



Comparing
Custom and
COTS Cylinders **p20**



Lighten the
Load With
Air Casters **p26**

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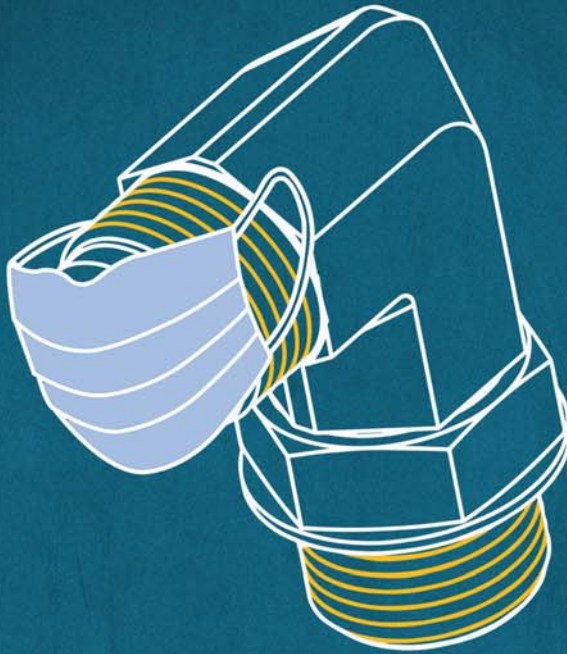
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The Future of Refineries: Demystifying Digital TRANSFORMATION

p14

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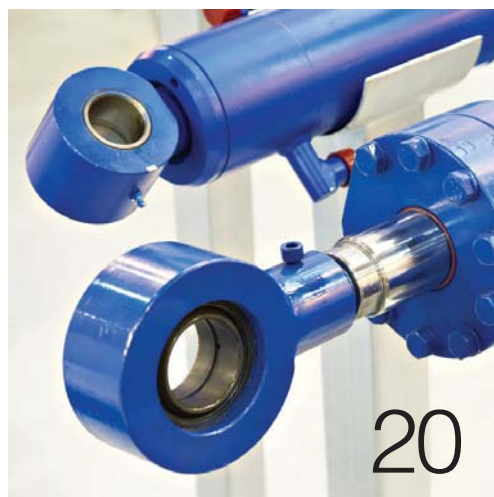
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EDITORIAL

SENIOR CONTENT EDITOR: **BOB VAVRA** bvavra@endeavorb2b.com

MANAGING EDITOR: **JEREMY COHEN** jcohen@endeavorb2b.com

SENIOR EDITOR: **STEPHEN J. MRAZ** smraz@endeavorb2b.com

SENIOR EDITOR: **REHANA BEGG** rbegg@endeavorb2b.com

SENIOR EDITOR: **MARIE MCBURNETT** mmcburnett@endeavorb2b.com

CONTRIBUTING TECHNICAL EXPERT: **PETER NACHTWEY** peter@deltamotion.com

CONTRIBUTING TECHNICAL EXPERT: **ROBERT J. SHEAF, JR.** rjsheaf@cfc-solar.com

CONTRIBUTING EDITOR: **RAY SCROGGINS** ray@scroggins.biz

ART DEPARTMENT

GROUP DESIGN DIRECTOR: **ANTHONY VITOLO** tvitolo@endeavorb2b.com

ART DIRECTOR: **BILL SZILAGYI** bszilagy1@endeavorb2b.com

PRODUCTION

GROUP PRODUCTION DIRECTOR: **GREG ARAUJO** garauja@endeavorb2b.com

CIRCULATION LIST RENTALS & CUSTOMER SERVICE

USER MARKETING MANAGER: **DEBBIE BRADY** dbrady@endeavorb2b.com

REPRINTS: reprints@endeavorb2b.com

LIST RENTAL / SMARTREACH CLIENT SERVICES MANAGER: **MARY RALICKI**

mrallicki@endeavorb2b.com

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SALES REPRESENTATIVES

NORTH AMERICA ACCOUNTS MANAGER: **PATRICK CARMODY** pcarmody@endeavorb2b.com

INTERNATIONAL SALES

ITALY: **DIEGO CASIRAGHI** diego@casiraghi-adv.com

GERMANY, AUSTRIA, SWITZERLAND: **CHRISTIAN HOELSCHER**

christian.hoelscher@highcliffmedia.com

BELGIUM, NETHERLANDS, LUXEMBURG, UNITED KINGDOM, SCANDINAVIA, FRANCE, SPAIN, PORTUGAL:

LARA PHELPS lara.phelps@highcliffmedia.com

PAN ASIA: **HELEN LAI** helen@twoway.com.com

DIGITAL

SENIOR DIGITAL INNOVATION & STRATEGY DIRECTOR: **RYAN MALEC**

rmalec@endeavorb2b.com

DESIGN & ENGINEERING GROUP

EVP, DESIGN & ENGINEERING GROUP: **TRACY SMITH** tsmith@endeavorb2b.com

GROUP CONTENT DIRECTOR: **MICHELLE KOPIER** mkopier@endeavorb2b.com

VP OF MARKETING SOLUTIONS: **JACQUIE NIEMIEC** jniemiec@endeavorb2b.com

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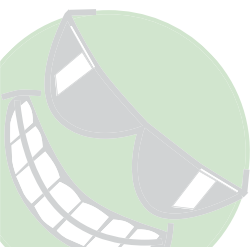


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Editor's Page

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The Fundamentals of Blocking and Tackling

AT THE START of another football season, it's appropriate to begin with a quote from one of the game's greatest coaches, Vince Lombardi.

More than 50 years after his death, the game Lombardi succeeded at has changed in many ways. It is a faster game played by bigger men who are specialists at their positions. They are afforded all of the technology available to analyze and parse every move on the field to find ways to improve performance and prepare for their opponent.

Yet one of Lombardi's greatest quotes remains true. "Football is two things. It's blocking and tackling," he said. "I don't care about formations or new offenses or tricks on defense. You block and tackle better than the team you're playing, you win."


I reflected on those fundamentals in two ways last month while attending the MD&M West convention in Anaheim.

Just as the latest wave of COVID-19 was flaring across the country, exhibitors and attendees gathered to take what was for many their first foray into trade shows in more than a year. And yes, it was a smaller, cautious group in attendance that week.

The enthusiasm in the room was larger than the attendance, however. There was a joy at being able to see people in three dimensions. There were fist bumps or, for those maintaining their distance, just a cheerful conversation. The fundamental need to learn about new product offerings and operational strategies was strong, and those in attendance benefitted from the experience.

It also reminded me of those fundamentals Lombardi spoke about. We have embraced technology more than ever over the last 18 months. We have relied on it for human contact and information and entertainment, and it has been a useful tool.

Technology will only take us so far, however. When technology is misapplied, it is like using a hammer when what you really need is a screwdriver. Like any other tool, technology is only as valuable as the training and application behind it. In our rush to embrace technology's undeniable value, we have to remain focused first on the job to be done.

Technology was on display at MD&M West, and it was encouraging to see the level of research and development that has occurred in spite of—and occasionally because of—the pandemic. We have continued to advance and continued to innovate. In our understandable rush to get back to more of business as usual, though, let's not forget the fundamentals of blocking and tackling. Let's make sure we're clear on the goals, clearer than ever with our people on the expectations and making sure we are providing all the fundamental tools they need to succeed. 



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News

IFPS Announces its 2021 Fluid Power **HALL OF FAME INDUCTEES**

Nine honorees will be recognized at the group's annual conference in October.

The International Fluid Power Society has named nine men to the 2021 class of the Fluid Power Hall of Fame.

The honorees are:

- Peter A.J. Achten, Ph.D.
- Timothy R. Bailey
- Jim Brizzolara
- George Doig
- Craig M. Fox
- Medhat Khalil, Ph.D.

To be inducted posthumously are:

- Harley E. Bergren
- Richard J. (Dick) Fontecchio

The 2021 inductees will be honored at a dinner and ceremony Oct. 6 as part of the 2021 Annual Meeting series in Reno, Nev.

In a press release, IFPS officials stated, "The success of the Fluid Power industry is not in its hardware, pumps, valves, cylinders and hoses—but rather the success is through the efforts of our dedicated individuals—innovators, researchers, application engineers, educators, as well as sales and service personnel. These people are the reasons that our industry continues to thrive."

IFPS also provided biographies of this year's Hall of Fame class. They are:



Peter A.J. Achten

Peter A.J. Achten, Ph.D.

An internationally recognized and outspoken proponent of efficiency and energy conservation, since long before they were "popular" topics, Peter A.J. Achten, Ph.D. has spent his four-decade career in fluid power emphasizing "the quest for a designer is not to find just a random solution, which you might do with just creativity, but to find the right solution." With over 40 individually titled patents in Europe, the United States, Japan and through the World Intellectual Property Organization (WIPO), Achten has also authored well over 200 survey reports, conference papers, magazine articles and books, and has presented invited speeches, workshops and lectures around the world and in several languages.

In 2019, Achten won the Robert E. Koski Medal from the American Society of Mechanical Engineers (ASME). The Koski Medal, established in 2007, recognizes individuals who have

advanced the art and practice of fluid power motion and control through education and innovation. In 2008, Achten was awarded the Joseph Bramah Medal from the Mechatronics, Informatics and Control Group of the Institution of Mechanical Engineers. Established in 1968, the Bramah Medal is awarded for outstanding achievement tending to advance the science of mechanical engineering, particularly in the field of hydraulic engineering.

Timothy R. Bailey

As perhaps the busiest and best-known fluid power activist on the Australian continent, Timothy R. Bailey is largely responsible for developing all the Australian fluid power organizations, their professional focus, content and training programs. Bailey has served as president of Western Australian Fluid Power Society Inc. for 12 years (1994-2006), president of International Fluid Power Society Australia Inc. from 2006 to 2014, president of Fluid Power Society Australia Inc. from 2014 to 2016, and president of Fluid Power Society (WA) Inc. from 2014 to 2019. In leading these organizations, Tim concentrated on developing and promoting fluid power training and certification.

He was instrumental in creating the original WAFPS Curriculum Matrix, which is now the central focus of the



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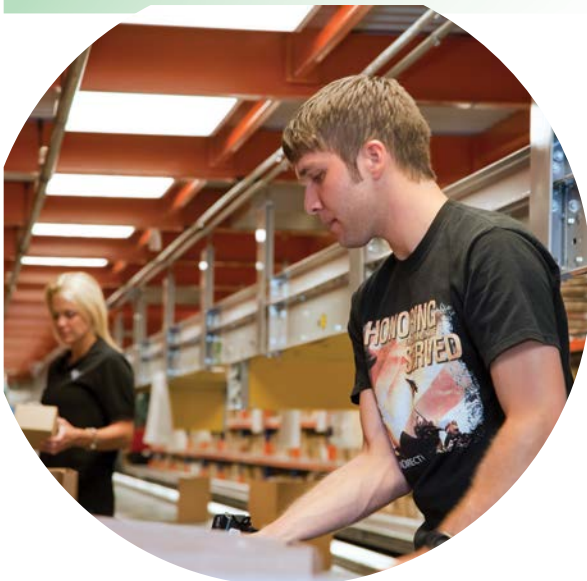
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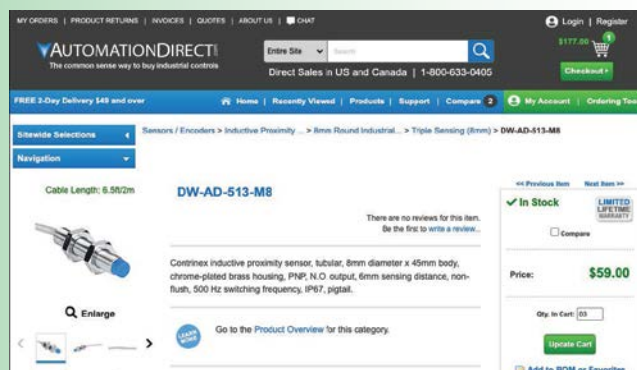
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Timothy R. Bailey

Australian Fluid Power Society, Inc., an International Associate Member of the IFPS. Individually, on land, sea or air, Bailey focused on another new topic—safety. For over 35 years, he has been integrally involved in chasing machine defects and finding the flaws on malfunctioning fluid power systems, as well as the design, construction and commissioning of a wide variety of systems. With a view to maximizing the safety of innumerable different machines, Bailey has served as consultant and expert witness for cases involving accidents, hydraulic equipment failures, specification errors and design mistakes that led to workplace injuries and fatalities.

Jim Brizzolara

With his 56 years of dedicated service in fluid power, Jim Brizzolara is well-known for his insistence on superior quality and uncompromised customer service. Brizzolara co-founded HydraForce in 1985 with a mission “to provide the customers with highest quality products and the most responsive support at a globally competitive price.” This mission became the job description for every employee, and the vision “to delight the customer” was adopted as each employee’s guiding mantra. Through Jim’s emphasis on quality and



Jim Brizzolara

performance, including the formation of a Quality Support Administrative Team, the company won industry awards and accolades including quality commendations from Bobcat, Caterpillar, Douglas Dynamics, Terex Genie, Clark Hurth and Skyjack.

HydraForce earned the Ford Q1 Quality Audit on its first attempt and the company was among the first 80 companies earning ISO-9000 Certification. Brizzolara placed strong emphasis on community involvement and student training. HydraForce supported the growth of students, suppliers and employees through contributions exceeding \$400,000 in grants, tuition support and training programs. Also making donations to local schools, HydraForce provided full sponsorship for the Wheeling High School Robotics Lab. Upon Jim’s nomination to the Hall of Fame, a colleague stated, “I do not believe the custom integrated hydraulic circuit and custom manifold industry would be what it is today without the ingenuity and foresight of these men.”

George Doig

George Doig started in fluid power after World War II naval service in the South Pacific. As he promised his mother, before enlisting Doig com-



George Doig

pleted his B.S.M.E. degree at Detroit Institute of Technology. George worked several years for J.N. Fauver before he and three others founded Numatics in 1953. George rose to senior vice-president and director of sales/marketing and participated in the rollout of Numatrol products. In 1966, George and L. Irwin Walle authored *Practical Air Circuitry* to address real, practical fluid power aspects—not included in published books of the day. The 1950s found George as one of 30 founders of the Fluid Power Society (IFPS) and Chapter 1 in Detroit. In 1973, he led the NFPA group establishing industry standards resulting in American National Standard Method of Diagramming for Moving Parts Fluid Controls.

George holds four U.S. air control patents, and most are also patented in Germany, Switzerland and Australia. He founded manufacturers’ representative Doig Associates in 1972, which also produced air circuit panels. George was well known for troubleshooting abilities as well as design creativity. He lived up to the company slogan “Air Logic That Works.” George was a certified Fluid Power Engineer (CFPE) from 1994 to 2010. After his retirement and more than 60 years in the fluid power business, George continued to participate in the annual southeast Michigan fluid power golf outing.

Craig M. Fox

Focusing on all aspects of excellence in fluid power education—including training design, teaching and publishing accurate educational materials—Craig M. Fox has spent most of his 41 fluid power years pursuing quality education in all its forms. Craig served as technical editor for the well-known industry standard *Lightning Reference Handbook* published by Berendsen Fluid Power (formerly Paul Munroe Hydraulics). He worked for Eaton Corporation, Maumee, Ohio as a senior technical trainer and contributed to Eaton's (formerly Vickers) published *Industrial Hydraulics Manual*, an industry-recognized hydraulics textbook. In this role, Craig also trained most personnel working in Eaton's accredited distributor warranty facilities.

As the founder of the Universal Stu-



Craig M. Fox

dios Internship Program and member of the Canyons Educational Program Curriculum Development group, Craig continues to be an active member of the electronic technology curriculum review board for the College of the Canyons in Santa Clarita, Calif. Craig's technical developments include the application of Eaton's EHST (electro-hydraulic system controller valve/board) to control critical hydraulic application pressure to within one psi.

He has been widely known as both a repair expert and personnel trainer for installed, non-functioning industrial hydraulic applications.

Medhat Khalil, Ph.D.

Winning the 2012 Otto Maha Pioneer in Fluid Power Award, Medhat Khalil, Ph.D. is serving his 16th year as the director of professional education and research development for the Applied Technology Center of the Milwaukee School of Engineering (MSOE) in Milwaukee, Wisc. Medhat is the recognized authority on the design and construction of Universal Fluid Power Trainers, which he originally developed under a grant from the Center for Compact and Efficient Fluid Power (CCEFP) in 2009. Since that grant, Khalil has contributed to the specification

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Medhat Khalil

and commissioning of training labs for MSOE, Concordia University's Fluid Power Research Lab, Egyptian Iron & Steel Company's Hydraulic Training Center and the Giza, Egypt Civil Aviation Authority's Fluid Power Training Lab. He has authored five books on fluid power components, systems, fluids and contamination controls as well as numerous periodical articles.

Khalil has served as the International Fluid Power Exposition's (IFPE) chair

of the Education Committee in 2017 and 2020. Tri-lingual in Arabic, English and French, he has taught fluid power courses to industry professionals for over 20 years in the United States, Canada and the Middle East. Medhat has developed and copywritten software programs for analyzing and training on hydraulic systems. Medhat's doctoral thesis for Concordia University in Montreal is the patent-pending "Double Swash Plate Axial Piston Pump with Valve Ring Concept."

Noah D. Manring, Ph.D., P.E.

Prominent educator-author Noah D. Manring, Ph.D., P.E. has served on the Mechanical and Aerospace Engineering Department faculty of the University of Missouri, teaching graduate and



Noah D. Manring

undergraduate courses in fluid power since 1997, and becoming dean of Engineering in 2020. He has published 44 archival journal papers, 38 conference papers and three books in fluid power. He is working on his next book, *Opportunity, Genius, and Entrepreneurship: A History of Modern Engineering*. Manring holds 12 United States patents, including his most recent in 2019: "Check valve pump with two-phase flow control." He earned his doctorate



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from Iowa State University and became a registered Professional Engineer for the State of Missouri in 2006. Extending well beyond the usual industrial fluid power impact, Manring's patents include 2018's "System to improve management and monitoring of cardiovascular disease."

A featured invited lecturer at Baylor and Vanderbilt Universities, as well as in Korea, China and Canada, Noah has assisted many upcoming engineers by advising doctoral, master's and honors-level undergraduate students. He has been a productive participant in \$2.245 million of grants, contracts and industry gifts, such as from Caterpillar and the National Fluid Power Association (NFPA).

He served from 2006 to 2010 as scientific advisory to the Center for Compact and Efficient Fluid Power (CCEFP). His former students say:

"His expertise created an environment which gave difficult topics elements of understanding to young, inexperienced engineers without losing detail and depth."

INDUCTED POSTHUMOUSLY WERE:

Harley E. Bergren (1917-2021)

An Army Air Corps veteran of World War II, Harley E. Bergren passed away during the 2021 Hall of Fame nomination year. At 103, Harley had been nominated as a living recipient but passed on March 19, 2021—three days before his 104th birthday. After service as an aircraft mechanic in North Africa and Europe during the war, Harley went to work at Gates Rubber in the Quad Cities selling to



Harley E. Bergren

agricultural equipment companies. Bergren moved over to Char-Lynn Company from 1958 to 1966. In 1966, Bergren founded Power Systems in Minnesota, a fluid power distributor with particular expertise in developing transmission systems for its customers. Harley retired in 1982 but remained a company stockholder until the company was sold in 1998. Today, Power Systems is a part of Applied Industrial Technologies. Colleagues remember Harley as an

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“interesting” and far-sighted inventor. He developed a unique lawnmower drive system before hydrostatics was invented, using a cam, a valve and two gear pumps to provide three forward speeds, neutral and one reverse. In 1967, Harley applied for and subsequently held the patent for a hydrostatic transmission and its attendant controls to propel land-based moving vehicles, such as garden tractors.

Richard J. (Dick) Fontecchio (1948-2014)


Richard “Dick” Fontecchio Began his fluid power career in 1965 as a summer intern at Fluid Power Systems in Glenview, Ill. Fontecchio went on to earn a bachelor’s degree and subsequently an MBA from Lake Forest College. In 1985, Dick co-founded HydraForce with Jim Briz-



**Richard J. (Dick)
Fontecchio**

zola in Northbrook, Ill. Following a discussion between the two men, Dick declared his insistence on quality products and excellent customer service as guiding principles. HydraForce was founded to satisfy the mobile equipment industry’s need for the finest quality hydraulic cartridge valves and their mounting manifolds, both provided with timely and responsive customer service. While emphasizing the two guiding prin-

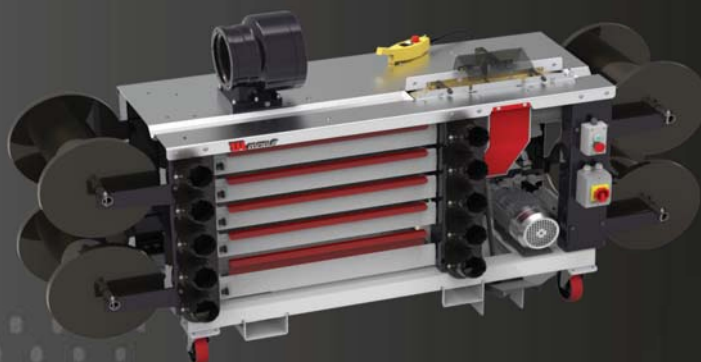
ciples, HydraForce became a leader in engineering innovation and design flexibility afforded by cost-effective and space-saving cartridge valves and hydraulic integrated circuits.

The legacy of Dick’s company is to now employ more than 1,000 people and manufacture both in the United States and abroad. With Dick’s leadership as vice president of sales and marketing, HydraForce released over 15,000 both standard and proprietary valves and their electro-hydraulic controls. The company grew into the world’s largest supplier of high-performance hydraulic cartridge valves, electro-hydraulic valves, custom manifolds and electro-hydraulic controls. HydraForce’s pervasive culture of superior quality and outstanding customer service is a testament to Fontecchio’s legacy, commitment and foresight. 



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Demystifying Digital Transformation in REFINERIES

For fluid power managers in refineries, a See-Decide-Act cycle puts the right information in front of the right expert.

AT A GLANCE:

- For fluid power managers, maintaining visibility for key actuators and processes is critical.
- Digital transformation allows operators to record data that reflects the current state of their assets.
- Optimizing operational processes puts into motion an unending cycle of information. This cycle includes three stages: See, Decide and Act.

Because high volumes of oil, gas or chemicals are moved every day, fluid power managers at such refineries are challenged with maintaining the actuation of process valves that control fluids and gases that are at the center of a plant's performance. Unmeasured parameters or unknown anomalies can compromise the valve package, resulting in catastrophic failure. If critical process valves and actuators fail, refineries suffer unplanned shutdowns that result in millions of dollars lost each day. To protect the area and maintain uptime, knowing the condition of assets, systems and equipment is critical.

Many plants don't yet have ways to monitor and measure asset health. If they do, such measurements often are

The digital transformation of process manufacturing enables personnel to see the real-time health of refinery assets, providing the insight needed to make decisions that can improve safety and increase productivity.

ineffective and potentially hazardous to workers. For some, service is time-based and performed in a fixed cycle or at a periodic interval. Others are reactive, running machines until components fail, then making repairs. Both have high operations and maintenance costs and a high frequency of unplanned downtime.

The third option is to use technology that enables operators to see the real-time health and condition of their assets remotely so they can make informed, proactive decisions that maintain the valve package and minimize unplanned downtime. Refineries use digital transformation to automate and optimize operational processes in order to keep processes running as long as possible and to keep personnel safe.

BENEFITS OF DIGITAL TRANSFORMATION

To some, the term "digital transfor-

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Emerson's TopWorx DXP discrete valve controller contains sensing and feedback in a single housing. Suitable for use in SIL-3 applications, it's certified for use in hazardous areas. It tracks a wider variety of variables and is easier to set up and integrate into processes than other HART 7 technologies.

mation” may sound cryptic and complicated, but it really is about taking practical steps to make operations clearer, easier and more concrete. By definition, digital transformation is a process that a facility, system or piece of equipment undergoes that allows end-users to see real-time data, make decisions based on it and act based on those decisions. Digital transformation puts the right information in the hands of the right expert, no matter where they sit, which improves the speed and accuracy of decision-making and action.

Some facilities manually measure and record critical data such as valve cycling and position. This “scorecard-and-stop-watch” process means that people must climb ladders and take catwalks to get data that’s already outdated by the time it can be used for decision-making. There also are some measurements that can’t be taken, so even stale data can’t be accessed.

Digital transformation allows operators to easily record data that reflects the current state of their assets. The information can be reviewed from a handheld device or control room work-

station. The digital transformation of a machine can be as simple as adding a sensor that captures data about its current performance and health. Through this process, real-time information is collected and converted into useful analytics and insights that can be used to automate a task, like moving from clipboards to digital record keeping or optimizing an area around safety, production, energy use or reliability.

In this way, digital transformation gives operators access to a previously hidden level of asset health and condition, affording them a deeper understanding of assets in their present state and the ability to compare them to the past, and even to predict the future. This empowers operators to make confident, informed decisions that significantly improve their operations, resulting in greater reliability, cost savings and safety.

SETTING THE SEE-DECIDE-ACT CYCLE IN MOTION

Automating and optimizing operational processes using technology puts into motion an unending cycle of infor-

mation. This cycle includes three stages: See, Decide and Act. In process applications, different fluid control devices automate each stage.

SEE. This starts the cycle at the sensor. Sensors and switches collect vital data about process valves that allows operators to see measurable input—such as cycles, temperature, contact status and position—in real time. These sensors are linked to technology that enables connectivity, such as a discrete valve controller.

DECIDE. a discrete valve controller sends sensor data to a control device, such as a distributed control system (DCS) or safety instrumented system (SIS) DCS.

The DCS analyzes and visualizes the data, translating it into dashboards that operators can easily interpret and synthesize. By quickly and clearly understanding what data means for operations, operators gain the expertise that empowers them to make better and faster decisions with confidence.

ACT. Mobility tools enable the appropriate personnel to access preset alerts, information and prescribed actions from multiple platforms. These critical actions spur personnel to repair an asset or replace a component and are a vital step that improves safety and reliability.

The collaboration of these layers provides valuable analytics and services that enable device life-cycle management, position feedback, transition dwell time and internal device temperature. This constant cycle of seeing, deciding and acting creates a technology loop that continuously improves expertise and efficiency.

USING TECHNOLOGY TO AUTOMATE AND OPTIMIZE OPERATIONAL PROCESSES

While sensing and feedback devices are available discretely, there are also integrated solutions available. Some discrete valve controllers combine sensing technology and a HART 7 module—as well as other components, such as a solenoid valve for piloting—in a single



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housing. This switchbox sits on top of the valve package.

While the position sensing switch monitors valve position, the HART module captures data from the sensor and sends it to the control system, which analyzes it and carries out appropriate actions in response to it. Analytics and diagnostics about valve condition, including position percentage, transition dwell time, last open/close stroke time, internal device temperature and cycle count, can be delivered to the appropriate personnel via handheld device or at a control room workstation.

As a critical part of the technology loop, integrated switchbox solutions help refineries solve several challenges. One big issue is maintaining uptime. Continuously monitoring performance lets operators improve the visibility of the valve package condition. The system sends alerts based on preset param-



The magnetically driven TopWorx GO Switch from Emerson provides reliable proximity sensing in demanding and extreme conditions.

ters to maintenance staff when necessary. This shifts plant maintenance from reactive to proactive maintenance.

Predictive and prescriptive main-

tenance analytics improve decisions around device and system replacement, reducing unplanned shutdowns while lowering scrap, repair and labor costs. When a single shutdown of a valve can cost \$1.3 million a day just in lost output, and a plant may likely experience 27 days of unplanned shutdown a year, costs add up fast. Reducing unplanned downtime by 36% through proactive maintenance results in significant savings.

By automating and optimizing maintenance, as well as data collection and delivery, discrete valve controllers like this also enhance safety. Proactive maintenance and preset safety alerts and alarms reduce the frequency of maintenance rounds, while remote monitoring of valve package condition curtails the need for workers to be physically close to the asset. Fewer maintenance and troubleshooting trips decrease the frequency of possible injury and improved

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insights empower personnel to make better safety decisions.

When properly networked, discrete valve controllers with a HART 7 module can also rescue stranded data, which can offer additional insights and further improve uptime and safety. An estimated 85% of HART devices in operation experience stranded information due to accessibility issues or legacy control systems.

Capturing diagnostics and parameters using traditional cabling may be too expensive or, in offshore applications, too heavy. As part of the integrated switchbox solution, HART can be networked with gateways either wired or wirelessly via an adapter, and connected to stranded devices wirelessly or a cable/wireless hybrid solution. As a global standard to exchange digital information, HART undergoes revisions that enhance its capabilities and can absorb or umbrella the previous

version, creating a long-term, future-proof investment.

ACCELERATING DIGITAL TRANSFORMATION WITH CONNECTED TECHNOLOGIES

By automating and optimizing operational processes, the digital transformation of process valves and actuators helps refineries solve critical challenges they face. And facilities don't have to face those challenges, or digital transformation, alone.

Whether they have a mature technology strategy or just starting on a digital transformation, plant managers can partner with an expert in helping hydrocarbon facilities navigate digital transformation. Such providers have a comprehensive offering, from valve to control system, from software to services, and can meet a plant at any stage in its journey.

Digital transformation doesn't have to

feel unknown, ambiguous or scary. It's built upon a foundation of data, which facilities have in abundance. Refineries can reliably access and put to work their data pools using reliable technology backed by expert support. By automating and optimizing their operational processes, refineries can better understand the condition of their process valves, reduce risk and reach new levels of uptime. **hp**

JASON MADERIC is director of global marketing at TopWorx for Emerson. In his role, Maderic specializes in discrete valve controllers. He has been with Emerson for three years.

AMIT PATEL is marketing manager for digital transformation within the Fluid Control & Pneumatics business at Emerson. He focuses on driving the marketing direction and strategic vision for the Industrial Automation segment.

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Hydraulic Cylinders: Comparing Custom and COTS Offerings



Off-the-shelf cylinders may be “good enough,” but custom ones often offer the best solution.

Hydraulic cylinders are the muscle behind many industrial and mobile operations. Compared to other actuators, hydraulics deliver:

- Efficient power-to-weight ratios.
- Variable speed control.
- Mounting and positioning benefits.
- Cost- and energy-efficient designs.

But once a design team opts for hydraulic actuators, they are faced with another decision: go with commercial off-the-shelf (COTS) cylinders or have them custom-made.

STANDARD CYLINDERS

COTS cylinders have definite advantages. For example:

- They are readily available and can be delivered almost immediately.

- They minimize manufacturing costs.
- Their performance is proven.
- They cost less than custom-made versions.

The main problem with standard cylinders is they are not optimized for any design team's application or product. In fact, it's highly likely COTS cylinders will be either over-designed or under-designed. If they are over-designed, customers will pay for performance and features they never use. This can lead to inefficiencies and lost performance and downtime. All of these leave customers dissatisfied.

Under-designed COTS cylinders are even worse. Users are stuck with under-performing cylinders likely to fail, leading to costly repairs and replacements. And depending on the failure, it can be extremely dangerous.

CUSTOM CYLINDERS

For many products and equipment, engineers should go with custom cylinders. It lets engineers “build” cylinders that fit the customers' needs and eliminates the inherent inefficiencies of under- or over-engineering.

They also provide host of benefits.

Design teams can move ports to different locations, change the mounting style, adjust the orientation and make other refinements. Even if no major design changes are needed, custom cylinders can be tweaked to ensure they fit exactly and simplify installation. For example, ports, manifolds, and hoses will all line up, avoiding delays and risky “good enough” assembly.

An off-the-shelf cylinder is a one-size-fits-all solution. So engineers may wind up designing products to accommodate the cylinder rather than the other way around. This limits design



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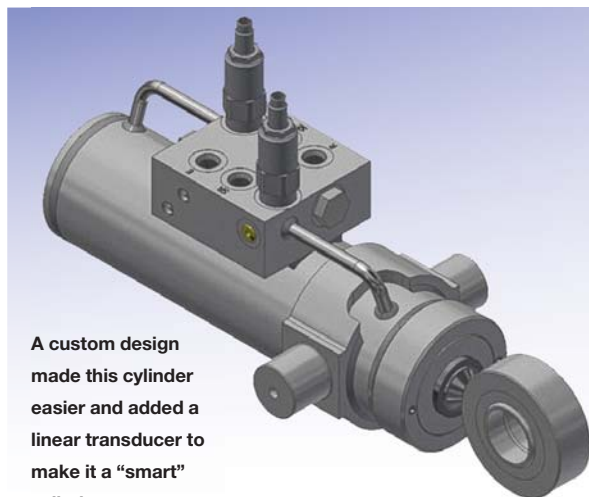
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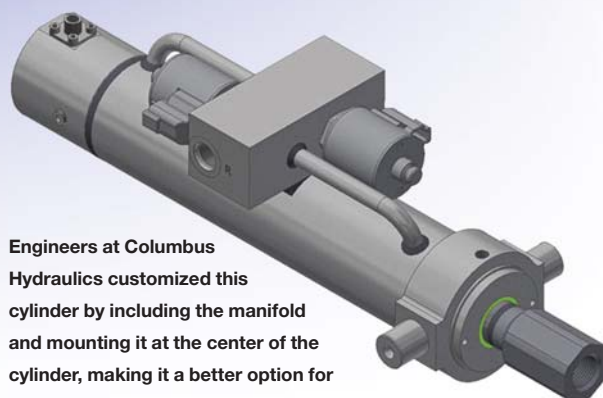


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A custom design made this cylinder easier and added a linear transducer to make it a “smart” cylinder.



Engineers at Columbus Hydraulics customized this cylinder by including the manifold and mounting it at the center of the cylinder, making it a better option for attaching the hose and simplifying assembly for the customer.

flexibility, and teams will have a harder time juggling the issues of space, weight, performance, serviceability and ease of assembly.

Companies also turn to custom cylinders to meet ISO certifications or other industry standards and regulations. This is especially important in the medical, food and beverage, and other highly regulated industries. Engineers can also design custom cylinders that are more compact and lightweight than their COTS counterparts, making custom hydraulics better for tight spaces and mobile.

There are several key design aspects to keep in mind when specifying custom cylinders. Each of these considerations presents a challenge for standard cylinders, but custom designs can overcome these challenges and turn them

into opportunities for better cylinder performance. Considerations include:

CYLINDER SIZING. An inappropriately sized cylinder can have drastic implications for the performance, efficiency and reliability of any hydraulic system. Cylinder bore size is particularly important, as it determines the force the actuator can generate. If the cylinder diameter is too small, the actuator may not reach the customer’s targeted speeds or cycle times.

ROD CHOICE. When choosing the best rod for a cylinder, its diameter and material type are important. The goal is to get the lowest priced rod that is suitable for the application at hand. By designing custom cylinders with fatigue, buckling and impact-failure in mind, engineers can design better, more efficient rods. This could help

reduce the rod diameter which, in turn, lowers the cylinder’s weight and the price of the cylinder.

Custom cylinders and rods also let designers choose among several materials. Nitro steel shafting, for example, offers protection when applications involve consistent exposures to chemicals such as fertilizer. Induction hardened shafts can be used for its added protection, which exceeds that of standard chrome when it comes to handling debris that may affect the shaft and lead to premature failure.

SEALS. No single seal material and type is compatible with every cylinder design. Depending on the customer’s application, they can be made of elastomers, thermoplastics or thermoplastic elastomers such as rubber, polyurethane and polytetrafluoroethylene. An applica-

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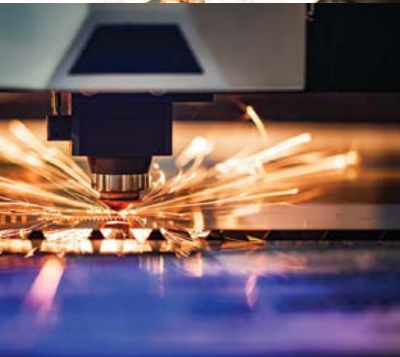
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tion and its pressure, temperature, speed and the environment must be taken into account to get the right custom seal.

CYLINDER MOUNTING, ASSEMBLY AND MAINTENANCE. Custom cylinders with orienting ports, manifolds and

hoses/fittings designed with a specific application in mind can simplify assembly and setup. This saves time when installing the cylinder at a customer's location. It also streamlines operations by making the cylinder more accessible

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Besides being lighter and more compact, custom cylinders are often easier to mount, as bearings and pinholes can be added wherever they are needed.

for repairs and maintenance.

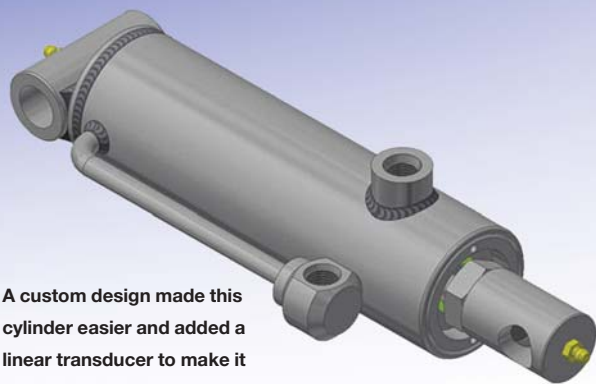
Besides being lighter and more compact, custom cylinders are often easier to mount, as bearings and pinholes can be added wherever they are needed. Changes in mounting position, even seemingly minor ones, can dramatically improve cylinder performance, efficiency and product life. And installations won't take nearly as long.

Less-expensive COTS cylinders quickly become the more expensive option if a company must waste time and money on grueling installations and purchasing additional fittings or longer hoses. There's also the risk of displeasing customers.

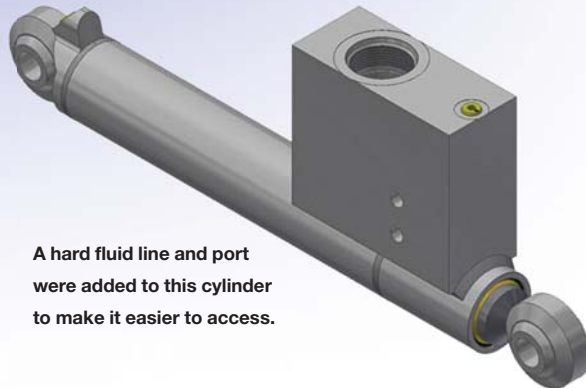
COTS cylinders will struggle with many of the above considerations and will likely never end up being better than merely "good enough." Custom hydraulic cylinders, however, can use those design aspects and application restrictions as a blueprint for success. The resulting cylinders will be much closer to optimal. For example, piston rods can be customized to be exactly the required length and diameter, and made of materials that best suit the application.

Custom cylinders also offer better design integration. Valves, valve manifolds and electronics can be built directly into the cylinder body. This helps customers get their equipment up and running quickly.

Custom cylinders can also be



A custom design made this cylinder easier and added a linear transducer to make it a "smart" cylinder.



A hard fluid line and port were added to this cylinder to make it easier to access.

designed for specific operating conditions and environments. It doesn't matter if the cylinders will be exposed to high ambient pressures in deep-sea environments, high ambient temperatures in near sweltering furnaces or sub-arctic conditions; custom cylinders can handle it.

CUSTOM CYLINDERS TO THE RESCUE

Custom cylinders can solve tough design problems and lead to more elegant and workable solutions. For example, one company was wasting a lot of time and money trying to get all the air bled out of the cylinders in a machine they were making. To make the problem more complicated, the standard cylinders they were using had to be embedded in the frame. They switched to a custom cylinder with a piston re-phasing valve that could bleed all the air out internally. This saved customers a significant amount of installation time.

In another example, a company's design team had little space to work with so it chose whatever standard cylinder would squeeze into the space. Once the designers installed it, they realized that they couldn't get a hose plumbed to the cylinder. They switched to a custom cylinder with a hard fluid line and a port that allowed for easy cylinder access. This saved

them assembly time and eliminated the need for additional hosing.

Early onset failure is common with standard cylinders. One company noticed this when trying to use catalog cylinders as the struts for a self-propelled sprayer. The main problem seemed to be the seals. To keep its

hydraulics up and running, the customer chose a custom option that involved a new seal package designed specifically for high speeds and violent pressure spikes. **hp**

JOE MIKSCH is director of engineering at Columbus Hydraulics, Columbus, Neb.



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Efficiency is an absolute requirement for manufacturing in terms of productivity and financial success. That is why most manufacturers go to great lengths to ensure their assembly lines are laid out in carefully designed configurations, workers and machine operators are strategically placed, and material and labor waste minimized.

Yet, one area of manufacturing in need of efficiency gains is one of the most overlooked, namely, joining subassemblies of multi-ton machines.

PROBLEMS WITH CRANES

Cranes have been traditionally used to join large and massive subassemblies, oftentimes two halves of the final machine. In this process, one subassembly, which can be as large as a house and weigh up to 50,000 lb, is suspended and lowered by a crane to line up with a matching subassembly. This is a time-consuming maneuver that creates unac-

ceptable risks of injuries to workers, damages to the subassemblies and surrounding equipment, and a major loss of productivity.

In a typical real-world example, a defense contractor that made large, armored vehicles regularly maneuvered a multi-ton sub-assembly hanging from a crane to line up with its mate, another massive sub-assembly on a stationary table, so technicians could join the two. This meant those technicians had to relay instructions to a distant crane operator.

The operator had to move the crane and assembly painstakingly slowly to keep the load from swinging out of control and colliding with surrounding equipment or workers. This meant the operator was forced to wait until the load's center of mass settled between small, incremental moves to ensure safety. As a result, the entire process routinely took hours to complete—an unacceptable amount of time.

Despite taking the time to be extra

cautious the company still couldn't fully eliminate the risk to workers and equipment posed by those multi-ton suspended loads. The slightest wrong movement or minor equipment failure could injure or kill someone.

The company was aware of the U.S. Bureau of Labor Statistics' reports of dozens of workers dying each year and hundreds more injured in crane-related accidents. Little wonder that the manufacturer eventually eliminated both cranes and suspended loads for equipment mating and switched to air-caster-powered transporters that could safely get the job done, and in minutes rather than hours.

The full assembly can then be driven through the rest of the manufacturing process on the air transporter. Efficiency goes up, process costs go down and safety hazards are significantly reduced—altogether producing superior results when compared with crane operations.

Workers join the two subassemblies into one piece, enabling the transporter to drive under both and safely move the fully assembled structure.

That's good news for workers who no longer have to worry about loads suspended above their heads.

AIR CASTER TECHNOLOGY

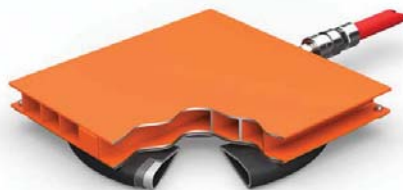
An air caster's main component is a durable, flexible, doughnut-shaped airbag that can be inflated with compressed air. It is affixed to a metal housing that supports the load. The airbag is inflated with standard plant air at about 90 psi. Once the airbag fills and reaches its maximum expansion, excess air is channeled between the floor and caster, creating a film of air that is as thin as a business card. The load then literally floats



AeroGo builds remote controlled transports (orange) that utilize airbags/air casters for moving heavy loads.

atop that film with the casters lifting the load no more than an inch or two.

Air casters work on the same basic physical principles as a hovercraft or the puck in an air hockey game. A thin film of air lowers friction coefficient between load and floor to less than one percent, so even extra heavy loads can be easily moved by a single worker. In fact, depending on floor



Air casters are relatively simple with few components. Mainly an airbag and housing, and some pneumatic connections.

conditions, a single operator exerting no more than 25 lb of force can move a 5,000-lb load over a surface that slopes 0.25 in. in 10 ft. And operating the casters requires only basic instruction; there is no need for certification or formal licensing.

Floors should ideally be flat, continuous and solid to get the best performance from a set of air casters. About 90% of applications are on standard factory smooth concrete floors. If the casters pass over cracks, bumps, gaps, joints or other irregularities, they may not be able to maintain enough sufficient air pressure to create the film of air. Such floor imperfections can be corrected by using overlays or other techniques.

Air casters fit beneath the load, enabling the load to be moved in any direction or rotated in place for precise positioning. They can also be differentially inflated so that casters under the front of the load are slightly deflated compared to those under the rear of the load. This lets workers slightly tilt a subassembly and align it to mate with another subassembly.

Air casters can be built into transporters that include drive and power subsystems, operator handles, throttle controls and no-load wheels to ease handling and direction control.



Profitability depends on maximizing production availability. I need to prevent unexpected machinery downtime caused by valve and cylinder failures.

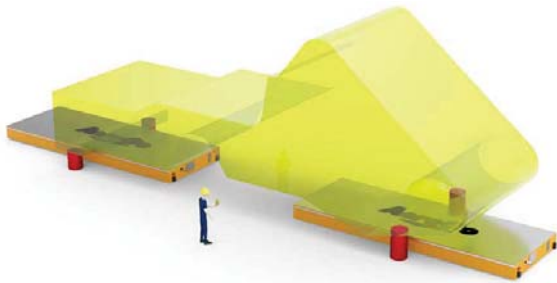
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CONSIDER IT SOLVED™



Large components can be easily moved and positioned using air casters to join them quickly.

DOWNSTREAM PRODUCTIVITY GAINS

Air casters did more for the defense contractor than expedite equipment mating; they helped completely revamp the whole workflow.

Air casters potentially enable wholesale changes to the duration of the assembly line process. Because they maneuver through narrower corridors, make 90-deg. turns, rotate in place and can be precisely positioned by hand, the manufacturer could completely reconfigure individual workstations for maximum efficiency. In the event of future changes, they can be further reconfigured without the stresses or limitations associated with crane accessibility.

EASING THE MATING PROCESS

Flexibility is paramount for successfully enacting lean manufacturing methodologies and other approaches to increase efficiency, throughput and plant capacity. The ability to re-design and re-sequence subassembly timing and workflow is key to reducing space, labor and time requirements. A material handling system that easily moves throughout a manufacturing facility is a vital tool for a manufacturer to maximize efficiency across the entire production process.

Air casters turn a laborious, potentially dangerous procedure into one that's short, simple and safe. Fewer safety barriers are required, and workers handle multi-ton loads with greater peace of mind and confidence. The manufacturer can achieve bottom-line improvements from greater throughput.

Air casters have proven ideal for mating massive structures in manufacturing environments by dramatically reducing completion time from hours to minutes with a safer, more efficient assembly process from start-to-finish. They represent a material handling system proven to create and maintain a seamless assembly line process. **hp**

MIKE BROWN is a mechanical engineer and sales operations manager at AeroGo, Inc., Seattle.

Miniature Valves



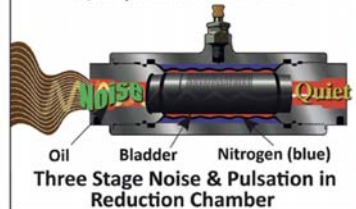
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Round Cylinder a Big Solution for Smaller Footprints

THE NEW DSNU-S round cylinder is in response to the need of machine designers for smaller versions of standard components so they can shrink the footprint of their machines or production lines accordingly. The DSNU-S is up to 40% slimmer, 35 mm shorter and 50% lighter than its ISO counterpart DSNU of the same bore and stroke length. The DSNU-S is designed for direct mount installation and built for reliability and a long service life thanks to its low-wear polyurethane seals and corrosion resistant piston rod and housing.

Depending on the size (piston diameter from 8-25 mm with a maximum stroke length of 200 mm), the DSNU-S is available with fixed end cushioning or Festo's proprietary self-adjusting cushioning (PPS).

FESTO www.festo.com

SmartStage XY is an Integrated Direct-Drive Solution



THE SMARTSTAGE XY platform combines the precise direct-drive motion of two axes (X and Y) with all of the motion control

components built inside of the stage. The integrated components include controllers, amplifiers, encoders, I/O and three communication options. The resulting SmartStage XY platform has two axes of motion with only a single stationary cable exiting the unit.

Available in four common travels (50, 100, 150 and 200 mm), each stage can be configured to match the mechanical and sample size needs of an instrument or microscope. As a result, the linear motor

based SmartStage XY allows the motion and controls subsystem volume to decrease by up to 400%.

For product release and launch, the SmartStage XY can be modified and optimized for specific customer needs. As a result, the configurable SmartStage XY platform decreases product design time, enables on-time instrument product launch and is a cost-effective solution for production volumes.

DOVER MOTION dovermotion.com



Brushless Motor Gives Oxygen Therapy the Silent Treatment

FOR PATIENTS RELIANT on oxygen therapy for a severe lung disease, oxygen concentrators offer more mobility than heavy, bulky oxygen tanks, but still can be noisy and tiring. Enter the Silencer BN Series Brushless DC Motors. The smallest Silencer motor, including housing, measures 1.2 in. in diameter and 1.3 in. long. The Silencer series motors have a continuous torque ranging from 2.4 to 519 oz. per inch, speeds up to 20,000 rpm and range-rated power up to 874 watts.

The Silencer's high level of efficiency also ensures a longer battery operating life for oxygen concentrators, whether running in a pulse-flow or continuous mode. Moog also designed the Silencer with high-energy magnets and exceptional winding density to not only reduce the motor's size, but also generate nearly twice as much torque as conventional stator technology.

MOOG www.moog.com



Larger Stepper Motors Now Available in Six More Sizes

THE SURESTEP MOTORS now are available in NEMA 42 frame sizes. Six new motor sizes are available with single or dual shafts, extending the SureStep line to 12 motors with a torque range up to 4,532 oz-in.

The mating extension cables are available in 6- 10- and 20-ft lengths, and an encoder adapter plate option allows the attachment of CUI Devices AMT132/AMT332 encoders and US Digital E6 encoders.

The online Stepper System selector has been updated to include these new NEMA 42 models and will guide you through the selection of a stepper motor and all the compatible system components.

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Valve Change Delays Cylinder's Motion

Try your hand at solving this month's head-scratcher.

The hydraulics used on a press had a pilot-operated directional valve that developed a leak at a construction plug. The company needed a gauge to set the main pump pressure and used a construction plug hole in the directional valve for the gauge. However, although the port was an

SAE O-ring connection, the technician forced an NPT fitting into the port, causing an unfixable leak.

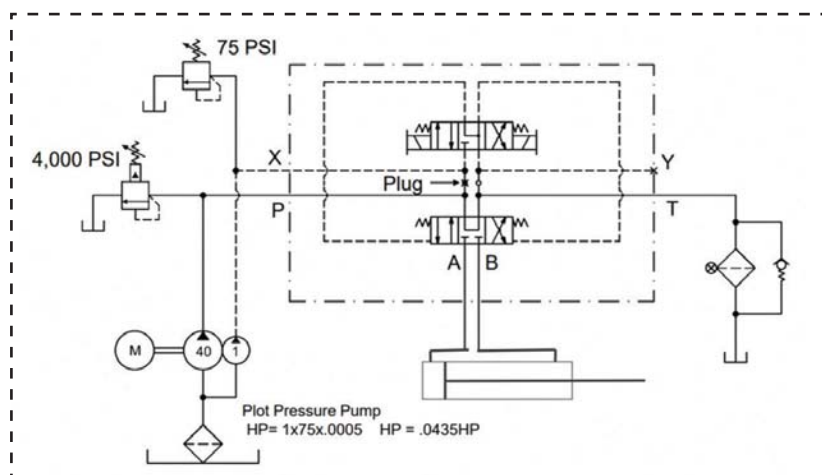
The company discovered a used valve in its storeroom with the same tandem spool set up and installed it. But then they had a problem with the system taking 14 to 16 sec. before the cylinder would move. Technicians

ensured the pilot-operated relief control orifice was clear of any obstruction, but the delay continued.

ANY IDEA WHAT THE PROBLEM COULD BE?

THINK YOU KNOW the answer to this month's troubleshooting problem? Then email your answer to rjsheaf@cfc-solar.com (put "Sept" in the Subject line.) All correct answers received by Oct. 30, 2021 will be entered in a random drawing. The winner will be mentioned in a future column.

ROBERT J. SHEAF, JR. is founder and president of CFC Industrial Training, a division of CFC Solar, which provides technical training, consulting and field services to any industry using fluid power technology. Visit www.cfcindustrialtraining.com for more information.

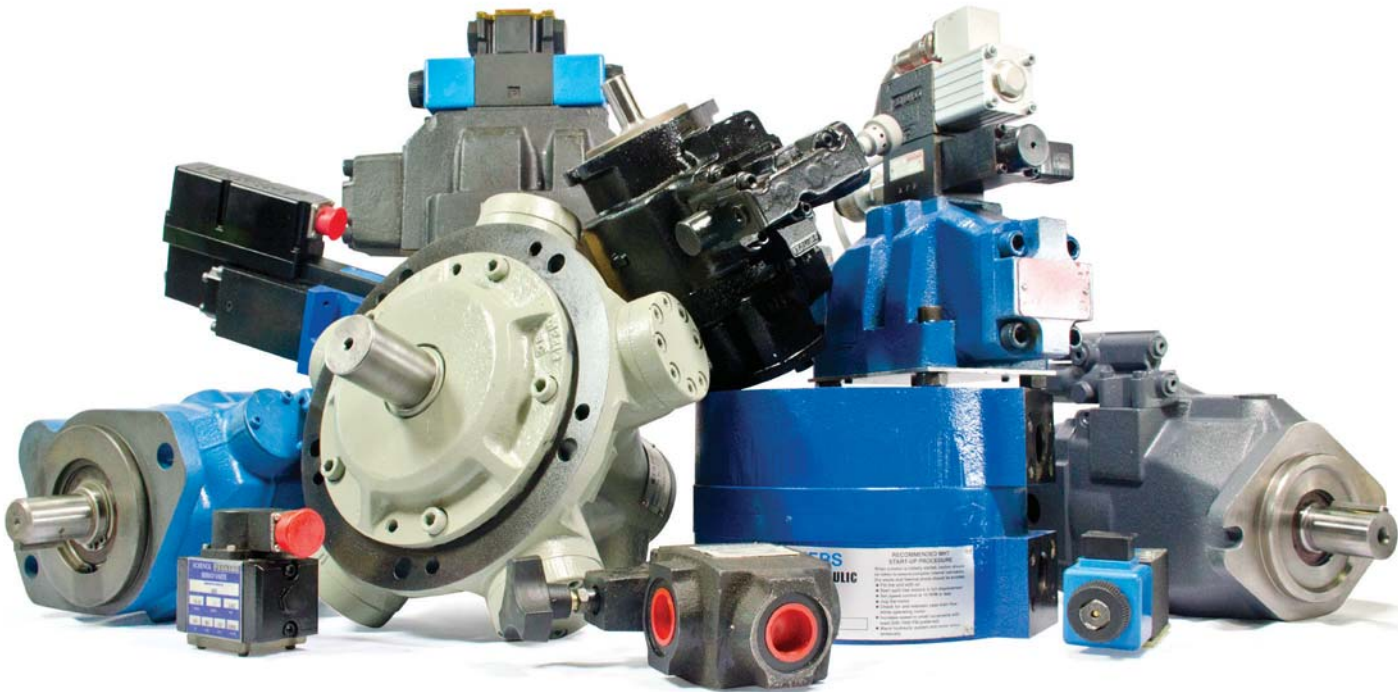


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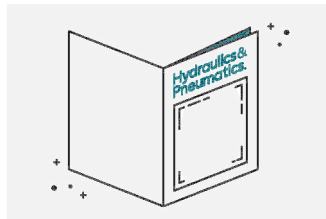
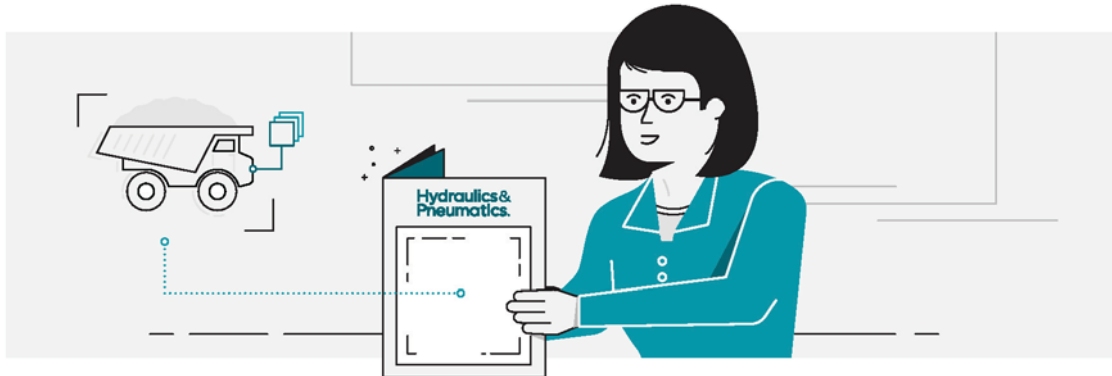
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After a long career in the newspaper industry, Bob has been an editorial team leader for more than 20 years. During that time, he covered the global transition of the plant floor and its systems and managed several international automation conferences. Bob is also a sought-after Webcast moderator and event emcee, and has presided over events in the U.S., Germany and China.

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