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Editor's Page

BOB VAVRA | Senior Content Director | bvavra@endeavorb2b.com

An Opportunity to Connect

AS THE NEW YEAR ROUNDS INTO business and the new federal administration settles into its work, there is no illusion about the many tasks that quickly must be dealt with. Two of the most discussed areas of attention will be to prop up the nation's financial infrastructure and the COVID-19 vaccine manufacturing and distribution infrastructure.

For either of those to succeed, though, the first order of business should be to repair and restore the nation's actual infrastructure. The appalling condition of the nation's roads, bridges and utilities had been for decades a source of frustration tinged with the fear of what might happen if the infrastructure network began to fail all at once.

This cannot be simply a federal initiative, though the proposals around infrastructure improvement must begin with bold strokes from Congress and the White House. The last major initiative was when Washington passed the Federal Aid Highway Act in 1956. In the 65 years that have passed, the system has been maintained, but that effort has failed to keep up with a booming population, the proliferation of heavy vehicles and the emergence of a decentralized distribution system.

But if our transportation superhighways have felt the strain, so too have our information superhighways. The pandemic has shown our weaknesses in this now-vital infrastructure link. Any legislation has to address inequities in the availability of internet access for both urban and rural consumers.

Yet the need for action in this area is intense. We need more than a single bandage to fix infrastructure. We need the bold ideas that help not just repair the system but improve it. We must find ways to future-proof our infrastructure to make it more efficient, safer and able to address the emerging use of alternative fuel vehicles and autonomous driving.

The scope of the infrastructure issue means that the jobs created will provide a longer-term economic boost. That will be good for all of us.

That was one of the points raised in this issue's discussion about the look ahead to 2021 with NFPA president and CEO Eric Lanke. He noted the need for both optimism and caution.

"The infrastructure bill as described at this point has the potential to be great for fluid power technologies that serve construction, transportation, utilities and clean energy industries. It would prompt equipment purchases, which in turn would be good for business," Lanke said, but added, "The challenge is to not be too optimistic in planning until we see the complete and final details when the bill passes…'Infrastructure' as a term can take on a broad meaning in certain contexts." hp

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News

IDEA! CONFERENCE
SEEKS INDUSTRY EXPERTS AS SPEAKERS

Presented by *Machine Design*, this conference will be part of November's Manufacturing & Technology Show in Cleveland

The Industrial Design, Engineering & Automation (IDEA!) Conference, presented by *Machine Design*, is looking for speakers on a wide range of engineering and design topics for its event Nov. 9-11 in Cleveland.

IDEA! will be presented as part of the larger 2021 Manufacturing & Technology Show, which also will offer *IndustryWeek*'s Manufacturing & Technology Conference, *EHS* Today's Safety Leadership Conference and a new track on Energy Efficiency & Sustainability. The event is designed to serve the total manufacturing industry—from effective executive management to efficiency-driven plant leadership, from cutting-edge engineering breakthroughs to world-class safety practices, from process to discrete industries—all in a cohesive conference and expo designed to provide actionable intelligence to fuel process improvement and market dominance.

"We are looking for speakers with practical experience in developing, implementing and managing leading-edge technology implementations, workforce best practices and continuous improvement strategies in their manufacturing operations," said Bob Vavra, senior content director for *Machine Design*.

Proposals must be submitted by Feb. 19. Prospective speakers can go to this link, which will provide details on the available speaking roles and other information about the call for papers process.

There are six tracks that will be presented at the IDEA! Conference:

- **ADVANCED MANUFACTURING IDEAS:** 3D printing, CAD/CAM software and AR/VR. The emergence of additive manufacturing, augmented reality and virtual reality and sophisticated CAD/CAM software give designers and manufacturers a deeper insight into how to turn ideas into products. It also allows designers to optimize their designs and shorten the time to market.
- **AUTOMATION IDEAS:** Designing systems, material handlings, AGVs. An automated plant creates a safe and productive flow of materials and finished products. It also allows humans to be used to their fullest potential, driving operational efficiency and cost management.
- **IOT IDEAS:** Connected systems, sensors, analytics software and data management. Putting a modern connected plant together requires not just the quality of the individual components but also the way those components are networked together to deliver the insight manufacturers need to improve their operation.
- **LASER ASSISTED PROCESSING IDEAS:** Offers an efficient, non-contact method for working with a wide variety of materials. It plays a critical role in best manufacturing practices for not only macro-products such as airplanes, but also micro-products such as implantable medical devices. The technology is essential to modern smart manufacturing strategies such as additive manufacturing and helps manufacturers produce higher quality products at lower cost. This conference deals with the science and technology of smart laser materials processing.
- **MACHINE VISION IDEAS:** Properly deploying machine vision technologies in industrial settings improves product quality and process control, increases productivity and saves on cost. Automotive, food and beverage, and semiconductors and electronics are just a few examples of manufacturing environments that rely heavily on machine vision systems today. This conference will cover all aspects of machine vision, from introductory descriptions, definitions and concepts to the latest innovations in enabling technologies such as artificial intelligence, non-visible imaging and 3D imaging technologies.
- **POWER & FLUID IDEAS:** Motors, drives, electrical systems, hydraulics and pneumatics. An automated plant creates a safe and productive flow of materials and finished products. It also allows humans to be used to their fullest potential, driving operational efficiency and cost management.

To learn more about the IDEA! Conference, the other associated conferences, as well as sponsorship opportunities, go to this link. ■

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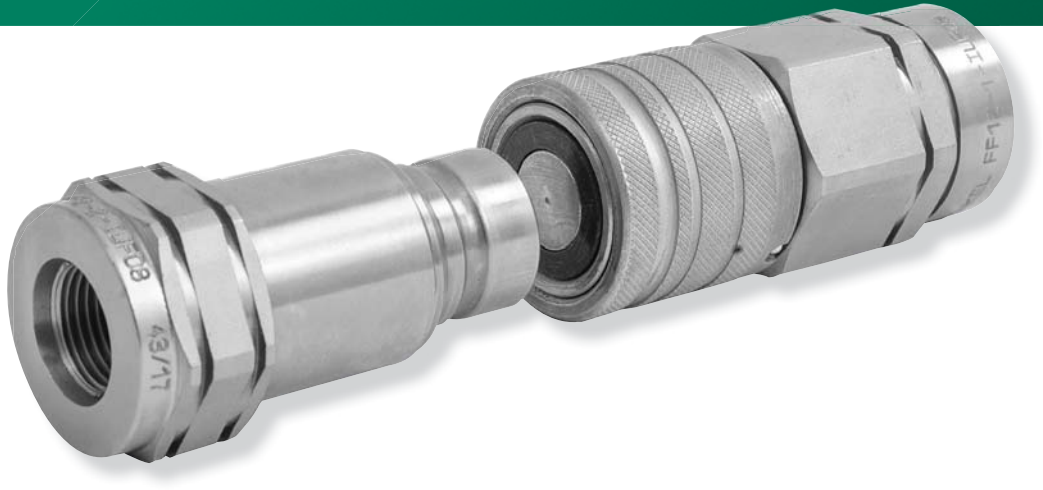

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PNEUMATIC VALVES Control Cataract Surgical Tool

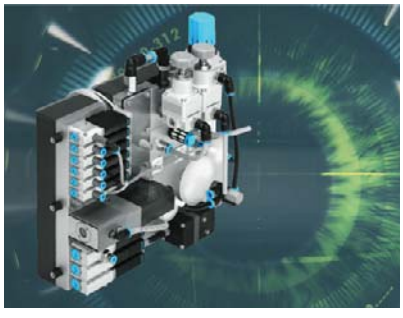
The valves let the new device make fast, accurate cuts and simplifies adjustments for doctor preferences.

Cataracts is an age-related condition that creates a growing cloudy area on the lens of the eye and degrades a person's vision. They are quite common among older people. In fact, The American Eye Institute estimates that half of all Americans 80 or older either have cataracts or have had surgery to remove them. Cataracts can also be caused by eye injuries or other eye problems such as glaucoma.

There is only one treatment for cataracts: surgery. It can eliminate the cataract and correct much of the vision problems they cause. That is why the procedure is one of the most common forms of surgery.

To make cataract surgery even safer and "more routine," engineers at BYTEC Medizintechnik in Germany developed QUBE and QUBE Pro, two devices that let eye surgeons carry out operations error-free. They also let the doctors adjust the devices to match their requirements and preferences in surgical technique.

During cataract surgery with QUBE, an ultrasound probe breaks up the cloudy lens. The lens fragments are then removed by cutting them into small pieces and using a suction/rinsing device. A closed-loop, proportional MPYE flow valve from Festo quickly responds to the surgeon's inputs so that flow is tightly controlled. The reliable valve has industry-leading response and flow control needed for this demanding surgical application.



Festo and BYTEC developed a valve control block less than half the size of conventional control blocks. An innovative manifold plate combines all the pneumatic connections into a protected, tubeless air supply in the form of ducts.

The eye is then infused and cleaned. Infusion pressure needs to be accurately regulated to maintain the structure of the eye during surgery. The fast response of the piezo valves is well-suited for this application. They also do not generate heat, use little power, and are lightweight and small, making it easier to build a compact surgical device. The Festo VEAB proportional precision regulator combines piezo valves with closed loop sensing and electronic control in a small package.

Most other QUBE functions are pneumatically controlled using solenoid valves. They drive the surgical tools, the vacuum-assisted suction, and the delivery or infusion of liquids. Festo provides a broad range of specialized valves to meet each specific application requirement. For example, to get a high cutting rate (up to 7,500 cuts per minute), which lets the surgeon work more precisely and cleanly, BYTEC uses fast-switching MHA2 valves from Festo to get these speeds.

BYTEC also had the design team at Festo develop a compact valve control block for the QUBE pro. It resulted in a manifold duct plate which contains all the pneumatic connections and protects them in a tubeless supply that uses ducts instead.

The manifold design also includes hollow spaces and silencers that otherwise would have required separate components. This made the control block half the size of a conventional control block with numerous individual tubing connections for each pneumatic component. The manifold duct plate is also equipped with a common electrical interface for all solenoid coils and sensor signals. ■

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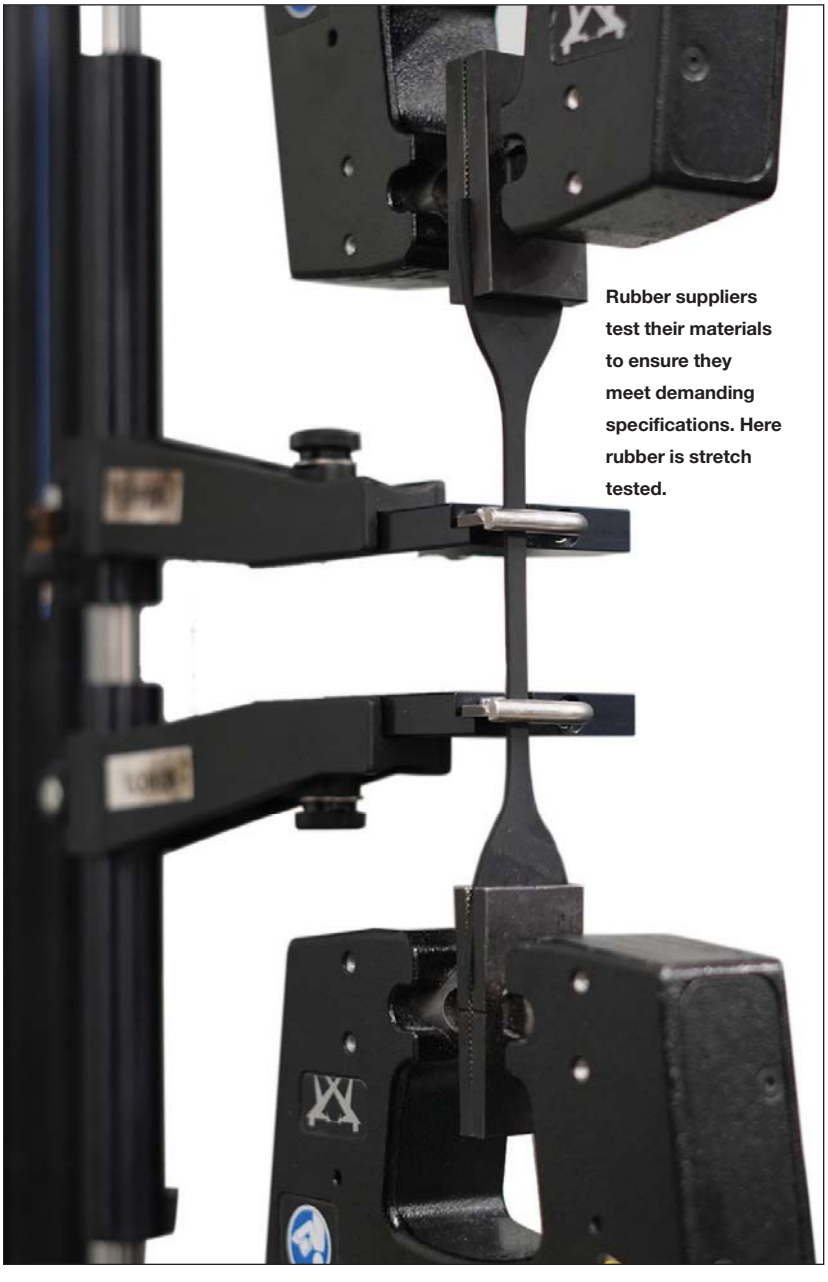
Why Do Some Hydraulic Hoses Outperform Others?

Formulation might be the most important factor in hose performance, but it's not the only one.



Rubber suppliers test their materials to ensure they meet demanding specifications. Here rubber is stretch tested.

Operational environments and application demands for hydraulic hoses are vast and varied. From snowplows in cold Canadian winters to the hot interior workings of industrial machinery, hydraulic hoses perform a great number of functions the modern world depends on.

Each of these hose applications has one thing in common: Failure is not an option. Unreliable hoses can cost companies millions of dollars in downtime on critical equipment. A failed hose on a transit bus can strand dozens of commuters for hours. Worse, a hose failure can seriously injure operators and workers. For these reasons, hydraulic hoses are far from a commodity. They are responsible for the safe operation of countless applications around the world, and given how different all these applications are, not every hose should be made the same.

Hose performance highly depends on what the rubber is made of, the standards under which that rubber was formulated and that formulation's ability to deliver the performance needed for a specific application. Rubber formulation may be the most important factor in hose performance, but there are others.

DEMANDS ON HOSES

While different applications have different demands, the general performance characteristics of a given hose typically fall into several categories: temperature, flexibility, weather resistance, abrasion resistance and durability.

TEMPERATURE. Hydraulic hoses can face a range of temperatures in their operating environments. In many hydraulic systems, increased demand for more power, speed and flow have driven up system temperatures. Higher flow rates increase friction, leading to higher fluid temperatures. Today's hoses must withstand these hotter temperatures.

FLEXIBILITY. This is a measure of how much force is needed to bend a hose and is important for several reasons. First, the hoses must be flexible enough to meet the OEM's design criteria and be able to bend and fit into compact spaces. Second, flexibility is important for ergonomic concerns. An assembly technician routing hoses through the frame of a vehicle, for example, could become fatigued if hoses are exceedingly difficult to bend. Finally, if a piece of equipment requires a hose to move during operation, that hose must have the right flexibility while maintaining durability.

WEATHERING RESISTANCE. Hydraulic hoses are often exposed to direct sunlight or ozone. Continuous exposure to these conditions degrades rubber compounds, potentially leading to cracks in hoses that have not been formulated with weathering protection in mind.

ABRASION RESISTANCE. Once in service, hoses regularly come into contact with other equipment parts or environmental hazards. Continuous rubbing or scraping against other surfaces erodes the hose cover, which can lead to corrosion or fatigue in the hose's reinforcing layers and eventual hose failure. For example, hydraulic hoses on forestry equipment regularly brush against logs and tree branches. Because abrasion is the most common failure mode for hoses, high tear strength is critical.

DURABILITY. Long service life is important for hydraulic hoses, especially in applications where downtime due to a broken hose can cost millions of dollars in losses. Longevity is often a function of the hose's ability to withstand high pressures, with dynamic pressure being the most challenging. In applications with continuously rising and falling pressure, fatigue leads to failures. These impulse applications call for hoses made of durable compounds that resist fatigue.

FORMULATION IS KEY

Each of these hose characteristics is influenced by what goes into the rubber the hose is made from (the formulation), as well as how the hose is constructed. Rubber compounds can contain 5 to 30 ingredients, and each plays a specific role.

Several industry standards help ensure a minimum level of performance in hydraulic hoses (SAE and ISO, for example), but they simply provide a baseline. Hose manufacturers with advanced rubber formulations and construction expertise can help OEMs get hose performance that goes above and beyond industry standards, helping increase longevity and uptime.

continued on p. 25

BY REHANA BEGG | Senior Editor

Call for Service: Hydraulic HOSE REPAIR

A hydraulic hose repair services franchisee sets up shop during the Great Lockdown.

PIRTEK USA

AT A GLANCE:

- A prospect to service the heavily industrialized areas of Detroit turns into a business opportunity.
- Pirtek's business model is built around equipping mobile service vehicles so technicians can visit sites to replace failed hoses on industrial and mobile hydraulic machinery.
- A mobile technician's inventory covers 90% of the work they can perform on site.
- The business' value proposition is that it runs 24/7 with a one-hour ETA.

When the world was subjected to the COVID-19 pandemic last year, its massive toll brought businesses and jobs to a screeching halt. Most people tuned in to navigate the shockwaves and struggled to cope with the uncertainty of the times. Others, like Eric Lacoste, mounted a response.

Between jobs and faced with the prospect of making his next career move, the former automotive components manufacturing executive was at a crossroads: He could seek out the next corporate role or start a business.

Lacoste chose the latter. He decided he could have "a better grip on the outcome" if he invested in his own venture. "In a year of unexpected events and shocks in private equity markets, investing in the stock market seemed risky," Lacoste explained. "The crisis set the stage for a more creative approach."

A franchise broker presented several options in June 2020, but a prospect to service the heavily industrialized areas of Detroit seemed like the best fit. An operating environment where big businesses such as GM, Ford and Fiat Chrysler rely on hydraulic machinery every day would not be out of his comfort zone. His venture, Pirtek Auburn Hills, was operational by November 2020. "It's a process that didn't take too long, but then again, COVID gave people time," he quipped.

Independent business owners know that a start-up has no guarantee of survival, but setting up shop during the Great Lockdown comes with a unique set of challenges. Fortunately, noted Kim Gubera, president and CEO of Pirtek USA, on-site hydraulic and industrial hose repair services is vital to the preservation of critical infrastructure and was deemed an essential service.

Hydraulic hose failure caused by abrasion, poor routing, high temperatures, improper assembly or poor fitting can occur at any time. These failures have serious financial and safety consequences, Lacoste noted, and plants can't afford unscheduled downtime. "We bring the mechanical know-how [to the site] to replace the equipment without having to bring the equipment back to the yard," he added.

THE OPTION

Pirtek is part of a $10 billion hydraulic hose and fittings industry and is expected to grow by $506.09 million during 2020-2024. Billed as a supplier of premium fluid transfer solutions, the company was started in Australia in 1980 and found its way to the U.S. in 1996. Its business model is built around kitting out mobile service vehicles so technicians can visit the customer's site to replace failed hoses on industrial and mobile hydraulic machines, as well as to perform installations and offer preventative maintenance programs.

It turns out the concept was an efficient way to conduct business during the pandemic, as autonomous technicians were fully equipped with mobile workshops and could make service calls at manufacturing facilities. This differentiator reflected in the organization's performance in 2020, since it did not experience the double-digit drop that many companies reported over the course of the year. "As we go forward, we're all hoping that the vaccine is going to return us to whatever the new normal is," said Gubera, "but I feel that we've done quite well, and some franchisees are exceeding the budget."

Still, not unlike most companies, Pirtek had to adapt and modify where needed. Gubera said that the workaround for running the risk of having

customers walk into a store for repair services was to set up tents outside. "This way customers did not have to go into an actual location to get service, or they could just drive through to get service," she said.

Kim Gubera, president and CEO of Pirtek USA

HANDS-ON APPROACH

The company operates on two franchise concepts: Tier 1 is built around a brick-and-mortar store, while Tier 2 provides mobile-only services. Lacoste, who is new to the franchise game, operates under the Tier 2 concept. The initial investment for a Tier 2 franchise is about $162K and includes the mobile sales and service units, training expenses, computer systems and five months of operating expenses. His business focuses exclusively on mobile repair and sales, which allows him to generate the revenue and a customer base with a view to scaling his operation. The investment is structured so a franchisee can convert to Pirtek's Tier 1 brick-and-mortar model within the first three years.

Lacoste's option includes his investment in two branded vans fitted with a workbench, crimper, saw and inventory of hoses and fittings. "I buy the fittings and hosing from the franchise and then I do the cutting and assembly of the hose specifically for the need of the customers," he explained. "The various sizes and variety of fittings means there is quite a bit of complexity—I carry about 850 tags of different inventory of fittings."

STRETCH OPPORTUNITIES

With just four months under his belt, Lacoste is learning the ropes and actively scopes out fresh opportunities in his territory. He has learned that sizing hydraulic hose is the most basic and essential factor in hydraulic hose selection. His inventory covers 90% of the work and can be used in assemblies that require up to an inch-and-a-quarter in diameter. Requests for larger, more specific requests—such as an inch-and-a-half or two inches—are rare, but Lacoste is beginning to stock more sizes of hose in his storage unit.

"In the industrialized area of Detroit, particularly with stamping and injection molding manufacturers, there is more opportunity for the larger hoses," he said. "In the past

two months, these hoses represented about 40% of turnover." This is also where networking with fellow franchisees is helpful. The four Pirtek stores located in Detroit stock larger equipment and Lacoste collaborates with these stores, as well as with the rest of the Grand Rapids territory in meeting the needs of his customers.

The real value proposition, according to Gubera, is that business runs 24/7 with a one-hour ETA. "When heavy machinery is down, the most important thing is getting it back up and running," she said.

Lacoste agrees. A client called him at 9 p.m. on a Saturday night to report a problem with the adaptor port of a plastic injection machine. They needed to replace it. "A maintenance crew would typically handle the problem in-house, but the operator said the plant was operating on a skeleton staff and he did not know how to do

Eric Lacoste, president and owner, Pirtek Auburn Hills, Mich.

PIRTEK USA

it," explained Lacoste. Since he lived 10 min. from the factory, he responded in record time. "But I didn't have the part," Lacoste recalled.

He sourced the part from a nearby store so the plant could have the machine back up and running within an hour-and-a-half. Working in hydraulics often means working at high pressure, so a "network is a good thing," said Lacoste. "Hoses, fittings and components have to be exact and we have to be able to identify the parts. At the end of the day, we are a solution provider. Even if we don't have the part at the outset, the attitude is, 'How can we resolve the issue?'"

CALLS FOR SERVICE

Pirtek's initial training includes a review of sales, operations, training, marketing and administrative support. But answering service calls also requires comprehensive knowledge of typical hydraulic issues. As a trained service technician, Lacoste is familiar with hose guidelines for size, tolerances, construction, minimum performance and routing, as well as hose protection and inspection techniques. He will assess and remove failed hoses and custom fabricate and install the hydraulic hose assembly on location.

Pirtek coaches that common failures may be attributed to two factors: site damage and wear-and-tear. Exposed hoses, especially on mobile equipment, can easily be damaged during day-to-day operations. This could lead to abrasion, for instance, where the high-pressure hose assembly rubs against another hose or clamp. Similarly, heat or extended exposure to ultraviolet light may cause the outer cover of the hose to become brittle and crack, exposing the reinforcement layers.

Strict protocols are advised in controlling contamination in hydraulic systems, as it can come from several different sources. Every time a connection or part is removed or loosened there is a risk that contaminants can enter the system. Examples include removing a cap or filler breather to fill with oil and replacing any component, including hose assemblies, worn or damaged seals or scored cylinders, and the breakdown of older components such as pumps and control valves.

To avoid contamination, technicians working on high-pressure hoses should not replace the hose assembly without locating the cause of the failure, according to Pirtek's technicians. If two hose assemblies are rubbing together, for example, the hose assembly ought to be routed dif-

ferently. Alternatively, an abrasion-resistant sleeve can be used to protect the assembly. If heat is an issue, the technician selects hoses rated for high temperature environments.

On the flip side, low temperatures may cause the outer cover of the hose to crack. A specific line of thermoplastic hose, for instance, can be fitted to forklifts working in large, refrigerated storage units designed to resist temperatures as low as −65°F.

Age-related failure is another common cause, said Lacoste, adding that manufacturers' recommended life for hydraulic hose can range between one to five years. "There shouldn't be any problems with the hose within the five years, provided it's run the right way," said Lacoste. "But with repetitive substance abrasion it won't last that long." For the most part, he noted, wear-and-tear does not originate from the inside—the contamination of the fluid itself—but from the movement or housings on the outside.

PROBLEM-SOLVER MINDSET

If leaving behind a stint managing a component manufacturer's two manufacturing facilities and engineering center with a P&L of $200 million per year provided the fortitude to start a business during the Great Lockdown, it also doesn't hurt that Lacoste holds an MBA focused on mid-cap companies and an engineering Master's in mechanics and electricity.

Experience has taught him the cost of unscheduled downtime, so he can explain why operations and maintenance crews are under pressure to balance the priorities of budgets and reducing downtime. "When I was working in plants, I tended to operate by putting maintenance where it needs to be, so that there are no surprises," he said.

Franchisees need not have industry experience, noted Gubera. "Pirtek operates with problem-solvers; that's really the mindset," added Lacoste. "And we operate on the basis of a long-term partnership."

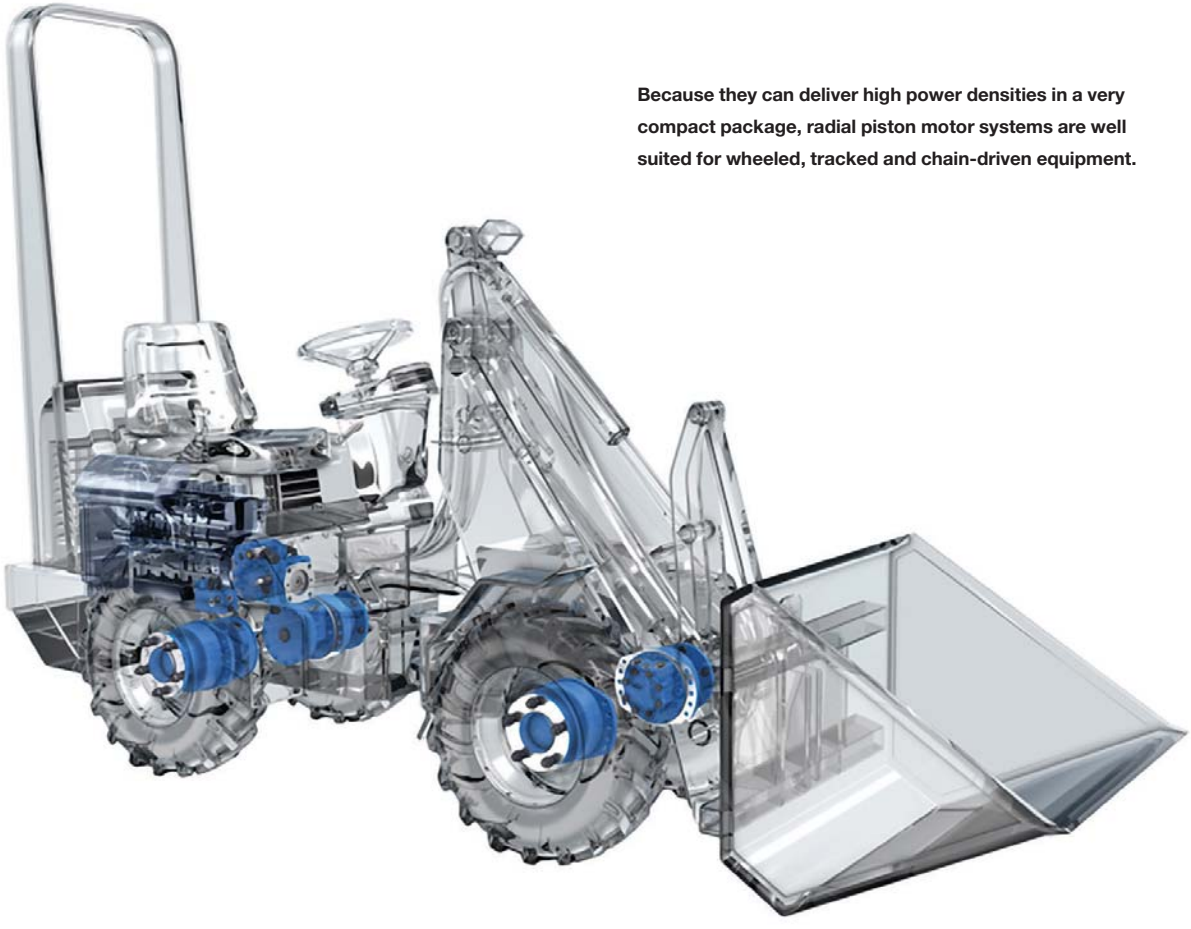
Still, in charting a course to success, Lacoste's history with the industry hints at his future. For him, the idea that self-efficacy alone steers success seems ineffectual. He points out the skillset for troubleshooting common causes and failure of hydraulic hose follows a standard course of procedures, which were covered in Pirtek's training.

"There is an opportunity—there is a business model to follow and a technical model to follow," he said. "I follow the recipe and move on." hp

STEVE ZELICH | Bosch Rexroth Corp.

Developments in Radial Piston Motors Add Functionality in Mobile Equipment

New features tackle new demands from mobile machine OEMs and end-users in the mining, construction and agriculture industries.

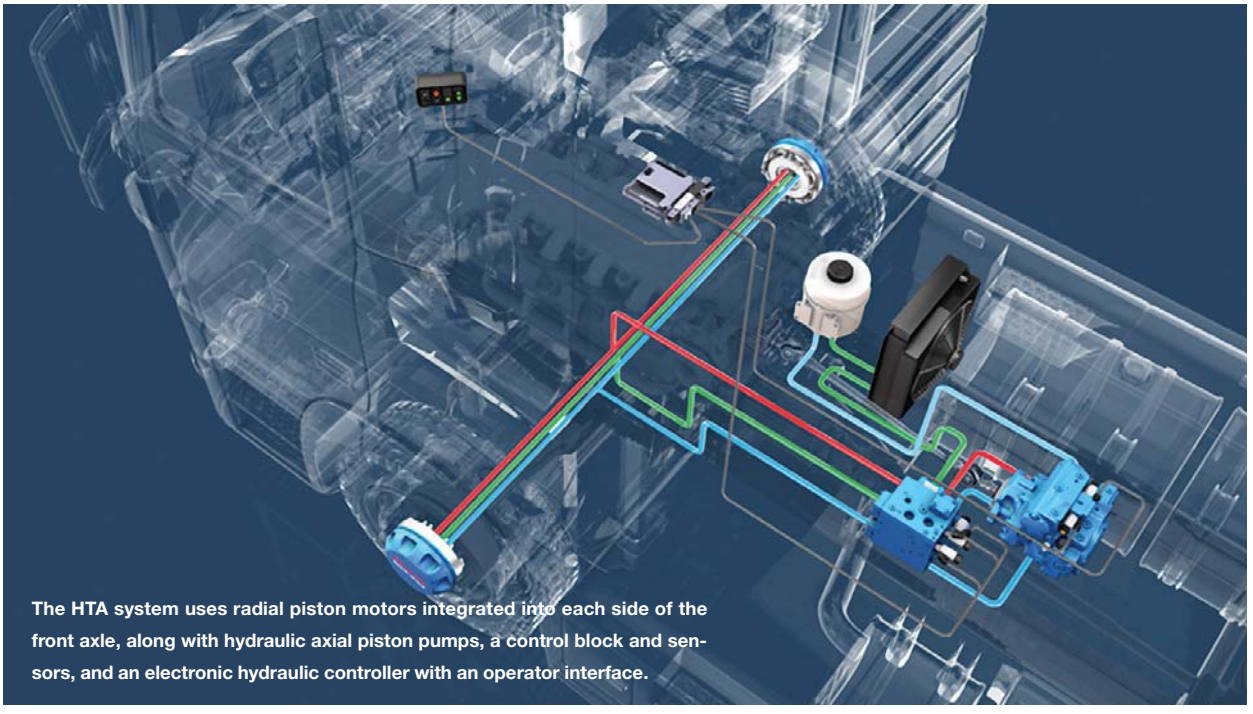


Because they can deliver high power densities in a very compact package, radial piston motor systems are well suited for wheeled, tracked and chain-driven equipment.

The hydraulic radial piston motor is a key component used to power and drive a broad range of mobile machines. Functioning as a direct drive, it operates as a low-speed, high-torque hydraulic motor coupled directly to the axis it is moving, so there is no requirement to add a gearbox in between. Because they can deliver high power densities in a very compact package, radial piston motors are well suited for wheeled, tracked and chain-driven equipment.

They are also rugged, with a minimal number of moving parts that do not require routine maintenance. These motors are engineered for operating environments in mines, construction sites, forestry and agricultural settings that demand heavy-duty performance and the ability to move big machines and large loads in rough terrain.

As a result, these fundamental features—power density, compact size, rugged design and high performance—have made the radial piston motor a reliable mobile machine drive for decades. And while these types of motors are considered a mature tech-



The HTA system uses radial piston motors integrated into each side of the front axle, along with hydraulic axial piston pumps, a control block and sensors, and an electronic hydraulic controller with an operator interface.

nology, innovative new features and drive concepts continue to appear to tackle the new demands and requirements from mobile machine OEMs and end-users across multiple industries.

BENEFITS OF LOW-SPEED, HIGH-TORQUE DIRECT DRIVES

Radial piston motors often power machine functions that require significant force to move heavy loads, such as the chain drives for augers and conveyor belts in asphalt laying equipment. They also provide fine positioning control more precisely than solutions that incorporate high-speed motors and gearboxes. For example, by using a radial piston motor to control the slew drive that rotates the upper body of an excavator 360 deg., it becomes easier for the machine operator to control the stop-point, positioning the bucket to do work.

Across multiple industry segments, mobile machine end-users value drive systems that deliver optimal fuel efficiency, high power density, maximum productivity and reliability. Added to these performance requirements are systems with compact footprints so they can fit into tight mobile machine frame spaces.

Responding to industry requirements for radial piston equipment, Bosch Rexroth developed a wide range of versatile, modular motor designs incorporating features for specific application needs. As a result, this hydraulic motor technology offers mobile machine OEMs and end-users several benefits:

- High volumetric and mechanical efficiency. To ensure maximum fuel economy, all radial piston motors have optimized sealing and low-friction properties within flow passages and rotating elements.
- Increased starting efficiency and smooth rotation. Precise control, even with shaft speeds as low as 0.5 rpm, is achieved through a rotary group design optimized for high-temperature applications and maximum efficiency without compromising durability.
- High temperature range capability. Tribological developments in the rotary group design have improved durability and resistance to high temperatures, which aids in reducing the overall system cooling requirement.
- Low operational sound levels. Low-speed, high-torque direct drives have very smooth interacting mechanical parts. This results in lower operational noise levels compared with other technologies such as gearboxes. Combined with hydraulic fluid flow optimization design enhancements, radial piston motors are a valuable way for mobile machine manufacturers to meet increasing customer demands for lower noise emissions from hydraulic components.

In addition, modular design offers integrated drive solutions for a wide range of customer applications. One example is the use of a radial piston half motor in combination with a drive axle. The versatility of this design also allows for the option to connect a second shaft for dual axle drive (four-wheel drive). The direct drive characteristics of the low-speed, high-torque radial piston motor eliminates the requirement for a drop box. In doing so, the vehicle ground clearance is greatly improved, and total machine costs are reduced.

ADVANCES FOR EVOLVING INDUSTRY NEEDS

Despite their long service, new radial piston motor technology concepts and

IoT technology enables OEMs and end-users to monitor and capture a wider range of real-time operational data about radial piston motor performance.

design advances continue to emerge to address ongoing OEM and end-user requirements. Reliability and maximum machine uptime are critical industry drivers.

There is also an expanding movement to apply IoT technology to enable OEMs and end-users to monitor and capture a wider range of real-time operational data about radial piston motor performance. End-users are always concerned about preventing unscheduled downtime, which can be quite costly since most machines using radial piston motors are expensive to operate in high-value applications.

In order to provide real-time data that machine operators can use to plan predictive maintenance programs, or to intervene to prevent major equipment failures, a broader range of sensors are being introduced. These include pressure sensors, temperature sensors and vibration sensors.

These sensor arrays are linked through mobile equipment controllers and new edge computing devices, with cloud connectivity now being introduced into many construction and off-highway mobile electronics portfolios. In addition, this data can also be relevant to operators to improve how they use and manage equipment in the field.

This includes new business models where equipment is leased to construction firms or other operators with cost parameters based on uptime commitments. Having real-time radial piston motor data can help ensure equipment is properly maintained. In addition, mobile machine OEMs are increasingly looking for more real-time, real-world sensor and operational data to help guide research and development efforts to design the next generation of products.

NEW DESIGNS ENHANCE EFFICIENCY & PERFORMANCE

There are also ongoing efforts to improve energy efficiency and reduce emissions in mobile machines by improving radial piston motor designs. By continually enhancing motor efficiency, it is possible to help reduce fuel consumption and diesel emissions from the mobile machine without impacting its ability to deliver a full day's work. This includes efforts to downsize the overall size of radial piston motors without giving up performance, depending on their application, so they can fit into tighter machine envelopes.

For example, Bosch Rexroth introduced its MCR-T compact drive solution for track and wheel applications. The design provides a 10% improvement in starting efficiency compared to conventional designs while featuring an optimized shaft position that accommodates higher radial loads due to better load distribution.

For tracked-drive applications, a parking brake is required on the drive motor. To save space, the parking brake was moved inside the motor rather than being located externally, reducing the motor's overall length by 20%. By reducing the size, it can be incorporated into a larger variety of mobile machines using track drives while saving component weight as well, which can help with fuel efficiency or equipment output. There are opportunities to incorporate this space-saving design into other radial piston motors, such as those used on skid steer loader drives.

The MCR-T radial piston motor compact drive solution for track and wheel applications provides a 10% improvement in starting efficiency compared to conventional designs.

Radial piston motor designers are also enhancing ways to provide greater speed for wheel drives so that mobile machines can move faster from one work location to another.

Radial piston motor designers are also enhancing ways to provide greater speed for wheel drives so that mobile machines can move faster from one work location to another.

This involves using a reduced displacement mode that reduces the number of active pistons that are transferring hydraulic power into rotational torque, thus increasing speed. Operators can select which displacement mode to use depending on the machine performance demands. This makes it possible to increase the radial piston motor's speed without having to install a larger displacement hydraulic pump.

Another significant advancement in the application of radial piston motor technology is the Hydraulic Traction Assistant (HTA) platform. This system is designed to provide added traction power on demand to the steering axle on heavy-loaded, 18-wheel trucks, such as those that haul loads in difficult ground conditions where traction is poor.

The system combines two radial piston motors integrated into each side of the front axle, along with hydraulic axial piston pumps, a control block and sensors, and an electronic hydraulic controller with an operator interface. In neutral mode, used when added traction is not needed, the radial piston motor is inactive, reducing drag losses to a minimum and improving fuel efficiency compared to a mechanical, all-wheel drive system.

When the operator has a full load and needs traction to drive out of the pit, the system is automatically or manually engaged. This transfers power and torque from the truck's diesel engine to the radial piston motors via the closed-loop hydraulic pumps, adding traction power to the steering axle. Once the vehicle has reached sufficient speed—approximately 18 mph—the system automatically returns to neutral mode unless the operator chooses to keep it engaged.

EXPANDING THE VALUE OF RADIAL PISTON MOTORS

Boosting vehicle traction is just one example where the compact dimensions and power density of radial piston motors can provide a powerful way to apply the technology in new and effective ways. Mobile machine builders are working with key radial piston motor and system providers to apply this technology, taking advantage of new developments to improve the versatility and performance of their equipment offerings.

Understanding the evolving needs of mobile machine end-users is also critical to sustaining innovation in radial piston motor technology. Key system and component suppliers that have vast experience in hydraulics technology—along with a long history of engineering and developing radial piston motor products and systems for specific machine requirements—are helping to ensure radial piston motor technology continues to improve to keep up with today's evolution in mobile machinery demands. hp

STEVE ZELICH is product manager – radial piston motors at Bosch Rexroth Corp.

continued from p. 13

Formulating rubber for a particular set of performance attributes can be tricky. For example:

- A chemistry that gives rubber a desired level of flexibility may reduce abrasion resistance.
- Specifications that require a specific certain level of rubber hardness may not address high tear strength.
- A polymer blend that lets a hose resist high temperatures may be incompatible with some system media or hydraulic fluids.

Finding the right chemical and polymer balance for a critical hose application is important; this requires a high level of formulation expertise and experience, along with the right development process.

Even when a formulation is correct, a hose is only as good as the materials from which it is made. That's why raw materials sourcing and supply are critical to hose quality. Good hose manufacturers know exactly where their raw materials come from and if their suppliers consistently send them high-quality raw materials. They also tightly control their manufacturing processes and have stringent traceability programs. With traceability, manufacturers can pinpoint flaws in production or supply after a hose failure, and hopefully prevent similar failures in the future.

Even when a formulation is correct, a hose is only as good as the materials from which it is made. That's why raw materials sourcing and supply are critical to hose quality.

GETTING THE MIX RIGHT

Performance characteristics and quality raw materials are important, but the best rubber formulation is about more than just the chemical properties that go into it.

When a hose needs specific performance attributes, OEMs should work closely with a hose manufacturer; it can make all the difference. With the OEM's performance needs and application intention in hand, a manufacturer should be able to tailor a rubber formulation and hose construction from the ground up to get the right performance.

For example, top-notch hose makers work closely with customers to deliver hoses with specific application needs. The process usually begins by reviewing customer needs and developing small-batch prototypes to ensure the rubber will have the proper performance attributes. After accelerated life testing in the manufacturer's labs verifies performance, the customer field tests the hose to make sure it stands up to real-world conditions. Once the right mix is determined, full-scale production can be ramped up using vetted source materials to get hoses into the customer's hands when they are needed.

It is a stringent process, and a worthwhile one. Hydraulic hoses must provide safe and reliable performance under increasingly severe conditions in a host of important applications around the world. There is no room for compromise. hp

CHRISTOPHER SCHWAB is the senior product manager for Eaton's Rubber Hydraulic Hose and Fitting Products, and Aaron Clark is the materials science manager and chief chemist at Eaton.

RAY I. SCROGGINS is a contributing editor

Hydraulic Pumps Streamline Tire Recycling

A new hydraulic mill uses hydraulic pumps for added reliability, responsiveness and the ability to withstand high shock loads.

The Krumbuster cracker mill uses hydraulic power to recycle tires into quality crumb rubber used to make pavement, playground surfaces and even artificial turf. (Courtesy Eco Green Equipment).

Crumb rubber and rubber powder made from recycled tires are in growing demand for use in artificial turf, playground surfaces, pavement and other applications. In the recycling process, a cracker mill turns the rubber in recycled tires from which steel and tire cord are removed into smaller "crumbs." In the mill, two corrugated rolls operating at different speeds crush and grind the rubber into particles. Current cracker mills have a fixed or narrow range of these speed differentials, known as friction ratios, and this limits their ability to turn out enough of the material with the right level of quality and size.

To overcome these limitations, engineers at Eco Green Equipment, a tire

recycling equipment manufacturer in North Salt Lake, Utah, developed the Krumbuster. It's a hydraulically powered cracker mill designed to crank out up to 4,000 lb of crumb rubber per hour in sizes smaller than 6 mesh. (Mesh is the number of holes in a screen per linear inch.) With the same setup, it can also produce up to 2,000 lb per hour of 30 mesh rubber powder. It hits these goals while using up to 35% less horsepower than traditional mills and occupies a smaller footprint. Hydraulic power lets it respond quickly to changes in friction ratios, high shock loads and constantly changing pressures, including pressure spikes.

Traditional cracker mills have a separate mechanical gearbox and motor driving each roll; their friction ratios are fixed by the gearboxes. Some of these machines incorporate variable frequency drives to adjust the friction ratios, but this prevents them from maintaining full torque throughout their speed range.

The Krumbuster uses individual Parker Gold Cup hydrostatic piston pumps to power identical Hägglunds hydraulic motors mounted directly on the roller shafts. Each pump's flow rate can be adjusted to provide the exact speed differential needed between the rolls. Typically, one motor may be running at 110 rpm while the other is at 3 rpm.

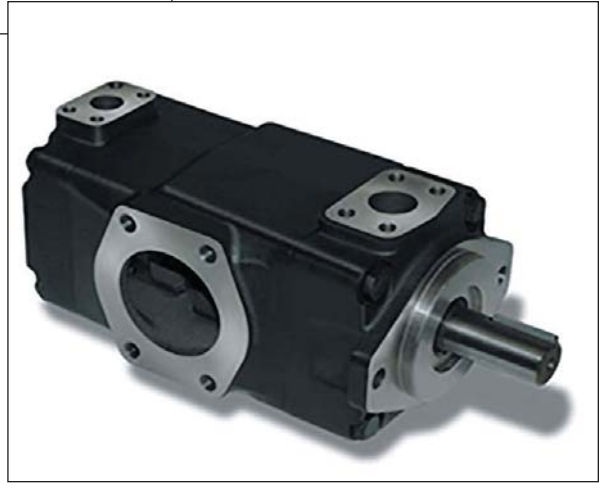
The higher speed motor is driven by a P24 Gold Cup pump, with a maximum displacement of 24.60 in3/rev. The lower speed motor relies on a P6 Gold Cup pump with a maximum displacement of 6.00 in3/rev. In addition, a three-section Parker T6 vane pump generates up to 250 psi to supply make-up oil to the other pumps and motors in the closed system. This replaces oil lost through designed-in leaks that lubricate the component's hydrostatic bearing surface, as well as providing oil flow through the heat exchanger. The vane pump circulates about 50 gpm of fluid from the low side of the loop through the heat exchanger and filtration to provide cooler and cleaner oil to the two piston pumps. Eco Green says the pumps were chosen for their reliability, responsiveness and the ability to handle the high shock loads the process creates.

▲ **Using bearings centered around the barrel instead of a support shaft reduces the size of the Gold Cup axial piston pump and provides higher speeds and saves energy. (Courtesy Parker Hannifin)**

The two piston pumps have bearings centered around the barrel instead of conventional roller bearings supporting a large diameter shaft. This lets the main shaft have a smaller diameter, and the rotating pistons can be located closer to the center, lowering fluid velocity and generating more flow for speeds up to 3,600 rpm.

With hydraulically driven rolls, the Krumbuster delivers full torque at all speeds and uses 25 to 35% less horsepower than traditional mechanical designs. The manufacturer says that the speed differential between the rolls means the slow-roll piston pump receives flow from the slow-roll motor, providing energy that assists the machine's electric motor in driving the larger pump. All three pumps are assembled and connected at the same time. They are driven by a single electric motor.

The Krumbuster's output is 50% higher than the closest traditional cracker mill when making 30 to 60 mesh crumb rubber, according to Eco Green. Compared to a mechanical drive, the hydraulic version needs little maintenance and is more energy-efficient because it recovers energy from the slow roller. The pumps also allow nearly infinite adjustment of the friction ratios so the rolls can be calibrated to suit the material being processed and the desired particle output size. They provide constant torque at all friction ratios and can be started under load, so the rolls don't have to be cleaned out before starting the machine. hp



▲ **Parker T6 three-section vane pump boosts flow to the main pumps and provides oil flow through the heat exchanger and filters. (Courtesy Parker Hannifin)**

RAY I. Scroggins is a contributing editor.

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Pump Drive

THE F600 PUMP Drive has a wide power range, from 1.5 HP (1.1kW) all the way to 4,200 HP (2.8 MW), for applications within the water, agriculture, and food and beverage industries, as well as for industrial heating and cooling. The F600 drive also creates energy savings and optimizes a system for efficiency. The F600 includes sleep mode, which automatically engages when demand falls below a specific point, and Control Techniques' leading-edge motor control technology, which initiates dynamic modification of the rated frequency to further save energy. It is designed for simple installation and commissioning, with core functionalities for pump applications readily available, meaning optimum performance can be achieved straight out of the box with minimal set-up.

CONTROL TECHNIQUES, Nidec Motor Corporation, acim.nidec.com

Linear Actuators

THE SUREMOTION LAHP series linear actuators, slides and accessories are XYZ Gantry components that allow for creation of a motion system with up to three axes of movement. These motor-ready linear actuators and sliding components have travel lengths of up to 910 mm. They turn rotary motion into linear motion and provide

a variety of X-Y and X-Y-Z positioning system solutions. Options for mounting stepper or servo motors as well as a full selection of accessories complete a linear motion system. Actuators are available in ball screw and lead screw driven units. Undriven linear slides in the same lengths as driven actuators can be used to stabilize the x-axis.

AUTOMATIONDIRECT, www.automationdirect.com

Resin Formulation

KYRONMAX STRUCTURAL THERMOPLASTIC product line has expanded with new resin formulations to meet the requirements of applications in the chemical, medical, oil & gas, aerospace, automotive and recreation

market segments. The KyronMAX line is based around structural compounds which can be used to replace steel in a structural component.

KYRONMAX, kyronmax.mcam.com

Triple Pump Controller

A TRIPLE PUMP model has been released for the PT2020 Automation Pressure Testing Control System. The triple pump PT2020 controller is designed to provide automated pressure control for a wide range of

hydrostatic testing, including test benches that utilize three different pumps for specific operations in their pressure testing. Operators simply set up their test, press start and walk away—the PT2020 controller will automatically run the test, give a pass/fail reading and generate a test report. The plug-and-play PT2020 controller is an easy-to-use upgrade for any existing manual pneumatic intensifier pump. The triple pump PT2020 controller addresses a need for hydrostatic test benches that utilize multiple pumps for specific functions. In order to maximize efficiency and prolong the service life of high-pressure hydraulic pumps, test benches often run two or three pumps to conduct their testing.

HIGH PRESSURE Equipment Company, Graco Inc., www.highpressure.com

Pneumatic Actuator Protection

THE RPV IS used to protect a pneumatic actuator such as a chuck, press or gripper from sudden bursts of high pressure. The internal needle valve restricts the initial movement of the actuator to a user-defined speed, and then opens up upon sensing back pressure. This allows the user to limit the impact that a work piece experiences when it is clamped down upon without sacrificing the pressurization speed of an open, free flowing connection. The RPV is pressure rated to 250 psig. It features a relieving valve, up to 32 UNF female threaded ports and corrosion-resistant stainless steel.

BESWICK, www.beswick.com

Run-Time Meter

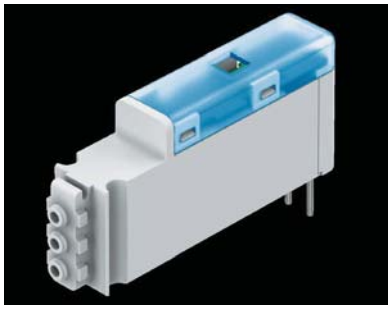
THE RFS200 RUN-TIME meter ensures that owners can conduct maintenance on a time-used basis, rather than machine hours, thus allowing for more astute and cost-effective management of hydraulic system health. Perfect for system and safety-critical applications, the run-time meter is activated by the passage of hydraulic fluid

to allow the precise monitoring of system usage. The RFS200 is unaffected by pressure, helping to ensure accurate and reliable readings. The switch point is fixed at 10 liters per minute with an anti-tamper design for security. When the switch point is reached, the counter starts incrementing—as indicated by a blinking decimal point on the LCD display. The meter keeps counting whenever the flow rate remains above the trigger point. All counting is cumulative.

WEBTEC, www.webtec.com

Valves

THE VOVK VALVE is designed for high-density small-footprint manifolds or for single valve duty. The VOVK delivers a wide pressure range, including vacuum, fast switching time and low power consumption. It is suitable for many applications, including in-vitro diagnostics and small point-of-care devices such as portable oxygen regulators. These miniature valves can actuate multiple diaphragms on a lab-on-a-chip cartridge that contains the analysis process and reagents. VOVK valves can control the flow of liquid in dialysis machines, turning on diaphragm switches that isolate contaminated liquids, and can serve in pilot valve applications. Non-medical related applications include controlling small gas flows in the electronics or semiconductor industry.



FESTO, www.festo.com

Particle Counter

THE WI-FI-ENABLED ICM 4.0 particle counter ensures complete visibility of contamination in hydraulic and diesel systems. This provides engineering teams with an accurate snapshot of the health of machine health. The ICM 4.0 features a reliable in-built Wi-Fi hub, enabling users to track the performance and contamination levels of every single machine they operate in real-time. Results automatically are uploaded and can be monitored via a variety of different feedback channels including a new mobile app, the user's own cloud systems, a secure web browser and sophisticated software suites created especially for the ICM 4.0.

MP FILTRI, www.mpfiltriusa.com

Heat Exchangers

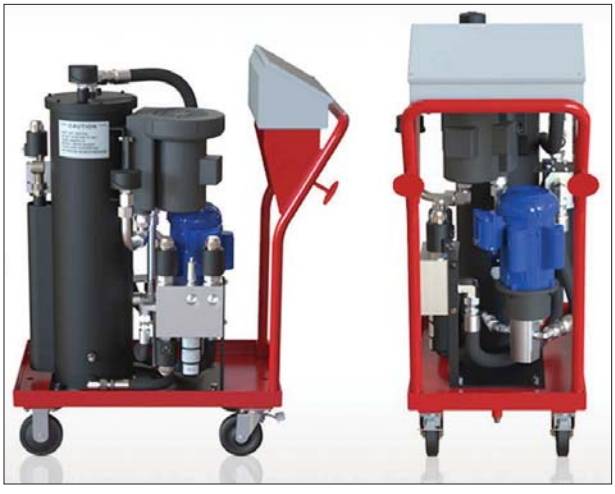
THE HELIMAX ULTRA-EFFICIENT electric heat exchanger with Continuous Helical Flow Technology helps reduce the coking and fouling typically associated with standard heat exchangers. HELIMAX

enables ultra-high heat transfer rates that lowers the skin and shell temperature rise above the process fluid and offers the ability to push the limit on high outlet temperature applications. It also minimizes fluid bypass, assuring tighter sheath temperature control and provides smaller shell diameters. As a result, high pressures can often be handled with thinner shell walls or without resorting to expensive exotic materials. HELIMAX is smaller and lighter in weight compared to traditional heat exchangers, offering significant benefits to space-constrained applications such as offshore platforms or floating production storage and offloading vessels.

WATLOW, www.watlow.com

Dehydration Station

THE TRITON A Dehydration Station eliminates 100% of free water and up to 90% of dissolved water from small reservoirs, barrels and gear boxes. Using its patented transfer process, the Triton A efficiently removes water



and particulate contamination quickly in all environments. The proprietary design also reduces aeration of free and entrained gases of returned fluid. The unit is mobile, due to its cart body, and portable, allowing easy access to tight areas.

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Fluid Power in 2021: **A Look Forward**

Ahead of its annual conference, NFPA's Eric Lanke looks to a more flexible future.

After a year of turmoil and transition in 2020, the fluid power industry faces new challenges—and opportunities—in the new calendar year. A new federal administration is touting both a rollout of a COVID-19 vaccine and a bipartisan effort to pass a large infrastructure bill.

How those events and other might affect the fluid power industry were part of a *Hydraulics & Pneumatics* discussion with Eric Lanke, president and CEO of the National Fluid Power Association (NFPA). NFPA's annual conference, a virtual event this year, will be Feb. 23-26, and details of the conference can be found at the NFPA website at nfpahub.com.


Eric Lanke

***H&P*: Coming off a year no one really wants to look back on, what are your members looking forward to in 2021?**

Lanke: The pandemic and its effects on business and the economy in 2020 affected different member companies differently, with some being hit hard and fast by the economic downturn while others were able to weather the storm largely intact with few changes. That said, NFPA members, along with most companies, are largely looking forward to business and sales practices and volumes returning to normal, as well as returning to regular in-person operations and attending NFPA events in person.

***H&P*: Among the first things the new Congress and administration will take up is a long-discussed infrastructure bill. Talk about the impact this bill will have on your industry. What are the benefits and potential challenges in such an effort?**

Lanke: The infrastructure bill as described at this point has the potential to be great for fluid power technologies that serve construction, transportation, utilities and clean energy industries. It would prompt equipment purchases, which in turn would be good for business. The challenge is to not be too optimistic in planning until we see the complete and final details when the bill passes.

How much of the final version of the bill will actually be for infrastructure, like roads and bridges and the utility grid, as most of us define it? "Infrastructure" as a term can take on a broad meaning in certain contexts.

***H&P*: At a time when unemployment is still impacted by the pandemic, there still is a need for skilled workers in the fluid power industry. What steps has the industry already taken to address the worker shortage? How do we effectively recruit more people to the industry?**

Lanke: In the short term, partnerships with relevant organizations and schools are the most effective ways to get access to qualified applicants and make the industry visible to potential workers. NFPA has worked to facilitate such connections for members through activities available to donors to our Pascal Society to interact with students and instructors across the country.

We also have a partnership with The Manufacturing Institute's (MI) program called Heroes MAKE America (HMA). HMA offers industry training designed to help our nation's service members transition into manufacturing careers, and NFPA members have access to these candidates because of NFPA's financial support of the HMA program.

Longer-term, it's important to ensure students are made aware of fluid power and the careers available within the industry from a young age to ensure to drive interest and participation in relevant courses starting as soon as high school or middle school. NFPA works to drive fluid power industry education and awareness at all grade levels, including an interactive Fluid Power Action Challenge in middle school, fluid power trainers in high school through the Fast Track Program, and a full menu of programs and support for fluid power programs at technical colleges and universities. These programs help get students interested in fluid power careers, get the education they need to be successful, and connect them to job opportunities at NFPA member companies.

***H&P*: Many companies had to adopt new technology and work practices on the fly in 2020. What are some of the lessons from 2020 that you think will carry forward after the pandemic is over?**

Lanke: Flexibility and the ability to pivot have been important to success in business for some time but really came to the forefront in so many ways in 2020. They are likely here to stay as a "need-to-have" and not a "nice-to-have." Use of technology to get the job done remotely is also likely to continue in certain cases, both for efficiency and cost savings.

Along with those lessons in how to use technology to work remotely, companies have had to learn how to get along internally in a remote environment. Effective leadership and a positive organization culture are keys to keeping people engaged, motivated and productive in crisis and when distanced.

***H&P*: What technology advances should we look for in 2021? What will the next generation of tools and systems include?**

Lanke: Some of the most important technology trends to watch this year include more sophisticated electronic control of hydraulic and pneumatic systems, continued advancements and more varied application in the connection of systems to the Internet of Things, and adaptation of hydraulic systems to increasingly electrified mobile drive systems. hp

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