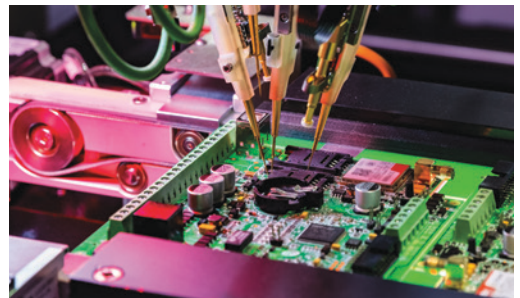


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