

# VALVE

MAGAZINE

FALL 2023  
VOL. 35, NO. 4

## Clean Energy Coming, But Oil Market Still Strong

: PRV BASICS

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: IMPACT OF  
: WATER HAMMER

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# Manufacturers Standardization Society

OF THE VALVE AND FITTINGS INDUSTRY

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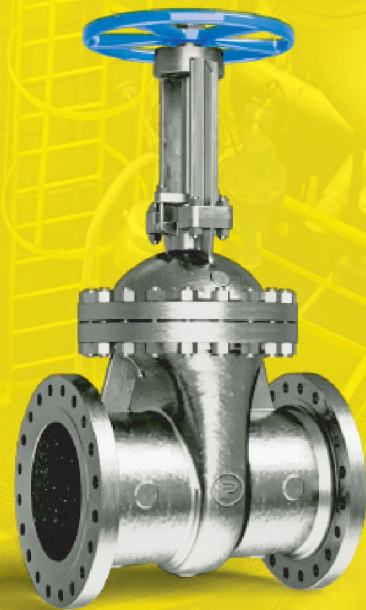
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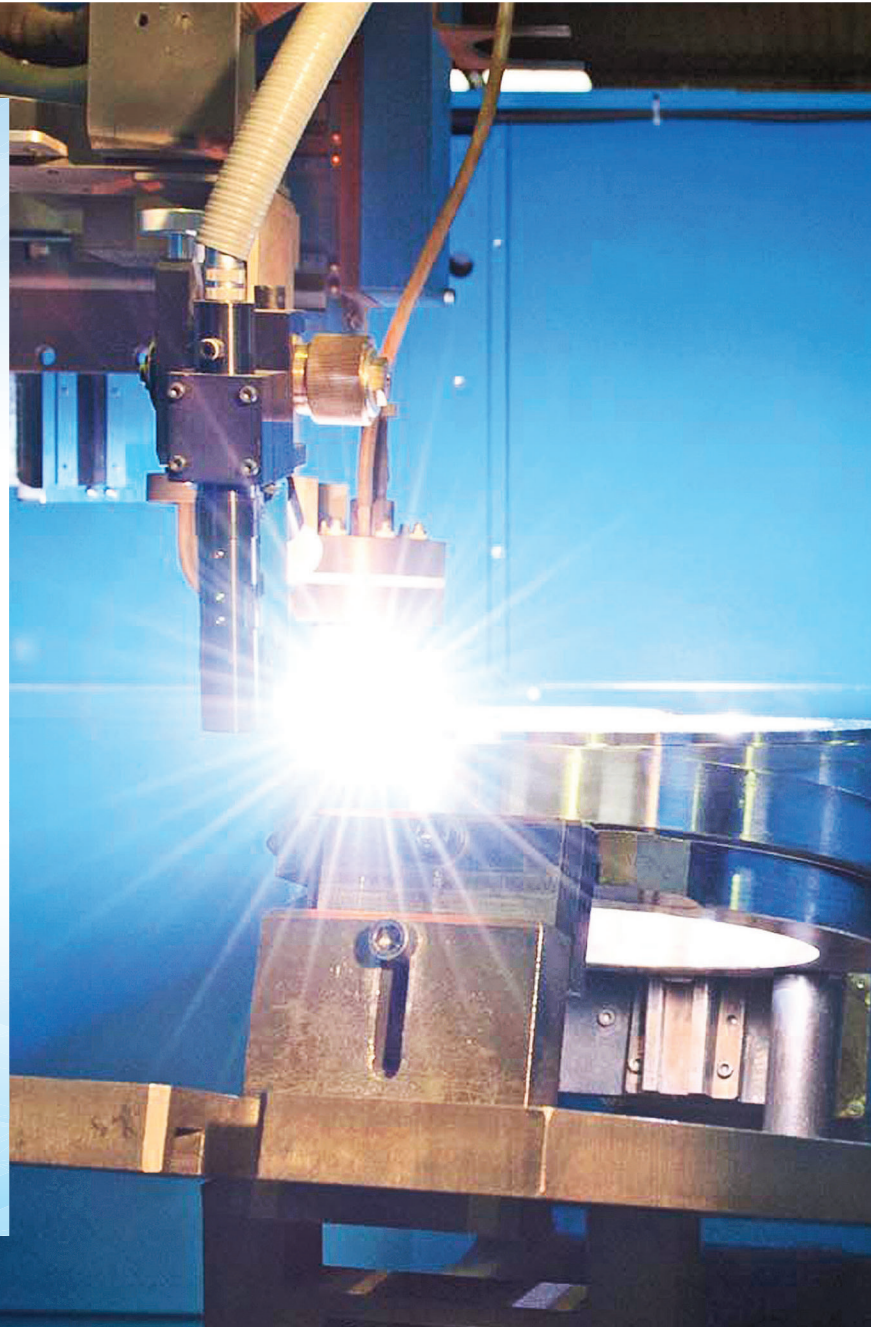


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**18**

## The State of the Valve Industry is... Mixed

Market Outlook Workshop speakers agreed that the future is very positive in some verticals but expect it to be much softer in others. **BY HEATHER GAYNOR**

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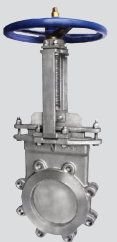
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Air Valves in Piping Systems



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**VALVE** MAGAZINE

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# Reflecting on 2023 and Looking Ahead to 2024



The fall issue of *Valve* is starting to become a favorite of mine, mostly because it provides the opportunity to share a lot of the activities and benefits that VMA member companies can access. This issue is no different, with a look at VMA's Market Outlook Workshop and the VMA and VRC Annual Meeting — VMA's 85<sup>th</sup>!

Both events are only open to VMA and VRC member companies, and attendees hear the latest and best insights into our industry and the markets served. At both events, but especially the Annual Meeting, it is heartening to see how many individuals contribute to not only VMA, but also to advancing the industry and their companies. I am incredibly honored to be able to recognize a few of these individuals each year with VMA's Membership Awards — see **page 12** for this year's winners.

At both events, attendees heard that the industry continues to be strong, and while there may be cracks showing in certain market segments, there is still plenty of opportunity overall for the industry. See **page 18** for more on the sessions.

Also heard at both events were topics like the possibilities with hydrogen and carbon capture, and sustainability. Our industry has contributed greatly to the reduction in fugitive emissions over the last quarter century, making a substantial, positive impact on the environment. VMA is proud to announce a more focused effort on sustainability with a sustainability message, and plans to develop and share toolkits and more. I am also excited that VMA will be holding our first Hydrogen Valve Summit, also addressing carbon capture technologies, on April 9, 2024, in Houston.

VMA's government affairs focus continues, especially regarding the effort to broadly categorize, legislate and regulate all PFAS chemicals. PFAS substances must not be categorized into overly broad groups or classes, otherwise, there will be significant negative economic, industrial competitiveness, national security, environmental and quality-of-life impacts. There are currently no alternatives to the gaskets, seals and coatings that use this material. VMA continues to raise awareness and educate legislators and regulators on our concerns and is also providing suggestions to a path forward.

As always, if you'd like to learn more about VMA, please contact me at [hrhoderick@vma.org](mailto:hrhoderick@vma.org).

*Heather*  
**Heather Rhoderick, CAE**  
President

# Large Valve Expertise

Valves come in a variety of sizes, from fit in your hand types to giant 40-foot-tall, 72,000-pound monsters. It takes unique infrastructure, equipment and expertise to repair, modify or service these giants of the flow control industry. At United Valve we rely on a purpose-built 42,000 sq. ft. repair building, designed to handle the largest valves and flow control devices. The 56-foot-tall repair building contains 40-ton, 20-ton and 10-ton overhead cranes which allow us to easily handle valves of nearly any size and weight.

Large-bore valve machine tools are also located in this building, including a 20-foot table, *Farrell* vertical boring mill that can handle components up to 20 feet tall. An additional 102" vertical mill is also located in this building, along with internal and external grinding machines for large-diameter rising-rotating plug valves. Welding positioners for the heaviest valves, along with submerged-arc and cold-wire TIG welding units provide ample welding and joining capability in the repair shop. Additional machine tools, including CNC equipment, are located in the adjacent 60,000 sq. ft. production building.

Our large valve testing capabilities include a very large *Porgetti* horizontal testing machine encased in a large timber-lined steel bunker. This unit can test the largest API 6D ball or gate valves. An 850-ton vertical test machine for testing large, high-pressure butt-weld end valves is also located in the building.



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## Acquisitions, Mergers & Partnerships

### FLOWSERVE TO TERMINATE AGREEMENT TO ACQUIRE VELAN

French authorities have informed both Flowserve and Velan that they will not provide the requisite regulatory approval for the sale of Velan to Flowserve. The initial arrangement agreement made on February 9, 2023, and amended on March 27, 2023, will be vacated. Flowserve informed Velan of its intent to terminate the agreement based on the lack of regulatory approval from France for the transaction to close.

The closing of the arrangement was always pending regulatory approvals. To meet that condition, Flowserve offered a package of remedies and undertakings to the French authorities to help the deal close, but they were informed

that they will not be provided with the regulatory approvals, regardless of these offers.

"We thank our employees and other stakeholders who supported the proposed transaction," says James Mannebach, chair of the board of directors of Velan. "Although we are disappointed with the outcome and the decision of the French regulators, we remain confident in the future of Velan's business. We will now turn our entire focus to the operation of a successful business while continuing to assess all strategic options available to the company to create value for all of our stakeholders."

Flowserve president and CEO, Scott Rowe, says: "We are obviously disappointed with the French government's decision. We do not believe the decision aligns with the French government's stated goal of

encouraging foreign investment into France's economy. Throughout this process, Flowserve worked diligently and proactively to address all of the concerns that were raised by the French government. We were optimistic about the acquisition of Velan and the numerous benefits this would provide for both companies and their stakeholders. We sincerely appreciate the efforts of our Flowserve associates and Velan team members who worked so tirelessly on the transaction. We remain excited about the future of Flowserve and will continue to aggressively pursue our 3D strategy."

The full statements and more information can be found on the Flowserve and Velan websites.

### EMERSON TO ACQUIRE FLEXIM

Emerson announced a definitive agreement to acquire Flexim Flexible

Industriemeßtechnik GmbH ("Flexim"), a global leader in clamp-on ultrasonic flow measurement for liquids, gases and steam.

Headquartered in Berlin, Germany, Flexim brings complementary technology and strong customer relationships to Emerson, with an installed base of more than 100,000 flowmeters, as well as approximately 450 employees. Flexim provides clamp-on ultrasonic flow measurement technology for a broad range of end markets, including chemical, water and wastewater, life sciences, food and beverage and power generation. The transaction will expand Emerson's automation portfolio and measurement capabilities, complementing its existing flow measurement positions in Coriolis, differential pressure, magmeter and vortex flow measurement. Upon the close of the transaction, Flexim's Berlin headquarters is

## PEOPLE IN THE NEWS

### MSS APPOINTS NEW LEADERSHIP AND STAFF

The Board of Directors of the Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry has named Lorna Soderberg as executive director. She previously served as MSS operations manager for more than three years.



Lorna Soderberg  
Photo Credit: MSS

President of the MSS Board of Directors, Jim Barker, says: "Lorna has very effectively demonstrated her business and leadership skills in this position. She was instrumental in planning and executing a successful 2023 annual meeting, implemented a new AMS and website, and oversaw the sale of the

MSS headquarters building." Barker notes that he and the Board "are confident Lorna will do an excellent job leading and building on the foundation of MSS as we begin the next 100 years."

"I have enormous respect for MSS and what the Society has accomplished since it was formed in 1924," says

Soderberg, "and I'm excited to lead the organization into an even more successful second century."

In addition, MSS has selected Stefania Adjei as technical coordinator. She comes to MSS with many years of project management experience. Adjei is pleased to join the MSS team to continue the excellent record of publishing new Standards and interacting with ISO as the US TAG 153 administrator.



Stefania Adjei  
Photo Credit: MSS

The Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. is a non-profit technical association organized for the development and improvement of industry, national and international codes and standards for valves, valve actuators, valve modifications, actuator mounting kits, pipe or tube fittings, flanges, pipe or tube hangers and supports, and associated seals, springs, spring washers and fasteners. MSS is an American National Standards Institute (ANSI)-accredited standards developer.

planned to become Emerson's Ultrasonic Flow Measurement Center of Excellence.

**GROTH CORPORATION'S BIOGAS BUSINESS LINE ACQUIRED**

Groth Corporation has announced that Energenex Inc. has purchased several product assets associated with the "Groth Biogas" business segment.

Groth Biogas, a business segment of Groth Corp. established over 60 years ago, provides pressure protection, control systems, flame control, liquid and foam separation, as well as

**EXXONMOBIL TO ACQUIRE PIONEER NATURAL RESOURCES IN ALL-STOCK TRANSACTION**

The merger combines Pioneer's more than 850,000 net acres in the Midland Basin with ExxonMobil's 570,000 net acres in the Delaware and Midland Basins, creating the industry's leading high-quality, undeveloped U.S. unconventional inventory position.

Together, the companies will have an estimated 16 billion barrels of oil equivalent resource in the Permian. At close, ExxonMobil's Permian production volume

transaction represents an opportunity for even greater U.S. energy security by bringing the best technologies, operational excellence and financial capability to an important source of domestic supply, benefiting the American economy and its consumers.

**UP TO \$1.2 BILLION ANNOUNCED FOR TEXAS AND LOUISIANA PROJECTS**

As part of President Biden's Investing in America agenda, the U.S. Department of Energy (DOE) announced up to \$1.2 billion to advance the development of two commercial-scale, direct air capture facilities in Texas and Louisiana. These projects — the first of this scale in the U.S. — represent the initial selections from the President's Bipartisan Infrastructure Law-Funded Regional Direct Air Capture (DAC) Hubs program, which aims to kickstart a nationwide network of large-scale carbon removal sites to address legacy carbon dioxide pollution and complement rapid emissions reductions. These emissions are already in the atmosphere, fueling climate change and extreme weather and jeopardizing public health and ecosystems.

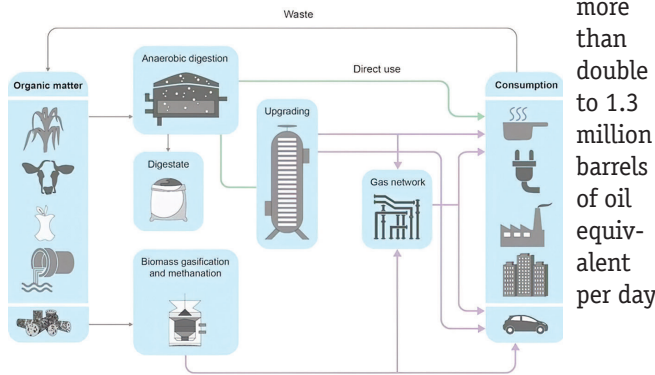


Image Credit: Groth Corporation.

fully integrated waste gas flare systems for the biogas and wastewater markets.

Since 2005, Groth has collaborated closely with Energenex to provide a complete line of equipment for the effective and safe control of gas from anaerobic digesters, covered lagoons, landfill gas sites and agricultural and renewable natural gas (RNG) systems in Energenex' sales territory in the upper Midwest, resulting in a partnership yielding positive results for both companies.

(MOEBD), based on 2023 volumes, and is expected to increase to approximately two MOEBD in 2027. ExxonMobil believes the

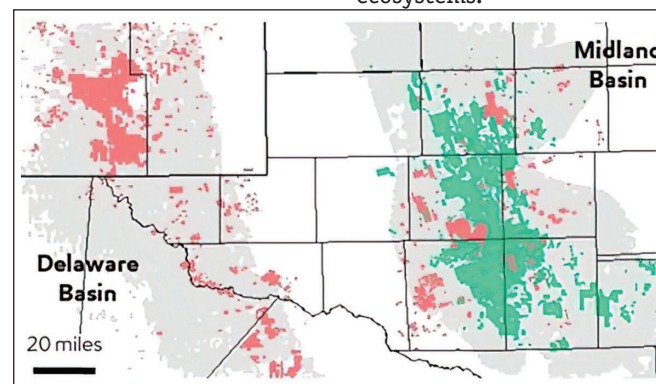


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**2024**

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**Hydrogen Valve Summit**

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**10-11**

**Valve Forum: Conference & Exhibits**

Houston, TX  
VMA.org

**OCTOBER**

**2-4**

**VMA/VRC Annual Meeting**

(VMA Members only)  
Savannah, GA  
Vma.org/AnnualMeeting

**OTHER VMA EVENTS**

Please visit [vma.org](http://vma.org) for additional programs as they are scheduled.

\*Open to VMA/VRC members only. Visit [www.VMA.org](http://www.VMA.org) to learn if your company qualifies for membership.

# VALVE MAGAZINE

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Gaynor, Editor-in-Chief,  
at hgaynor@gardnerweb.com

VMA's mission is to serve the growth and innovation of the U.S. and Canadian industrial valve industry globally by providing a forum that enhances a positive operating environment, increases knowledge, advances technology innovations, and facilitates business and government connections for manufacturers, distributors and service providers of valves actuators, and controls. This "VMA News" section of VALVE Magazine provides readers with a look into some of the VMA activities over the past quarter. For more information on any of these activities if you are a VMA or VRC member, or to learn about becoming a VMA or VRC member, contact VMA President Heather Rhoderick at [hrhoderick@vma.org](mailto:hrhoderick@vma.org).

## VMA Government Affairs Updates

### PFAS WORK CONTINUES

The North American and European focus on a full ban of all types of PFAS chemicals continues — as does VMA's efforts to raise industry awareness and advocate on behalf of our members to our government. Such a ban, which would regulate all substances containing PFAS or broad categories of PFAS in the same way, is excessively broad and would have a significant impact on polymers of low concern — many of which are used in the industrial valve industry. In July and August of this year, VMA went on the record voicing our concern with this approach and submitted comments on both prospective legislation and EPA proposed regulation.

In September, the EPA announced a final rule on reporting data that requires all manufacturers (including importers) of PFAS and PFAS-containing articles in any year since 2011 to report information related to chemical identity, uses, volumes made and processed, byproducts, environmental and health effects, worker exposure and disposal.

To support VMA's efforts further, VMA's "fly-in" on October 25, 2023, focused on addressing PFAS concerns as well as issues around Section 174 Capitalization Legislation. VMA is proud to work with our members as we reach out to members of Congress and educate them on our vital industry, and the significant impacts that potential legislation and regulation would have.

### VMA SUPPORTS EXPANDING "529 PLANS" TO HELP ALL WORKERS

On September 27, 2023, VMA joined with over 600 other associations and organizations supporting a workforce bill titled, "Freedom to Invest in Tomorrow's Workforce Act." The bill is important so that students, families and workers can better access the credentials and skills training that help grow strong, resilient careers, including those that are critical to the industrial valve industry and its end-use market customers. Under current law, 529 plan beneficiaries cannot use funds to obtain or maintain recognized postsecondary credentials, including professional, voluntary certifications, licenses and other valuable training and credentials. The Freedom to Invest in Tomorrow's Workforce Act would expand qualified expenses under 529 plans to include postsecondary skills training and credentialing programs, such as licenses and nongovernmental certifications — many of which apply to workers in the industrial valve industry. VMA is proud to help champion this important effort for a trained manufacturing industry workforce.





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# VMA and VRC Annual Meeting Recap

## SHAPING THE FUTURE OF THE VALVE INDUSTRY: A RECAP OF THE 85TH VMA ANNUAL MEETING

The Valve Manufacturers Association (VMA) celebrated its 85th annual meeting, September 18-20, in Savannah, Georgia, where industry leaders came together to explore the dynamic landscape of the valve industry. With an array of insightful sessions and expert speakers, the event provided a platform to discuss political and economic outlooks that will shape the industry's future.

The meeting kicked off with a deep dive into the political realm, addressing the legislative, regulatory and trade issues impacting the valve industry. Attendees engaged in discus-



Matt Thiel addresses the attendees.



Eric McClafferty and Omar Nashashibi share their insight.

sions on critical topics such as PFAS, infrastructure development, workforce challenges, tariffs, taxes and more. Expert insights from Eric McClafferty of Kelley Drye & Warren LLP, and Omar Nashashibi of The Franklin Partnership, shed light on the Biden Administration's stance on U.S. manufacturing and the regulatory hurdles ahead.

Understanding the economic factors influencing the valve industry's growth and sustainability is paramount. Michael Halloran from Baird, and Ken Matheny from S&P Global Market Intelligence, provided valuable insights into forecasting and effective planning for the industry's future.

The annual meeting featured specialized sessions where industry leaders were updated on specific aspects. More information on many of these and other sessions not highlighted here can be found in the article on page 18.

### Energy & Politics Combination:

Dr. Scott McKnight from the University of Toronto delved into the intricate connections between the energy crisis and global politics. Attendees gained insights into China's geopolitics and the dynamics of the oil and gas industry.

**Sustainability Insights:** Madelyn Street Tutewiler of Middleground Capital initiated discussions on the increasing demands for transparency and reporting on sustainability efforts within the valve industry. Attendees learned about customer expectations, sustainability best practices, and



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strategies to engage employees in these crucial efforts.

**Future-Focused Leadership:** The event concluded with Todd Hirsch providing futurist insights on various issues discussed throughout the meeting, including workforce challenges. Attendees left with practical tools to navigate the dynamic forces of the economy, geopolitics and evolving societal trends.

The 85th VMA Annual Meeting provided a rich array of subjects, empowering industry leaders with knowledge and strategies to tackle upcoming challenges. In addition to the

formal sessions, a number of networking and social activities ensured attendees had time to build relationships with their industry peers. The VMA and VRC take pride in offering this invaluable platform to its members. Looking ahead, VMA and VRC members should mark their calendars for the 86th Annual Meeting, scheduled for October 2-4, 2024, in Park City, Utah. As the VMA continues to collaborate with industry leaders and drive innovation in the industrial valve manufacturing sector, the future of the valve industry promises to be a dynamic and promising journey.

## VMA Establishes Sustainability Statement

VMA's Board of Directors approved a sustainability message for the VMA which will help to guide the organization as it develops tool kits and guidance for members working on their own sustainable initiatives. The full message, along with examples and links to information on how member companies are addressing sustainability efforts, can be found on the VMA website. A shortened statement is below. "VMA member companies recognize the importance of highlighting their own sustainability efforts to help provide a high quality of life for current and future generations," says Heather Rhoderick. "VMA's Sustainability Committee will help to guide VMA and our members throughout this effort with tools and information."

*Check out the full message, along with examples and links to information on how member companies are addressing sustainability efforts at [VMA.org](http://VMA.org).*

### SUSTAINABILITY MESSAGE

The industrial valve industry is dynamic, innovative, vibrant and responsible. VMA member companies play a vital role in the production of products essential to improving the quality of life of the public and protecting the planet. VMA members provide essential products that support energy, health, water and wastewater, food and beverage, construction and many other industries that are a part of the modern world.

VMA and its member companies recognize the challenges facing our society today, including climate change, meeting energy needs, economic security, and a healthy and safe quality of life for all. The products our members produce contribute to creating a more sustainable environment for all stakeholders. From fostering GHG emission reductions as societies work toward Net Zero targets to optimizing operations in support of sustainable manufacturing practices, valve products play a crucial role regardless of market sector.



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# Congratulations to VMA's Membership Award Winners

VMA 2023 Membership Awards recognize deserving individuals each year. This year, the awardees are Ron Warren of Bray International and Nathan Brunell of Baker Hughes.

VMA was honored to present Ron Warren with the distinguished Person of the Year Award. This award is VMA's highest honor and is given to one individual each year. The winner possesses a passion for the industry and shares their knowledge with others to help advance VMA and the industry at large. Through his leadership this past year and over the past years, Ron has been instrumental in guiding VMA through a number of changes to benefit our members, including the focus on government affairs activities.

VMA's Service Award recognizes individuals who provided outstanding service, expertise and guidance while participating on a committee or to VMA in another way. Nathan Brunell was recognized for his contributions over the year and in his support of others from Baker Hughes working on VMA Committees, including the newly formed PFAS Task Group.

"VMA is comprised of so many members who are the backbone of the association. We exist to serve our member companies and the growth and innovation of the U.S. and Canadian industrial valve industry globally. We could not do



Ron Warren



Nathan Brunell

Images: Bud Johnson

that without the exceptional efforts of individuals like Ron and Nathan, and are honored to have them helping to lead the Association," says Heather Rhoderick, VMA's president.

## VMA SCHOLARSHIP WINNERS ANNOUNCED

The 2023 VMA William Sandler Scholarship Winners are official. Congratulations to the following students whose parents or guardians work for a VMA or VRC member company, and who are studying topics related to STEM and our industry. Each will receive \$1,000 toward their studies.

■ **Lucy Dunn** – She is attending Tennessee Tech University and studying computer and electrical engineering. Her father, Jody Dunn, works for Quality Valve.

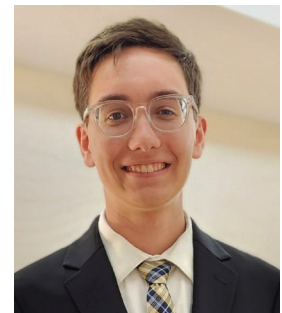
■ **Jacob Mizer** – He is attending Ohio University and is studying mechanical engineering. His father, Craig Mizer, works at AUMA Actuators.

■ **Daniel Triah** – He is attending Texas A&M and is studying computer engineering. His mother, Shitzuka Mita, works for KITZ Corporation of America.

Scholarship applications for 2024 will open in November 2023 and close in March 2024. Visit [www.vma.org/sandlerscholar](http://www.vma.org/sandlerscholar) for more information.




Lucy Dunn



Jacob Mizer




Daniel Triah


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# Call for Abstracts: Hydrogen Valve Summit and The Valve Forum: Exhibits and Conference

Are you interested in providing a presentation at VMA's newest event, the Hydrogen Valve Summit, or at the Valve Forum? If so, let us know your interest by providing the topic, a short description, learning objectives and presenters (if you know them). All submissions will be reviewed by the VMA committees responsible for developing the program. The presentations must be content-based and not sales-focused in nature. For more information about the events, visit [VMA.org/ValveForum](http://VMA.org/ValveForum). To submit a presentation abstract, visit [SurveyMonkey.com/r/VMAabstracts](https://www.surveymonkey.com/r/VMAabstracts) or contact Abby Brown at [abrown@vma.org](mailto:abrown@vma.org). See the ad on page 16.

## VMA and VRC Headquarters Have A New Address

VMA and VRC have moved offices from inside the District of Columbia to right over the Potomac River in Old Town in Alexandria, Virginia. The new office provides a modern layout and flexibility to meet the changing needs of staff and the way in which work is conducted today. It will have space available for VMA Committee meetings and also offers members a home base if they are in the DC area for business. The new location allows VMA to still effectively serve our members on Capitol Hill and meet with other like associations. A small display area filled with examples of our industry products — past and present — as well as an area to facilitate video content development are also part of the new office. The new address is 209 Madison St., Ste. 303, Alexandria, VA 22314. All email addresses and phone numbers remain the same.



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Photos courtesy of Getty Images.

# Flow Control Valves in Energy: Problems and Solutions

When systems are operating optimally, they can improve productivity, lower operating costs, increase reliability, reduce emissions and enhance safety.

BY COLLEEN URIARTE

Flow control system efficiency is central to operational sustainability across multiple energy markets. When operating optimally, these systems improve productivity, lower operating costs, increase reliability, reduce emissions and enhance safety. However, outdated systems and equipment — which continuously bear extreme demands — present a major challenge. To ensure safe and smooth operations, aging control systems within the oil and gas industry need preemptive maintenance monitoring to support peak performance.

Thankfully, advancing technologies offer significantly improved methods to solve engineering problems, leading to more accurate and efficient processes. Let's explore the critical nature of control systems in addressing energy market challenges and enhancing system performance — and how technological advancements can help.

## THE IMPACTS OF AGING SYSTEMS AND INFRASTRUCTURE

Oil and gas leaks or release from aging flow control systems can have disastrous consequences, including worker injuries, safety hazards, pollution, environmental damage, danger to surrounding communities — and ultimately, a major blow to a company's bottom line. In addition, the energy market faces increased scrutiny from regulators and the public con-

cerning environmental impact and safety risks. Even if your outdated system doesn't result in a catastrophe, you could still face the pressures and fines of increased regulation.

## UNPACKING SOME OF THE PROBLEMS POSED BY AGING TECHNOLOGY

■ **Unresponsive BOP Control Systems:** Due to outdated designs, aging systems lack the latest safety features. As one example, unreliable blowout preventer (BOP) control systems may not be able to handle sudden changes in extreme pressure environments. This increases the risk of failure and exacerbates the safety risks of uncontrolled flow during drilling.

■ **Reduced Performance:** As with safety features, obsolete flow control systems lack the latest high-performance components. Not only does this reduce efficiency, but systems are also more likely to suffer breakdowns — both critically detrimental to your bottom line.

■ **Lack of Spares:** The inaccessibility to spares for outdated machinery parts further prolongs downtime during repairs. This affects productivity and profitability significantly.

■ **High Energy Consumption:** Outdated technology leans heavily on energy consumption; higher energy outputs for lower performance ultimately means increased operational costs down the line.

## ENHANCING FLOW CONTROL SYSTEMS FOR IMPROVED EFFICIENCY

Despite the problems posed by aging systems, technological advancements can offer noteworthy flow control improvements in the energy market. Let's take a look at simple maintenance strategies to enhance your system and maximize efficiency.

### Seal Replacement

While seal maintenance is crucial, complete seal replacement on aging flow control components can be costly. Many service providers that leverage new technologies can offer re-lapping services as an alternative. This provides a precise and consistent solution to recondition tungsten carbide seals, removing surface irregularities and imperfections. It extends the seal lifespan and effectively restores full functionality to prevent leakage in a cost-effective way.

### Customized Conversions

Reverse-flow hydraulic locking failure in blowout preventer circuits can be a critical problem in aging systems. Considering the immense pressure the systems are under, consequences can be severe if control fluid pressure prevents component movement.

Energy companies can solve this issue with cutting-edge directional flow control advancements by integrating newer check and shuttle control valve designs that accommodate unique flow rates and shuttling pressures. The check valves permit free oil flow in one direction and block oil flow in the

opposite direction, eliminating reverse flow. In new shuttle valve designs with the shuttle as the only moving component, the shuttle shifts back and forth to allow fluid to pass from a given inlet to the outlet while blocking the opposite inlet.

Together, these control valve options facilitate the smooth functioning of the BOP and solve hydraulic locking, allowing drill ships to resume operations safely and efficiently.

### Smart Valves

Since the margin between function and failure is minuscule in the energy market, there is a growing need for automation and precision. Valves, therefore, require accurate controls behind them to complete an effective design.

With modern technology, smart valves offer improved accuracy and significantly more data transferred between the control point and control center. Since systems can communicate data continuously and immediately, operators gain a real-time view to manage quality control components.

## OPTIMIZING REGULATOR PERFORMANCE AND DECK TESTING EFFICIENCY

Accurate prediction of oil or gas production requires effective well testing. But testing processes are easily hindered by vibrating unstable regulators, causing fittings to loosen from excessive shaking. As a result, deck testing becomes resource-intensive — involving extra labor hours, equipment operation and finances.

There are several alternative solutions to improve deck



testing efficiency and regulator performance. These solutions provide reliable and smooth hydraulic pressure during testing — while also reducing testing time.

### Advanced Regulator Features to Improve Performance

Advanced regulators that feature guided hydraulic damping technology significantly reduce dynamic oscillation. Some other features key to improved regulator performance during well testing include:

- Bolted plunger guides for accurate guidance
- Dynamic plunger T-seals to prevent spiral wound O-ring failures
- Improved set point resolution to lower deadband

### Reducing Debris Levels

Control fluid contamination or buildup of solids are also common issues that significantly reduce system performance. Besides hindering efficiency, this can lead to unnecessary downtime in various oil and gas operations.

Control valves with dual direction seal-in dependability and high debris tolerance will ease system component wear and tear, improving overall service life and decreasing ownership costs.

### UPGRADING FOR ENERGY SAVINGS AND LONG-TERM RELIABILITY

As the scale of projects in the energy market has increased, so too have demands and pressure on equipment. To maintain safe operations, optimize productivity and reduce operational costs, it's essential that infrastructure maintains prime working condition, even as it ages.

Relapping seals, implementing upgraded check or shuttle valves and leveraging smart valve technology are all effective solutions to improving efficiency, enhancing safety, and reducing downtime in aging systems. In addition, expert insights and advanced engineering developments allow flow control suppliers to offer customized solutions — specific to unique control system designs.

You don't have to risk major losses due to aging infrastructure. With specialist field engineers and well-established manufacturing teams leveraging new technologies, energy companies can work cleaner, safer and more cost-effectively. **VM**



Colleen Uriarte is the marketing manager for Gilmore and has worked with Gilmore's technical authorities for over a decade to provide quality product content for the company.

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**Introducing the Hydrogen Valve Summit:** Explore and gain a better understanding of the hydrogen market opportunities for the industrial industry with this focused, one-day Summit. Attendees will gain an understanding of the overview of the hydrogen landscape from government, research, and industry perspectives, as well as hear the latest technical information, case studies, and application considerations of the role valves play in the hydrogen market.

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**Plenty of networking takes place throughout the event, and tabletop displays and product demonstrations, competitions, and academic opportunities are available in the Exhibit Area.** Learn more and sign up for information at [www.vma.org/valveforum](http://www.vma.org/valveforum).

Both events are open to anyone in the flow control industry, from end users, manufacturers, to suppliers and distributors. Whether you are new to the industry or experienced you'll find valuable education, suppliers, and networking.

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FORWARD

# The State of the Valve Industry Today Is... Mixed



**VMA and HI members participated in an interactive, two-day workshop to discuss the biggest challenges and opportunities that lie ahead for industrial valve manufacturing and the markets served.**

BY HEATHER GAYNOR

In August, the VMA and the Hydraulics Institute (HI) held their annual Market Outlook Workshop for members in person for the first time since 2019. Attendees heard from a variety of global and national economic experts from key vertical markets as well as consultants, and like the last couple of years, the predictions are mixed and still being affected by the complete disruption of the pandemic. Overall, the experts don't think we're in for a bottoming out of the economy from a deep recession, but most do predict a softening and more contraction across industries. In this article, we'll cover the highlights from some of the key sectors and verticals where industrial valves play a critical role.

## OVERALL FLOW AND MOTION CONTROL PERSPECTIVE

Regularly featured speaker and senior research analyst for Baird, Michael Halloran, predicts a volatile next 6-12 months, or a bit longer for flow and motion control-focused companies that are in his purview. His long-term view is still strong, but in the short- and medium-term, he says he's less enthusiastic about returns. There have been several factors driving uncertainty for a few years, currently including: geopolitical issues with Russia and China; monetary policy; debt levels; a sluggish economic recovery in China post-Covid; student loan repayment resumption; globalization reversal, and the upcoming U.S. presidential election. Halloran says he and his colleagues believe that companies are still working out what

the new post-Covid normal is for orders and inventory stocking, and he thinks deglobalization will continue as U.S. companies onshore more of their manufacturing. Halloran also warns about government debt levels being historically high, and higher interest rates than we've seen in years, so companies may be holding back on investment while they wait for interest rates to dip again.

For 2024, Halloran shared the trends he sees for the next year and the cycles ahead — what he calls more of the same. Order levels should normalize, but he thinks that inventory levels will be reduced. There will be pockets where a recession has more of an impact, with up to a 20% decrease in revenue possible, but he thinks we'll be on the



Pipelines are being built across the country and around the world for petroleum products, as well as LNG and hydrogen.

upside of any recession in the next 18 months. He believes the U.S. is in better shape than most of Europe and even China as far as workforce challenges and demographic shifts, but it's still something that industrial companies need to anticipate. As part of supply chain control, he also predicts that customers will trend toward system and subsystem

purchases to reduce their supply chain risks, and that the workforce shift is a massive driver toward widespread automation.

When it comes to specific market verticals, oil and gas production levels are still quite high and he's optimistic they'll remain that way for a while. Chemical production is more closely

aligned to GDP, so it may still see fluctuations. LNG demand is still positive globally, and if natural gas prices start to rise substantially, there could be faster growth of LNG. And even with the push toward clean energy and decarbonization, Halloran says coal isn't dead, particularly because of strong markets for it in developing markets and countries like India and China. He's also bullish on nuclear as a good source of clean energy.

In closing, Halloran says, "In a world that has more debt than it's ever had, funding is a challenge and returns are vital. It's so important for you to be able to show ROI for [management's] willingness to spend. Demographic fixes don't have a return, but automation and productivity do. We need to think outside those boundaries."

#### **WATER AND WASTEWATER ARE STILL BOOMING**

Tom Decker, a consultant with more than four decades of experience in water and wastewater, calls the outlook



A municipal water system under construction – a sight in many cities and towns with the influx of government funding.

for the water and wastewater market like the last boom in the 1970s. With new laws and regulations passed, and billions of dollars appropriated for expansion and infrastructure, the industry is poised for a solid few years of continued steady growth, despite a significant shortfall in the number of workers.

The aging infrastructure, climate change and worker shortages are some of the largest challenges the industry faces. But drought is also a market driver for utilities, as half of the largest lakes are losing water and groundwater shortages are impacting cities such as Phoenix. But with the allocations from The Water Infrastructure Finance and Innovation Act (WIFIA), funds are flowing into water utilities across the U.S., with \$5.3 billion in projects in the pipeline for the year by May, and more coming. As of the workshop, 107 loans had closed for \$18.3 billion, with \$6.1 billion saved from WIFIA allocations already.

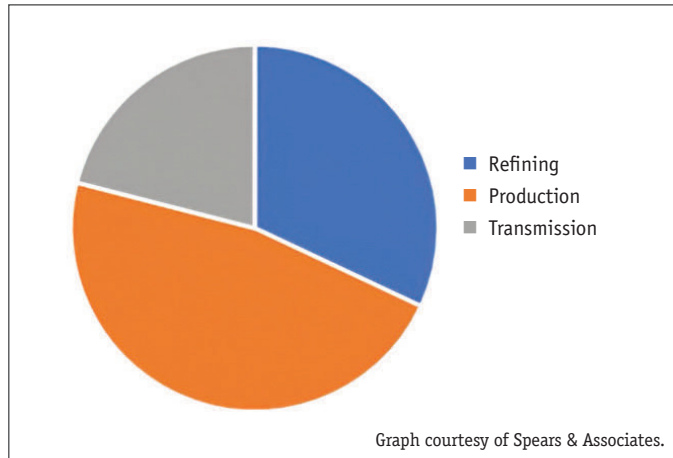
“Forever chemicals” like PFAS (per- and polyfluoroalkyl substances) have a direct impact on the country’s water systems and utilities. Estimates are that 45% of the U.S. drinking water

sources have PFAS in them, and the EPA and state governments are starting to pass guidance and legislation on the management of PFAS in water systems. This will continue to be monitored, and water utilities can expect to address this in the future. Decker says the American Water Works Association (AWWA) estimates a cost of \$2.5 billion per year to address this across 3,400-6,500 systems in the U.S. alone. But, only \$10 billion is currently allocated from the Infrastructure Investment and Jobs Act (IIJA). This shortfall in the

future will need to be addressed.

Other challenges today include difficulty sourcing products for these large jobs funded by the Build America Buy America Act (BABAA) which requires all iron, steel, manufactured products and construction materials used in federally funded projects for infrastructure to have a certain percentage of sourcing and production in the U.S. Many states are issuing waivers and accepting bids for non-U.S. products because they can’t currently be sourced from American manufacturers.

## U.S. Valve Manufacturers Shipments in 2023



LNG terminals like these will continue to be constructed as the fuel source grows in volume globally.

The high cost of concrete and labor are hindering some of the potential growth, or at least costing more than anticipated. Decker says there are currently 383,000 unfilled construction jobs in the U.S., and in infrastructure, only 11% of the workforce is currently under age 24, with 17 million infrastructure workers hitting retirement age in the next decade. This is already resulting in fewer bids and longer schedules, and this may continue for the foreseeable future.

Decker's forecast for the water and wastewater markets is for double-digit expansion for the rest of 2023 and 2024. Inflation and supply chain issues persist but are getting better, and the influx of government investment will help continue to keep this sector on an upswing for the next few years.

#### POWER MARKET

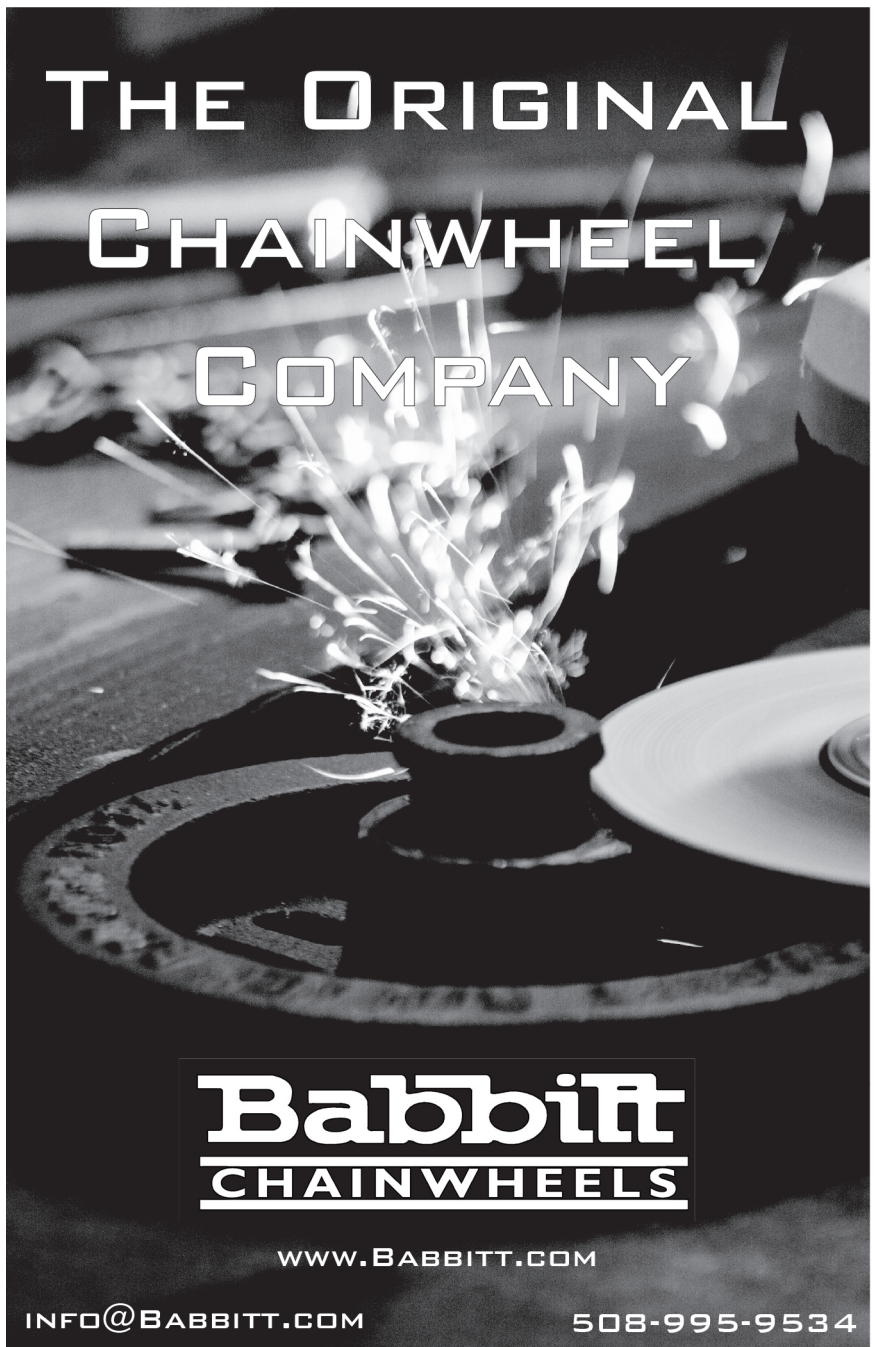
Climate activism is changing the power market. But the economics of shifting to clean energy is not just slow but very expensive. Lyle White of LWSC Consulting says that \$6.5 trillion has been spent to reduce fossil fuel emissions since the year 2000, and it's only reduced 1% from 82 to 81%. At that rate, and the cost necessitated to achieve this, current climate initiatives by the U.S. and the west won't offset the growing fossil emissions of China, India and other developing countries in Asia to meet any of the set goals.

Today, 22% of U.S. power production comes from solar and wind, but 60% must be achieved in the U.S. to meet the government's stated 2035 emissions goals. Renewables today still need to be backed up with conventional power sources, and White suggests that natural gas and nuclear plants will be part of the solution. According to the North American Electric Reliability Corporation (NERC), a nonprofit regulatory authority whose mission is to assure effective and efficient risk reduction to the power grid, at current rates the U.S. is predicted to sustain power shortfalls in the next decade, requiring brownouts and blackouts across the country at different times of year during peak loads.

In addition to power generation, many power companies are investing in carbon capture and underground storage (CCUS) technology to capture CO<sub>2</sub> at its source and transport it to be stored underground, removing it from the atmosphere. Currently, four projects are underway in the U.S. for CCUS, but this number will continue to rise. Companies are also looking at energy storage options to back up their grids. Currently, there is 1650 MW of energy

storage in the country, but 12,500 MW is needed by 2050 per NERC's estimates.

White said he believes that small nuclear reactors may be key to lowering emissions and having stable power. These carbon free, easy to build and run plants can be strategically located, even onsite for some large companies to be power independent. The first U.S. plant coming online is TerraPower's 345 MW plant in Wyoming, planned in 2024. This Sodium reactor demonstra-



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tion project will have access to high-assay, low-enriched uranium (HALEU), and is a public-private partnership and part of the U.S. DOE's Advanced Reactor Demonstration Program. It will feature a 345 MW sodium-cooled fast reactor with a molten salt-based energy storage system which can boost output to 500 MW when needed. This project will serve as a model to future small reactor projects in the U.S. and around the world.

Green and blue hydrogen will be fuel types of the future for both the power market and for vehicles, White predicts. Hydrogen vehicles are powered by fuel cells that convert hydrogen to electric to drive motors, with only water as emissions. Today, the cars are very expensive, with an average fueling cost of \$16 per gallon and a 400-mile range, similar in range to many of today's electric vehicles (EV). The EV market is predicted to grow exponentially from 2.5 million EVs today to 33 million forecasted by 2050, requiring 28 million charging stations. One of the biggest obstacles to this growth is going to be the scarcity of critical minerals needed to build batteries for the cars. Many of these minerals today are mined in countries with poor labor protections

and with limited production capability. There are a number of these resources believed to be available in the U.S., but to secure and permit a mining operation today takes up to 20 years and brings with it many environmental concerns that must be overcome.

With artificial intelligence (AI) discussed in many sectors, the technology has major implications for bringing systematic, real-time controls for power

plants and a smarter grid that can be optimized based on need. Look for more smart products built to harness the power of AI in the coming years.

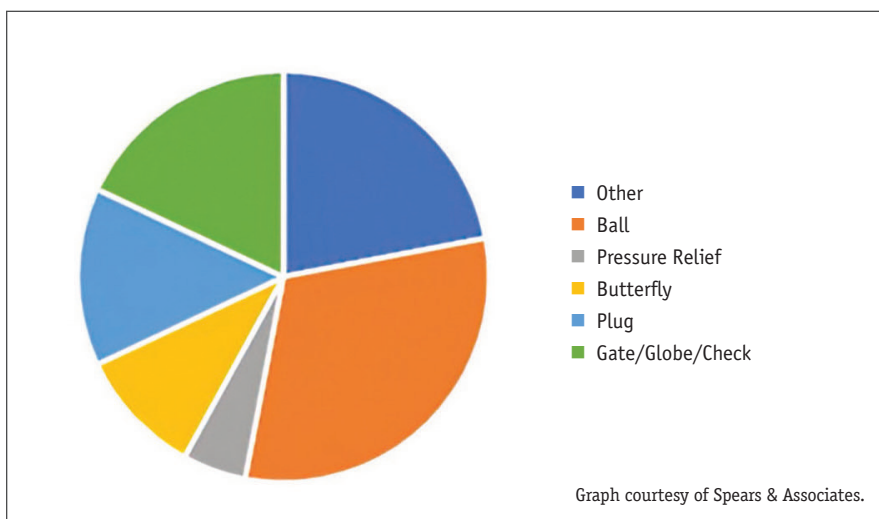
White closed by saying there needs to be a compromise between government, industry and consumers to build renewables to meet our future power needs. And while the valve industry has already brought great enhancement to energy efficiency through leak protection in power generation and beyond, it can continue to offer value through product and service models that provide ROI for its customers in the future.

#### OTHER SECTORS DISCUSSED

While these were a few of the key sectors covered during the two-day event, there were also experts on pulp and paper, construction, LNG and the chemical market. Supply chain slowdowns, lack of skilled labor, upcoming retirements and higher costs of goods were consistent as challenges that lie ahead for the U.S. industrial markets. Sustainability and the greening of industry are also weighing heavily on the minds of leaders in all organizations, particularly in the industrial world where valves and pumps are widely used. We will continue to discuss these challenges in upcoming issues of *Valve* magazine and on our website. **WM**

HEATHER GAYNOR is the editor of *Valve* magazine.

## U.S. Valve Manufacturers Shipments Energy Valve Shipments by Type in 2023



As both governments and organizations set sustainability goals that are interdependent, significant cooperation and funding will be required to meet them – only a fraction of which is available today.

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# Pressure Relief Valve Basics – Spring-Loaded Safety Relief Valves

Learn for the first time or brush up on this common valve product.

BY WAI LOON CHEONG

Pressure relief valves have been around for hundreds of years and continue to play a very important role as the last line of defense for the protection of life and property in the event of an overpressure event.

Depending on your expertise level, this article could be a great starting point to learn everything about the basics of pressure relief valves or this could be a refresher for those who like to double-check and compare notes. This article will be the first in a series of three where we will introduce three types of pressure relief valves. In this first article, we will cover the operational basics of a spring-loaded safety relief valve. In future articles, our second installment will cover the operation of a pilot-operated safety relief valve and a third installment will cover the operation of safety valves.

Pressure relief valve (PRV) is a term used to describe a category of valves designed for use in overpressure protection

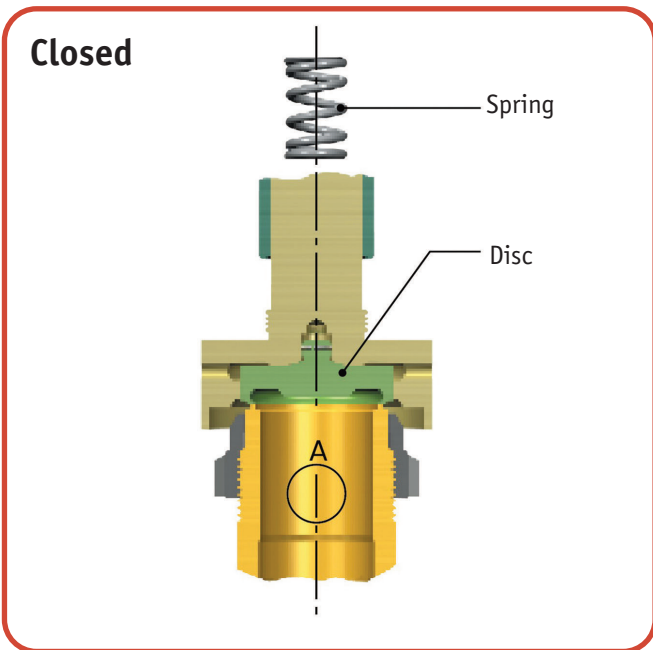


Figure 1: SRV closed position

Photo Credit: All images courtesy of Baker Hughes

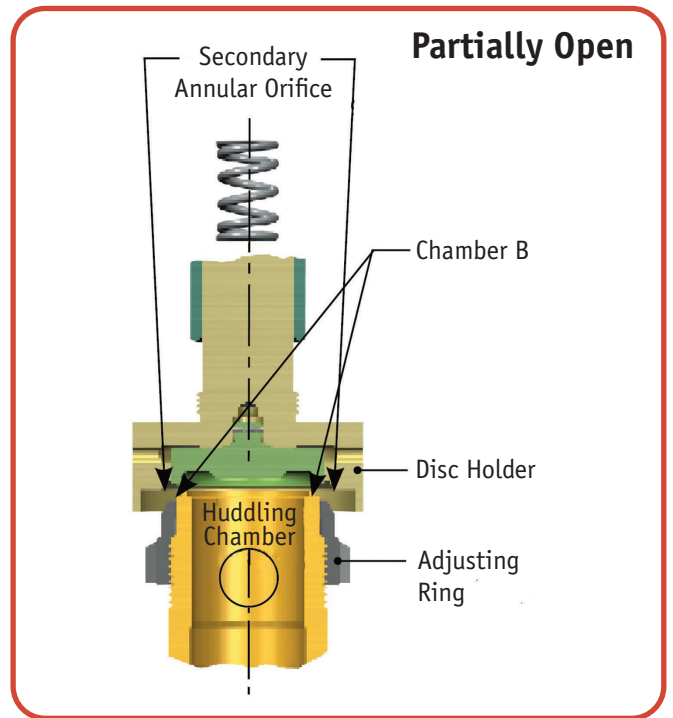


Figure 2: SRV partially open

applications. You may have heard a lot of different terms for PRVs: safety valve (SV), relief valve (RV), safety relief valve (SRV) or pilot-operated safety relief valve (POSRV). They all operate similarly but are not exactly the same, depending on who you talk to and the level of pressure relief valve knowledge one has. Like any other type of equipment, whenever you look from the outside in, everything seems to be the same. If you start to dig a little bit deeper into the details, you will discover the differences. So, let's get right into the details. First, we will cover some terms and definitions and then we will get into the details of how a **spring-loaded safety relief valve** operates.

**Pressure relief valve (PRV)** — a device designed to open and relieve excess pressure, then close and prevent the further flow of fluid after normal conditions have been restored.

**Relief valve (RV)** — a spring-loaded pressure relief valve actuated by the static pressure upstream of the valve. A relief valve is used primarily with incompressible fluids.

**Safety Relief Valve (SRV)** — a spring-loaded pressure relief valve that may be used as either a safety or relief valve, depending on the application.

**Pilot-Operated Safety Relief Valve (POSRV)** — a pressure relief valve in which the major relieving device or main valve is combined with and controlled by a self-actuating auxiliary pressure relief valve called a pilot valve.

**Safety Valve (SV)** — a spring-loaded pressure relief valve actuated by the static pressure upstream of the valve and characterized by rapid opening or pop action. A safety valve is normally used on compressible fluids, primarily steam.

Now, let's get into this article's topic, which is the operational basics of a spring-loaded safety relief valve (SRV).

A spring-loaded SRV consists of an inlet nozzle that is connected to a vessel or system to be protected, a disc that moves to control the flow through the nozzle and a spring that controls when the valve opens and the position of the disc. The valve operates by using inlet system pressure to overcome a spring load and, as a result, the valve opens to relieve a defined capacity. When the valve is closed, as shown in Figure 1, the spring force resists the upstream pressure acting against the seating surfaces (Area A). As the pressure increases, the pressure at (A) tends to equalize the spring

force and the pressure holding the seats together approaches zero.

When the upstream pressure increases to within one to two percent of the valve's set pressure, media will move past the seating surfaces into Chamber B, as shown in Figure 2. Flow restriction in the secondary annular orifice causes pressure to build up and to act over a larger area, creating an additional force to overcome the spring force. The disc will then move away from the nozzle seat and the valve will "pop" open.

Once the valve has opened, an additional pressure build-up occurs at (C) as shown in Figure 3. This is due to the sudden flow increase and the restriction to flow through another annular orifice formed between the inner edge of the disc holder and the outside diameter of the adjusting ring. These additional forces at (C) cause the disc to lift substantially at "pop." Flow is restricted by the opening between the nozzle seat and disc seat until the disc seat has been lifted from the nozzle seat by approximately one-quarter of the nozzle-throat diameter. After the disc has attained this degree of lift, flow is restricted by the primary orifice rather than by the area between the seating surfaces. Blowdown (the difference between opening and closing pressure) can be controlled within limits by positioning the single adjusting ring. Blowdown is caused when the spring force is unable to overcome the summation of the forces at (A), (B), and (C) until the pressure at (A) drops below the set pressure.

Figure 4 illustrates the fluid flow through the valve. It is significant to recognize that the system pressure enters through the nozzle and remains at a high pressure until it expands through the secondary annular orifice. Pressure downstream of the secondary annular orifice is much lower than the system pressure.

## FEATURES

**Adjusting Ring** — The adjusting ring in a safety relief valve is set to predetermined positions before the valve is put into service. Presetting makes it less necessary to pop the valve in service to ascertain that the ring has been set properly to achieve the necessary lift and relieving capacity.

**Simple Blowdown Adjustment** — A single adjusting ring adjusts blowdown, or reseating pressure, in a safety relief valve. When the ring is moved upward, blowdown is increased (lowering the reseating pressure), and when it is moved downward, the blowdown is decreased (raising the reseating pressure). In comparison, when valves have two or more adjusting rings, each affects valve action as well as blowdown.

**Common Industries and Applications** — Spring-loaded SRVs can be found in many industries. Some common industries include power generation, refining, petrochemical, chemical, midstream oil and gas, upstream oil and gas, and pulp and paper. Some common applications for spring-load-

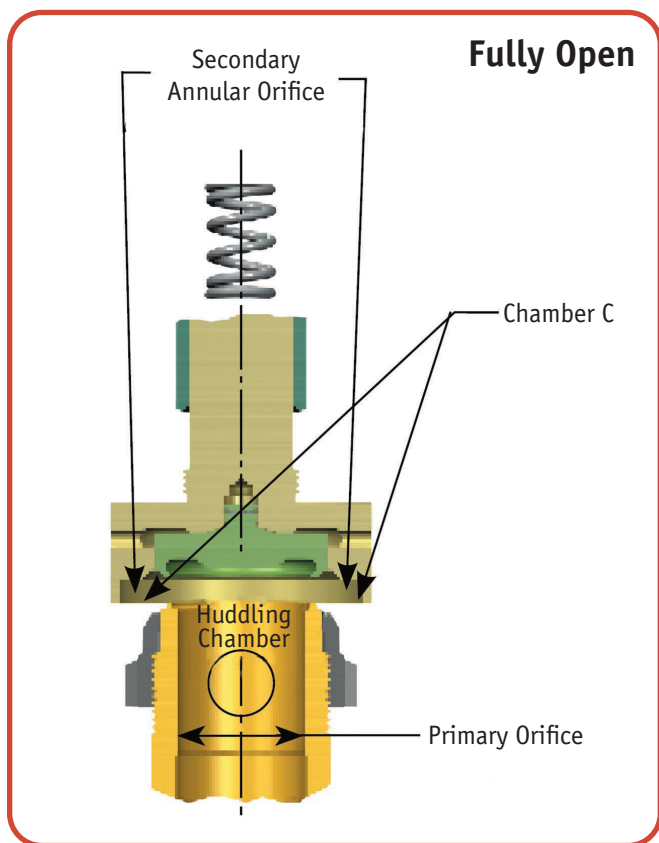


Figure 3: SRV fully open

ed SRVs include distillation, hydroprocessing, reforming, cracking, blending, fractioning, charge gas compression, separation, compression, pipeline integrity, dehydration and balance of plant applications for gases, liquid and two-phase application media.

The operation of a spring-loaded SRV is basic in principle with just a few elements which control their function. There is plenty more that can be discussed about SRVs, such as trim types, how they operate and when to use specific trim but for now, we will just stick to the basic SRV operation principles. Look for future articles on the operation of pilot-operated safety relief valves and safety valves. VM



**WAI LOON CHEONG** is the valves training leader for Baker Hughes. He has more than 20 years experience, and has worked in a variety of roles at the company.

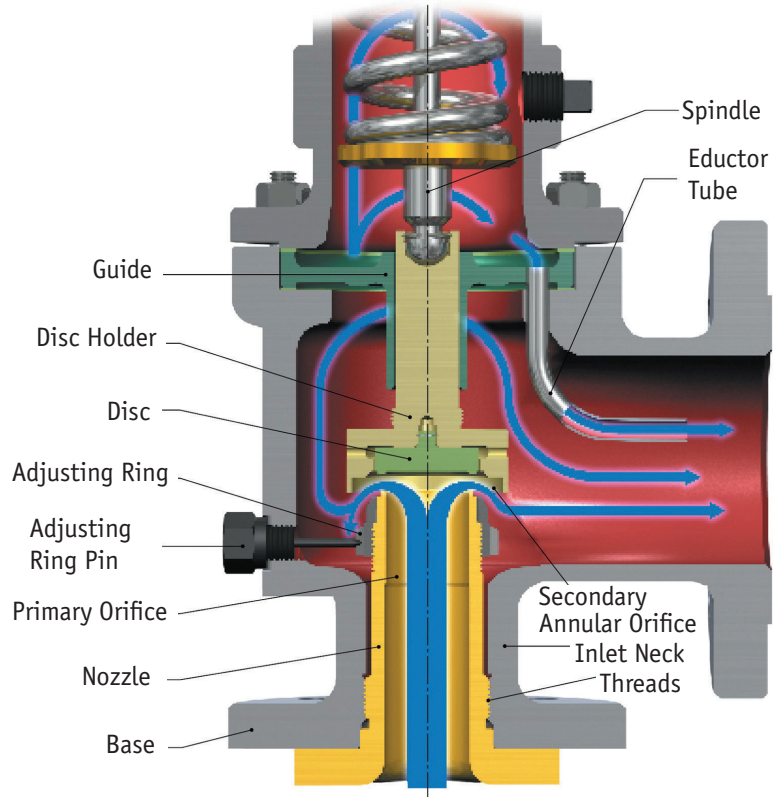


Figure 4: Flowpath through PRV



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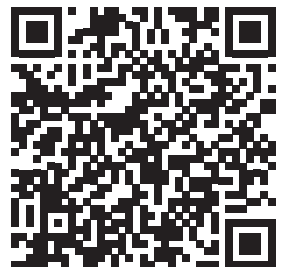
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# Water Hammer's Impact on Valve Operation and Piping System Design

The risks of water hammer to fluid systems can be catastrophic.

BY MARIA AGUIRRE

It's a well-known fact that most liquids are inherently non-compressible, meaning no matter how much pressure is exerted on them, their volume remains unaltered. This characteristic proves invaluable in power transmission systems like hydraulic pistons. However, it can pose a risk of catastrophic accidents in piping systems. This article addresses this potential risk, that of water hammer.

Water hammer, a phenomenon rooted in this non-compressibility principle, occurs when a volume of fluid traveling through a pipe suddenly has its direction altered. Because

this fluid carries inertia due to its mass, it abruptly halts the momentum, resulting in a rapid surge in pressure. Due to the non-elastic nature of the fluid, this excess energy cannot dissipate or be absorbed, leading to the creation of a pressure wave that travels through the pipe until it finds a way to dissipate the energy. This pressure spike is directly proportional to the volume, much like what would transpire if an unyielding object collided with a wall at high speed. For instance, a 50-kilometer-long pipe with a nominal diameter of 24 inches, filled with water, possesses an approximate mass of 16,000 tons. Any disruption to this mass's momen-



A 700 mm cast iron water pipe that burst as a result of water hammer.

Photo Credit: Cowan Dynamics

tum demands a significant amount of energy. Consequently, in large pipes, this phenomenon can result in catastrophic damage, ranging from vibrations and noise to complete pipe collapse.

Various methods exist to prevent or mitigate water hammer, all hinging on the idea of averting abrupt changes in fluid movement or safely dissipating the wave's energy without harming the system. Valves play a pivotal role in this phenomenon, as they are engineered to alter fluid direction. Ensuring the proper operation of valves within the system is fundamental to designing an effective piping system.

### SO, HOW CAN VALVES BE OPERATED TO REDUCE OR PREVENT WATER HAMMER?

One effective approach involves prolonging the time during which changes in fluid movement occur. In pipes, the valve's closing time can be extended, allowing for energy dissipation due to pressure loss. As a valve closes, its flow capacity decreases, which is determined by the relationship between the pressure differential across the valve and the flow rate passing through it. The higher the percentage of closure, the lower the capacity and the higher the differential pressure for a given flow rate. The pressure spike generated by closing a valve correlates with the time it takes to close it. An instantaneous valve closure yields the maximum pressure spike. While it may seem that closing the valve extremely slowly could entirely eliminate water hammer, this isn't a practical solution in all cases or for certain applications.

In many isolation or shut-off valve applications, it's essential for the valve to operate as swiftly as possible. This is necessary not only to promptly halt the flow, but also because on/off valves should not remain partially open for extended periods, as this could lead to damage to the closing membrane, seats, and other components due to erosion. This challenge can be addressed by implementing a dual or variable-speed system to operate the valve. Such a system enables the operator to close the valve, say, 80% of the way at high speed and then gradually reduce it in the remaining 20% to maximize energy dissipation in the shortest time. This approach also significantly reduces the valve's flow capacity in a short duration, allowing for efficient flow blockage while accounting for the necessary pressure loss to mitigate or prevent water hammer.

The actuator's operational controls manage this system, relying

on valve position feedback and an energy supply system. For simple hydraulic actuator systems or those utilizing non-compressive fluids, synchronization of target position setpoints is typically achieved using limit switches or position transducers. Once the valve reaches the desired position, the system reduces the flow rate to slow down the actuator's stroke time. Similar operational configurations can also be designed for pneumatic systems or those using compressive fluids. Calculations for the time required to alter the pipeline fluid are determined by transit analysis of the piping system.

Another common technique for mitigating the potentially damaging effects of water hammer centers around the deliberate reduction of the velocity of fluid travel within the pipeline. This velocity, in turn, is linked to the pipe's nominal diameter. The crux of the matter lies in understanding this relationship: as the diameter of the pipe increases, it inherently provides a more expansive cross-sectional area through which the fluid can flow. Consequently, to maintain a consistent flow rate, the fluid has to move at a lower velocity within the larger-diameter pipe. Conversely, when a smaller diameter pipe is used, the fluid must surge through it at a higher velocity to maintain the same volumetric flow rate. The more swiftly the fluid is moving, the greater its kinetic energy, and the more pronounced the pressure surge resulting from abrupt changes.

Considering this, pipe diameter emerges as a pivotal design consideration. While it might be tempting to opt for smaller pipes that meet the minimum flow velocity requirements on paper, this approach often leads to elevated flow velocities in practice. These elevated velocities escalate the vulnerability to water hammer during valve operations or other flow disruptions.

A proactive strategy involves choosing pipes with larger diameters than the minimum specified by flow calculations. By opting for larger pipes, the flow velocity is naturally attenuated for the same flow rate. This reduction in velocity acts as a buffer, facilitating more gradual adjustments in flow and pressure and reducing the likelihood of pressure spikes and the associated potential to inflict harm on the system.

In summary, the proper design of pipeline valve actuation systems is essential to prevent or mitigate the effects of water hammer in piping systems. Valves, designed to alter flow direction, impact the momentum of the fluid within the pipe. Depending on the application, valves may need to effect these changes quickly, but rapid changes can lead to increased pressure. Introducing a variable-speed system for valve operation, coupled with fluid transit analysis and consideration of future flow increments when sizing a piping system, can provide a viable solution to the issues posed by water hammer in the operation of pipeline valves. **WM**

**MARIA AGUIRRE** is a certified professional mechanical engineer with a master's degree in mechanical engineering and a master's degree in environmental engineering. She is the director of business and product development for Cowan Dynamics and is a member of *Valve's* editorial advisory board.



# The Evolution of the All-Encompassing Ball Valve

The compact design, simplicity of use, ease of repair and wide performance capability have helped to make the ball valve a dominant modern design.

EDITED BY GREG JOHNSON

The invention of the ball valve has proven to be a revolutionary development for the valve industry, supplying numerous unique solutions that meet modern flow control requirements. But its successful application was not immediately evident.

Early in the life of the ball valve, its current assets and values were not realized. The lack of machining technology to make a truly round ball did not exist. And sealing materials of the time, associated with the use of natural rubbers, were very limited and prevented the ball valve from being applied to any

significant industrial use.

During World War II and into the 1950s, machining technology developed for the war effort allowed the inherent advantages of the ball valve to be introduced into military usage. The development of synthetic materials such as polytetrafluoroethylene (PTFE), often known by the brand name Teflon, paved the way for industrial sector applications.

Today, the ball valve is used in a wide array of applications for flow control of liquids, gases and even solids. These applications are in temperatures that range from -450°F (-267°C) to more than 1600°F (871°C). Pressures can range from full vacuum to in excess of 20,000 psi.

## BALL VALVE DESIGN

The major components of the ball valve are the body, ball, seats and stem. These components can be made from a wide variety of materials. Ball valves are offered in numerous end connections, including flanged, threaded, weld end and wafer, as well as specialized end connections.

## BASICS

Ball valve designs fall into the quarter-turn category of valves, including

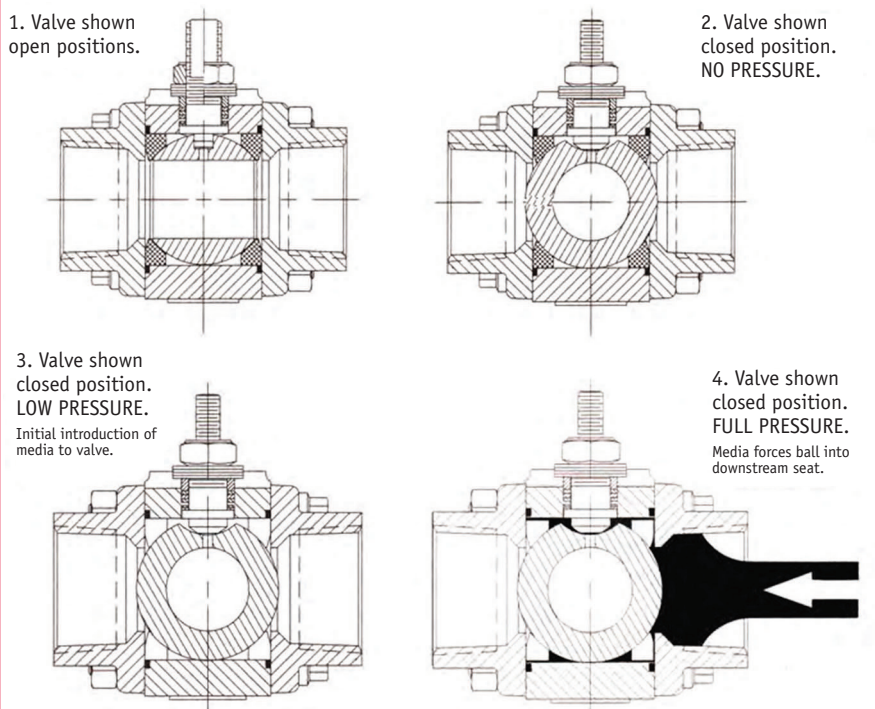


Figure 1: How floating ball valves work. All images are copyright of Flowserve Corporation.

plug and butterfly valves. This quarter-turn category means the valve stem is turned 90 degrees for operation.

The most common of these designs are the floating design and the trunnion-mounted design. They are typically bi-directional in sealing and can be oriented in any position or direction for opening and closing.

Some of the basic advantages these ball valves have over other designs include:

- full port for high-flow efficiency
- lower torque
- wider pressure and temperature range
- high cycle capability
- superior stem seals
- fire-safe
- lower cost to automate.

The floating ball design (Figure 1) initially compresses the ball between soft seats when the valve is assembled. This forces the seat material to cold-flow into the pores of the ball, creating a vacuum and low-pressure seal. In the closed position, line pressure forces the ball into the downstream seat. This provides for a tight shutoff over the pressure and temperature design of the seat.

The floating design is most common in a size range from 1/4 to 12 inches, though some manufacturers offer sizes up to 18 inches. Floating ball valve

size is limited by the size and weight of the ball, and by the torque required to rotate it as the size increases.

Trunnion-mounted designs (Figure 2) work the opposite of the floating design. In the trunnion design, the ball cannot float but is rigidly located by the stem on top and a shaft or trunnion, utilizing bearings on the bottom. The seats are compressed against the ball using a spring or springs to develop the initial low-pressure seal.

Trunnion valve seats are designed with seals to be process-energized, with increasing pressure forcing the upstream seat harder into the ball. This provides for a tight shutoff over the pressure and temperature design of the seat.

Trunnion designs typically take over where floating ball design application leaves off and can be found in a size range from 3-72 inches. The advantage of this valve design becomes apparent as the valve size grows.

The weight of the ball and the operating torque are not factors, as the seats in a trunnion valve do not support the ball. This means the trunnion valve seats can specialize in sealing the ball, allowing much larger valves with smaller actuation than can be made in any type of floating design.

### BODY

The ball valve body can be cast, forged

or machined from about every conceivable metal. This is due to the ball valve's simple and compact design. Applicable metals include:

- Non-ferrous, such as brass, bronze and aluminum
- Ferrous-based, including iron, carbon steels and stainless steels
- Nickel-based metals, which include Hastelloy, Inconel and nickel
- Reactive metals, including titanium, tantalum and zirconium.

Ball valves are also made in a variety of plastics and polymers, including PVC, polyethylene and polypropylene. Ball valves can be lined with polymers and plastics, and made from or lined with ceramics such as alumina and zirconia.

The basic design of valve bodies in the United States meets the ASME (American Society of Mechanical Engineers) standard B16.34 guidelines. These standards determine wall thicknesses, stress levels and other parameters along with pressure-temperature relationships for most ferrous alloys.

B16.10 guidelines also specify the acceptable dimensions of many classes of valves, such as industry-specific standards like the API (American Petroleum Institute) standard 6D for pipeline valves and API 608, "Metal Ball Valves—Flanged, Threaded, and Welding Ends." These specifications control the dimensions, materials and applications to ensure the valve design remains consistent from manufacturer to manufacturer and is safe for the intended application.

Ball valves in waterworks service are covered in AWWA (American Water Works Association) standard, C507-18, "Ball Valves, 6 in. through 60 in. (150mm through 1500 mm)."

Many other countries have national standards, and several organizations foster international standards as well. Valve manufacturers wishing to enter the global market must conform to ISO (International Organization for Standardization), PED (European Commission — Pressure Equipment Directive), CE (PED) and ATEX (Bureau Veritas) standards, among the many others that exist, such as in China and Russia.

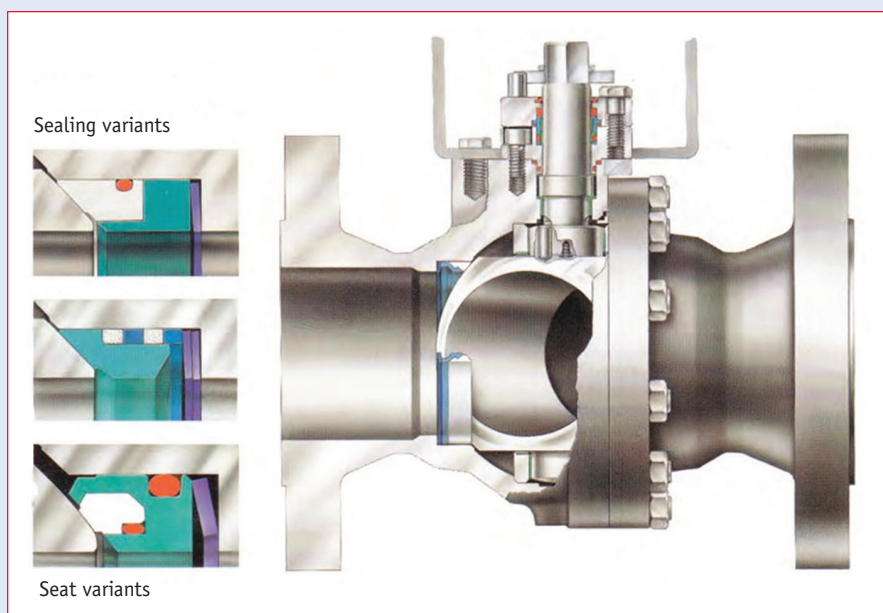


Figure 2: Trunnion design.

Meeting these standards has become a mandate for trade with the European Union, as well as JIS standards for Japan and similar requirements elsewhere.

Other common specifications for the rating of ball valves include WOG (water/oil/gas), CWP (cold working pressure) and WSP (working steam pressure). These ratings are more limited and are typically established by the individual manufacturer. All of these specifications will establish a pressure/temperature curve for the valve design, which lowers the pressure rating as the temperature rises.

#### BODY DESIGNS ARE DIVIDED INTO FOUR BASIC CONFIGURATIONS:

- **Three-Piece Swing Out.** The body is designed in three pieces with the ability to easily swing the center body section out of the line for repair without having to remove the entire valve (Figure 3). This is handy when valves are threaded or welded into a pipeline.
- **End Entry.** This design uses a one-piece or unibody

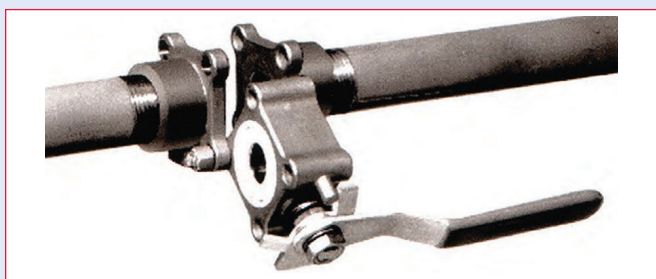


Figure 3: Three-piece ball valve design.

design (Figure 4). All the internal components are assembled into the valve through the end, where an end plug is installed to retain the parts. This design eliminates any form of body or bonnet seal, eliminating a potential leak path.

- **Split Body.** This design (Figure 5) splits the body into two halves and allows for easy assembly and one less seal than the three-piece design.

This split body design is especially advantageous when the valve is large, making it easier for the assembly of large components.

- **Top Entry.** The top entry design (Figure 6) utilizes a one-piece body like the end entry, except that the top of the body is exposed in order to assemble the internal parts. A bonnet is then bolted on the top of the valve, making this design repairable in-line, similar to the three-piece design. The most common top entry designs are unique to ball valve designs, as the ball and seats float and operate in unison and on a taper within the body, unlike the other designs.

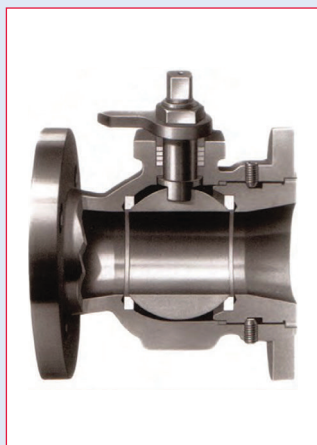


Figure 4: End-entry design.



Figure 5: Split-body design.

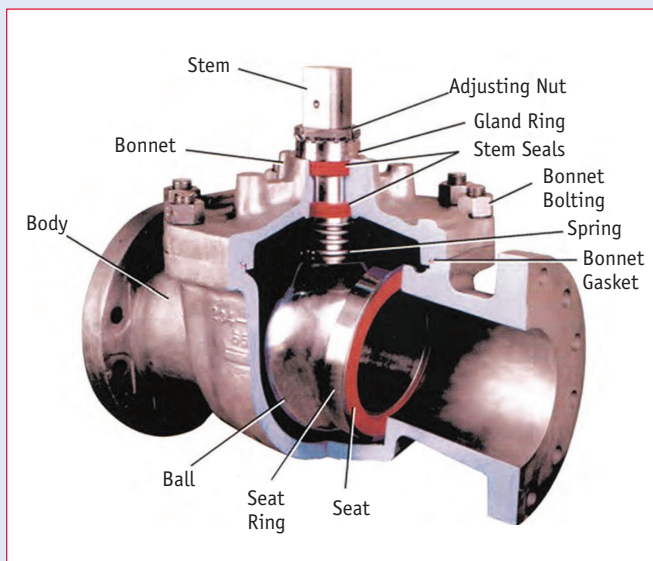


Figure 6: Top-entry design.

#### THE BALL

The flow control element of the ball valve is, of course, the ball. The ball acts against the seat and can stop or control flow through the valve. Balls are designed and manufactured to exacting tolerances for surface finish and sphericity, or roundness. Both the ball and seat are critical to smooth operation, reduced torque and good sealing performance, especially when metal seats and metal-to-metal sealing are required. The ball port configuration can vary from a standard straight and through-hole style to a multi-port style for ball valves that offer three- to five-way port designs (Figure 7). While most ball valve designs use a full spherical ball, there are also designs that use a half ball (sector) and those that use cam action to force the ball into the seat.

The balls are machined from many materials, including metal, ceramic or plastic. Metal balls can be enhanced with a variety of coatings or surface treatments to provide improved wear resistance, corrosion resistance or high hardness to prevent galling, which is where the base metal does not hold up.

Surface enhancements can include polymers, flame spray, electroless nickel, PVD coatings and diffusion processes such as nitride and boride application. These enhancements are a major reason for the successful application of ball valves in the wide variety of applications they are used.

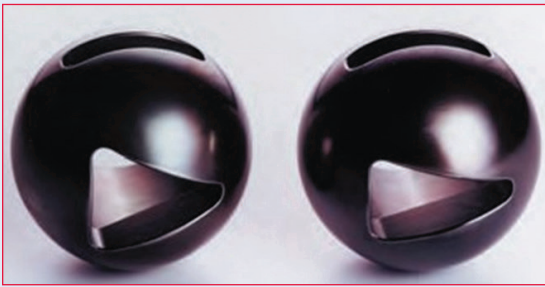


Figure 7:  
Configured  
port balls.

## SEATS

The enhancement of seat design and technology has allowed the ball valve to expand into a wide array of applications. These seats can provide multiple functions, depending on the valve design and the seat material.

They need to provide tight shutoff in the case of resilient materials, as well as support the ball in floating ball designs, resist the service and provide good cycle life. Seats can also incorporate characterized ports for flow control purposes.

Soft seat designs are commonly referred to as “jam” designs that provide full-face contact when assembled, or as flexible lip designs that have reduced face contact for lower torque and improved cycle life.

Different body designs will use these or variations of the basic soft seat design. Many manufacturers’ designs also provide some form of cavity pressure relief, preventing seat and valve damage in the event of trapped cavity pressure from the media trapped in a closed valve.

Soft seat materials used today include, but aren’t limited to:

- Rubbers, including neoprene and Buna
- Fluoropolymers, including PTFE, TFM, PBI and PFA
- UHMWPE (ultra-high molecular weight polyethylene)
- PEEK (polyether ether ketone)
- Delrin
- Nylon

Metal seat designs are used in ball valves to handle the most severe applications, including high pressure, high temperature, abrasiveness and flow control.

There are many metal seat designs in use, the most common of which incorporate seats of surface-hardened or coated metal, lapped to a ball that has been similarly hardened. This matches the ball and seat surfaces to affect a good seal.

Other designs include sintered metal impregnated with graphite or PTFE, and even some flexible designs. Resilient seats are required to be bubble-tight, yet most valves with metal seats are allowed some leakage per leakage specification rates of metal-seated ball valves, the most common of which are MSS-SP-61 and API 598. Other specifications that are commonly applied to metal-seated ball valves include FCI 70.2 and API standards.

Most metal-seated, floating ball designs use springs and/or seals to compress the seats against the ball, and to seal the backside of the seat for low pressures. The ball floats against the downstream seat as pressure increases, providing shutoff over the pressure and temperature design of the seat, similar to the action of the soft-seated version.

In trunnion designs (Figure 8), springs and often several seals are used to capture the line pressure, forcing the seats harder against the ball as the pressure increases. Some manufacturers even machine the seating surface into the valve body, eliminating springs and seals in one direction. This, however, typically results in a unidirectional valve operation.

## STEMS

The stem is used in the ball valve to rotate the ball to an open or closed position, or to an intermediate position for flow control. Materials considered for stems must withstand more than just the pressure of the body, ball or seats. They have to resist the process corrosion and temperature while retaining enough strength to withstand the torque applied to them when the valve is operated. For this reason, higher strength and corrosion-resistant materials are usually selected for stem manufacturing.

As the stem is the connection to the ball, it must pass through the body so it can be operated externally. This requires that the stem have seals to prevent the media in the valve from escaping. The seals must seal bubble-tight, withstand the fluid corrosion and temperature, and provide good cycle life.

Typical stem seal materials include polymers such as PTFE and PEEK. For higher temperatures or fire safety, graphite stem seals are typically used. These materials remain flexible over wide temperature ranges and are chemically resistant. In fire-sealed valves, the seals must survive a fire without leaking.

Rotary quarter-turn valve designs like the ball valve have the best-performing stem seals. This is due to the stem moving in a rotary motion as opposed to a rising stem motion found in gate and globe valves. With today’s environmental concerns and regulations, stem seal performance is critical to valve manufacturers and end-users.

Stem seal designs fall into two basic categories: stem-energized seals and body-energized seals (Figures 9 and 10). These designs use many different types of seals, with the most common being flat ring, chevron, cup and cone and monolithic elements.

**Stem Energized.** In this design, there are usually multiple seal rings. Some of these are inside the valve body pressure boundary that becomes the primary seal, and others are outside the pressure boundary in what is called the “packing” or “stuffing” box.

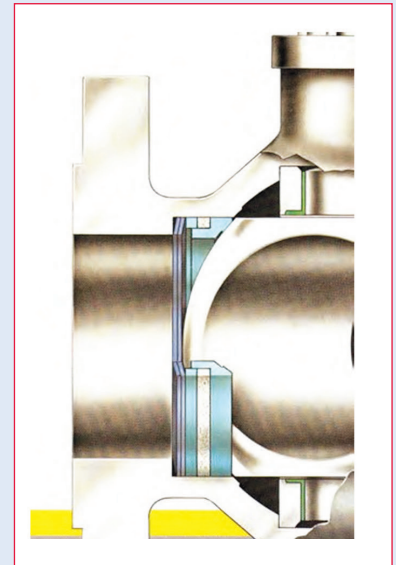


Figure 8: Trunnion metal seated ball valve.

These seals are compressed or energized through the action of pulling up on the stem with a stem nut, which simultaneously compresses the upper seals with a packing follower. Most of these designs incorporate Belleville springs to live load the seals. This makes the stem seal assembly self-adjusting and temperature compensating, allowing for longer cycle life before readjustment is needed.

**Body Energized.** In this design, sealing is accomplished above the pressure boundary in the stuffing box, again using single or multiple seal rings. Some manufacturers may use a thrust bearing on the stem below the pressure boundary, but no sealing is actually performed there.

These seals are loaded using a “yoke” or “gland plate,” compressing the seals in the stuffing box using bolts threaded into the body. The design typically utilizes multiple Belleville springs on the bolts to “live load” the gland plate, making the stem seal self-adjusting.

The advantage of this design is that the stem is free to float within the seals, reducing torque and increasing stem seal life. This design also allows the incorporation of “fugitive emission” designs, which utilize multiple sets of seals, cre-

ating additional or redundant seals for toxic and high-cycle applications (Figure 11).

## APPLICATIONS

With the advanced designs and materials offered in modern ball valves, they are utilized in many services and industries. Success in these applications depends on the correct specification of all of the designs and components as discussed.

Ball designs are not limited to on/off service. They can be used to divert, control or mix flows. Different functions can be accomplished by having multiple ports for diverting and mixing, or by having a characterized port, such as a V-port, for flow control.

Quarter-turn control ball valve usage is becoming more common in moderate-pressure drop flow control applications. This is due to the process advantages of lower cost, tight shutoff and high accuracy when coupled with digital controls on electric and pneumatic actuation.

There are also specialty ball valve designs for unique applications. These can include valves for cryogenic service, which must handle extremely low temperatures, and valves for high-pressure steam, which must handle extremely high temperatures and pressures.

Other ball valve applications include their use in pharmaceutical, aerospace, nuclear, biotech and pulp and paper industries, in applications including acids and chemicals, slurries, thermal fluids and steam.

## CONCLUSION

The compact design, simplicity of use, ease of repair and wide performance capability have helped to make the ball valve a dominant design in modern industrial applications. And ball valves continue to evolve in order to meet new and more difficult demands.

The industrial sector is placing greater and greater emphasis on safety, the environment, improved efficiency and cost reduction. Thus, the assets of the ball valve will continue to make it an important player with many future roles. **VM**

This article was originally written by Brian Hood (Flowserve). It was previously published but has been updated by Greg Johnson, president of United Valve, and member of Valve’s editorial advisory board.

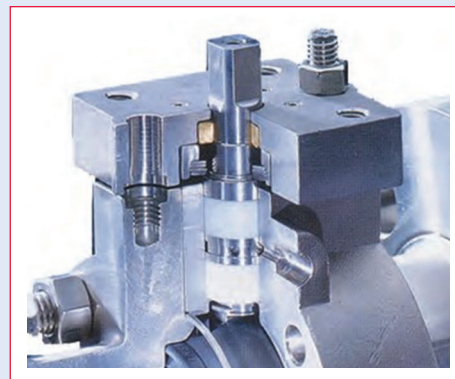


Figure 11: Dual fugitive emissions valve stem.

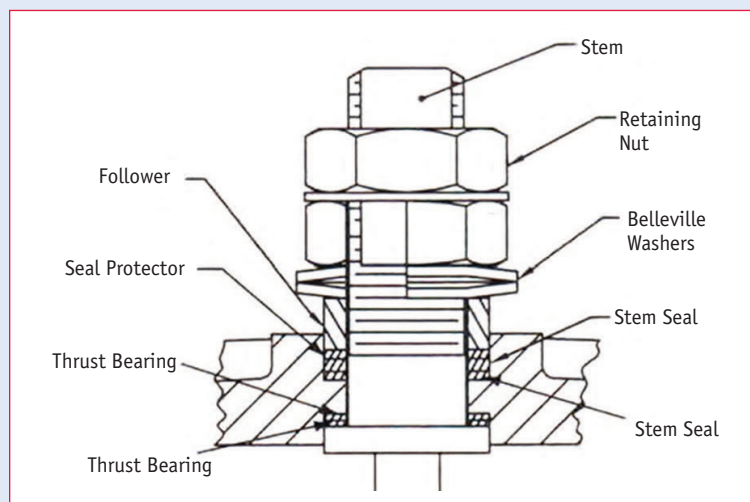


Figure 9: Stem-energized stem seal.

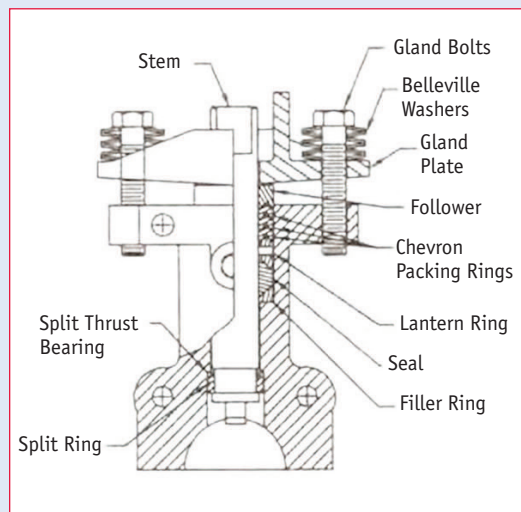


Figure 10: Body-energized stem seal.

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**NEW VALVE STEM PACKING DESIGN MAKES REDUCING FUGITIVE EMISSIONS EASIER**

With valves accounting for up to 70% of fugitive emissions (FE) from plants and refineries, tackling leakage is among the biggest obstacles to U.S. industry achieving net zero by 2050.

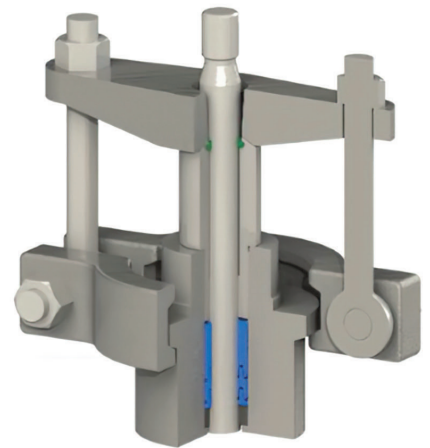
IMI CCI's EEEasy-Seal emission packing solution provides up to ISO Class AM FE leakage protection and is third-party certified to ISO 15848-1, the industrial standard for FE control valve testing. In contrast to conventional packing set designs with external springs, the EEEasy-Seal is live loaded via an internal spring utilizing the internal hydraulic pressure to optimally energize the seal, resulting in a

closed, low-maintenance design.

Traditional, low-emission packing solutions could wear faster due to higher friction and require frequent maintenance on site, according to the company. They require more upkeep and monitoring and may give cause for concern on unmanned platforms or vibration-sensitive systems.

The IMI CCI EEEasy-Seal can be installed in a compact, fireproof packing box without external live loading or requiring continuous maintenance, helping tackle FE leakage concerns.

**IMI-Critical.com**



**SPIRAX SARCO INTRODUCES EXHAUST VAPOR CONDENSER**

Spirax Sarco has expanded its product line to include the new Exhaust Vapor Condenser (EVC). The Spirax Sarco EVC is a reliable innovative heat exchanger that utilizes flash steam from discharge and exhaust vent pipework to preheat make-up or process water, thereby recovering valuable heat energy that would otherwise be lost to atmosphere. It is designed for a variety of industries including food, beverage, and health-care, and is environmentally friendly, reducing CO<sub>2</sub> + carbon emissions.

According to the company, the EVC is easy to install. As standard, the construction is completely stainless steel and the tube side is all in AISI 316. The EVC is designed and manufactured

in accordance with EN 13445 code and fully complies with the requirements of the Pressure Equipment Directive (PED). The EVC complies with EC1935:2004 Food Contact Materials and also complies with regulation EC2023:2006 on good manufacturing practice for materials and articles intended to come into contact with food. There are no gaskets (except for the piping connection) and no painted components. The heat-exchanging surface is of straight corrugated tubes designed for low-viscosity fluids and for turbulent flow working conditions. The tube sheets are of an integral type and are supplied ready for installation. **spiraxsarco.com**

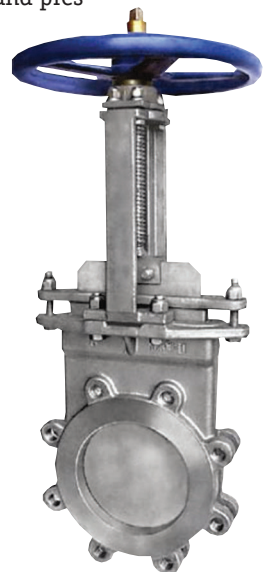


**MUELLER INTRODUCES PRATT P77 PERIMETER-SEATED BI-DIRECTIONAL KNIFE GATE VALVE**

The new knife gate valve was designed to handle tough slurries and abrasive materials. Built to MSS\_SP-81, AWWA C520-10 and TAPPI-TIS 405-8 standards, it can be used in a variety of applications in industries such as mining, chemical, food and beverage and pulp and paper.

The heavy-duty cast stainless steel yoke prevents deformation or damage under extreme loads, and full-circle packing reduces potential leak paths. The rubber-seated gate delivers a bidirectional drop-tight seal that can withstand pressures of up to 150 psi effectively. An EPDM perimeter cartridge seat resists chemicals and high temperatures.

**henrypratt.com**



**NEW VALVE CONTROLLER FROM EMERSON OFFERS EMBEDDED EDGE COMPUTING**

The Fisher Fieldvue DVC7K Digital Valve Controller features "Advice at the Device" technology with embedded computing and analytics that convert raw data into actionable information locally with Bluetooth capability, within the device. This means maintenance personnel can receive the data via their phone, tablet or computer wirelessly without having to be in a control room at the plant location. The new valve controller technology improves the performance, reliability and uptime of both on-off and control valves — and, by extension, an entire process plant or facility — in a wide variety of process industry applications providing the information required to create streamlined work processes.

The DVC7K interprets data to create an optimized path to action by combining patented technology, experience-based algorithms and continuous real-time analytics with flexible connectivity and easy integration. It uses powerful, real-time and onboard edge computing to analyze issues and create actionable information, providing awareness of valve health by analyzing data locally via its onboard diagnostics. If analysis reveals a problem, an alert is created, which can be viewed locally or remotely, providing the information required to create streamlined work processes that save time and money. All alerts include recommended actions to fix the problem, a new feature for digital valve controllers and unique to the industry.

With increased remote connectivity and Advice at the Device local diagnostics, flexibility increases, providing the information needed for fast decisions and quick action to address arising issues. The DVC7K can be specified for all new valve purchases, and it can be retrofitted to most existing valve installations, in either case, quickly and easily commissioned via the local user interface. **emerson.com**



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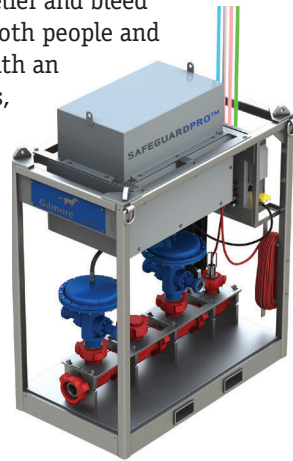
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**NEW DUAL-PURPOSE RELIEF AND BLEED PACKAGE IN ONE UNIT**

The new Gilmore Agiliti SafeguardPro offers a dual-purpose relief and bleed package for unconventional surface applications protecting both people and assets. The electro-pneumatic control system is automated with an intuitive HMI interface with min and max automated settings, and bleed and relief dual service in one unit.

With a rated working pressure of 15,000 psi, the unit has an API 7HU2 3-in. Fig 1502 inlet and 2-in. outlet. It includes an industrial air compressor with automatic condensate drain, and an industrial regulator equipped with a desiccate dryer and filter. The unit has a wireless range of 300 ft., and is available in configurations of 25, 50 or 75 BPM discharge rates. A bridle iron is included with the unit, and many custom requirements can be accommodated by contacting the company. [gilmore.com](http://gilmore.com)



**AUMA ACTUATORS GET VA2 CERTIFICATION**

Gas Industry Standard (GIS)/VA2 specifies the requirements for electric-powered actuators for use with two position (open/closed) quarter turn valves manufactured to the requirements of GIS/V6. AUMA's range of SAEX and SAREX actuators, with the combination of explosion proof controls, are GIS/VA2 compliant.

Explosion-proof devices must be used in plants where potentially combustible atmospheres can occur. AUMA's comprehensive range of VA2 approved devices is designed so they will not act as an ignition source, manufactured to exacting specifications to prevent the occurrence of ignition sparks or hot surfaces. The actuators are also qualified to receive high Safety Integrity Level (SIL) capability.

Actuators manufactured to VA2 are suitable for use in areas in which an explosive gas atmosphere is likely to occur in normal operation; with atmospheres containing propane, or gases and vapors of equivalent that are equally hazardous.

AUMA's actuators for hazardous locations are designed to meet the exacting requirements of the global oil and gas industry, combining the highest level of explosion protection, robust design, ease of operation and the latest trends in digitalization. The products provide safe and reliable valve automation across all application sectors, including oil and gas production, pipelines, tank farms and refineries.

This class of actuators are IECEx certified for the highest gas group IIC, which includes highly flammable hydrogen. Actuators are designed to withstand the harshest environmental conditions, covering a particularly wide temperature range from -85°F to +167°F (-65°C to +75°C).

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**Registration and more information is available online at [VMA.org/ValveForum](https://VMA.org/ValveForum)**



"The guest interaction was outstanding, and the presenters made themselves available for discussion." — 2023 Valve Forum Attendee



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