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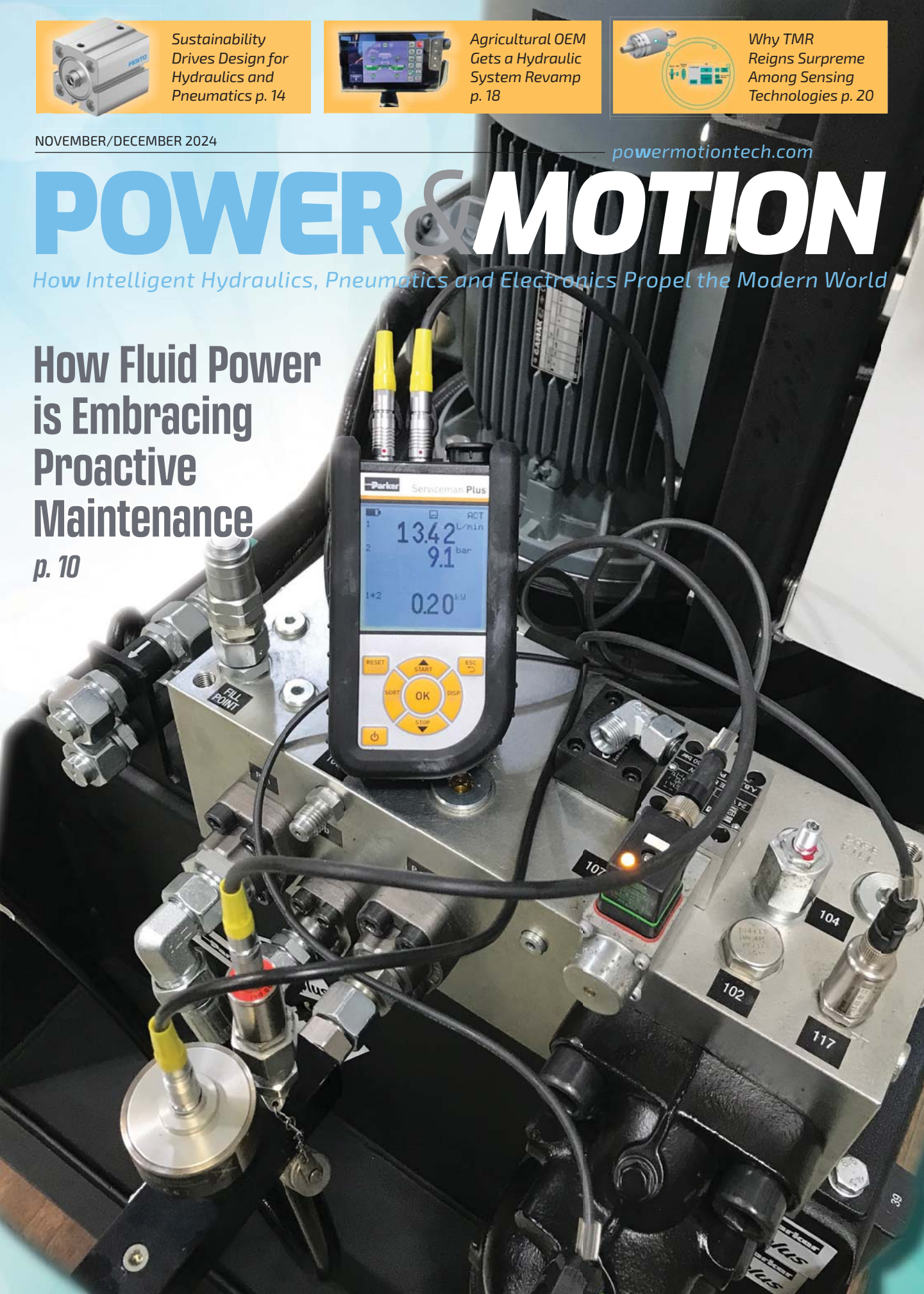
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Cover image: Parker Hannifin Quick Coupling Division

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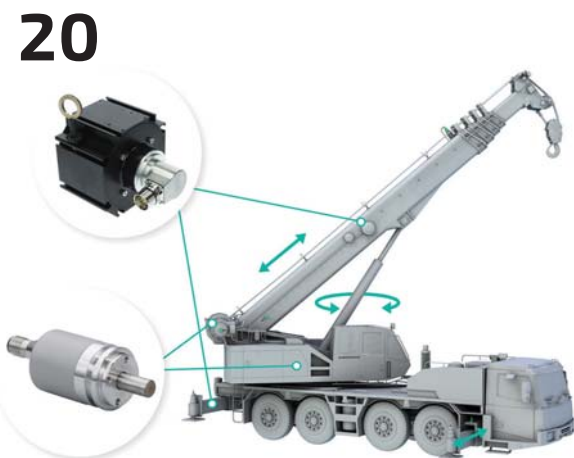
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A Positive Outlook for Pneumatics Market in 2025

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[Editor's Note]

SARA JENSEN
Executive Editor

Embracing Change in the New Year

AS 2024 BEGINS to wind down, it is time to start looking ahead to what 2025 will bring. Many are optimistic that global markets will begin to turn around as interest rates are lowered, aiding demand in many sectors.

Although much of the hydraulics and pneumatics sector has faced challenging market conditions in 2024, that has not hampered innovation. Quite the contrary from several conversations we had this year, and as demonstrated by many of the pieces in this issue starting with our cover story which looks at how preventative and predictive maintenance technologies are being utilized in fluid power on pg. 10.

On pg. 14, you can learn how the growing focus on sustainability is influencing hydraulic and pneumatic designs. Meanwhile, on pg. 20, we examine the growing use of TMR (tunnel magnetoresistance) sensors as an alternative to the commonly used Hall-effect sensor technology.

Change is inevitable, and it has been good to see so many in the fluid power industry embracing it as electrification, digitalization and other major trends have necessitated new technological developments.

As the sector continues to evolve, so too does *Power & Motion* to meet the needs of our readers. This first came in the form of

our rebranding in 2022 which was done to showcase our expanded coverage to include other technologies being used in conjunction with, and in some cases in place of, hydraulics and pneumatics.

Now, as we move into 2025, we are further embracing the digital world we live in by making this our last print issue. We will of course continue to bring you the latest information related to fluid power and other motion control technologies through our website, newsletters, eBooks, and videos. But now our team will have the resources to deliver information faster and in new formats to better serve the way people take in content today.

Have thoughts on how you'd like us to present content in the future, or topics we should cover in the coming year? Let me know by emailing me at editor@pmtmag.com. **P&M**



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2025

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[News]

Packaging Machinery a Bright Spot for Manufacturing Sector

Interact Analysis is forecasting 0.5% growth for the global packaging machinery market which will help prop up the broader machinery sector in 2024.

Global economic conditions have burdened many industries in 2024, including the manufacturing sector. According to market intelligence firm Interact Analysis, the machinery segment of this industry has been hit particularly hard.

High interest rates and inventory levels have contributed to lower demand for machinery as well as the components used within them.

The latest quarterly Manufacturing Industry Output (MIO) Tracker from Interact Analysis shows there are some sectors better weathering the current global economic challenges though. Packaging machinery is one of them and is forecast to grow 0.5% globally in 2024.

The Current State of the Packaging Machinery Market

Machinery for packaging materials and goods are utilized in a wide range of industries from pharmaceuticals to food and beverage to cosmetics, just to name a few. Widespread use of packaging machinery in a range of applications will aid the sector's resiliency in 2024.

Investments in the manufacturing sector are likely to benefit packaging machinery this year and into 2025 and beyond as



Packaging machinery is used in a range of industries for an array of applications.
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these machines are important to the final stages of the production process. Results will vary by region though.

Interact Analysis said China is the world's largest machinery producer but is currently dealing with an overcapacity situation due in part to weak domestic and export demand. Shifting investments from other sectors to manufacturing also contributed to this and is causing downward pressure on prices globally, said the market intelligence firm. This is making it difficult for other regions to compete in the manufacturing machinery market.

Oversupply is also hindering innovation in China because manufacturers are focused on unloading inventory instead of developing new technologies which could negatively impact growth for the region.

Technology adoption could be a factor which impacts recovery for the U.S. manufacturing machinery market in 2025

as well. Domestic machinery production still lags behind many other global markets, noted Interact Analysis. In addition, it takes time for manufacturing facilities to come online, slowing the uptake of new machines to an extent.

However, investments are being made in the manufacturing sector — such as the CHIPS and Science Act and Infrastructure Investment and Jobs Act — which should help to increase demand for machinery of various types, including those for packaging as well as technologically advanced options. As such, recovery is anticipated for the U.S. manufacturing machinery market starting in 2025 and continuing through the rest of the decade (see Fig. 1 on page 8).

Germany, also one of the top global regions for machinery production, is currently facing significant headwinds. Interact Analysis is forecasting a 2.5%

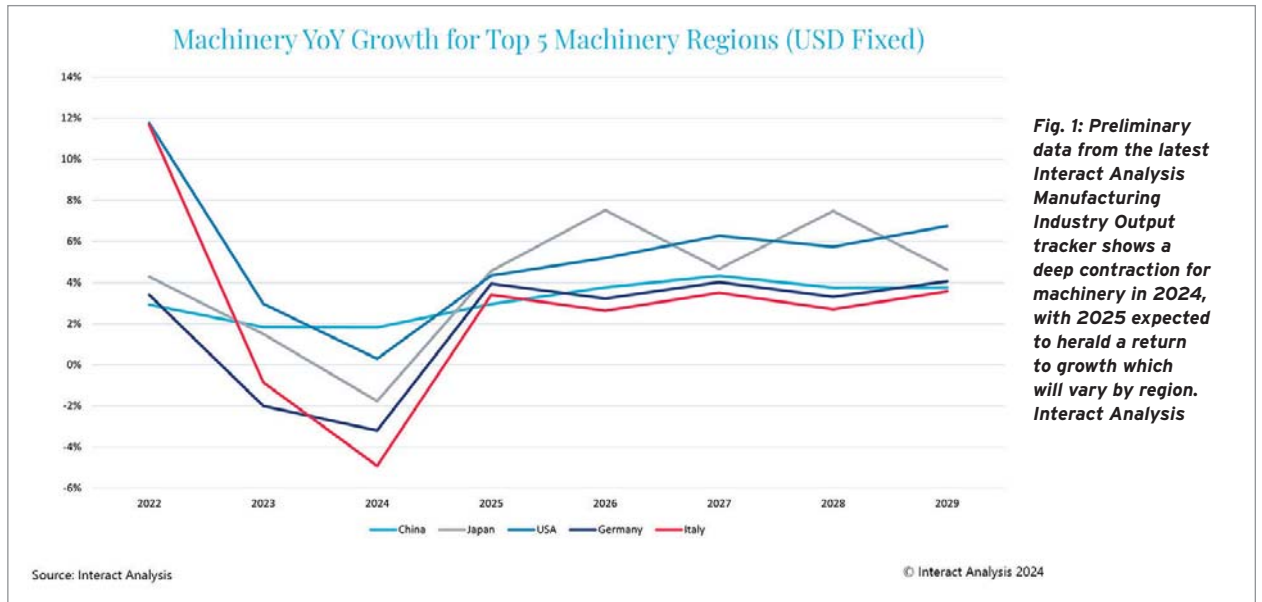


Fig. 1: Preliminary data from the latest Interact Analysis Manufacturing Industry Output tracker shows a deep contraction for machinery in 2024, with 2025 expected to herald a return to growth which will vary by region. Interact Analysis

decline in 2024 for Germany’s machinery sector. Packaging machinery will be impacted, the firm said, due to weakened domestic demand and competition from Asian manufacturers.

The country’s focus on producing high-quality, precision packaging machinery for use in industries such as pharmaceuticals and food processing should help to alleviate some of these

challenges though said Interact Analysis. This should help in the long-term as well because Germany has a strong reputation for engineering excellence. The market intelligence firm noted it will be important for the region to adapt to rising demand for automated and sustainable packaging solutions to ensure its long-term competitive advantage.

Packaging Machinery to Benefit from Drive Toward Automation

Interact Analysis said sustained investment in automation within the packaging machinery sector will be a benefit going forward. It noted that companies in China, Italy, and the U.S. are embracing automation to improve efficiency and cut costs; packaging machinery has become a critical area of focus for these investments.

Automation also plays into sustainability by improving productivity and efficiency, leading to less energy used and thus emissions produced. As sustainability has become a larger focus for many, the market intelligence firm sees companies which leverage automation to address sustainability issues faring the best in 2025 and beyond.

This focus on sustainability and the more efficient, automated technologies being developed as a result could play a

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part in the motion control components utilized in packaging machinery going forward. Data shared by the National Fluid Power Association (NFPA) in a 2023 report showed packaging machinery is one of the top 20 customer markets for the fluid power industry.

Hydraulic and pneumatic technologies are still used in many packaging machinery applications. But like other machinery segments, there is also a move toward electromechanical alternatives where feasible. Electric actuators, for instance, are considered by many to be more efficient while also providing improved precision and reliability, both of which are important in automation.

To ensure continued relevancy of hydraulics and pneumatics in industrial applications like packaging machinery, NFPA's next Technology Roadmap will focus on these applications. The roadmap is a document which highlights development areas the industry should consider prioritizing its efforts to meet

customer needs. It is currently seeking input from the fluid power industry and industrial customer markets to help create this document.

Overall, Interact Analysis said the packaging machinery sector is proving to be a resilient outlier of the manufacturing segment and is expected to remain on its growth trajectory in the coming years. Its more positive outlook will help bring the broader machinery market out of its slump.

There are of course some uncertainties such as which regions will fare well, and which will continue to struggle. The firm noted this is exemplified by Germany's current situation contrasted with the strong growth taking place in smaller Asian countries such as South Korea. Competitive pressures in Europe and increasing demand for sustainable packaging machinery solutions will contribute to future market conditions as well.

In general, though, Interact Analysis said there is optimism that 2025 will be a

turning point for the packaging and broader manufacturing machinery market. Continued investments in new technologies and automation will play important roles in the market's recovery. **P&M**

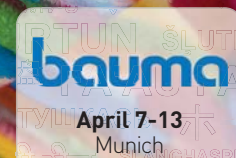
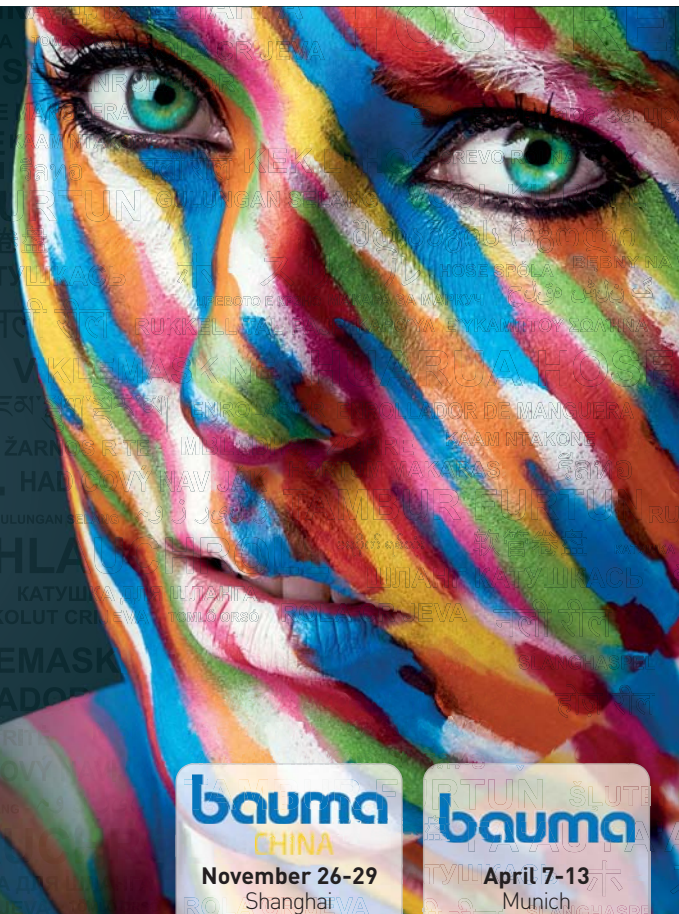


Robotics are becoming a key part of many packaging machines and operations to help automate, and thus improve the productivity of, various tasks. S. Jensen



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Preventative and Predictive Maintenance in Fluid Power: The Technologies and Benefits

Integration of sensors and other technologies into fluid power systems is enabling a shift from reactive to proactive maintenance to minimize unplanned downtime.

by Sara Jensen, Executive Editor

Proper maintenance of hydraulic and pneumatic systems is critical to ensuring long-lasting performance. Typically, maintenance practices over the years have been more reactive in that a problem is fixed only once it is detected.

With the reactive approach to maintenance, it is simple and intuitive — if a motor wears out, it gets replaced. There are low up-front costs because no sensors or networking capabilities are required. But when that motor does fail, hopefully a replacement is available otherwise production is held up for the machine and every worker who depends on it, said Connor Dudas, Application Engineer at Schroeder Industries, during a presentation given as part of the National Fluid Power Association's (NFPA) March 2024 Quarterly Technology Conference.

If that motor is used in a CNC which makes manifolds, for example, he said all the parts assemblers that depend on production of the manifolds to complete their work are also impacted by the machine going down. "This reactive maintenance strategy has a costly, cascading effect," he said.



Parker Hannifin's SensoControl measuring devices for mobile and industrial hydraulic systems can measure flow, temperature and pressure to detect potential maintenance issues. Parker Hannifin Quick Coupling Division

Integrating sensors, telematics and other technologies into a machine and its fluid power systems to move toward more preventative and predictive maintenance enables machine owners to better determine when there is an issue and be more proactive about addressing it before downtime occurs.

Understanding the Differences Between Preventative and Predictive Maintenance

While the goals of preventative and predictive maintenance are similar, understanding how they differ can ensure deployment of the system which best meets the needs of end-use customers.

Preventative maintenance, also referred to as planned maintenance, uses historical data to estimate maintenance needs.

Often, maintenance is scheduled for an optimal time to minimize costs, such as during a planned facility downtime.

However, there are disadvantages associated with this approach. Dudas said if you have a pump with a rated lifespan of 8,000 hours continuous duty, which is about 333 days, but conducting maintenance every quarter, you could be missing out on as much as 2 months of that component's lifespan. "That's roughly 20% of the estimated lifespan that you're paying for but not able to use."

Predictive maintenance, on the other hand, requires more data that is machine specific. This allows individual decisions to be made about an individual machine. It typically uses sensor technology and data analytics to monitor real-time asset condition, Dudas explained. "This is a



The HYDAC CSM-E Contamination Sensor Module combines sensors and gateway devices to provide predictive maintenance capabilities. HYDAC

further improvement upon preventative maintenance strategies,” he said.

There are upfront costs associated with predictive maintenance systems for the sensors and networking capabilities, but Dudas noted these have come down in recent years and most companies have the IT infrastructure in place already which also helps to reduce system costs.

And these costs are going to be lower in comparison to an unplanned downtime event that might otherwise occur. Downtime is directly responsible for unproduced goods, which means a company’s product is not getting into the market and creating revenue.

There are also costs associated with employee wages that still need to be paid during a downtime event, ordering of emergency spare parts, contractual obligations possibly not being met, as well as potential safety and legal issues.

Dudas cited data from a Siemens Senseye study which showed there has been a 50% rise in costs associated with unplanned downtime since 2019 for manufacturers in various industries, demonstrating the value preventative and predictive maintenance systems can bring.

Sensors Improve Failure Detection

The ideal scenario for any hydraulic or pneumatic component is to get as much life out of it as possible without experiencing downtime. Unfortunately, this will not always be the case.

Therefore, being able to detect potential downtime issues is beneficial to extending the useful life of components when feasible. Dudas said there are many indicators for machine quality and typically those which are most observable are those indicating impending failure. Here again he gave the example of a motor — if it is hot to the touch and noisy, those are easy to tell in person but also dangerous indicators of failure.

These types of indicators often show up moments before catastrophic failure “and the component has likely already lost significant efficiency by then,” he said.

However, there are places where predictive maintenance strategies can be implemented, typically for those aspects which are harder to observe. “We can use sensor technology to monitor things like vibration, fluid condition and thermography to help estimate remaining oil and component life,” said Dudas.

He said there are three main parts to predictive maintenance systems — sensor integration, gateways and IoT (Internet of Things), and analysis. Sensors used in these systems can come in many forms; those most applicable for the hydraulics industry include:

- particle
- saturation
- oil life
- temperature
- flow and pressure
- vibration.

By incorporating these sensors, it is possible to continuously monitor various performance aspects instead of relying on manual observations, which may not even be possible for some of these parameters.

From Schroeder Industries’ perspective as a developer of hydraulic filtration technology, fluid condition monitoring sensors (particle, saturation and oil life) are the most valuable and effective, said Dudas. “These sensors allow you to get to the root of the problem and make a meaningful, holistic solution.”

He said vibration sensors are valuable in that they can tell what pump is failing, but it can’t tell you why whereas fluid condition sensors can. For instance, if a particle sensor is reading higher than standard, it may be because a filter needs to be changed. With that information, machine owners can be proactive about replacing the filter to prevent downtime.

Maintenance Technologies Need to Provide Valuable Information

Dudas said data without analysis is meaningless. “Sensors are necessary and useful, but only a small part of the [predictive maintenance] story.”

It is not feasible to hire people to monitor sensor data all day, which he said is where the second part of a predictive maintenance system comes in, the gateway devices and IoT. “These devices allow us to pull meaningful data from all of the sensors [and] analyze trends to predict



Easy to observe indicators of machine failure, such as a hot or noisy component, often show up moments before catastrophic failure. 64628554 © Yodrak Sangprom | Dreamstime.com

[Cover Story]

failure,” he said. “We know the warning signs of machine failure in hydraulic systems — excessive heat, vibration, noise, decreased efficiency. All of these are useful and detectable symptoms of failure.”

He continued that gateway and IoT devices can help isolate meaningful data and communicate it to a centrally located system where it delivers the signs of failure and delegate maintenance tasks to address them. “Analysis without action is pointless,” said Dudas.

Understanding the need to provide actionable maintenance information, Parker Hannifin’s Quick Coupling Division developed its SensoControl measuring devices for mobile and industrial hydraulic systems. The portfolio includes sensors capable of measuring flow, temperature and pressure as well as handheld devices which read data from these sensors and provide information to diagnose potential maintenance issues.

Cameron Koller, Market Development Manager at Parker Hannifin’s Quick Coupling Division, said the technology is typically used when there is an indication of a problem to determine what it is and how to address it, enabling maintenance personnel to prevent further issues downstream. “You can get active measurements and record them in real time while [still safely] using a machine,” he said.

This enables machine owners to gather information and start diagnosing potential issues as soon as possible to mitigate larger and more costly downtime issues. The ability to provide rapid, accurate information on hydraulic system performance is an important part of SensoControl’s value proposition he said. “That allows [end users] to make much more informed decisions and define how they can solve the problem before it becomes a bigger problem.”

When it comes to maintenance tools, Koller said fluid power has historically been an antiquated market in terms of visibility to information and data. Many applications are in dirty environments and cost has been a factor as well, so adding preventative and predictive maintenance technologies to an operation requires a clear value proposition.



Pressure sensors such as those pictured from HYDAC can help to detect potential performance issues in hydraulic systems. HYDAC

“At the end of the day the end customer has to use it, and it has to be meaningful for them,” he said.

His colleague Emily Santoni, Product Sales Manager at Parker Hannifin’s Quick Coupling Division, agrees that people need to see the value proposition of using preventative and predictive maintenance technology.

She offered the example of pressure spikes in a hydraulic system which can cause expensive downstream issues if not detected early. If a pressure spike occurs,

it can lead to seal wash out which then negatively impacts the pump system and filters. “These can be very expensive, time consuming, [and] labor-intensive problems,” she said.

But by investing in maintenance tools, it is possible to identify these issues early and determine how to fix them. In addition, tools like SensoControl enable users to read and export data without being in the immediate vicinity of a machine, giving them “safer, faster, better information,” she said.



The SensoControl handheld device from Parker Hannifin’s Quick Coupling Division can help diagnose maintenance issues with hydraulic systems in mobile and industrial applications. Parker Hannifin Quick Coupling Division

Santoni said speaking to the customer and making sure they understand the value of such products is important.

Machine Learning and AI Improving Analysis Capabilities

Data analysis has been a relatively manual process for many years. However, Dudas said implementing machine learning and artificial intelligence (AI) tools into maintenance systems can help improve analysis.

With these tools, it could be possible to reliably tell maintenance teams when it's time to change a motor to get 90% of the lifespan out of it, he said. Automatically creating a schedule for when to replace components based on the urgency of doing so could also be possible.

In conjunction, purchasing teams can be notified when a hydraulic motor is at 50% of its lifespan so spare parts can be ordered in a timely manner. This also reduces the number of spare parts that need to be kept on hand and thus the costs associated with storing and ordering them.

"We see this could ultimately change the landscape of predictive maintenance," he said.



Use of artificial intelligence in maintenance tools, such as those available from AssetWatch, can help improve accuracy of data collection and analysis as well as ease of use for customers. AssetWatch

To help its customers be more proactive with their maintenance, AssetWatch offers an oil analysis program in which dedicated engineers analyze data as soon as they receive it and provide feedback to customers on any issues they may detect. The company told *Power & Motion* it is able to compile this data, set thresholds and alarm limits, and contact customers immediately with the best recommendations or next steps if any of those are surpassed.

AssetWatch said it uses AI and humans working together to find speedy and accurate resolutions for its customers. Its oil analysis program can be used to test for particle contamination, wear metals, viscosity, acid, water and more, all of which can negatively impact the performance of a hydraulic system. The company noted its oil analysis capabilities can be combined with its Vero continuous monitoring technology which sends vibration and temperature data for further performance information to aid maintenance, and that the technology can be used with both hydraulic and pneumatic systems.

Use of machine learning and AI will help to create more digital, easy-to-use interfaces which Koller and Santoni noted preventative and predictive maintenance technologies are moving toward. This will help to provide a better value proposition for end-users by making information easy to collect and interpret, enabling them to quickly address maintenance issues.

As the fluid power industry and its customer markets continue to experience a generational shift in which personnel with years of experience are retiring and the younger generations coming in do not yet have that industry knowledge, tools capable of helping to easily detect and address maintenance issues will be critical. **P&M**



Use of maintenance tools like Parker Hannifin's SensoControl enables maintenance issues in hydraulic systems to be detected early before expensive downtime issues occur. Parker Hannifin Quick Coupling Division

The Rising Influence of Sustainability on Hydraulics and Pneumatics

Sustainability is becoming a larger driver for the design and use of fluid power technologies.

by Sara Jensen, Executive Editor

A greater emphasis is being placed on sustainability within the fluid power industry as manufacturers and their customers look to reduce their environmental impact while at the same time achieving performance improvements.

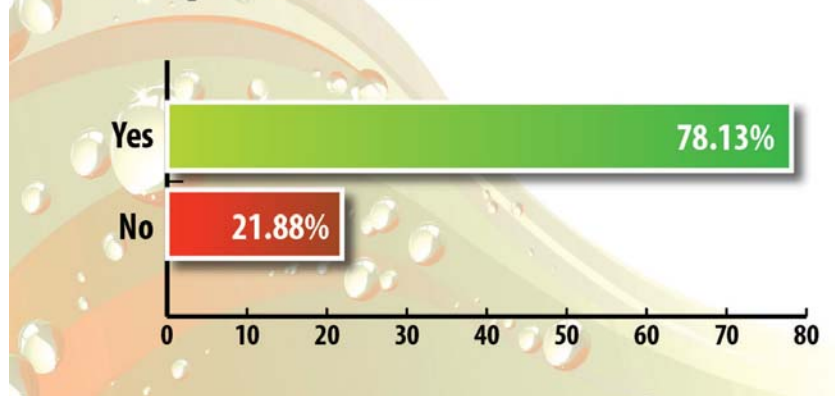
Government regulations being enacted around the world are a driver for the creation and use of more sustainable fluid power technologies as well as companies' own desire to reduce emissions, material use and more.

In a recent reader survey conducted by *Power & Motion*, 78% of respondents said sustainability is influencing their design and use of hydraulics and pneumatics.

Christopher Parisse, Senior Controls Product Engineer, Bosch Rexroth, told *Power & Motion* that sustainability is one of the company's pillars on which it designs systems. "From a component standpoint, we're designing our latest generation of pumps and valves to be more efficient which allows our customers to reap these benefits just by swapping parts out," he said.

In addition, the company is developing technologies for the production and use of hydrogen such as its new A4VZA pump to perform hydrogen compression, aiding with the transition to diesel fuel alternatives.

■ Is sustainability influencing your design or use of hydraulics and pneumatics?



A large number of respondents to Power & Motion's survey see sustainability influencing their design and use of hydraulics and pneumatics. © Endeavor Business Media

Frank Langro, Director – Product Market Management, Pneumatic Automation, North America at Festo Corp., said that as a company Festo is committed to supporting the Sustainable Development Goals of the United Nations which sets out targets for helping people and the planet.

As such, he said Festo places “a significant focus on the impact of our products on energy usage, both via operation and in [their] production.” In conjunction with this, the company takes into consideration the impact a product will have on sustainability during the product design specification phase.

How Sustainability is Influencing Fluid Power Designs

When asked what percentage of their hydraulic and pneumatic system designs, or use of these technologies, are being

influenced by sustainability, almost 36% of respondents said 21% or more are being impacted.

The ways sustainability is impacting the fluid power sector are varied. Some respondents said maximizing the lifespan of their products and easing maintenance are how they are incorporating sustainability into their designs. By enabling products to work longer there is less waste created and materials required to produce a new component.

One respondent noted sustainability is influencing their designs through the use of systems with variable flow pumps, electronic control, and electro-hydraulic proportional valves. These can lead to more precise and efficient operation, helping to minimize energy use and emissions.

Several other respondents noted the development of leak-free systems. This ensures not only efficient operation

but also prevents harmful substances, such as hydraulic fluid, from getting into the environment.

Use of sensors to monitor pneumatic air consumption and selection of raw materials and performance validation processes were additional methods noted by respondents.

A number of respondents also noted the growing interest from customers in wanting information on the sustainability practices of manufacturers and their suppliers and general interest from customers in utilizing products considered to be more sustainable.

Of the design changes being made to hydraulics and pneumatics to meet sustainability goals, increasing efficiency was the top choice for survey respondents.

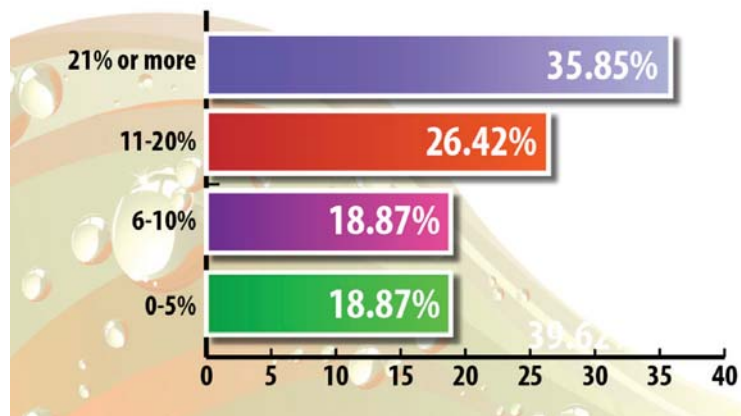
Some additional design changes respondents said they are making include incorporating sensors, better engineering their products and improving oil purifying solutions.

Hydraulics are known to be a relatively inefficient, but powerful, technology. As such, this is an area in which many hydraulics manufacturers have been focusing their technology development efforts in recent years because of the energy and emissions savings which can be achieved. It is also becoming increasingly important to the transition to electrification to ensure battery power can last as long as possible between charges.

Parisse said that more and more Bosch Rexroth has customers asking how they can save energy to reduce their carbon footprint. "It's therefore incumbent on us that our technologies serve as simple ways to integrate with existing machines to achieve substantial sustainability targets," he said. "Companies are constantly looking for those solutions when they want to make their processes more efficient."

According to Dr. Andreas Schumacher, Senior Director, Head of Sustainability and Product Compliance at Danfoss Power Solutions, the benefits of efficiency can be broken into three aspects — cost, performance and sustainability. Higher levels of efficiency lead to fewer losses,

What percentage of your hydraulic and pneumatic designs or use of these technologies are being influenced by sustainability?



Almost 36% of survey respondents indicated 21% or more of their fluid power technologies, or use of them, are being influenced by sustainability. © Endeavor Business Media

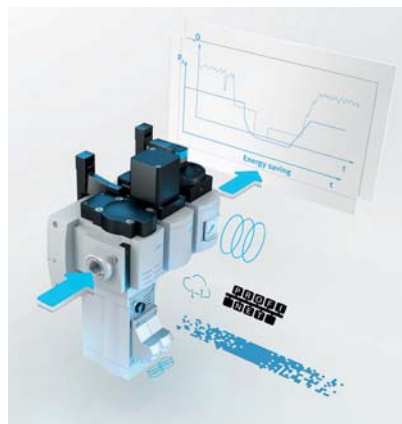
creating a more attractive system from a total cost of ownership perspective he said during a webinar with *Power & Motion* about efficiency.

In terms of performance, more efficient systems allow you to either do the same amount of work with less energy or you can do more work with the same

amount of energy. For the sustainability aspect, he said fewer losses means fewer emissions "because you are not burning energy."

There is also room for efficiency gains in pneumatics. Langro said Festo is bringing more intelligence into its products to enhance efficiency such as the company's intelligent air prep series, the MS6E energy saving modules. "The unit can detect when the machine goes into an idle state and can then maintain a reduced pressure or shut down air to the machine or section of the machine, eliminating excess energy usage due to compressed air leaks," he explained.

In recent years, Langro said Festo has released new products which are lighter in weight to aid with sustainability efforts as well, leading to a reduction in the amount of excess material that might otherwise be used in a product. He provided the example of the company's compact cylinder ADN-S offering a 48% weight reduction compared to the ISO standard ADN cylinder. "The two-fold advantage here being the lower carbon



The MS6E energy saving modules from Festo can detect when a machine goes into an idle state and maintain a reduced pressure or shut down air to the machine to help reduce energy consumption. Festo Corp.

[Hydraulics]

footprint of the product while meeting the market need of a space saving, compact footprint,” he said.

The company has also increased use of re-melted aluminum in its products, to a point that it makes up 78% of annual aluminum usage, said Langro. This helps to reduce the number of raw materials

required which can have several environmental impacts associated with them.

Sustainability Presents Challenges and Opportunities for Fluid Power

Costs were the most common response when asked about the challenges associat-

ed with taking sustainability into account for the design and use of fluid power technologies. Many noted the higher initial cost of newer, more sustainable products.

As one respondent pointed out, existing hydraulic and pneumatic components are getting outdated day by day and the present-day components are more advantageous. However, modifications required to replace older technologies with newer options can be difficult and expensive.

Parisse agreed that higher initial costs are typically associated with incorporating sustainability measures and this can pose challenging. “[Adding] extra devices that slow down pumps, monitor pressure feedback, and track insightful data, those all come with an added up-front cost,” he said. “However, when considering sustainability measures, we encourage customers to answer the question, ‘What is the return on the investment?’ ‘How important are these measures to them?’

“We make sure we’re having educated conversations about the positive impacts these solutions can have, including how they ultimately impact a company’s future bottom line.”

Survey respondents noted several other challenges presented by sustainability including:

- resistance from end customers,
- component availability,
- raw material selection and availability,
- compatibility with existing systems,
- considering the entire lifecycle of a product
- ensuring productivity, maintenance and other performance attributes.

Langro said it is important to create a balance between employing sustainability and meeting desired performance specifications. In addition, looking at the full “cradle to grave” supply chain for a product is necessary to truly improve sustainability practices. For Festo, this includes an assessment of the most efficient ways to transport products as well as utilizing reusable materials for its product packaging.



The advertisement features a photograph of a tennis player in a white outfit, captured in the middle of a serve. The player is looking upwards, and their right arm is extended high, holding a tennis racket. The background is a clear, bright sky. In the top right corner, the Diesse logo is displayed, consisting of the word "DIESE" in a stylized, outlined font, with a small green tennis ball above the letter 'E'. Below the logo, the text "DIESE RUBBER HOSES" is written in a smaller, sans-serif font. In the bottom right corner, a close-up of a black rubber hose is shown, with the Diesse logo and the text "DIESE Fighter 2SC/R16" visible on its surface. The hose also has "Made in Italy" printed on it. The overall design is clean and professional, emphasizing the company's focus on high-performance products.

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The majority of survey respondents, 88%, said they see efforts to be more sustainable as an opportunity for the hydraulics and pneumatics industry.

Several respondents said sustainability provides the chance to create new products and integrate advanced technologies such as IoT (Internet of Things). There are also emerging market opportunities such as the production of hydrogen.

Many also noted the benefits that will be achieved through more sustainable fluid power solutions such as reducing energy consumption and service needs. One respondent noted that “hydraulics are still the most efficient way of transferring energy (in terms of power density). But in order to keep hydraulics alive we must keep [increasing the] overall efficiency of hydraulic systems.”

Both Parisse and Langro agree that sustainability offers opportunities for the fluid power industry.

For Bosch Rexroth, this includes more solutions based on its Sytronix technology which utilizes variable-speed pump drives to save energy and reduce noise. Parisse said it enables pump efficiency to be optimized and provide energy on demand. “With eco-friendly solutions, every drop of energy that’s put in, you’ll get more out.”

Hydraulic circuit design will be an important aspect as well going forward as more solutions for sustainability will be considered from the ground up. This will lead to more efficient pumps, less throttling across valves and reduced oil use.

“We’ve seen that with our CytroPac and CytroBox — they use a quarter of the oil as a traditional power unit,” he said. “In general, the less oil that’s used in any solution, the better. We see that continuing in the future along with an increased use of electronics and greater incorporation of sustainability measures in the design of hydraulic circuits.”



Bosch Rexroth's CytroPac and CytroBox incorporate its Sytronix technology comprised of a variable-speed pump drive which aids with energy savings and noise reductions. Bosch Rexroth

“I believe that change always creates opportunity. As the users of fluid power request higher levels of sustainability in their machine operation and decreased carbon footprint of the items in their machines, this will require further innovative products and solutions,” concluded Langro. **P&M**

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Hydraulic System Redesign Enables Performance Improvements for Agricultural OEM

HydraForce collaborated with SaMASZ to redesign the hydraulic and electronic control systems for a tractor mounted disc mower, enabling new performance features and implementation of ISOBUS.

by Megan Tolley, PR & Marketing Coordinator, HydraForce Ltd.

H ydraForce recently partnered with SaMASZ, a manufacturer of agricultural equipment, to design a new tractor mounted disc mower using improved hydraulic systems and ISOBUS technology to increase efficiency, sustainability, and improve ergonomics for machine operators.

Prior to HydraForce joining the project, the original design of the SaMASZ mower consisted of a controller, operator panel, and four individual hydraulic blocks, connected with hydraulic hoses. The combination of four blocks made the mower vulnerable to hydraulic leaks and damage; assembly of the hydraulic system required ongoing expertise, resulting in a longer manufacturing process.

In addition, the machine's conveyor belts were controlled by the hydraulic system, leading to high service costs due to continuous oil and filter changes and the requirement of an oil cooling system.

Due to these collective issues, SaMASZ partnered with HydraForce to redesign the mower's hydraulic and electronic control system, allowing the OEM to take full advantage of HydraForce's hydraulic expertise.

New Hydraulic System Enables Compact Design and Enhanced Capabilities

Partnering with SaMASZ provided the opportunity for HydraForce to design a



With the new electronic system developed by HydraForce, it was possible to receive ISOBUS certification which ensures the SaMASZ disc mower will work seamlessly with various models of agricultural tractors, ISOBUS terminals and other external equipment. Images courtesy of HydraForce

dedicated manifold to house multiple cartridge valves which would result in a more versatile compact hydraulic system as well as provide additional hydraulic features, such as a transport latch, side guards, and hydropneumatic suspension with breakaway functionality to lift the mower and avoid obstacles in the field.

To create the hydraulic solution, HydraForce designed a set of three custom hydraulic manifolds, providing SaMASZ with the ability to customize machines according to users' individual equipment and machine capabilities.

Each hydraulic manifold holds a different function for the machine, and by flanging each block together it eliminates the pos-

sibility of hose or fitting leakages, resulting in a more compact hydraulic solution.

The function of the main manifold is to operate the machine actuators by controlling the general functions of the mower, including the hydraulic breakaway system, and the lifting and lowering of conveyors, protective side guards, and transport safety devices. This manifold is also responsible for the folding and unfolding of the machine back to the transport position as well as the raising and lowering function between the headland and working positions, all of which help to protect the mower against external damage.

The secondary (optional) manifold is offered by SaMASZ as part of the stan-



HydraForce developed a new electronic control system for the SaMASZ mower which allowed implementation of ISOBUS, providing operators with the ability to choose all of the implements' functions from a virtual terminal leading to improved ease of use.

standard machine equipment and is responsible for controlling the front mower. Its function is to allow users to raise and lower the front mower when working or preparing the machine for transport, which provides the possibility to set the pressure in the hydraulic system of the front mower.

The third and final manifold is responsible for driving the conveyors by using oil from the machine's load-sensing system. Use of this third manifold as a flanged section also makes it possible to replace it with another attachable conveyor drive system.

"The newly developed hydraulic system has given us the possibility to drive the conveyor belts from the tractor's load-sensing system, resulting in zero requirement for an oil tank on the machine and no need for additional oil cooling," explained Krystian Gotlib, Manager of Hydraulic and Control Section in the R&D Department at SaMASZ.

"Another advantage of the new solution is the ability to automatically adjust the pressure in the hydraulic suspension system so that pressure of the cutter bars on the ground remains the same, regardless of the height of the hitch or the unevenness of the meadow," he said.

Electronic Control System Improves Machine Performance and Compatibility

As part of the redesign, HydraForce also provided SaMASZ with a new electronic



HydraForce designed three custom hydraulic manifolds, each of which is used for a different function on the SaMASZ tractor mounted disc mower.

control system which added new features to improve the overall implement control while offering even more customer value to SaMASZ as the equipment manufacturer could purchase the complete solution from one supplier.

This new electronic system facilitated the implementation of ISOBUS, a standardized communication protocol used by agricultural and forestry machines.

The electronic system was developed in house at HydraForce in Europe and the United Kingdom and is the company's first ISOBUS project. Incorporating ISOBUS has allowed SaMASZ to extend its portfolio with a new control solution by providing operators with the ability to choose all of the implements' functions from a virtual terminal.

For those operators who already use ISOBUS compatible tractors, it is not a requirement for them to have an additional control panel which provides savings for end-users. Whereas for those customers without an ISOBUS compatible tractor, SaMASZ offers ISOBUS-certified virtual terminals. The implement also presents the ability to map functions to an AUX-N joystick, allowing easier and more comfortable control for the operator.

The SaMASZ KDD 911 STH ISOBUS received ISOBUS certification by the AEF (Agricultural Industry Electronics Foundation), allowing the mower to be listed on the official database — a tool which can be used by farmers and dealers

to compare the compatibility of different manufacturers of ISOBUS machines.

"By obtaining the AEF certification, our customers can be assured that the KDD STH/WTH mower set works seamlessly with various models of agricultural tractors, ISOBUS terminals and other external equipment to meet the relevant standards," explained Gotlib.

The mower is the first of its kind in the SaMASZ portfolio to be equipped with this type of hydraulic and electronic control system which has made the brand more attractive to the wider global market.

"The provision of a complete hydraulic and machine control solution by HydraForce has reduced costs and saved time, both during the project and in the machine's implementation," said Gotlib.

"The high level of expertise within HydraForce has provided a smooth and seamless development of the entire control system for the mower, and the team's engineering knowledge of load-sensing and ISOBUS control, coupled with the ability to implement and link these systems, proved to be an invaluable benefit."

Working with HydraForce enabled SaMASZ to add new features whilst still maintaining the optimum performance that farmers have come to expect from the SaMASZ brand. The SaMASZ KDD STH ISOBUS was officially released to the market at the end of 2023 and promises an efficient and comfortable solution for the agricultural market. **P&M**

Why TMR is Becoming a More Desirable Sensing Technology

The high level of sensitivity and other benefits provided by tunnel magnetoresistance are making it a preferred technology for various types of sensors.

by Sara Jensen, Executive Editor

A variety of sensing technologies are available in the market, enabling sensors to detect position, temperature, speed and more. Magnetic sensing is a commonly used option, with Hall effect and magnetoresistive being two of the major types.

Hall effect is likely the most well-known technology as it has been around for a long time and is used in various types of sensors. However, major developments in magnetoresistive technologies over the years have made it a popular option as well.

The most recently developed technology, known as tunnel magnetoresistance (TMR), is gaining ground as an alternative to Hall effect. TMR is comprised of two ferromagnetic layers which are coupled and separated by a very thin non-magnetic, non-conductive insulation layer through which electrons will tunnel, explained Christian Fell, General Manager, Fraba Inc.

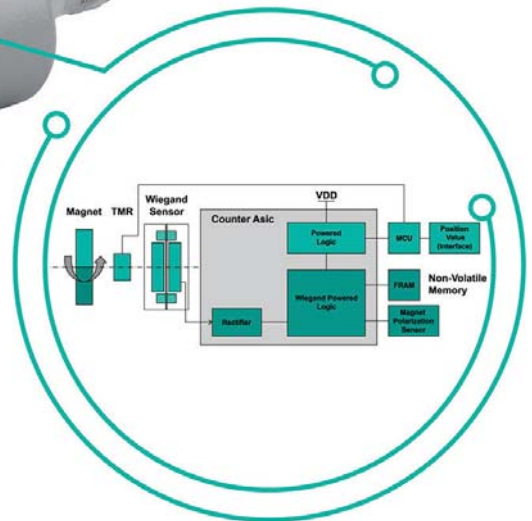
It is a robust design with a high level of magnetic sensitivity, leading to improved sensing capabilities which can benefit many applications.

The Benefits of TMR Sensors

According to Fell, use of TMR is increasing in the magnetic sensing market because of the many advantages it can provide versus other technologies. Among them is the fact this technology is less susceptible to temperature fluctuations which helps to ensure its performance in various operating environments.



This diagram shows the composition of a TMR sensing element which is comprised of two ferromagnetic layers coupled and separated by a very thin non-magnetic, non-conductive insulation layer. Images courtesy of Fraba Inc.



TMR is also known for its low power consumption, bidirectional sensing capabilities and high-voltage isolation to help assure safety.

“The big advantage of TMR over all of the other [magnetic sensing] effects is just the size of the effect,” he said. “Larger effects mean a better signal to noise ratio, more sensitivity...better accuracy and higher resolution.”

From Fraba’s perspective as a developer of position sensors, the larger effect provided by TMR enables the creation of higher quality sensors. “In our case, it’s all about resolution and accuracy of the sensor,” said Fell.

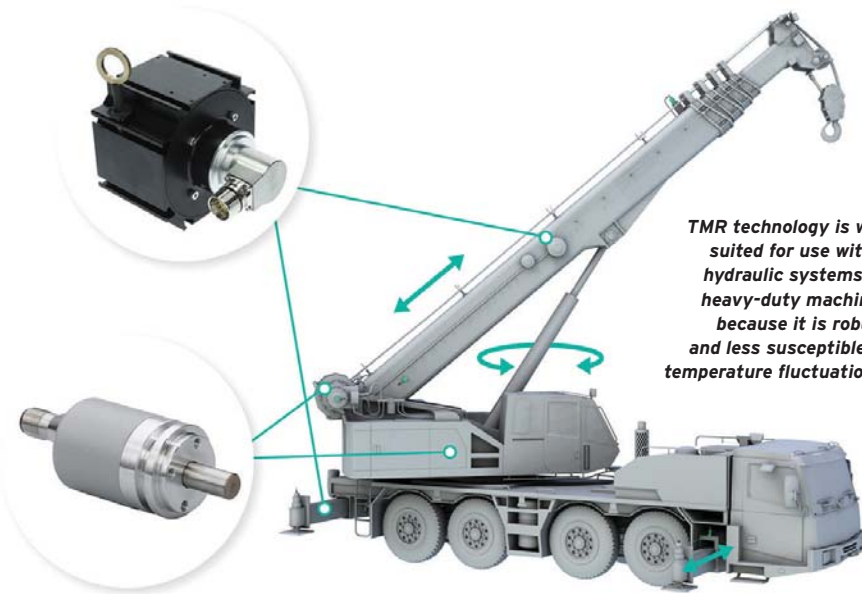
A higher resolution and level of accuracy means improved detection of an object’s position. Depending on the application, this could be vital to ensuring the safety of a machine or overall operation.

He went on to say that with TMR, it is possible to get close to the higher

resolutions currently possible with optical sensors. This creates a broader market in which magnetically based position sensors can be used, including applications previously reserved just for optical sensors.

Rotary encoders, for instance, are increasingly using magnetic sensing instead of optical sensing, said Fell due in part to the reduced size and cost of magnetic sensors. Their widescale use in automotive and various other applications have helped to bring down costs while their compact size eases installation and costs as well.

Magnetic sensors are also known to be more rugged and robust, he said, benefiting their use in harsh operating conditions such as off-highway machinery. Inclusion of position sensors on heavy equipment such as excavators and dozers is increasing; while optical sensors could be used for position sensing, they are more suscep-



TMR technology is well suited for use within hydraulic systems on heavy-duty machines because it is robust and less susceptible to temperature fluctuations.

tible to the shock, vibration, condensation and other elements common in the outdoor environments in which most heavy equipment operates. Therefore, magnetic sensors are a better option.

Fell said Fraba decided early on to use TMR technology for its magnetic based sensors. “We believe in doing our own data processing in the sensor,” he explained. The raw signals provided by TMR sensors enable the company to do this.

By doing the signal conditioning and data processing itself, Fraba gains more flexibility in its sensor designs. It can develop the algorithms necessary to achieve higher resolutions for quicker and more accurate position sensing.

Future Growth Potential for TMR

With TMR technology, sensor manufacturers can create higher performance systems which have a smaller form factor and are more cost efficient, said Fell.

These are important aspects to end use customers. How a sensor will solve a customer’s measurement problem is the most important criteria, but form factor, reliability and cost are also driving factors when choosing a sensor, he noted. TMR makes it easier for sensor manufacturers to meet these criteria.

Allegro Microsystems, a manufacturer of sensor integrated circuits, has invested in TMR technology over the last several years because of the many benefits and

application uses it sees. When it acquired Crocus Technology, a developer of TMR sensors, in August 2023, the company cited the greater application use and forecasted growth of the TMR market as key reasons for the acquisition.

Automotive and industrial applications are expected to be among the key drivers for this market growth in the coming years, aided in part by the transition to electrification and automation where the company is seeing greater use of TMR technology. The sensing accuracy, temperature resistance and compact size of TMR sensors are just some of the reasons they are being used in these applications.

Automation in particular requires a high level of accuracy to ensure vehicles and machines move as desired and in a safe manner. The better a sensor is at determining position, sensing objects or providing other necessary data, the greater the accuracy and safety which will become increasingly more important as higher levels of automation are achieved.

Fell concluded that TMR is still a fairly new technology. As such, further technological developments are likely to occur in the coming years which will improve its capabilities even more. This will help to bring down the cost of TMR sensors as well as enable an even broader range of applications in which they can be used. **P&M**



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Eaton VS6 Electronic Differential Pressure Sensor

Eaton's Filtration Division has developed the VS6 electronic differential pressure sensor, a clogging indicator for hydraulic and lubrication oil filters.

Key features of the sensor include:

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Thomson 48V Electrak MD Actuator

Thomson Industries Inc. has introduced a 48V version of its Electrak MD actuator to provide an option for battery-powered systems.

Key features of the 48V actuator include:

- ability to handle loads up to 2 kN (450 lbs.)
- lower current draw than lower voltage options
- reduced cabling
- smart features such as position feedback.

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Proportion-Air AODD Pump Controller

Proportion-Air has developed a pump controller which ensures air-operated double diaphragm (AODD) pumps run consistently and optimally through long cycles.

Key features of the pump controller include:

- proportional electro-pneumatic regulator for accurate, repeatable performance
- maximum inlet pressure of 125 psi (8.6 bar)
- automatic and manual modes
- NEMA 4X-rated enclosure to prevent contaminants from entering system.

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Danfoss KBFRG4-5 Industrial Hydraulic Valve

The KBFRG4-5 from Danfoss Power Solutions is a single-stage, four-way hydraulic valve with round solenoid design for various industrial applications.

Key features of the hydraulic valve include:

- pressure rating of 350 bar (5,076 psi)
- maximum flow of 290 lpm (77 gpm) at 57 bar (827 psi)
- step response of 20 ms for enhanced performance
- multiple spool options with various flow ratings.

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[One More Thing]

by Sara Jensen, Executive Editor



Danfoss Optimistic About the Future of Hydraulics

Danfoss Power Solutions President Eric Alström is optimistic about the future of hydraulics because of the development potential which still lies ahead.

Hydraulics remain an important part of Danfoss Power Solutions' business and a technology in which the company is continuing to focus new development efforts.

Despite the growth taking place in the electrification space, Eric Alström, President of Danfoss Power Solutions, does not see a point at which hydraulics will completely disappear due in part to the power density they provide. In this interview with *Power & Motion*, Alström discusses why Danfoss continues to be optimistic about hydraulic technologies and their ability to meet ever-evolving market trends.

Power & Motion: Danfoss is continuing to invest in hydraulic solutions of various types, so I presume the company continues to see a long life for this technology?

Eric Alström: Absolutely. Still, in most cases, power and energy density speak in favor of hydraulic technologies. I don't think there's going to be a tipping point where it's going all electric. And in fact, we're seeing a lot of hybrid machinery, where it makes sense such as forestry machinery that are hybrid-electric diesels and so forth. There is an element of pure electric machinery that makes sense too, usually smaller, but packaging of electric motors and carrying batteries as an energy source is difficult still for most of the applications we serve.

This will take a while before we see any meaningful trend change. It's picked up faster than we thought, the electrification side, and it's our fastest growing business. But I also think we're coming to a point

where most of those early, easy applications are sort of done, and now we come to the more difficult ones, so it will plateau a little bit. We're helped by the fact that we're also in the on-highway space with Editron. There we are very successful, for instance, with our onboard charger, [and] also with our rugged motors and our inverter platform.

I'm pretty optimistic; we're well positioned to benefit from any trend change, because we're trying to listen carefully to what our customers say, and reading how the general public also is reacting to different types of technologies, and not the least, of course, our end users. And we do in fact test a lot of our machines with end users to get their feedback also. So not only with our OEM and distribution partners, but also with their end users; we are in discussions and test machines together.

P&M: Besides electrification, are there other industry trends or technologies that could be coming to hydraulics or will influence their development in the coming years?

EA: I think so. It's similar to the combustion engine, where everybody said in the early 90s that they can't get much better than they are but if you see what the fuel efficiency of a combustion engine is today versus then, it's a little bit the same in hydraulics. The new generations of valves and pumps that we launched are significantly more efficient than the previous generation and also more productive.

Our technologies help machinery become more productive [because when] you use less fuel, you work more productively. I think that productivity trend is

another one that a lot of customers pay attention to, although in the past, I think maybe that was more focused from end users than efficiency, today it's more balanced. It's a similar value for both. If you can offer higher productivity and better fuel efficiency, which we do through systems that we engineer for many of our customers, that is a very compelling value proposition.

P&M: Are you seeing much impact from digitalization of hydraulics technologies, and how might that trend continue?

EA: It's really a clear benefit to be able to offer the connectivity inside of an entire machine, everything from the software, which we have on the controllers, to controlling each individual part of the hydraulic system through digital means. Software is incredibly important for us today, and that's another way for us to differentiate and bring more value to our customers. The whole aspect of connectivity is in hydraulics, I think today; it's not just a benefit, but it's a necessity. If you want to have a productive and fuel-efficient machine that end users will appreciate, digital controls are absolutely critical.

It's that aspect of also having a whole systems approach because it's one thing sourcing a controller, loading your software then sourcing different components. But if you can get all that tailored from one source, many of the OEMs really value that because that's a much easier way of optimizing the system rather than them trying to do that with individual components from different sources. **P&M**

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