Don't Neglect Hydraulic Hose Size p22

Pneumatics For Railway Applications p30

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THE AUTHORITY ON FLUID POWER TECHNOLOGY

JULY/AUGUST 2021 hydraulicspneumatics.com

IDEA! AWARDS FINALISTS HELP PICK 2021's BEST PRODUCTS

p8

How Mining Should Adopt Smart Solutions 18

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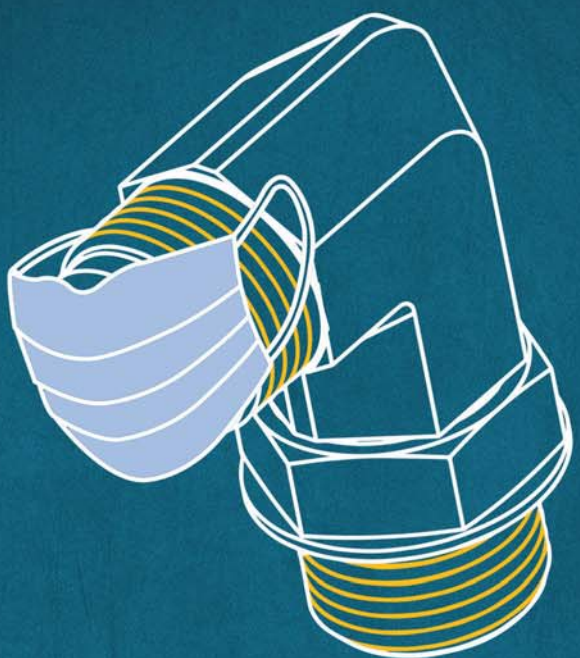

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BOB VAVRA | Senior Content Director | bvavra@endeavorb2b.com

Innovation Starts with "What if?"

YOU'D THINK product innovation begins with an idea. After watching product managers and design teams work for the last 20 years, I can tell you that the first step in the process usually begins with two simple words:

"What if?"

The process of continuous improvement is as the name implies. It is an unending quest for better. You push your teams to look at their specific job for small ways to improve and then you bundle those improvements into a systematic approach to excellence. And when that process is complete, you do it all again.

Throughout all of that effort, the first question is: "What if?" What if we had a better way to measure the temperature, vibration and lubrication level of a motor? What if that motor was smaller without losing power so we could save space and energy? What if there were new hoses and valves that would reduce our compressed air spending and improved air delivery to our pneumatic system?

Product managers love to answer "What if?" It is what drives their quest

for improvement. Product managers can't get asked "What if?" enough, and that question leads us to the products in the 2021 IDEA! Awards program.

From category entries in Fluid Power to Motors, and from Automation to Motion Control, the 2021 finalists showcase the answers to "What if?" They are the response to their own customer's needs in the last year. They listened, began to evaluate the possible answers to "What If?" and started to hone in on the solution.

As you begin the process this month to evaluate and vote on the finalists for the 2021 IDEA! Awards, these great new products and others like them in the industry, see how many of these product innovations answer your own questions of "What if?" The voting begins now online at machinedesign.com as part of the IDEA! Awards finalists.

The product manager is at the front line of the continuous improvement process, and the IDEA! Awards are a celebration of that work. When we announce the winners Nov. 10 in Cleveland at the IDEA! Conference, we'll get the chance to thank these product managers and product development teams for their solutions, but also for the curiosity to keep asking "What if?"

This announcement is going to change hydraulics. **Forever.**

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Cover Story

BOB VAVRA | Senior Content Director

2021 IDEA! AWARDS FINALISTS

The VOTE Belongs to YOU

Ideas drive innovation, and innovations drive the opportunity for improvement. For design and operations teams, one good idea can improve productivity, decrease costs and improve safety.

The latest crop of new ideas have been collected here in the 2021 IDEA! Awards Finalists. From high-tech solutions such as automation to the fundamentals of machine building and components, the IDEA! Awards offer a chance to review the great new innovations of the last 12 months while also adding your vote for the best new ideas of the year.

Readers are asked to review the IDEA! Awards Finalists in six categories:

- **Automation**
- **Fluid Power**
- **Machines & Components**
- **Motion Control**
- **Motors & Drives**
- **Sensors**

Vote for the product you think will have the greatest impact on improving product design or operation. Votes will be tabulated from now until Sept. 10, and the winners will be announced on Nov. 10 at the 2021 IDEA! Conference in Cleveland. The product receiving the most votes from readers will receive the Big IDEA! Award as the top new innovation of 2021.

Voting is limited to manufacturing engineers and design professionals only. Go to the link on the ***HydraulicsPneumatics.com*** homepage to cast your vote.

While only seven products will win, every one of this year's IDEA! Awards Finalists offer a new idea on how to make their own process a little better. md

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The future of proportional control has arrived—and it's digital. The **Clippard Cordis** is a revolutionary microcontroller primed for escape velocity from a proportional control market that has grown stagnant.

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AUTOMATION

Kurt RV36 Robotic Gripper

The Kurt RV36 Robot end effector is a two-finger parallel gripper with a revolutionary design that allows automated finger/end effector changes without gripper body changes. An amazingly adaptable gripper by itself is made even better with automatic finger changes. Quick, operator-free finger changes using standard pull studs on each gripper finger allow for increased flexibility, less downtime for your robot and cost savings for your business.

Kurt Workholding
www.kurtworkholding.com

AUTOMATION

ION/CME N-Series Digital Drives

ION/CME N-Series Digital Drives are compact, PCB-mountable modules that provide high-performance motion control, network connectivity (Ethernet, CAN, RS232, RS485 and SPI), and power amplification (output up to 1,000 watts) for Brushless DC, DC Brush and step motors. These powerful digital drives are fully user-programmable and perform profile generation, PID servo compensation, direct encoder input, field-oriented control and many other motion control functions. These miniature devices are ideal for creating embedded control solutions for medical, mobile, scientific, semiconductor and a host of other automation applications.

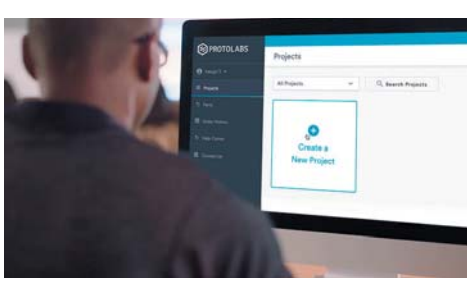
Performance Motion Devices, Inc. (PMD)
www.pmdcorp.com

AUTOMATION

NearFi Coupler

NearFi is the new contactless real-time transmission technology from Phoenix Contact. With protocol-independent Ethernet communication, it facilitates flexible application possibilities for all Ethernet protocols. With NearFi couplers, power (24 V, 2 A) and real-time Ethernet data (100 Mbps, full duplex) can be transmitted across an air gap of up to 10 mm. You can use this technology to replace connections subject to wear and slip rings in industrial applications and minimize costs caused by failures.

Phoenix Contact
www.phoenixcontact.com



AUTOMATION

Digital Quoting Platform

Protolabs' digital quoting platform brings the speed and agility customers demand from a digital manufacturer to new levels. Uploaded CAD files enter an end-to-end digital thread beginning with an e-commerce system featuring collaboration tools allowing for a team approach to the ordering process, and transparency tools detailing cost implications of each decision. Enhanced DFM analysis utilizes AI to identify the issues upfront that could slow down production, including gate and injector pin layout—all displayed in a 3D viewer. The intuitive, AI-powered interface has reduced clicks to quote, configure, approve and order 10 parts by nearly 50% since its debut.

Protolabs
www.protolabs.com

AUTOMATION

Studio 5000 Design Software

Two new additions to the Studio 5000 design software allow for industrial engineers to design machines and processes more efficiently. The Simulation Interface tool transforms how users design, test, validate and commission systems using digital engineering. The tool connects a system's controller to advanced simulation and modeling tools. Users can then simulate how products or processes with dynamic properties will behave in production. The Application Code Manager (ACM) tool allows users to automatically generate documentation for projects after creating a template and placeholders for data. The ACM also allows users to import information from architect tools, which reduces rework.

Rockwell Automation
www.RockwellAutomation.com

AUTOMATION

OPTIME

OPTIME is an affordable and easily scalable condition monitoring system that consists of wireless, battery-powered vibration sensors, a cellular gateway and an app to visualize the resulting data. OPTIME provides 15,000 unique measurements per sensor per year to deliver advance warning of potential damage to machines such as electric motors, fans and pumps. OPTIME's sensors, which install in just minutes, can be put into operation without any prior condition monitoring expertise. OPTIME captures six different vibration measurements plus temperature at preset intervals, thereby adding value to the customer by providing timely information on machine condition status to avoid unplanned outages.

Schaeffler Group USA Inc.
www.schaeffler.us

AUTOMATION

Sitara AM2x MCU

The Sitara AM2x microcontroller portfolio combines processor-level performance with MCU design simplicity to enable real-time control, networking and analytics applications at the edge. The portfolio enables 10 times the computing capability of traditional, flash-based MCUs. The Sitara AM243x device features up to four Arm Cortex-R5F cores running up to 800 MHz each, with integrated real-time control and industrial communications to simplify factory automation. Integrated stacks support common industrial protocols and gigabit Ethernet with TSN. The on-chip security features help engineers meet encryption requirements, while functional safety mechanisms and collateral can help achieve up to SIL 3 for industrial systems.

Texas Instruments
www.TI.com

FLUID POWER

Cartridge Flow Transmitter (CFT)

DGD Fluid Power enters the hydraulic market with the CFT (Cartridge Flow Transmitter) with multiple output options providing a convenient digital solution to measure flows in hydraulic systems. The flow transmitter can be easily installed anywhere in the hydraulic circuit for continuous monitoring of all critical hydraulic functions, e.g., component performance, diagnostics, closed loop control and data acquisition for predictive maintenance and remote troubleshooting. Future models to be released include pressure and temperature sensors, combined with the CFT in a cartridge valve format.

DGD Fluid Power
www.dgdfluidpower.com

FLUID POWER

SLV20 Load-Sensing Proportional Directional Valve

Eaton's SLV20 load-sensing proportional valve is a priority flow-sharing solution for mini and micro machinery. Utilizing screw-in cartridge valves in aluminum sections, the SLV20 offers greater versatility and serviceability than cast iron valves, plus significant weight and space savings. A patent-pending multi-function logic element enables flow sharing and flow prioritization in the same valve bank, a feature previously available only on heavy traditional valves. Individual sections can be produced with additional functions, such as counterbalance valves, replacing remotely mounted ancillary valves. By reducing machine weight and providing flexible flow-control options, the SLV20 can increase efficiency, load-carrying capability and battery life.

Eaton
www.eaton.com

FLUID POWER

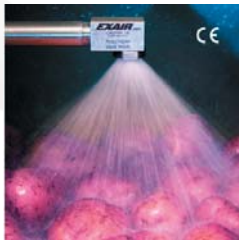
VariBlast Precision Safety Air Gun

EXAIR's VariBlast Precision Safety Air Gun with Nano Super Air Nozzle provides a focused blast of air capable of handling tough jobs with remarkable strength. This CE compliant lightweight air gun employs an engineered variable-flow trigger able to produce variable force upon a target simply by pulling the trigger. The Nano Super Air Nozzle requires only 8.3 SCFM and is made of Type 316SS or PEEK thermoplastic. The air gun body is made of high impact polyacetal. The airflow that exits the nozzle can't be blocked, assuring safe operation, with a quiet 75 dBA noise level, well below OSHA limits.

EXAIR Corporation
www.exair.com

FLUID POWER

1/2 NPT FullStream Liquid Atomizing Spray Nozzle

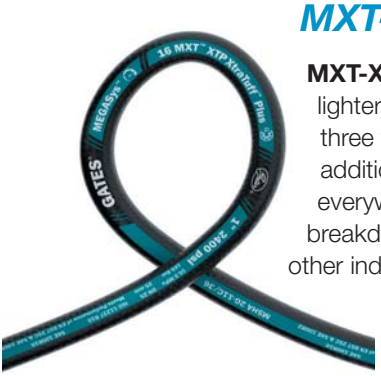


EXAIR's 1/2-NPT FullStream Liquid Atomizing Spray Nozzle provides a full cone spray pattern for pressurized liquids. This inexpensive and versatile nozzle offers the ideal solution for cooling, cleaning, washing, rinsing and dust suppression. With a vaneless, tangential flow design, the FullStream has wide open internal features to resist clogging while simultaneously producing uniform distribution in a round pattern with medium to large droplets. The compact right-angle design operates at up to 250 PSIG liquid pressure, and functions seamlessly with liquids containing particulate. Type 303 stainless steel construction provides durability and corrosion resistance, with operating temperatures up to 800°F (427°C).

EXAIR Corporation
www.exair.com

FLUID POWER

MXT-XTP Hydraulic Hose



MXT-XTP is a hydraulic hose that combines patented wire braid technology that makes it lighter weight and more flexible while maintaining 600,000 impulse cycle performance, which is three times the industry standard. The abrasion and ozone resistance XtraTuff cover provides additional protection for the hose to stand up to the toughest of applications. Ozone is everywhere and impacting hose performance, so having a robust cover material to prevent hose breakdown and keep machine uptime high is of great benefit. MXT-XTP joins the Gates lineup of other industry leading products that include MXG4K-XTP and Multi Master GMV.

The Gates Corporation
www.gates.com

MACHINES & COMPONENTS

Antimicrobial Food Grade Type LAFG

Type LAFG is a UL listed, CSA certified "Heavy-Duty," flexible liquid-tight steel conduit that is now antimicrobial. It is designed to safety route electrical wiring through modern food processing plants, while safeguarding foreign material contamination and inhibiting bacteria growth. The flexible PVC jacketing contains an antimicrobial biocide additive, inhibiting bacteria growth, and reducing commonly known food processing microbes in a 24-hour period. The blue jacketing color does not occur naturally in the food chain, making plastic contamination in the product stream easy to spot. The increased high/low working temperature is critical for installations near heat-producing equipment and hot washdowns.

Electri-Flex Company
https://www.electriflex.com

MACHINES & COMPONENTS

GMX-20DP Ultrasonic Metal Welder

The Branson GMX-20DP ultrasonic metal welder joins thin, fragile nonferrous foils and films (approx. 5-10 µm) in assemblies of 100-plus layers using higher downforce and lower weld energy (weld amplitude). Its unique "direct press" actuator delivers direct vertical downforce on parts (unlike typical cantilever-type actuators) for more consistent, yet gentle joining of more "energy dense" many-layered battery structures, while virtually eliminating the film/foil tearing and cracking that compromises battery assembly quality. The Branson GMX-20DP welder directly enables the development of lighter, more "energy-dense" battery cells and packs, capable of delivering more watt-hours of energy per unit of battery weight.

Emerson
www.emerson.com

MACHINES & COMPONENTS

Four Outlet Gen4 Power Supply

EXAIR's Gen4 Four Outlet Selectable Voltage Power Supply allows the choice of input voltages of 115 VAC or 230 VAC. Four 5kV stainless steel output connectors can energize four static eliminators at once. They are UL component recognized, CE and RoHS compliant. They feature an electromagnetically-shielded modular power supply cable which eases routing and connections. An integrated fuse on the primary protects against voltage spikes. The lighted power switch indicates operation and is field replaceable. The Gen4 Power Supply is housed in a durable metal enclosure (6 in. L x 4.0 in. W x 4.4 in. H) that is ideal for rugged, industrial environments.

EXAIR Corporation
www.exair.com

MACHINES & COMPONENTS

Har-Modular

HARTING's har-modular series offers a unique and flexible solution for the connection of PCBs. A modular concept, based on the time-tested and reliable DIN 41 612 connector family, this product allows engineers to develop custom connectors using off-the-shelf components. In this way, customization can be achieved without the normal barriers of long lead times and development costs. This revolutionary PCB connector system offers over a billion combination possibilities for data, signal and power. It is configurable online and can be ordered in quantities of 1.

HARTING
www.harting.com

MOTION CONTROL

Z-Theta Dual-Motion Actuator

The Z-Theta dual-motion actuator offers linear and rotary point-to-point motion in a compact footprint, providing flexibility, value, durability and performance for lab automation, semiconductor and light factory automation applications. Unlike standard designs with multiple components requiring added engineering, vendors and assembly, Z-Theta is a modular bolt-in package that reduces complexity. Z-Theta's configurable design features the patented ScrewRail linear actuator, combining guidance and linear transmission in a slender co-axial profile. A pair of stepper motors create rotary (theta) motion. The design reduces system size by 50% to 80% and cost by up to 60% compared to traditional approaches.

AMETEK Haydon Kerk Pittman
www.haydonkerkpittman.com

MOTION CONTROL

SmartStage XY

The SmartStage Linear is the first of its kind high performance stage where the motion controller, drive circuit and encoder are all built-in, reducing the overall motion footprint within the instrument. By embedding multiple cables and external electronics, the control is seamless and performance-optimized for low noise.

- Takes up 75% less space
- Built-in controller, 3 phase servo drive, 5 nm resolution
- Flexible communication supports RS-232, RS-485 and CAN
- Cables reduced from 4 to 1
- Reduces complexity, product development time, and overall system cost
- Improves instrument's throughput with high-speed linear motor
- 50-200 mm travel available, stackable for XY

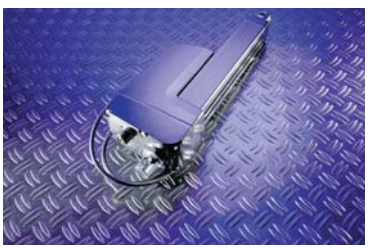
Dover Motion
www.dovermotion.com

MOTION CONTROL

PGVA Pressure Vacuum Box

The Festo PGVA pressure vacuum box provides an all-in-one solution for generating regulated, filtered air for pressure and vacuum-controlled liquid dispensing systems. This innovative compact solution is installed on or inside an instrument to supply compressed air and vacuum for liquid handling. This is useful for laboratory automation solutions when compressed air is not available. For easy operation, PGVA can be controlled from any RS232, USB or Ethernet port. It features a compressor, proportional pressure/vacuum control, air filter, silencer, pressure/vacuum reservoirs, pressure sensor, switching valves, 24V power supply, digital outlet for valve actuation, and all within an 8 in. x 3 in. x 8 in. housing.

Festo
www.festo.com



MOTION CONTROL

Electrak LL Electric Actuator

Thomson Electrak LL actuators give linear motion designers new capabilities to deploy intelligent electric products for long-life operations in challenging environments. A brushless motor design enables up to 100% duty cycle and ten-fold increase over standard travel distance. High ingress protection and wide temperature ratings maximize reliability in harsh environments. Designers can now leverage smart actuators in applications that previously required more complex and expensive configurations, such as battery-powered mobile devices and machines. The Electrak LL is ideal for lifting and positioning in mobile equipment; pantographs; door, hatch and valve control; pick, place and sort; material handling; and conveyor control.

Thomson Industries, Inc.
www.thompsonlinear.com

MOTORS & DRIVES

Explosion-Proof Gearmotor

Bodine's Explosion-Proof Gearmotor was developed for customers in the oil & gas industry. Bodine has supplied thousands of gearmotors to manufacturers of chemical injection pumps over the years. Some of the installations require an explosion-proof motor because of the proximity of the pump to flammable vapors. Until Bodine released its explosion-proof gearmotor, customers had to buy a separate motor from one company and a separate gearbox from another company and integrate the two components themselves. Bodine's integrated product simplifies customer's designs, reduces assembly labor and increases product reliability.

Bodine Electric Company
www.bodine-electric.com

MOTORS & DRIVES

Hägglunds Atom

The Hägglunds Atom from Bosch Rexroth is one of the fastest, most power-dense hydraulic motors in its class. A revamped version of the Hägglunds CAb, Bosch Rexroth's smallest Hägglunds motor, this radial piston motor supplies maximum torque of up to 13.6 kNm and a specific torque of 40 Nm/bar. With full torque at speeds up to 400 rpm, its maximum power of 394 kW substantially outstrips motors of similar size. Hägglunds Atom is ideal for mobile, marine and recycling applications, including smaller shredders and other machines in tough and unpredictable applications.

Bosch Rexroth
www.boschrexroth.com

MOTORS & DRIVES

DS2020 Digital Servo Drive

Moog's DS2020 drive with Combitronic capability satisfies customers who need larger, high torque motors, while leveraging the advantages of SmartMotor technology. The DS2020 expands Moog's standard drive's capabilities by allowing it to act as a follower device on the Combitronic network, which means the drive can be controlled by any Moog SmartMotor on that network. The DS2020 works seamlessly in SmartMotor-based machines and applications, while supporting the SMI software and AniBasic programming language to configure and program the entire system.

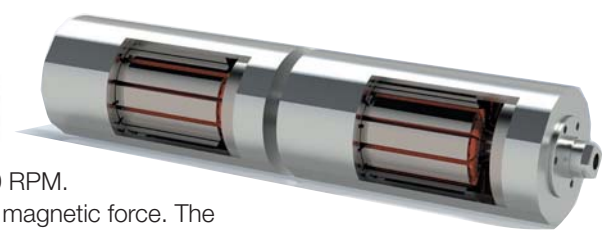
The DS2020 offers:

- Quick, precise movements
- Natural and fan cooling
- Integral holding brakes

Moog Inc.
www.moog.com

MOTORS & DRIVES

Twin Multi-Drive



The Twin Multi-Drive by One Motion is a revolutionary design that allows for independent control of two rollers on a single shaft, with precise registration and speed ranging from up to 500 RPM. Motion is created by directly driving the outer rotating shell using magnetic force. The gearless, magnetic direct drive design is hygienic, reliable and highly efficient. The Twin offers a high-performance solution for numerous applications such as product merge, skew correction and more. Multiple OEMs have improved merge performance from 140 products per minute using conventional servo-motors to 180 products per minute using the Twin.

One Motion
www.onemotion.info

SENSORS

Cordis Electronic Flow Controllers

Clippard's new compact Cordis Flow Controller utilizes an extremely fast-reacting mems technology sensor upstream of Clippard's proportional electronic valve. Adding an optional DR-2 precision regulator for accurate and precise pressure control makes for a very small, compact package by eliminating the need for an external regulated supply. <50 ms response time, ≤25 mV resolution and IP65 housed. It features:

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Clippard
www.clippard.com

SENSORS

SBV-01

The SBV-01 is the first world safety motion device for industrial applications based on radar technology certified SIL2 PLd. It consists of a controller and from one to six sensors that monitor operator body presence both in access and in restart prevention, and even when the operator is standing still. Volumetric 3D detection and increased robustness allows for outdoor and harsh environment use. The field of view settings range is from 0.5 to 5 meters and includes up to four independent safety zones. It has Profisafe and OSSD connections available.

INXPECT
www.inxpect.com

SENSORS

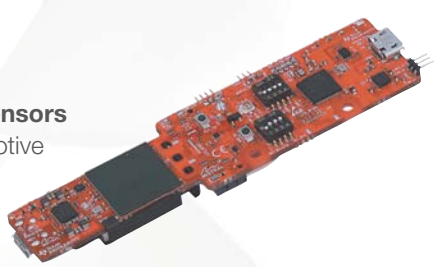
Tag-It Program

The Regal Tag-It program powered by Perceptiv intelligence is an asset management platform with functionality that enables users to view details on mechanical and electrical assets in operation and reduce redundant or obsolete inventory. Perceptiv wireless monitoring can also be added to watch critical assets at all times. A push of a button shows the equipment health, allowing users to be proactive with maintenance and replacements before there is unplanned downtime. The combination of hardware, software and humanware provides a new way for users to interact with Regal products and their equipment.

Regal Beloit
RegalBeloit.com

SENSORS

AWR Antenna on Package Sensor



TI's family of in-to-pin compatible 77 GHz/60 GHz single-chip radar sensors with integrated antenna-on -package (AOP) for near-field and in-cabin automotive applications are 25% smaller than non-AOP devices. Sensors can be added to space-constrained areas such as door handles and headlights for smart door openers and parking sensors and the vehicle pillars and overhead console to enable child-presence detection, seat belt reminders and gesture recognition. Unlike other sensors, AOP sensors have RF, digital processing and antenna elements integrated on a single chip sensor. A wide field of view enables 3D detection of objects inside and outside, even in snow or rain.

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News

Dig Deeper:
A Method Behind the Data Madness

by Marie McBurnett

BOSCH REXROTH

We've heard it now for more than a decade: Everything is going smart—from homes to cities to manufacturing enterprises.

A market report released by Verified Market Research predicted the global smart mining solutions market will increase at a CAGR of 16% over the next seven years and will be valued at $33.35 billion by 2028.

In industries like mining, smart technology will propel safety and efficiency efforts. We sat down with Brian Howell, U.S. sales manager-large hydraulic drives at Bosch Rexroth, to discuss how the industry can use its OEMs to get data it can really use.

***Hydraulics & Pneumatics:* Where, in your view, is the mining industry when it comes to adopting new digitally enabled devices? Where are some adoption pain points?**

Brian Howell: Depends on the user and the background their staff have. If they are "tech"-type people, then they are likely more interested in wanting to have enabled devices to allow them to view and know how their machines are running, but some customers are not yet ready to adopt this level of technology, and sometimes they even are "anti-tech" because if they don't have trained or skilled staff who can support the use of enabled technology they view it as a negative. So, it is up to companies like Bosch Rexroth to support these customers to show them how the technology can help them and what value it will bring to their operations.

***H&P:* What sort of systems and equipment are mining companies leveraging to improve worker safety?**

BH: Temperature monitoring, camera technology, pressure and gas sensors are all types of technology that mining companies are deploying to allow equipment to be analyzed and monitored from remote to ensure before maintenance personnel go into that area that the equipment is in a safe condition to be worked on.

***H&P*: How can mining companies use software and systems not necessarily developed for mining to improve efficiency in their operations?**

BH: It is really up to the industry to develop the software and systems that mining companies need to resolve their pain points in operations and maintenance tasks. Having software tools that helps min-

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Technology can help with machine and condition monitoring, but the industry will still need a skilled and trained workforce to perform the ground-level maintenance and support needed to keep machines running at peak performance.

ing operators have "eyes" on their equipment will certainly boost operations and help them minimize equipment downtime. Who doesn't want that—get more from your machines and keep them doing the things they were meant to do and allow the mining company to make more revenue.

***H&P:* We've been seeing a lot of innovations around digital twin technology. How can this technology apply to the mining industry?**

BH: Digital twin technology can help mining companies better understand how equipment they may purchase can optimize their process or production by being able to make upset conditions in software to see how a machine will respond. This would provide the ability to play alternate scenarios of issues to tailor machine parameters to meet each mine's unique operating needs.

***H&P:* What sort of data-driven decisions can mining companies make to improve safety and efficiency?**

BH: Without analyzing machine data, companies can often be blind to how machines are performing and if throughput and efficiency gains can be made. Deploying condition monitoring systems can allow mining companies to analyze and trend their machine performance in real time and tailor their settings to boost productivity and eliminate bottlenecks in their processes.

The world is becoming more and more data driven, and by employing enabled devices on their machines, mining companies can work with equipment OEMs who know the performance characteristics of their machines best, learn what data to collect, and analyze it to make intelligent decisions for machine performance and safety.

***H&P:* Sensors are getting more and more complex with the data they capture as well as their communicative network ability. What sort of smart sensors should mining companies look for?**

BH: Mining companies should work with their OEM equipment providers to learn and understand what type of enabled devices are available and what benefits can be leveraged by using the available data. Often you can be overloaded with data. Monitoring too much data with no plan of how to make use of it can be a waste of time. There must be a method behind the data madness, and collaboration between the OEMs and the site maintenance and operations personnel can yield the mining user with the appropriate set of data analytics to help them improve their processes and understand machine performance.

***H&P:* Do you see additive manufacturing, robotics and/or AI playing a larger role in the global mining industry moving forward?**

BH: AI for sure, being able to remotely analyze a maintenance issue on a machine or troubleshoot via AI technology from remote will become a more common practice in the coming years. During the pandemic, we have become very accustomed to digital meetings, being able to meet colleagues and customers anywhere in the world virtually...this type of technology will also become mainstream to provide remote support and troubleshooting using AI tools.

***H&P:* How can all these technologies help recoup the loss the industry will face as the workforce retires?**

BH: Technology can help with machine and condition monitoring, but the industry will still need a skilled and trained workforce to perform the ground-level maintenance and support needed to keep machines running at peak performance. Enabled devices will certainly help boost the intelligence an operator has about how their equipment is running, but cannot replace a skilled workforce. hp

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The Importance of HYDRAULIC HOSE SIZE

Replacing a hydraulic hose with the incorrect size can lead to adverse effects.

MINARET2010 | DREAMSTIME

AT A GLANCE:

- **REPLACING WORN-OUT COUPLINGS** with the incorrect size can cause unintended consequences.
- **FLOW VELOCITY IS** an important consideration when replacing a larger hydraulic hose inside diameter with a smaller hydraulic hose inside diameter.
- **LEARN HOW TO** calculate flow velocity.

Suppliers of hydraulic hose assemblies will face this common scenario: An end-user brings in a worn-out hydraulic hose to be replaced, but the couplings needed for this particular size hose are out of stock, backordered or the store doesn't stock the couplings needed to replicate the original hose assembly. However, you do stock the correct couplings in a smaller hose size inside diameter (ID).

The logical solution might be to rebuild the hose assembly using the smaller size hydraulic hose with a jump-size fitting. Though this may seem like a harmless solution, replacing a hose assembly with a smaller hose size than what was designed for that hydraulic system could cause unintended harm and create inefficiency to the equipment.

What is affected when you replace a hose with the incorrect hose size?

Flow is the movement of fluid and is broken down into two categories: flow rate and flow velocity. Flow rate is the volume of hydraulic fluid produced by the hydraulic pump over a specific amount of time and is commonly measured using gallons per minute or GPM. Flow velocity is the speed at which hydraulic fluid travels in a certain direction over a specific amount of time and is measured using feet per second.

Flow velocity is determined by both the hydraulic pump's flow rate and the hydraulic hose size. Changing the flow rate of the hydraulic pump but leaving the hydraulic hose size the same will affect flow velocity. In contrast, keeping the flow rate the same but changing the hose size will affect flow velocity.

Flow velocity is an important consider-

ation when replacing a larger hydraulic hose ID with a smaller hydraulic hose ID. When an existing hydraulic hose is replaced with a new hydraulic hose that has a smaller ID, the same amount of fluid that was flowing through the original, larger hydraulic hose is now forced through the new, smaller hose. This will restrict flow and increase downstream pressure, thus causing flow velocity to increase.

In some situations, this might not be a problem, so it is important to properly analyze the situation. An easy option to avoid this problem is to size-up to the next larger hose size. However, larger hoses usually come with a higher price, plus larger hoses take up space and could even decrease the customer's equipment performance.

Why can high flow velocity be undesirable for a hydraulic system?

Flow velocity determines if the flow pattern will be in a laminar or turbulent state. Ideally, we would like for flow to be a steady, smooth and uniform pattern from the pump all the way to the actuator. This pattern is referred to as laminar flow. Laminar flow is achieved at lower velocities, and the fluid layers move in a nice, even, parallel flow pattern.

This flow pattern is ideal to minimize friction and pressure drops and maximizes hydraulic system efficiency. Fluid-on-fluid friction will still be created as the layers of fluid, which are flowing at different velocity rates, slide on each other, but this is expected. A laminar flow pattern also provides better system response, lubrication and decreases air pockets or bubbles that can cause inefficiencies.

The higher the flow velocity, the more turbulent flow characteristic are seen. When flow velocity is high, the roughness on the surface of the inner tube will disrupt the flow path and cause it to become chaotic. Turbulent flow patterns cause a decrease in energy in the form of friction (law of conservation of energy), resulting in unwanted pressure

drops and hydraulic system inefficiencies.

Furthermore, high flow velocity also causes increased fluid temperatures. Fluid temperature has been empirically linked to significant reduction in hose life, so a reduction in hose size may also cause unwanted system downtime. Additional details on this temperature impact can be reviewed in the Heat Gain Data section of the Gates Fluid Flow Pressure Calculator, which can be found at www.gates.com.

For suction and return lines, having high flow velocity can lead to pump cavitation over time. In other words, the hose tube ID must be suitable to keep flow velocity at an appropriate rate to avoid energy loss due to friction.

How do you determine fluid velocity and how much velocity is acceptable?

To calculate flow velocity, use a constant, the cross-sectional area of the hose and the hydraulic pump's flow rate using a flow meter. With this information, apply the formula:

$$Flow\ Velocity = \frac{0.3208 * Flow\ Rate}{\pi r^2}$$

Once flow velocity is determined, use the calculated velocity rate, along with the pump's flow rate, to verify if the replacement hose size is acceptable for the system. An easy way to do this is to use the Gates nomographic chart located in the Gates Hydraulic and Fleet Hose catalog. The chart has three parts: 1) the flow rate axis, 2) the hose ID axis and 3) the flow velocity axis.

You only need to know two of the three axis values to determine the third value—lay a straight edge through the known values and extend the line to determine if the flow rate and flow velocity are at acceptable levels based on your hose size, or help you determine the proper hose size based on flow rate and fluid velocity.

Hydraulic System	Recommended Flow Velocity
Suction Lines	2 to 4 ft/sec
Return Lines	10 to 15 ft/sec
Medium-Pressure Lines	15 to 20 ft/sec
High-Pressure Lines	20 to 25 ft/sec

BETTER SAFE THAN SORRY

Though it may be convenient to substitute a customer's hydraulic hose with a different sized hose than what is intended for the hydraulic system, you can inadvertently cause hydraulic equipment to become less efficient and potentially damage the hose tube. The best practice is to replace the hose with the same size. hp

GARRETT BELL is key accounts sales manager – Automotive Aftermarket at Gates. Gates product application engineers can be reached on the technical hotline at (303) 744-5651 or FPPA-Support@gates.com.

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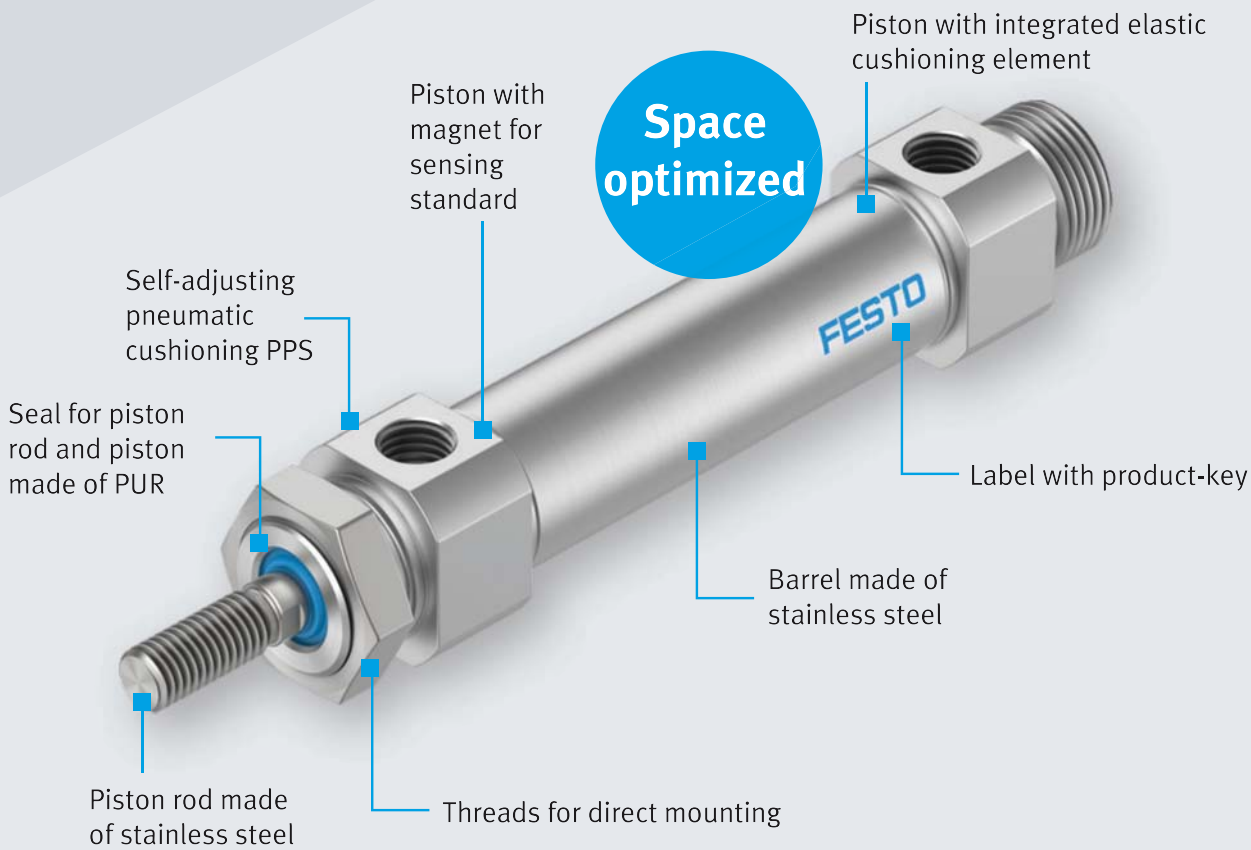

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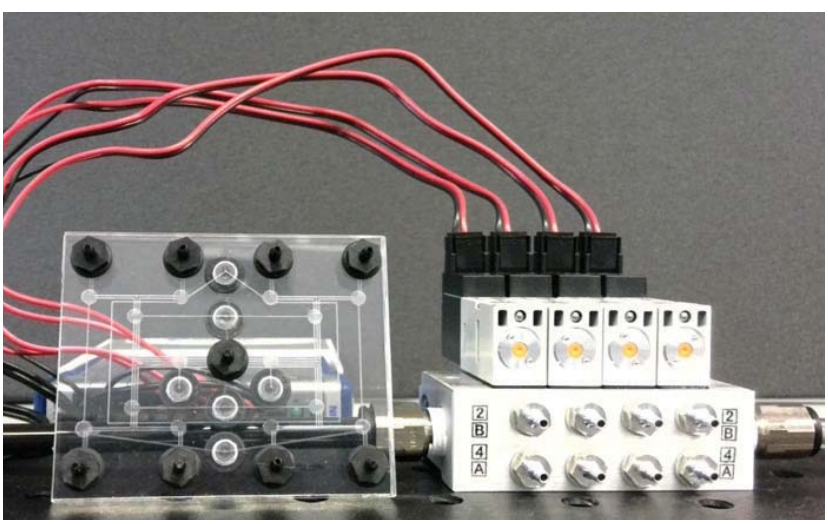
REHANA BEGG | Senior Editor

Robot Uses Pneumatic RAM to PLAY PIANO



WILLIAM GROVER/UCR

An eight-bit pneumatic RAM chip used to help a soft robot control its movements. The chip uses microfluidic valves to control airflow instead of electronic transistors.

If pneumatic technology is associated with high force and speed, electronic actuators conjure up notions of precision and control. Together, the two technologies broaden the scope for the field of soft robotics.

Engineers at UC Riverside have successfully combined the best of both worlds by unveiling an air-powered computer memory that can be used to control soft robots.

Most soft robots are powered by pressurized air and are controlled by electronic circuits. Pneumatic soft robots use pressurized air to move soft,

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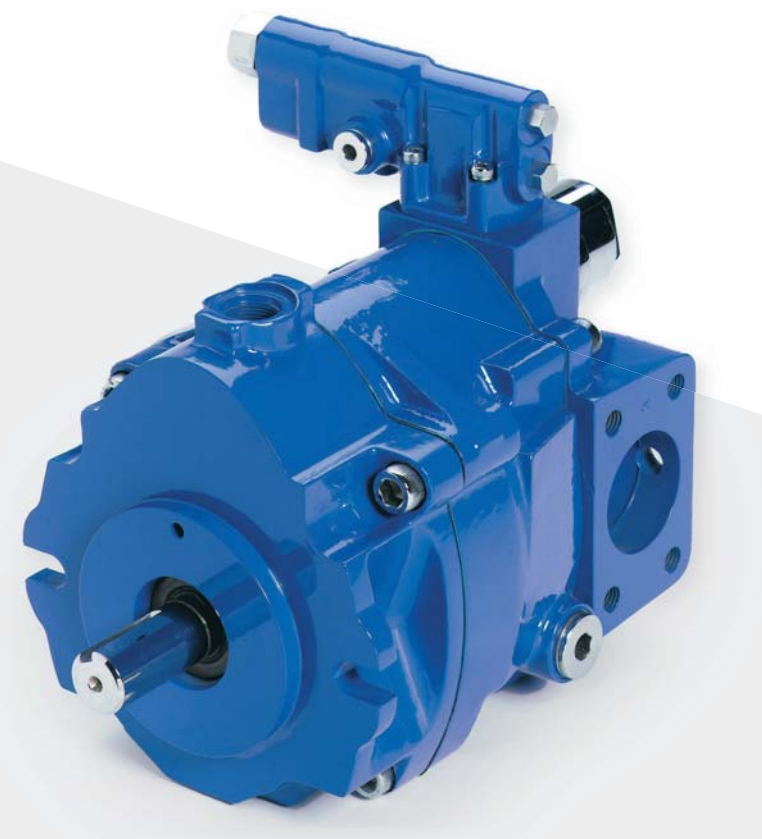

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Air pressure is used to represent on/off or true/false. In contrast, modern computers use electricity. These logical states are represented by 1 and 0 in code to trigger or end electrical charges.

rubbery limbs and grippers, making them superior to traditional rigid robots for performing delicate tasks.

The downside of using electronic valves and computers to controlling pneumatic soft robots is that electronic parts are expensive, and require considerably more power and size for the robot's moving parts. These constraints limit the range of practical applications.

WHAT'S THE LOGIC?

The researchers borrowed from the past where "pneumatic logic" was used extensively to control products, such as thermostats and components in climate control systems. In pneumatic logic, air flows through circuits or channels, note the researchers. Air pressure is used to represent on/off or true/false. In contrast, modern computers use electricity. These logical states are represented by 1 and 0 in code to trigger or end electrical charges.

To design a robot that can play a tune on a keyboard, the pneumatic soft robot would have to "memorize" notes and maintain positions of moving parts. The researchers would need to replace the electronic memory currently needed for this purpose with a pneumatic logic "memory" for a soft robot.

Combining expertise in computer science and mechanical engineering, the researchers made their pneumatic random-access memory, or RAM, chip using microfluidic valves instead of electronic transistors.

The microfluidic valves were originally designed to control the flow of liquids on microfluidic chips, but they can also control the flow of air, the researchers explained. The valves remain sealed against a pressure differential even when disconnected from an air supply line, creating trapped pressure differentials that function as pneumatic memories and maintain the states of soft robotic actuators.

The researchers noted that dense arrays of these valves can perform

advanced operations and reduce the expensive, bulky and power-consuming electronic hardware typically used to control pneumatic systems.

The research team—led by bioengineering doctoral student Shane Hoang, his advisor, bioengineering professor William Grover, computer science professor Philip Brisk, and mechanical engineering professor Konstantinos Karydis—further modified the microfluidic valves to handle larger air flow rates.

An eight-bit pneumatic RAM chip was produced to control larger and faster-moving soft robots. It was incorporated into a pair of 3D-printed rubber hands. The researchers noted that the pneumatic RAM uses atmospheric-pressure air to represent a "0" or FALSE value, and vacuum to represent a "1" or TRUE value. They explained that the soft robotic fingers are extended when connected to atmospheric pressure and contracted when connected to vacuum.

The robot can play notes and chords; this is achieved by varying the combinations of atmospheric pressure and vacuum within the channels on the RAM chip, explained the researchers. They programmed the soft robot to play a whole song on a piano ("Mary Had a Little Lamb").

In theory, this system could be used to operate other robots without any electronic hardware and only a battery-powered pump to create a vacuum. The researchers noted that without positive pressure anywhere in the system—only normal atmospheric air pressure—there is no risk of accidental over-pressurization and violent failure of the robot or its control system.

Further opportunities for robots using this technology would be safe for delicate use on or around humans. Wearable devices for infants with motor impairments is one example.

The paper, "A pneumatic random-access memory for controlling soft robots," is published in the open-access journal *PLOS One*. hp

Further opportunities for robots using this technology would be safe for delicate use on or around humans. Wearable devices for infants with motor impairments is one example.

FRANK GEVERS | Emerson

Selecting Standard-Compliant Pneumatics for RAILWAY APPLICATIONS

EMERSON

AT A GLANCE:

WHILE DURABLE, SOPHISTICATED pneumatics technology is key for OEMs to successfully face the extreme conditions of the railway industry, they also need expert partners who know railway standards inside and out.

FIRE PROTECTION, ELECTROMAGNETIC compatibility of components, and climate conditions such as pressure and humidity are important safety considerations.

SOME APPLICATIONS FOR rail pneumatics include door operation, suspension and leveling, brake control and water management.

In this article, we'll discuss some pneumatics rail applications and their corresponding international standards.

As the railway industry evolves in response to globalization, digitalization and climate change, it faces new challenges. In order to solve them, the technology used in rail transport must develop too. However, as products change, they must meet stringent national and international safety requirements. Many of these products are pneumatic components and systems to control various functions on passenger and freight trains.

To overcome the latest industry challenges successfully, rail OEMs must implement effective, future-proof pneumatic systems that meet all railway standards. Railway compliant pneumatic components must fulfill the highest safety requirements and toughest industry demands across a wide range of applications.

TRACKING INDUSTRY STANDARDS

Many national and international regulations set the foundation for

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As the railway industry changes, it faces new challenges.

rail safety and successful innovations. OEMs that want to effectively and efficiently launch new products must keep track of these regulations and comply with them all. But as globalization creates new sales markets with different requirements, that can prove to be quite challenging.

Here are a few important standards for pneumatic components, many of which apply to both the European and Asian markets.

EN 50155

Railway Applications–Rolling Stock–Electronic Equipment

This standard explains the requirements for electronic components. The mechanical tests are also applied to solely mechanical solutions (e.g., shock and vibration, climate, etc.).

EN 45545

Railway Applications–Fire Protection on Railway Vehicles

This is the European standard to define requirements for fire behavior of materials and components.

EN 50126

Railway Applications–The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS)

This standard specifies how to assess and define system safety, reliability and related life cycle costs.

EN 15085

Railway Applications–Welding of Rail-

way Vehicles and Components

This standard defines procedures and quality measures for design and production of welded components in railway.

TSIS (TECHNICAL SPECIFICATIONS FOR INTEROPERABILITY)

These are European Commission regulations concerning technical specifications for interoperability of subsystems for the European Union rail system.

DIN 6701

Adhesive Bonding of Railway Vehicles and Parts

This standard defines procedures, quality measures for design and production of adhesive bonded materials.

In addition to these standards, railway components must be able to cover voltage tolerances of +25% to –30%, achieve an IP protection class of typically IP65 (EN 60529) or higher and endure humidity of at least 95% for 30 consecutive days.

Pressures between 2 and 10 Bar and nominal voltages of 24 to 110 V DC for pneumatic components usually apply. The drop-out voltage must be higher than 10% of the nominal voltage, especially in braking applications, and only negligible leakage is allowed at low temperatures.

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SELECTING COMPONENTS FOR SAFE, HEAVY-DUTY OPERATION

Compliance with safety requirements is part of what makes railways one of the world's safest means of transportation. Selecting highly reliable, quality components and systems is central to protecting people and property on board as well as avoiding downtime and repair costs.

Fire protection is fundamental for safe operation. All potentially flammable products must cover appropriate fire protection properties to ensure effective protection. In Europe, all products and systems must meet the EN 45545 series of standards, while in the U.S., NFPA 130 fire protection regulations apply.

Another safety concern is the electromagnetic compatibility of components, governed by EN 50121-3-2. This EMC

Directive is also part of the EN 50155 and defines limits and measurement methods for electromagnetic emission and immunity to interference for all types of railway vehicles and their electric components.

The climatic conditions of railway vehicle operation add another layer of safety complexity. Components used must be sufficiently shock- and vibration-resistant. Pneumatic components are usually subject to shock and vibration tests according to EN 61373, category 1 or 2, depending on where and how they are installed. Tests are expanded to include environmental conditions, typically defined in EN 50155, the standard for electronic equipment on rolling stock.

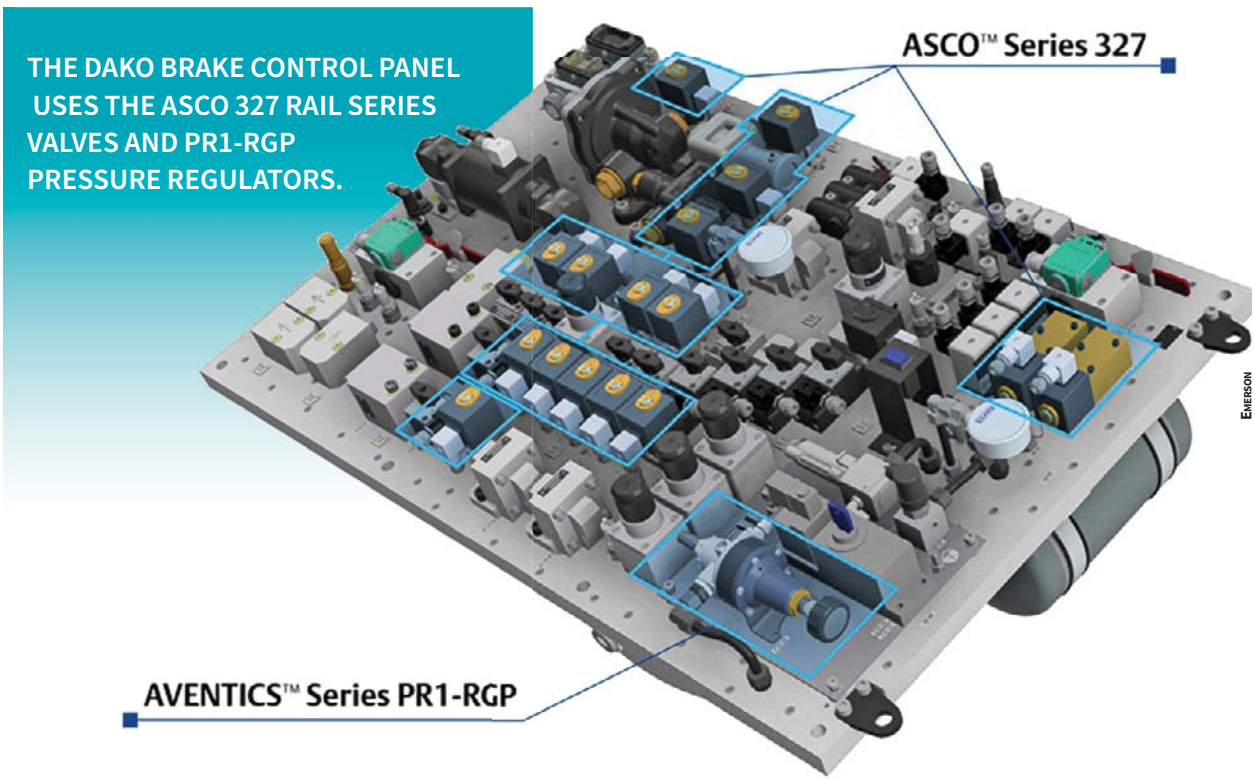
IMPLEMENTING COMPLIANT PNEUMATIC RAILWAY APPLICATIONS

Since the air brake was invented more than 150 years ago, compressed air has played a major role in the railway industry. Today, pneumatic components are used in a wide range of applications in both passenger and freight vehicles. For successful product development, OEMs must implement pneumatic applications that meet the highest safety requirements and industry demands. Outlined below are a few of the many applications and compliant solutions.

Compressed Air Preparation

Nearly everywhere in the world, compressed air must be processed in accordance with ISO 8573-1 and its required cleanliness classes. A high-quality supply of compressed air ensures all pneumatic components and systems on board function perfectly. Appropriate levels of pressure, air dryness and air purity are critical for compliance and reliable operation.

In order to achieve this level of purity, powerful filtration removes dirt particles to less than 5 microns and compressor oils from compressed air, while air dryers with advanced



absorption technology remove moisture quickly and efficiently.

Bottom Discharge Door

Unloading bulk cargo from freight cars is a tough job that requires proven components with robust designs. They ensure that bottom discharge doors can reliably open and close when needed.

Look for heavy-duty cylinders and valves that are tested to the required specifications and related control valves specifically designed for outdoor applications. These can stand up to freight transport's severe operation environment. For a convenient, time-saving solution, there are ready-to-install products with corresponding accessories, such as tubing, filters and stainless-steel fittings that can be used at temperatures of up to 80°C.

Suspension and leveling

Complex applications that affect safety, such as controlling bogie suspension bellow pressure for height control, require proportional pressure control valves. They form a ready-to-install levelling control system with solenoid

While durable, sophisticated pneumatics technology is key for OEMs to successfully face the extreme conditions of the railway industry, they also need expert partners who know railway standards inside and out.

valves, regulators, pressure switches and wear-free height sensors, simplifying installation and saving time compared to individual components.

The electronically controlled air suspension ensures the exact entry and exit height of the vehicle, which facilitates quick boarding. Control electronics assure height accuracy, while cutting air consumption in half.

Designed in protection class IP66, the complete solution is protected against water and dust and is suitable for all climate zones, covering a temperature range of –40°C to 70°C.

Brake Control

Completely configured pneumatic control manifolds can be used to adjust the brake pressure on trains. They are matched to the respective assembly and brake performance specification and are appropriate for the pneumatic service, emergency and parking brake. Modern braking systems frequently use proportional control valves for more accurate brake pressure control.

Internal and External Doors

High-speed trains travel at speeds of up to 350 km/h. Reliable external doors and the fast-switching valves that open, close and lock them are vital for the safety of everyone on board. Direct acting poppet valves together with special door cylinders for safe operation, including preset cushioning and speed customized for the door weight and kinematics, are used to offer optimum performance combined with reliable anti-trap protection.

Nose Cone and Coupling

Like internal and external doors, proven assemblies consisting of railway-compliant control valves and heavy-duty cylinders operate nose cones as well as the coupling mechanisms on trains. Compact, light-weight valve manifold solutions or individual components can be used to fulfill the desired coupling function. Because of the harsh environments these applications face, it's important to look for cylinders with high-performance special wiper seals and scrapers at the piston rod to reliably remove dirt and ice, and to use limit switches designed for extreme environments.

Toilet Control and Water Management

The potential of a direct operated poppet valve is often underestimated, but 3/2 poppet valves specifically designed for the railway industry prove their advantage on toilet and water applications. The valves control different functions of vacuum toilets, fresh water supply and grey water applications on trains, combining a compact size with high reliability and ensuring comfort at all times.

To make this application compliant and as comfortable as possible, look for robust poppet valves that have been tried and tested in practice, are shock- and vibration-resistant, and meet fire protection requirements according to EN 45545.

PARTNERING WITH COMPLIANCE IN MIND

While durable, sophisticated pneumatics technology is key for OEMs to successfully face the extreme conditions of the railway industry, they also need expert partners who know railway standards inside and out. In order to apply the many different railway standards and comply with their specification, it's important to look for a supplier that has a high degree of product expertise and in-depth knowledge of the railway industry, as well as a comprehensive, compliant pneumatics portfolio.

Robust pneumatic railway components set the benchmark for quality and functionality. They meet the exceptionally high demands of the railway industry and improve application performance, safety and reliability. Using pneumatic components that comply with all applicable standards ensures an OEM's long-term success in railway product development. hp

FRANK GEVERS is director, railway, fluid control and pneumatics at Emerson. With a degree in mechanical engineering from the University of Applied Sciences, Cologne, he has been involved in the railway industry for nearly 15 years.

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