VMA'S CAPITOL HILL VISIT | NEW MEMBERS | EDUCATION & EVENTS

VALVE

MAGAZINE | SUMMER 2022 | VOL. 34, NO.3

The Chemical Industry's Diverse Markets Demand Equally Diverse Valve Needs

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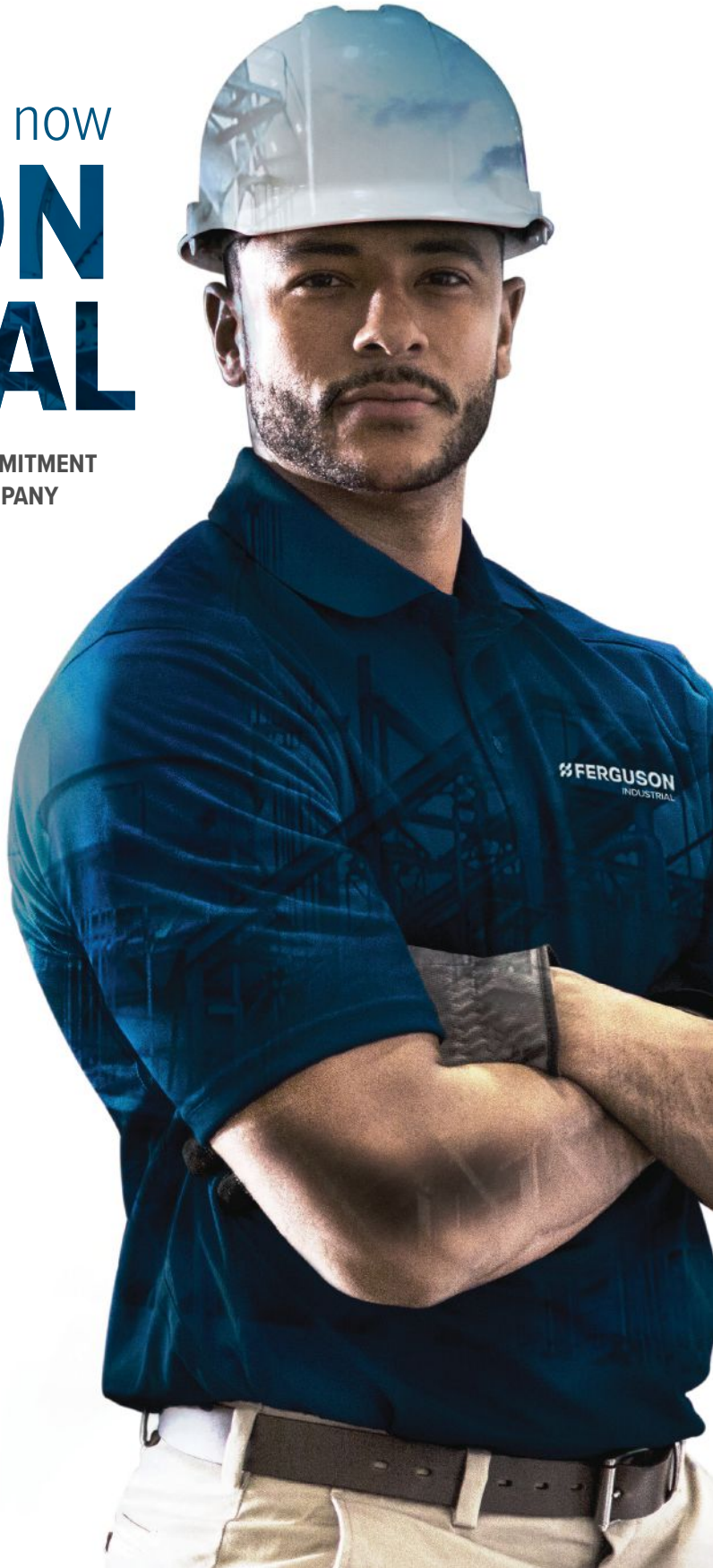

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VALVE MAGAZINE
SUMMER 2022 | VOL. 34, NO. 3

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The Diverse Role Valves Play in the Chemical Industry

Wide-ranging chemical industries span agriculture, pharma and consumer products and require many valve types for handling these compounds that demand rigorous and careful capabilities.

COVER IMAGE CREDIT: GETTY IMAGES

BY BY LINDSAY COUTINHO, FRED PORTH AND DHANESH BHASKARAN

PRODUCTS

40 Editor's Picks

> Valve sizing and selection software
> Control valve for general service
> Redesigned, ergonomic valve handles
> Smart valve positioner
> High-pressure electronic controller

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COLUMNS

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VALVE MAGAZINE

www.VALVEmagazine.com

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VMA VALVE MANUFACTURERS ASSOCIATION OF AMERICA

www.vma.org

The Critical Role of Our Industry in the Ebb and Flow of a Changing World

As anyone with even a small stake in the valve industry knows, many markets and sectors are served. Companies source materials from all over the world and in different ways; serve numerous types of customers; manufacture different kinds of valves, actuators and controls; offer various solutions; and take unique approaches in marketing and selling their products. It is a complicated web, which is not surprising for an industry that has developed organically over hundreds of years. Our products are just as needed today as they were 1,000 years ago when the first valve was developed.

While this longevity may provide security, it is important not to become complacent. New challenges, materials, products and opportunities will continue to arise and become commonplace. Case in point: Words and concepts like sustainability, green manufacturing, net zero, environmental, social and governance (ESG) are not mere buzzwords. Companies of all sizes representing many industries continue to grapple with how to react to government, societal, shareholder and customer pressure to measure their impact and demonstrate responsible stewardship. At first glance, this may seem like a major shift for our industry with a big stake in markets like oil, gas and chemicals. However, as our second article in a two-part series points out (page **26**), while there are opportunities in new energy sources like hydrogen, fossil fuels will still play an important part in providing energy to the world for some time to come.

Because our industry is complicated, those new to it — and those that have been a part of the industry for years — seek out basic information on valves, actuators and controls. VMA provides education and courses on this type of information through our Valve Basics events and webinars, as does VALVE Magazine in articles such as Electric Actuator Controls on page **18.**

Since becoming VMA president, I've learned about how diverse and important the industry is, as well as the many similar challenges and opportunities for all companies with a stake in the industry. Some of these are highlighted throughout the magazine — our manufacturer, distributor and industry supplier members can draw on this information and knowledge to more fully understand how to address issues and incorporate these learnings for continued success. I encourage anyone interested in knowing more about VMA membership to contact me directly or visit http://vma.org/membership.

Heather

Heather Rhoderick, CAE
President

At IMI Critical Engineering, our customized, highly engineered flow control solutions are at the heart of complex energy and production processes. They are backed by comprehensive service support that ensures efficient maintenance and plant optimization.

With decades of expertise, 15 world-renowned brands, and more than 750,000 valves installed globally, no one knows more about operating hazardous processes safely, efficiently, and with minimum environmental impact.

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IMI CCI™
Critical flow control technologies for oil & gas, nuclear and power industries

IMI FLUID KINETICS™
Noise abatement solutions for process and power industries

IMI NH™
Globe and ball valves for nuclear reactors

IMI ORTON™
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Solutions for critical nuclear and naval applications

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ACQUISITIONS, MERGERS AND PARTNERSHIPS

Valmet and Neles Merger Finalized

With the merger between Valmet and Neles into Valmet, the new company will provide a unique offering for process industries globally. Valmet's Flow Control business line is a global leader in flow control solutions and services with renowned brands such as Neles, Neles Easyflow, Jamesbury, Stonel, Valvcon and Flowrox. "Our customers operate in oil and gas refining, pulp, paper and bioproducts industry, chemicals and other process industries. With our market-leading expertise, products and services we are committed to bring your business forward," says president and CEO, Pasi Laine.

Ferguson Industrial Acquires AP Supply Chain Co.

Ferguson Industrial (formerly Wolseley Industrial) has acquired AP Supply Co. Since 1960, AP Supply has established itself as a premier distributor of industrial pipe, valves and fittings in the southern United States. Headquartered in Texarkana, AR, the company has two additional locations in El Dorado, AR and Bastrop, LA. All three locations will be joining Ferguson Industrial's Gulf Coast district. The acquisition allows for geographic expansion into areas of Arkansas, Louisiana and Texas where Ferguson does not currently have a brick-and-mortar location.

ITT Acquires Habonim

ITT Inc. acquired privately-held Habonim for $140 million in April 2022. Habonim will become part of ITT's Industrial Process segment. Based in Kfar HaNassi, Israel, Habonim designs and manufactures valves, valve automation and actuation for the gas distribution (including LNG), biotech and harsh application service sectors. The company has operations in Israel, the U.S. and the Netherlands and employs over 200 highly skilled professionals globally.

Baker Hughes Acquires Mosaic Materials to Advance Carbon Capture

Baker Hughes has acquired Mosaic Materials Inc. to further develop and scale its next-generation capture technology for (CO_2) reduction from stationary sources and CO_2 removal from the atmosphere. Mosaic's metal-organic framework technology is a proprietary adsorbent material that acts like a high-capacity molecular sponge to selectively capture CO_2. Baker Hughes will draw from its existing advanced capabilities, including modular design and material science, to develop and scale Mosaic's innovative technology, enabling direct air capture with a solution that requires significantly less energy to operate.

Baker Hughes Acquires Qi2 Elements

Baker Hughes has acquired Qi2 Elements, a designer and manufacturer of advanced robotic sensor systems that inspect, assess and monitor the integrity of critical energy infrastructure. Baker Hughes' range of asset inspection solutions includes pipeline inspection services that detect, characterize, locate and size defects that can compromise pipeline integrity. The company's Electro Magnetic Acoustic Transducer (EMAT) technology enables the detection and measurement of cracks and crack-related features that may occur in gas pipelines. The acquisition also includes Qi2 Elements' robotic inspection technology.

Flowserve Partners with Gradiant in Water Technology

Flowserve Corporation has entered into a non-exclusive partnership agreement with Gradiant to help address the most challenging problems in water and wastewater treatment. Gradiant develops and delivers advanced water and wastewater treatment facilities around the world, with a primary focus in the rapidly growing Asia Pacific and Americas for customers with mission-critical needs in cleantech water and sustainable operations. This partnership will combine Flowserve's flow control solutions and product expertise with Gradiant's innovative tailored water treatment technology to provide total water treatment solutions for customers.

Hunt Valve Company Acquires Montreal Bronze Ltd.

Hunt Valve Co. has acquired Montreal Bronze Ltd. (MB). The acquisition brings MB into the Hunt Valve portfolio of severe-duty valve and automation technologies under the new name MB Valve. Founded in 1985, MB Valve supplies severe-duty, bronze marine valves including qualified U.S., Canadian and NATO-friendly Navy MIL-STD valves, and specialty valves for pharmaceutical and nuclear applications. Hunt Valve is a specialty valve engineering and manufacturing company serving the U.S. Navy and industrial customers worldwide.

PEOPLE IN THE NEWS

Quality Valve CEO Jody Dunn has announced the promotion of **Matt Hariel** to CFO. Hariel has been with the company, serving as controller, for nearly three years. With the acquisition of the Griffco operation, his responsibilities now span both divisions and a much larger enterprise.

Admiral Valve LLD dba CPV Manufacturing has appointed **Ryan Howard** as regional sales manager, Gulf Coast region. He brings seven years of sales experience in the industrial market. Throughout his career, Howard has gained extensive knowledge about valves and fittings used in industrial applications, specifically in the vast oil and gas and petrochemical industries.

Ryan Howard

CHANGES

Wolseley Industrial Becomes Ferguson Industrial

During the past 15 years, Wolseley Industrial Group has grown into one of the nation's leading industrial supply chain service providers of MRO, high-quality pipe, valves, fittings and specialized services. Since the formation of Wolseley Industrial Group, the company has been powered by Ferguson. In line with that legacy, the company will now be known as Ferguson Industrial. The new name will leverage the Ferguson brand, organizational structure, resources and capabilities to create efficiencies and share best practices to maximize growth.

Crane Co. Board Approves Plan to Separate into Two Companies

Crane Co., a diversified manufacturer of highly engineered industrial products, announced that its board of directors has approved a plan to pursue a separation into two independent, publicly-traded companies. Upon completion, Crane Co.'s shareholders will benefit from ownership in two focused and simplified businesses. Crane Co. will be a leading global provider of mission-critical, highly engineered products and solutions, with differentiated technology and respected brands. After the separation, Crane Co. will include the Aerospace & Electronics and Process Flow Technologies businesses. Crane Co. will be led by Max Mitchell, who will continue to serve as president and CEO. Crane NXT will be a premier industrial technology business. This year, the Payment and Merchandising Technologies business that will become Crane NXT is expected to achieve approximately $1.4 billion in sales.

AWARDS & RECOGNITION

ITT Donates $100,000 to Support Ukrainian Refugees

ITT Inc. contributed $100,000 to the CARE Ukrainian Humanitarian Response Fund, which aims to provide life-saving assistance to four million people who have been impacted by the conflict. CARE provides emergency aid through local partner organizations like Polish Humanitarian Action and SERA, helping them provide emergency aid to Ukrainians escaping to Poland, Romania and Moldova. In addition to its $100,000 company donation, ITT has launched a special 1:1 employee matching gift program where it will match the total contributions ITT employees make to CARE in 2022 up to $50,000.

Baker Hughes Named to Fortune's First Modern Board 25

Baker Hughes has been selected as one of *Fortune* magazine's new Modern Board 25, which is a list of the most innovative boards of directors among S&P 500 companies. It's based on the belief that in a rapidly changing business climate, innovation at the board level — and the high performance that comes with it — can be predicted based on who is in the room. As companies seek to drive change on talent strategy, diversity, sustainability and social issues, they will need more diversified leadership at the very top.

Fortune has collaborated with the Diligent Institute, the research arm and think tank of the global corporate-governance software company Diligent, to develop this ranking.

2022 YEAR-LONG

VMA Valve Basics 101 and 201
Virtual
www.vma.org/valvebasics

AUGUST

3-4
2022 VMA/HI Market Outlook Workshop*
Virtual (members only)
www.vma.org/marketoutlook

SEPTEMBER

7-9
2022 VMA Annual Meeting*
(members only)
Santa Barbara, CA
www.vma.org/annualmeeting

12-17
IMTS 2022 (International Manufacturing Technology Show)
Chicago
itms.com

OCTOBER

8-12
WEFTEC 2022 Conference & Expo
New Orleans, LA
weftec.org

NOVEMBER

9-11
VMA Valve Basics 101 and 201
Pasadena, TX
www.vma.org/calendar

OTHER VMA EVENTS
Please visit vma.org/calendar for additional programs as they are scheduled.

*Open to VMA/VRC members only. Visit www.VMA.org to learn if your company qualifies for membership.

VALVE MAGAZINE

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ARTICLE SUBMISSIONS
VALVE Magazine welcomes articles, proposals, manuscripts, photographs and ideas from our readers. For a copy of the magazine's Author's Guidelines, contact Margo Ellis, Editor-in-Chief, at mellis@gardnerweb.com

AWARDS & RECOGNITION (continued)

Emerson Pledges $200 Million for Education Equity

Emerson has announced a new chapter in its philanthropic commitment to U.S. communities where it operates with a pledge to devote $200 million of its charitable contributions over the next decade to help address the vital issue of education inequity. With this announcement, Emerson is launching into its next phase of giving, building from its strong philanthropic foundation of the past 50 years. Emerson's commitment to education equity will focus on programs or initiatives targeting children from infancy through 12th grade, with an emphasis on early childhood and student services in under-resourced communities.

Flowserve Receives Top Scores in EnergyPoint's Customer Satisfaction Survey

Flowserve Corporation has been named as the top supplier in the categories of performance and reliability according to EnergyPoint's 2022 Oilfield Products customer satisfaction survey.

The survey, which concluded on Dec. 31, 2021, reflects opinions from more than 3,700 customer evaluations and comprises more than 50 questions that focus on factors shown to drive satisfaction among customers of product suppliers. This survey is considered by EnergyPoint to be the "industry standard for independent customer satisfaction ratings of global oilfield products providers."

ITT Honored by VETS Indexes

ITT Inc. is proud to announce it was bestowed the designation as a VETS Indexes Recognized Employer as part of the 2022 VETS Indexes Employer Awards. The award recognizes ITT's commitment to recruiting, hiring, retaining, developing and supporting veterans and the military-connected community.

"ITT is fortunate to have our amazing colleagues who are veterans and military family members. They come with an incredible array of experiences, wisdom and accomplishments that contribute significantly to ITT's higher performing culture," says ITT's Veteran Resource Group sponsor, Dave Steblein, senior vice president and Industrial Process president.

CONTRACTS & PROJECTS

Hunt Valve Awarded $2M Contract by Newport News Shipbuilding

Fairfax Morse Defense (FMD) has been awarded a contract by Newport News Shipbuilding (NNS) to provide essential parts through Hunt Valve for the Ford Class aircraft carriers CVN 78-CVN 81. The contract, valued at approximately $2 million, covers parts that will be delivered during the second and third quarters of 2022. Hunt Valve, which was acquired by Fairbanks Morse Defense in 2021, manufactures valves and electromechanical actuators for naval defense applications.

This contract reinforces FMD's position as a key supplier to its core naval defense customers. Having traditionally been a naval engine supplier, Fairbanks Morse Defense has expanded into a single-source product and service solutions provider for the entire vessel. Over the last 18 months, the defense contractor has acquired several companies and currently offers a large array of best-in-class marine technologies, OEM parts and turnkey services for the entire vessel to ensure Navy and Coast Guard fleets are always mission ready.

Flowserve to Provide Equipment for European Open-Source CCS Initiative

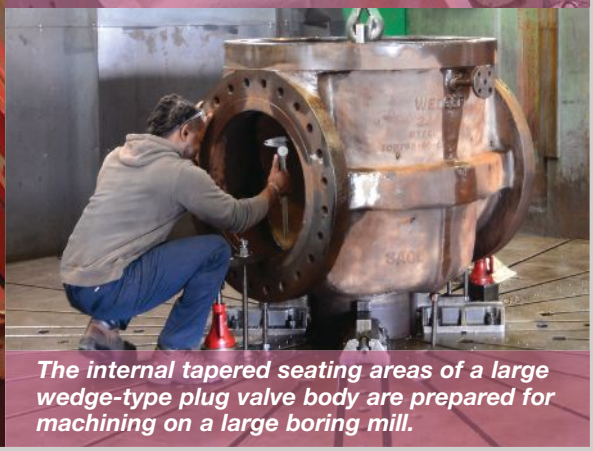
Flowserve Corporation has been awarded a contract to provide control valves for a portion of Norway's first cross-border and open-source carbon capture and storage facility. With an estimated 2024 completion, this facility will be the first of its kind and will help further enable the acceleration of decarbonization in Europe.

Flowserve's Flowtop and Mark One control valves for the facility's onshore site in the Bergen region will facilitate carbon capture before it is ultimately transported to an offshore terminal and stored permanently below the seabed. Once completed, the facility will have the ability to potentially store an estimated equivalent of 1,000 years of Norwegian emissions.

Rising-Rotating Plug Valve Repair & Service

The seating areas of a DN 30, wedge-type plug valve are weld-repaired, prior to machining and grinding.

The raised faces of a DN 24 wedge-type plug valve are machined on a horizontal boring mill.



The internal tapered seating areas of a large wedge-type plug valve body are prepared for machining on a large boring mill.

United Valve is fully equipped to handle repairs and modifications on all types and brands of rising-rotating metallic plug valves. These valves are mainstays of Coker-valve block service as well as many other critical fluid control applications, such as overhead vapor lines and ethylene cracking units. We offer in-shop or field-service repair on these valves and their associated actuators.

The largest boring mills in our machine tool inventory can machine plug valve components of any size or material, while our grinding machinery is capable of handling valves of up to NPS 24 for both internal and external grinding. The machining department features 20-ton cranes, while the adjacent assembly area is served by a 40-ton crane.

Weld repairs are often required on these plug-type metallic valves. The United Valve welding department is led by our in-house welding engineer and features both manual and mechanical welding processes. All of our 200+ welding procedures are created and qualified in accordance with ASME Section IX, as well as approved by many, even stricter end-user specifications.

United Valve

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VMA Drives Industry Awareness, Membership Opportunities

It was a busy spring for the VMA, with no plans for that to change going forward. VMA's Board of Directors, committees and professional staff are working to deliver resources and education to help members address pressing topics, provide venues to share information and find business partners and to represent the importance of the industry to external stakeholders.

As reported in VMA's monthly pulse survey, VMA members continue to experience strong orders and business opportunities with a robust 40% of respondents indicating their shipping volume is up over 10% compared to last year. However, they continued to be challenged with supply chain and workforce issues.

Earlier in the spring, VMA members visited Capitol Hill with the goal of raising awareness of the industrial valve industry. Visits were made to offices where many members are located — including those in Texas, Pennsylvania and Ohio. The visit was followed up with VMA joining 133 other prominent associations in signing a multi-trade letter in support of the supply chain subtitle in the American COMPETES Act.

Of course, our voice on Capitol Hill is only as strong as our members who join and support the VMA. We recently welcomed several new member companies ready to take advantage of VMA benefits and demonstrate their company's commitment to the industry.

VMA continues to provide top-notch education and insights on the issues affecting our industry. Since the start of the year, webinars were conducted on topics such as valve materials, trade and tariffs changes. In April, a successful Valve Forum Conference & Exhibits took place in San Antonio, Texas, and three events are on the horizon. While the Valve Forum and Valve Basics events, and some webinars are open to anyone, companies interested in the Market Outlook Workshop and VMA/VRC Annual Meeting can join VMA and view additional membership benefits at vma.org/membership.

VMA Members Promote the Valve Industry to Capitol Hill and Reiterated Supply Chain Concerns

For the first time in over 15 years, VMA members visited Capitol Hill with the goal to raise awareness of the industrial valve industry and how the industry impacts the economy and lives of Americans.

VMA members met with the staff from offices in Ohio, Texas, Pennsylvania and Minnesota to explain the importance of discussing issues that are paramount to our industry, including supply chain challenges, taxes, workforce development and infrastructure investment.

VMA's work in this area continues with a tool kit for VMA members to use while hosting elected and other government officials at their facilities.

Additionally, VMA recently joined 133 other prominent associations in signing a multi-trade letter to Congress in support of the subtitle in the America COMPETES Act pertaining to supply chain issues. The letter was submitted to House and Senate leadership, House Energy & Commerce Committee and the Senate Commerce Committee in May.

On the steps of the U.S. Capitol (left to right); Matt Thiel, AUMA Actuators Inc.; Brian Wright, A-T Controls; Heather Rhoderick, VMA; Nathan Brunell, Baker Hughes; and Arie Bregman, DFT Inc.

VMA/VRC Annual Meeting Offers Foresight and Industry Recognition

VMA and VRC members are invited to Santa Barbara, CA, for the 2022 VMA/VRC Annual Meeting from Sept. 7-9, 2022. The association's premier event, the Annual Meeting, is **open to VMA/VRC members only** and delivers unparalleled networking, discussion and analysis of the most important external and internal issues being faced, and how they affect the valve industry. A sample of topics on this year's program included:

- China's Impact on Business, Manufacturing, the Economy, the Supply Chain… on Everything?
- Energy Transition — The Rest of the Story
- U.S., Canadian and Global Economic Outlook
- Government Policy and External Influences on the Valve Industry
- Leadership Through the Great Resignation and the Great Regret

Leaders are also recognized for their contributions to the VMA and the valve industry with various awards at the Gala Dinner, which closes out the event on Friday evening. The Annual Business Meetings of VMA and VRC will also take place, and a spouse/guest program is also offered.

Learn more and register at vma.org/annualmeeting.

Valve Forum – A Return to Form

The VMA Valve Forum Conference & Exhibits took place in San Antonio, TX, this past April, with attendance matching pre-pandemic levels. Participants learned the latest on topics that are impacting the present and future of the valve industry, and networked with exhibitors in a small exhibit area. Survey results indicated that 96% would consider recommending the event to others.

Sessions related to current events such as supply chain issues, crisis communications and workforce topics such as the future of the workplace and finding and retaining employees resonated with attendees. In addition, the opportunities that growing trends like environment, social and governance (ESG) and hydrogen offer the industry piqued everyone's curiosity as some of the highest attended sessions. A deep dive session on valve systems in the tank farms was also well received and generated a robust Q&A session. Open discussion forums around technical topics also provided participants with unique insights from peers.

Attendees also got a continued look into the changing the future of manufacturing, including sessions on automation, robotics and energy transition. One attendee summed up the program well: "I especially liked the wide range of topics that the speakers covered, and I thought this year's speakers were particularly applicable to trends in the valve industry.

Very interesting topics and the speakers did a nice job providing practical guidance on each topic."

Exhibitors and sponsored companies included amtec North America Inc., AUMA, Bodycote SP3, DFT Inc., EGC Inc., EFCO and Zwick.

The 2023 Valve Forum Conference & Exhibits will take place in San Antonio, TX, on April 17-19, 2023. A larger exhibit hall and the addition of experiences only available in person like company tours will be offered next year, as well as some activities to facilitate forming business relationships for those new to the industry and seasoned professionals.

For more information, visit vma.org/valveforum.

Hands-On and Virtual Training Offered to Industry

The Valve Basics program is your gateway into the world of valves and actuators. Split into two programs, virtual Valve Basics provides an overview of valves, valve actuators and valve automation and how they are used in various applications. For 2022, we are now offering a virtual and an in-person option.

VIRTUAL VALVE BASICS

When you register for the full Valve Basics program, you will get 24/7 access to:

- **Valves 101** — covering the major valve types, including linear, check, quarter-turn and pressure-relief, plus actuation basics.
- **Valves 201** — offered for those who want to take the next step in learning more about critical flow control products, including actuators, controls, automation and more.
- **Live Town Halls** — meet virtually with Valve Basics instructors, get answers to any burning questions you may have and learn the latest developments and new trends on specific topics.

VALVE BASICS IN-PERSON

The Valve Basics In-Person program is similar in content to the virtual version, but with the benefit of the hands-on experience of the "Petting Zoo." The Petting Zoo is a showcase of the many valves and actuators that are discussed during the Valves 101 and 201 programs. It's an opportunity to get a better understanding of how these products work and provides a better all-around real-world learning experience. The program will occur at the Houston Area Safety Council training center in Pasadena, Texas, from November 9-11, 2022.

Learn more and register at vma.org/valvebasics.

VMA Welcomes New Member Companies

The VMA is proud to welcome new members to its ranks, including Ecoat U.S., JACQUET Mid-Atlantic, WedgeRock Inc. and three of IMI Critical Engineering's U.S. brands, IMI CCI, IMI Fluid Kinetics and IMI Z&J.

Find out more about membership benefits and join at vma.org/page/membership.

ECOAT U.S.

Ecoat U.S. has been a leader in the e-coating industry since the early 1990s. The company has helped to shape e-coating, developing innovative, patented solutions for the oil and gas and HVAC industries and beyond. The company currently supplies its patented ZPEX coating product to valve OEMs.

For more information, visit ecoat.us/oilgas.

IMI CRITICAL ENGINEERING U.S. BRANDS

Three of IMI Critical Engineering's U.S. joined VMA along with IMI PBM, which remains a member. The brands include:

- IMI CCI
- IMI Fluid Kinetics
- IMI Z&J

IMI Critical Engineering offers customized, highly engineered flow control solutions at the heart of complex energy and production processes, helping industries operate safely, cleanly and efficiently. The company designs, manufactures and installs critical flow control systems, backed by complete plant lifecycle service support that ensures efficient maintenance and plant optimization.

IMI Critical's portfolio also includes the following global brands:

- IMI Bopp & Reuther
- IMI Newman Hattersley
- IMI Orton
- IMI Remosa

For more information on IMI Critical Engineering, visit imi-critical.com.

JACQUET MID-ATLANTIC

JACQUET is an established market leader in the distribution of stainless steels and nickel alloys. JACQUET specializes in the storage, processing, and distribution of high-value metals in the form of Plate and Bar products.

Located in Limerick, PA, JACQUET is the U.S. headquarters and the largest of the U.S. facilities with over 110,000 SF storing commodity and specialty grades of stainless steel and nickel alloy in plate and round bar.

For more information on JACQUET Mid-Atlantic, visit usa.myjacquet.com/our-locations/jacquet-mid-atlantic/the-company.

WEDGEROCK

Based in Limerick, Maine, WedgeRock provides high-efficiency geared actuation solutions for the most demanding torque and thrust applications, covering all valve markets, from subsea to aerospace and everything between.

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Valmet
FORWARD

The Diverse Role Valves Play in the Chemical Industry

The chemical industry is extremely diverse with more than 60,000 known products. Chemicals are typically split into basic categories including petrochemicals, agrochemicals, specialty chemicals, pharmaceuticals and bio-chemicals, and consumer products. Like all process industries, the chemical industry needs valves designed for safe, efficient and reliable process operation.

BY LINDSAY COUTINHO, FRED PORTH & DHANESH BHASKARAN

From a functional perspective, the industry has a need for control, emergency shutdown, manual/automated on/off, safety and pressure relief valves. Typical valve types used are gate (multiple variations), globe, check, plug, diaphragm, ball, butterfly, as well as other rotary control valves like segmented ball and eccentric plug valves.

There are many ways chemical compounds can be extremely dangerous. They can be either extremely corrosive, abrasive, sticky, volatile or highly toxic substances. To ensure safety and reliability, it is important to take both the process conditions and the characteristics of the flow media into account when selecting valves. The chemical in question may affect the lining, material selection or even construction or design of the valve.

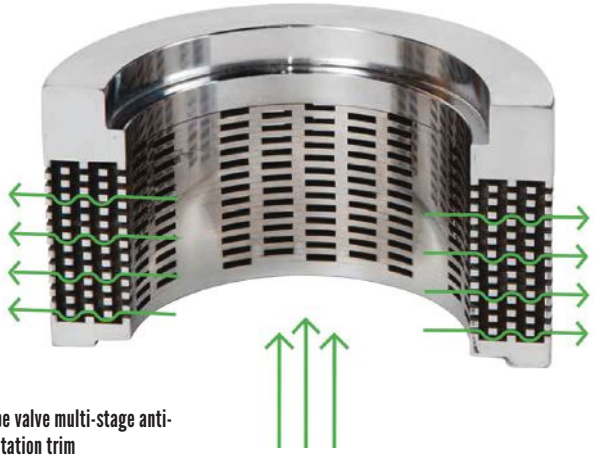
THE DIVERSE PETROCHEMICAL AND POLYMERS SECTOR

Within the chemical industry, petrochemicals are one of the largest segments – including olefins (ethylene, propylene, butadiene) and aromatics (benzene, toluene, xylene) – that are used for many applications to produce a wide variety of products. For example, ethylene, produced typically by the steam cracking process, is further utilized in the production of polyethylene by polymerization and other ethylene-based derivates.

In a steam cracker, the fuel gas valves need to handle various control loads, hence rangeability of valves can be a critical factor. On/off valves handling the fuel gas may need third-party approvals with compliance to *EN161, Factory Mutual (FM) Global Class 7400 (fire safe class 7440)*, or CSA International Standards Specification *Z21.21/CSA 6.5 Automated Valves for Gas Appliances*.

Drying ethylene before it enters the cold zone area is typically done by using molecular sieve beds. Valves around these dryer beds are subject to various thermal conditions during adsorption and regeneration. Valves in the cold zone need to handle cryogenic temperatures and very high-pressure drops. For fuel gas control, globe valves are typically the primary solution but when rangeability is a factor, segmented ball valves can be a viable option as well. In the cold area, where valves capable of handling cryogenic temperatures and high-pressure drop applications are needed, globe valves with multistage trims help to eliminate noise and cavitation.

From left: Sampling of valves used in chemicals processing: linear globe valve; modular trunnion mounted ball valve; and a butterfly valve pressure swing. All images courtesy of Valmet Flow Control.

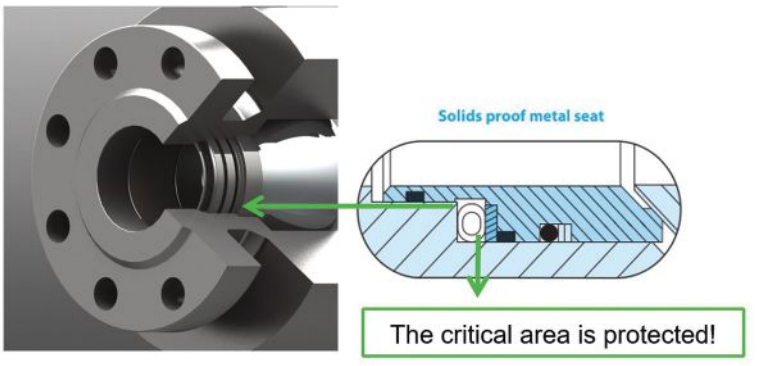


Globe valve multi-stage anti-cavitation trim

Metal seated ball valves are an ideal solution for dryers in a steam cracking unit. These valves can handle wide temperature swings and frequent cycling. Rotary valves are easy to handle, compact and offer various orientation options compared to other valve designs.

The polymerization process needs to handle fluid medium with polymers, resins and catalyst residue. These fluid media are challenging as they can accumulate in the valve body cavity thereby affecting the availability of these valves. This may result in process interruptions with every minute the process is out of use causing considerable loss to the plant owners. Another challenge associated with this process is high cycling (up to 1.5 million cycles annually). Valves around the catalyst systems that handle dry catalysts typically face severe trim erosion. Fugitive emissions and seat leakage in valves also need to be tackled, given the importance of safety and a minimized environmental impact.

Once again, metal seated ball valves with solids-proof seats have excellent proven performance. The "polymer proof" seat helps to prevent the media from entering the seating area. Continuous contact of the ball and seat with a scraping seat design helps to remove any particle build-up on the ball. For polymer slurries, segmented ball valves are quite effective.



Ball valve with solids proof seats and live-loaded packing

Aromatics units with dry flow media like p-xylene sticks to the trim surfaces, hence increasing the friction and wear. In certain separation processes, valves are subjected to high cycles, requiring precise control. Typical solutions include metal seated ball valves with scraping seat design, as well as segmented ball valves and eccentric rotary plug valves with specific coating material to handle the high friction. Triple offset butterfly valves can also be suitable solutions in the benzene and toluene extraction processes.

FERTILIZERS AND THE AGROCHEMICAL SEGMENT

In the agrochemicals segment, nitrogenous fertilizers account for more than 50% of the market, with ammonia being a vital key component. Ammonia synthesis is used to produce ammonia from nitrogen and hydrogen. A mixture of hydrogen and nitrogen, usually originating from a steam reformer, is admitted to the synthesis loop and compressed in two stages into the synthesis pressure of 2200-4400 psi (150-300 bar). The ammonia conversion process is a compromise between temperature and pressure. For the catalyst to be efficient, a temperature of at least 750°F (400°C) is needed.

The high temperature, very high-pressure presence of hydrogen and ammonia are challenging for any valve. Emissions control is important due to the toxicity of the media being handled. Triple-eccentric butterfly valves provide the optimal solution for ammonia synthesis loop isolation and control. The design reduces wear and facilitates an extended operational life through the wide pressure and temperature range, body and trim materials, with tight shutoff in some of the harshest conditions.

Solid metal seated options allow the highest possible flow velocities without damaging the seat. Additionally, seats are typically interchangeable without the need to disassemble the disc and shaft. Live-loaded stem seals are standard, and valves are fire tested and generally certified for emergency shutdown up to Safety Integrity Level (SIL) 3.

THE RISE OF SPECIALTY CHEMICALS

The drive toward solar energy has generated increased demand for photovoltaic panels in which polysilicon is a key raw material. Polysilicon has long been a raw material in semiconductor devices whether it be your mobile phone, laptop or personal vehicle.

A typical polysilicon process uses SiO2 (quartz sand) as raw material to produce metallurgical grade Si, also known as MG-Si. MG-Si is obtained in an arc furnace with the presence of carbon. During the process, raw material, intermediate products and by-products include Si powder, Cl2, H2, HCl, SiHCl3, SiH2Cl2 and SiCl4; therefore, the valve's design must be able to deal with these media, especially the highly abrasive Si powder. H2 and SiHCl3 are easily combustible, HCl is extremely corrosive and SiHCl4 is a highly toxic substance. All these chemicals

Neles Neldisc triple eccentric metal seated butterfly valve

should be captured and recovered to decrease raw material consumption and increase overall process efficiency.

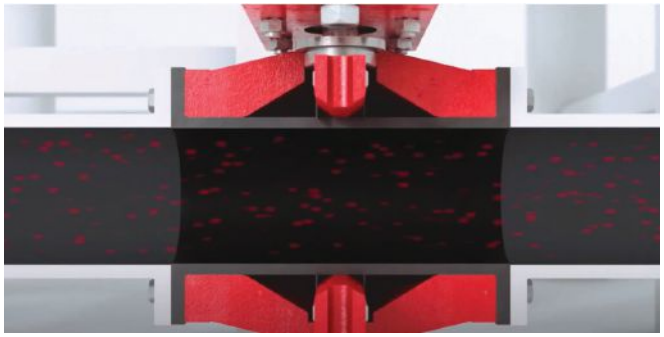
Rotary stem operation, live-loaded gland packings and an inherently fire-safe design ensure that all the latest emission and fire safety standards can be applied. Soft-seated ball valves with polymeric flexible lip seal designs that use molecular enhanced PTFE as a seat material provide a long-term solution even with high cycle operation. Metal seated ball valves with dustproof seats have proven themselves well in silicon powder addition where the valve is typically subject to high erosion.

DEMANDING INORGANIC CHEMICAL PROCESSES

Titanium dioxide (TiO_2) is another application that is demanding for valves. The material is commonly used as a white pigment in paint manufacturing, paper, plastics, rubber, ceramics and fabrics. TiO_2 is generally produced from its ore, which is either ilmenite or natural or synthetic rutile. Ilmenite-based raw materials are typically used for the wet sulfuric acid process, while rutile is used in the high-temperature chloride process.

The production process exposes valves to high temperatures, abrasive slurries and corrosion. Metal seated ball valves with carbide coatings and bellow seats are the most suitable for isolation at high temperatures. Pinch valves are often preferred in the handling of abrasive slurries. They provide a full and true bore in the open position with no restrictions. Heavy-duty pinch valves with superior elastomer technology are ideal for both shut-off and control applications. Controllability can be further

Pinch valve



Interior view of pinch valve

improved with conical sleeves and intelligent positioners. The rubber sleeve is the only wearing part, which helps extend service intervals and significantly reduce maintenance costs.

The chlor-alkali segment also presents many challenges for valves. Chlorine passes through liquefaction for storage and transportation and vaporization for processing. Liquefaction is performed in stages and valve sizes typically range from 3 inches to 20 inches and ANSI Class 150.316SS is the typical material of construction due to low temperatures. With liquid chlorine, valves with CS bodies and Monel trims are recommended. Double-eccentric butterfly valves with live loaded packing to contain fugitive emissions are commonly used.

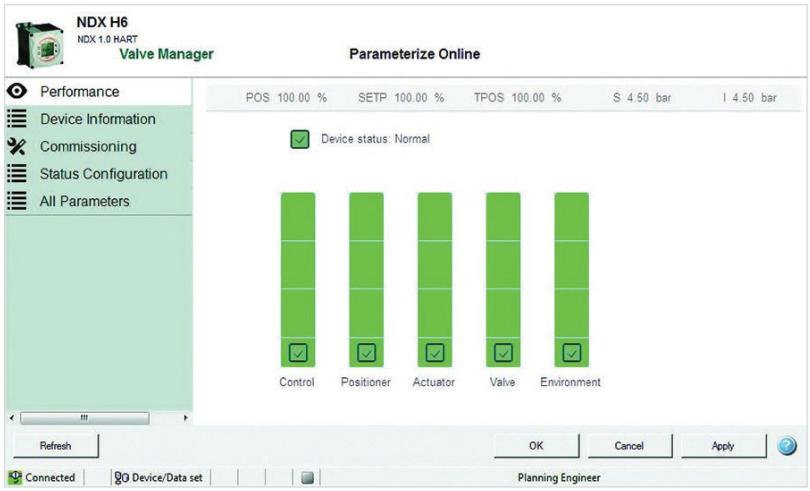
The process of turning Cl2 liquid into vapor requires the application of heat under controlled conditions. Hot water or steam is modulated to maintain the vapor-producing temperature of the vaporizer section. Rotary control ball valves are used for modulation, while the numerous drain and isolation valves used are almost exclusively threaded end ball valves.

PFA-lined ball and butterfly valves as well as diaphragm valves find extensive use in brine preparation and caustic soda production for corrosion protection.

TECHNOLOGY IMPROVES SAFETY IN ALL CHEMICAL PROCESSES

Intelligent controllers combined with reliable valves and actuators have ushered in an era of enhanced safety and availability. SIL 3-approved intelligent solenoid valves with partial stroke testing ensure that plant emergency shutdown

Neles NDX valve controller



Comprehensive device diganostics

valves will always perform when needed. Advanced intelligent on/off and modulating controllers ensure high positioning accuracy and fast responses. Modern valve selection and sizing programs can ensure the best valve performance and process control.

Open FDT/DTM-based technologies allow seamless interfacing between the controllers and device management and condition monitoring systems. Valve performance trend data is collected and easily analyzed, facilitating predictive maintenance and reduced unscheduled downtime.

Like all other industries, the chemical industry is also in a race to achieve net zero emission targets set out at the last COP26 summit. Energy optimization, the use of alternative forms of energy and decarbonization are under active pursuit and will offer new opportunities and challenges to valve manufacturers in the coming years. VM

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**Neles merged with Valmet on April 1, 2022, and became Valmet's Flow Control business line.*

Valve Basics

Electric Actuator Controls

Electric valve actuators control the opening and closing of valves. With a motor drive that provides torque to operate the valve, these actuators are frequently used on multi-turn valves such as gate or globe and also on ball, plug and other quarter-turn valves.

BY JEREMY PAYNE

Electric valve actuators are ubiquitous in today's industrial space. They can be found in various industries and applications, including water treatment and wastewater plants, hydroelectric power generation, oil refineries, shipbuilding and numerous processing industries such as chemicals, food and beverage, pulp and paper, and pharmaceuticals. For anyone charged with the selection and operation of these products, it is important to understand the power source, controls, feedback, commissioning, security, backup power and failsafe required for the application.

This article will review different types of control systems and configurations available to electrically operate valves, which some in the industry refer to as motor-operated valves (MOVs), and how to make an informed decision on which type of actuator to use.

POWER SOURCE

An electric actuator must have a power source available. Prior to selecting an actuator, it is important to determine the type of electricity that is available on site.

- Single-phase AC power
- Three-phase AC power
- DC power

This will decide the type of electric actuator supplied for the application. The power source will be used to operate the motor through a set of reversing contactors, either located within the actuator, or in some cases located in a remote cabinet.

Actuator-mounted local controls

All photo credits: courtesy of AUMA

The power source must be capable of supplying the proper voltage and current required by the electric actuator to operate the valve. An electric actuator may be required to operate the valve as an open/close or modulating actuator; make sure the actuator is manufactured and supplied according to the required specifications.

CONTROLS

Controls are what operate the electric actuator so the next step is to determine how the actuator will be controlled.

There are two main types of controls:

- **Local controls** are mounted directly to the actuator. Photo 1.0
- **Remote controls** are systems that operate the actuator remotely.

REMOTE CONTROL TYPES

Discreet open and close signals from a PLC or other system are most commonly used with open/close valves and can be used for modulating service

Remote control system

as well. This is done with open/stop/close signals sent from pushbuttons or switches (pilot devices) from the PLC or remote-control station to the actuator. Control power is typically a 24VDC or 110VAC signal. Remote-control power can be provided on-site, or in some cases, actuators come equipped with a control power transformer (CPT) that provides this voltage for the customer's control system to use.

Analog control signals are common with modulating valves. The analog control signal can also be referred to as a positioning signal or set point. Most analog controls utilize a 4-20mA signal, with 4mA being fully closed and 20mA being fully open. A 0-20mA is typically not used because 0mA could be misinterpreted as a loss of signal. The valve's position in between close and open can be reached by setting the mA control signal to a signal position in between 4mA and 20mA, respectively. This signal could be sent from the control room, or in some cases, it could be the output of a flowmeter upstream of the valve used to regulate flow.

Digital bus communication can be used on open/close valves or modulating valves. Digital bus communication is also referred to as fieldbus or two-wire control, as the control signal communicates along wires connected in between a group of actuators and a digital bus controller.

To use a fieldbus communication, first determine which protocol will be used. Some of the available protocols are:

- Foundation Fieldbus
- Profibus
- Modbus RTU (Remote Terminal Unit)
- Modbus TCP/IP (Transmission Control Protocol/Internet Protocol)
- Hart
- Ethernet IP (Internet Protocol)
- Device Net
- Back Net

If the site is communicating via fieldbus, make sure the actuator can use the same protocol.

Some actuators can provide the option to operate with discreet inputs and fieldbus communication.

FEEDBACK

Feedback are the signals coming from the actuator to the control system, also referred to as output signals.

Analog feedback. Actuators can supply a 4-20mA signal to give the control system the existing valve position, like the setpoint analog control signal. 4mA or 20mA may be set to indicate the open or close position based on the application. Some actuators can also offer torque feedback in the form of a 4-20mA signal indicating actuator output torque, if the application requires.

Discreet feedback signals. Many actuators have status relays available to the customer signaling actuator position, torque-fault, general fault, run indication or intermediate position. In the case of non-intrusive (defined below in *Commissioning*) actuators, they will have relays that can be programmed to the customer's desired feedback signal requirements.

Bus communication feedback. Fieldbus monitoring can be done across the fieldbus signal to include many more signals than are capable using the discreet feedback. For example, this can be the actuator's position or status, and fieldbus system status, in addition to many others depending on the fieldbus protocol.

Visual position feedback screen

Limit/torque switches. These are available as voltage-free dry contacts to give position/torque feedback status.

Visual position feedback. Most actuators come with a physical position indicator that shows the position of the valve and actuator; this may be in the form of a mechanical dial or on-screen indication. If the valve actuator is mounted to an additional gearbox, it often is supplied with a pointer cover

Visual mechanical position feedback indicator.

to offer visual position indication.

COMMISSIONING

Commissioning of an actuator is required to ensure proper operation of the valve and integration to the control system. Commissioning requirements may include verification or setting of end positions, setting of torque and the feedback signals. Commissioning is performed based on the type of actuator provided.

- **Intrusive actuators.** These actuators must have the covers opened, and tools are used to set the limit switches and torque switches in the actuator.
- **Non-intrusive actuators.** These smart actuators can be programmed using the local controls. Additional options, such as a Bluetooth and a laptop, a mobile phone app, or other device may also be used to perform the commissioning.

SECURITY

There are different levels of security available for the customer when it comes to an electric actuator.

Physical security: Actuators can be supplied with lockable pilot devices, such as selector switches. Additionally, lockable covers may be supplied to cover the local controls. There is also the option to have padlocks on the handwheel/declutch devices, which are used to operate the valve manually.

System security

- **Bluetooth —** The ability to turn the Bluetooth on/off, password protect or eliminate it entirely may be an option.
- **Permissive signal** — When setting up a control system, a permissive signal can be given to the actuator before it will operate electrically. This can be used to ensure the valve is not accidentally operated.
- **Interlock signal —** A permissive signal is supplied to the actuator from a separate actuator or other device within a facility. This interlock is used if opening or closing the valve requires a defined status elsewhere in the facility.

BACKUP POWER

Backup or emergency power may be important in an instance where the main power on-site is interrupted. A decision must be made as to the type of actuator operation required upon the loss of main power. Does the actuator still need to operate the valve normally or just place the valve in a safe position?

These options can operate the actuator and/or place the actuator in a safe position in a loss of main power:

UPS (Uninterrupted Power Supply): If a solution for actuator normal operation during a power outage is needed, a UPS backup power system could be a good option for the actuator. This will allow a customer to open or close the valve in the event of an emergency power outage.

DC (Direct Current Power): Actuators are also available in a DC voltage version. These can be used if a site has backup DC voltage available to operate an actuator during an emergency power outage.

FAILSAFE

An actuator may be supplied with a device to place it in a safe position. This device often uses a spring or other technology to place the actuator in the defined safe position.

BEST PRACTICES

Power Source

- Ensure the site has the power and current available to operate the actuator supplied.
- Separate power cables from signal cables.

Type of Controls

- Make sure the actuator is supplied to match the controls available at site.

Feedback

- Ensure the actuator is supplied with the proper feedback for the application.
- Ensure that you know who is supplying the analog feedback power.

Commissioning

- Always employ a trained professional familiar with the equipment supplied.

Security

- Keep track of changes to actuator passwords. OEMs may be capable of resetting passwords back to factory default.

Backup Power

- Make sure the actuator and backup power sources are compatible (voltage, current, etc.)

Actuator and hand wheel with locks and an alternative option for a faceplate cover

Failsafe

- Make sure the actuator is supplied with the desired failsafe position. The failure position may not be changeable after delivery.

Electric actuators have an important role in safe and efficient operation valve operation. Understanding the various elements, such as those discussed here, allow the user to successfully define, set up and operate a basic control system. VM

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New Technologies Solve Severe Cavitation Problems

An advanced anti-cavitation control valve design enabled by 3D metal printing solved a power plant's severe cavitation problem and dramatically improved its bottom line.

BY MARK NORD & STEVE ZINDA

Applications with very high pressure drops often create control valve problems, requiring solutions created by combining innovative valve design and advanced metallurgy. These issues are even more pronounced in a power plant where magnetite (iron oxide) is often present in boiler feedwater (BFW) systems. In these cases, the damage caused by cavitation is compounded by erosion and plugging created by the magnetite.

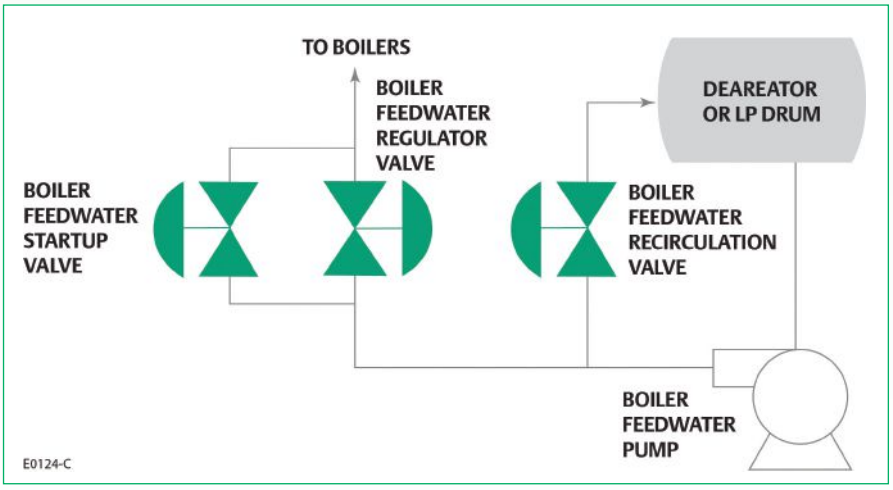
Emerson engineers were engaged to address a vexing control valve application problem of this nature at a local power producer in Wisconsin. The solution required a novel design created using additive technology, specifically 3D metal printing.

APPLICATION ISSUES

The BFW pump supplies high pressure water to the boiler or heat recovery steam generator to maintain proper drum level and pressure, producing significant pressure increase across the pump. This pressure increase also produces an associated increase in feedwater temperature across the pump. If a constant minimum flow through the pump is not maintained, the temperature will rise to a point where substantial damage to the pump may occur.

Therefore, a recirculation system is needed to protect the BFW pump. During startup or low flow conditions, a BFW recirculation valve opens to maintain a minimum flow through the pump to avoid pump damage from overheating. Under these conditions, the pressure drop across the valve is very high, nearly 2500 PSI. A back pressure regulator is installed downstream of the valve to take some of the pressure drop and reduce the strain on the valve (Figure 1).

The water coming from the low pressure (LP) drum is over 300°F, and this elevated temperature combined with the very high-pressure drop can create cavitation within the valve. While cavitating conditions tend to damage valve internals, the problem is made much worse by magnetite in the feedwater, which further erodes the valve internals and plugs the small passages inside a typical drilled hole or torturous path



All photos courtesy of Emerson

Figure 1. A boiler feedwater recirculation valve is installed on the discharge of the boiler feedwater pump, and it opens during plant startup to avoid deadheading the pump.

anti-cavitation valve trim. This plugging reduces flow capacity, and thus plug and seat erosion from cavitation and particulate erosion can damage both the seat surfaces and valve plug seals, preventing the valve from shutting off tightly.

If this type of damage occurs, the valve has a constant minor leak when it is fully seated, reducing water flow to the rest of the process. This leakage causes further damage to the valve, and to the downstream regulator, which should see no flow under normal operating conditions. In the worst case, there is insufficient feedwater to the boiler or the heat recovery steam generator to meet load demand, causing a plant derating and lost revenue.

ANTI-CAVITATION TRIM TO THE RESCUE?

The internals of a control valve in these types of very high-pressure drop applications are specially designed to eliminate damaging cavitation. Cavitation occurs when liquid flows through a valve and falls below the vapor pressure as it passes through the valve seat at high speed.

Once the liquid passes through the valve trim, the velocity slows and the pressure recovers, collapsing the vapor bubbles in the fluid. As each bubble collapses, it emits local shock waves that damage the seat, plug and walls of the valve — as well as the downstream piping. A cavitating valve sounds like it has gravel passing through it, and the resulting damage reinforces this observation.

Anti-cavitation trim eliminates damaging cavitation by taking a number of smaller pressure drops (stages) as the liquid passes through the valve. By taking several smaller drops, the pressure stays above the vapor pressure of the fluid, thereby eliminating damaging cavitation (bottom dashed line in Figure 2).

This type of trim is usually fabricated using hardened, high-strength alloys and many small holes (Figure 3, left). As the plug moves up and down inside the cage, the holes are exposed, and each takes a pressure drop, avoiding any pronounced pressure dips as the liquid passes through the valve.

The installed control valve had three-stage trim, which would ordinarily work very well in this application. However, this particular plant had significant magnetite in the BFW, which tended to plug the small holes in the trim. This reduced the overall valve capacity, while damaging the primary seating surfaces and valve plug seals (Figure 3, right).

Rather than allowing water to pass only when open during start-up or low flow conditions, the valve had a minor leak continuously, and this flow damaged the valve even more.

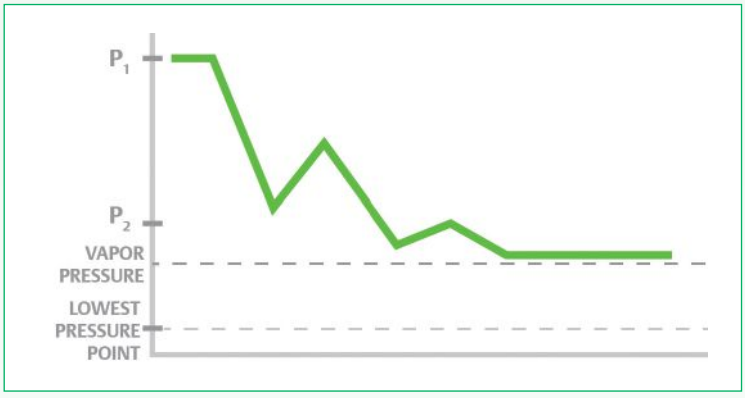


Figure 2. Cavitation in a control valve can be avoided if the pressure drop is taken in small steps and kept above the vapor pressure of the liquid.

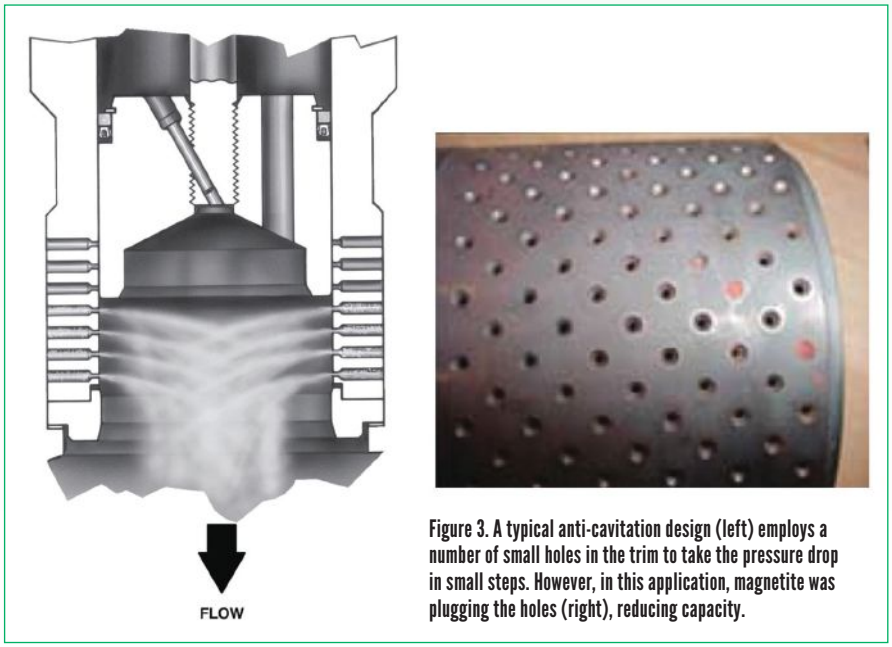


Figure 3. A typical anti-cavitation design (left) employs a number of small holes in the trim to take the pressure drop in small steps. However, in this application, magnetite was plugging the holes (right), reducing capacity.

CASCADING PROBLEMS

The issues associated with this one valve created a chain of other problems. The valve trim was designed to minimize cavitation but damage from magnetite within the valve resulted in:

- Valve leakage created a constant

flow/vibration through the downstream backpressure regulator, damaging it over time.

- Valve leakage constantly eroded and damaged the control valve internals, as well as the downstream piping.
- As the valve leaked, the damage got worse, creating still more leakage, and required the plant to rebuild the valve twice a year on average.
- The leak recycled BFW back to the LP drum rather than to the process. This loss in BFW capacity forced the BFW pump to run at ever higher capacity to make up for the loss in flow, wasting energy.
- Eventually, the pump was driven to run at 100% capacity, wearing out the pump much sooner than normal, requiring overhauls with increasing frequency.
- When the valve leakage became too high, the pump could not keep up and a duct burner had to be shut down for lack of BFW, reducing plant capacity and resulting revenue.

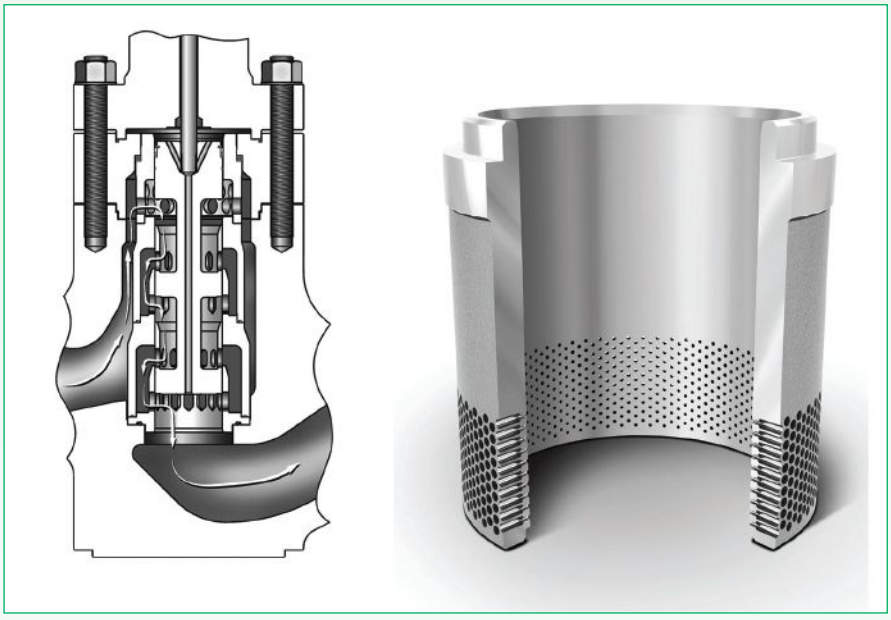


Figure 4. This anti-cavitation trim (left) has a large number of very small holes. Dirty service trim (right) has much larger flow paths, allowing up to $^{3}/_{4}$-inch particulates to pass through.

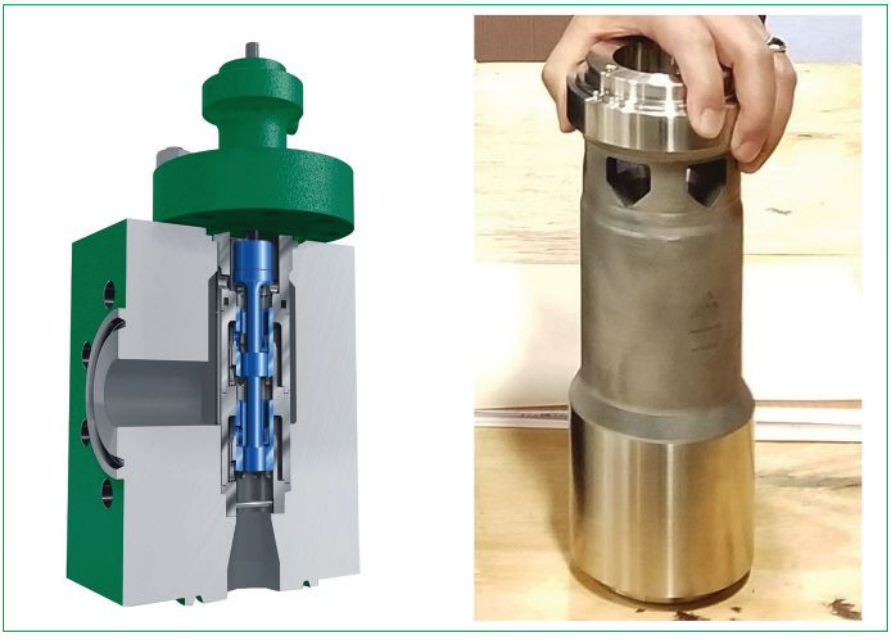


Figure 5. DST Valve design and R31233 cobalt chrome internal components enabled by additive technology (3D metal printing).

The plant tried installing mesh strainers upstream of the valve, but these plugged and had to be pulled and cleaned regularly, creating a maintenance problem. Clearly, a better solution was needed.

INNOVATIVE DESIGN ADDRESSES ISSUES

After evaluating the process conditions, engineers recommended a recently introduced anti-cavitation control valve design with dirty service trim (DST). As can be seen in the comparison pictures in Figure 4, the trim has very small holes subject to plugging in applications with a high degree of particulates, while the DST can pass entrained particulates from ¼ to ¾ inches. The seat is also protected from the major flow path in the DST design — so it lasts much longer, even in erosive, plugging service — ensuring tight shutoff.

The DST design was quickly developed utilizing a new method of manufacturing called additive technology, specifically a subset of this technology referred to as 3D metal printing. While 3D printing was originally limited to plastics, it has advanced rapidly. Lasers can now be used to fuse metallic powders into virtually any shape imaginable, including some designs that cannot be made using standard machining methods.

Historically, very intricate parts could not be made of high-hardness materials because they were too brittle. However, 3D metal printing allows parts

to be created from very high-grade, high-hardness materials, regardless of the level of intricacy. In this case, the new DST valve (Figure 5) was manufactured using R31233 cobalt chrome (like alloy 6), so the new internals were much harder and erosion resistant than the valve trim originally installed.

REMARKABLE RESULTS

The results were dramatic and very profitable for the plant. The new DST trim eliminated the leakage and erosion issues, generating the following bottom line profit improvements:

- Savings of $20,000 per year due to reduced backpressure regulator repairs (includes parts, labor and scaffolding)
- Elimination of $100,000 per year in control valve/piping repairs (includes parts, labor and scaffolding)
- BFW pump required capacity was lowered, cutting energy costs
- BFW pump overhaul interval extended by four years
- Most importantly, the plant now runs all its duct burners at full capacity, generating an additional $7,000,000 per year in revenue.

These improvements were the result of close cooperation between the control valve manufacturer and the plant engineers throughout the process of identifying the specific problem, creating a solution, and verifying its effectiveness in this challenging application.

CONCLUSION

Recent advancements in additive technology, specifically 3D printing, have allowed for the development of new valve designs and prototypes with unprecedented speed. New critical service valves can now be fabricated with increased capabilities for challenging process conditions.

This technology also allows parts, even those with complex geometries, to be fabricated from much higher hardness materials, so even existing valve trims can be upgraded to solve erosion and resulting internal damage problems. For power and other process plants struggling with a critical service, high-pressure drop application, this option should be considered. VM

Mark Nord is a control valve solution architect, Global Industry Sales at Emerson's Flow Controls Business Unit. He has a BS in Mechanical Engineering from the University of North Dakota and more than 30 years of power industry experience, including over 25 years of control valve experience across all major industries.

Steve Zinda is a key account manager for Novaspect, an Emerson Impact Partner. He has a BS Mechanical Engineering and an MBA, both from UW-Madison. Zinda has 30 years of power industry experience, and 20 years of experience providing Emerson solutions to improve plant performance and reliability.

Grappling With the World's Complex Energy Transition Through an ESG Lens

With a long list of contributing factors, the world is barreling headlong into an energy transition that's full of challenges, opportunities and lofty net-zero goals.

BY MARGO ELLIS

ESG: Environmental, social and governance. Sustainability. Renewables. Decarbonization. Net zero. In the lexicon of the world's pressing energy transition, these terms dominate the new narrative. The reasons for this shift are varied, complex and numerous, but chief among them are changing corporate priorities that more deliberately consider not just shareholders but also a broader and critical group of stakeholders like communities, employees and customers. Capitalism is going through a transformation that acknowledges climate risk, and the International Energy Agency (IEA) has laid out its plans for net zero emissions by 2050 with a majority of vital OECD (Organization for Economic Cooperation and Development) countries in support.

For people who have spent their careers in industry, energy and manufacturing dating back some 30+ years, ESG is a major change that poses multi-faceted hurdles and likely a fair amount of resistance. It's an approach that challenges outmoded notions of increasing profits at all costs in a time of unfettered capitalism. It weighs industry's impact on the world, especially when considering the environment and issues of sustainability.

Discussing these ESG themes at the in-person VMA Valve Forum in April, Mike Troupos, managing director, Foresight Management, expanded on the investment aspect during his presentation *Green Drives Green: How Embracing Sustainability Lowers Operating Costs, Increases Sales and Creates a More Resilient Company*, "If you haven't heard of Blackrock, the company is the globe's largest asset manager where trillions of dollars of stocks are owned." He added, "Blackrock CEO Larry Fink has pushed hard in the past couple years, saying plainly that *climate risk is investment risk*." Troupos quoted Fink as having argued, "The evidence on climate risk is compelling investors to reassess core assumptions about modern finance. In the near future — and sooner than most anticipate — there will be a significant reallocation of capital."

Looking at the social part of ESG — and partially impacted by COVID's effect on the workplace and job satisfaction — there's a shift to more employee-centric approaches in valuing what each and every person brings to the table and the importance of bringing jobs back to the United States as we push to stay innovative and regain a strong foothold in manufacturing after decades of outsourcing jobs overseas.

In addressing the last part of the ESG triad — governance — Troupos also talked about a new Securities and Exchange Commission (SEC) mandate that was recently approved in March 2022 titled *The Enhancement and Standardization of Climate-Related Disclosures for Investors.* This rule, once it's in place, will mandate companies to report greenhouse gas emissions on their annual reports, ranging from Scope 1 to Scope 3, which is a progression from direct to more indirect, respectively. And he pointed out that all those in attendance at the conference — whether working for publicly traded companies, private equity (PE) firms or family-owned businesses — fall into the category where their scope 3 (indirect) emissions are drastically larger than their Scope 1 or 2 emissions.

HYDROGEN ON THE RISE

Pertinent to the valve industry in particular, Troupos discussed the major role valves along the entire value chain will have in the future of our economy, especially in green infrastructure like hydrogen technologies. With it expected to play a significant part in a net-zero path, hydrogen ser-

vice relies heavily on valves in dealing with high pressure and cryogenic temperatures.

Pradeep Venkataraman, senior manager at Mitsubishi Heavy Industries America, who presented on the *Role of Hydrogen in Energy Transition* at the Valve Forum, explained the challenges with hydrogen: "We have an efficiency problem. It's the lightest gas and it takes a lot to compress hydrogen to the density needed and transport is much more energy-intensive than natural gas. We've flown astronauts on spacecraft powered by liquid hydrogen, so there's a lot of knowledge about how to handle and produce hydrogen, but the challenge is how to do it at scale and in an economically feasible way."

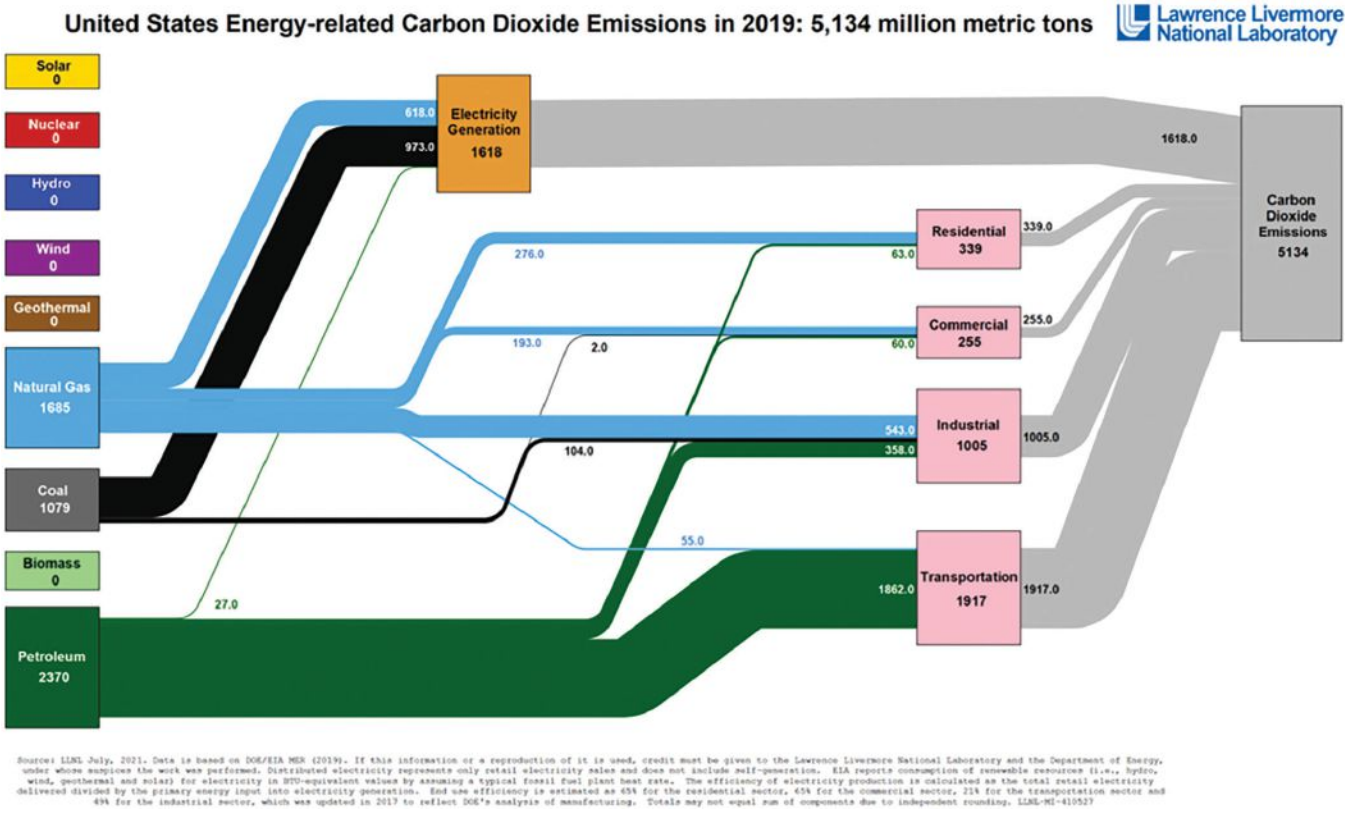
If we can tackle the hydrogen problems of energy density, safety and the bottleneck in transportation and storage (where valves play a major part), Venkataraman said, making the element safe for consumer use on a mass scale is a significant step toward a lower-carbon future. There are currently more than 150 fuel cell electric vehicle [FCEV] fueling stations throughout the country (primarily in California), with 4,300 expected by 2030.

A repeating theme is that this gargantuan effort and energy transition will have myriad paths, so it's crucial to employ all opportunities and technologies to come anywhere close to net zero emissions by 2050. In clarifying this point, Venkataraman explained, "It's a combination of a lot of different solutions. We have to look at carbon capture and storage (see sidebar), automate sources like electrification, hydrogen and renewables replacing fossil fuels; it has to be *all* and not just one."

Hydrogen's hues. In terms of producing hydrogen that is useful, there are three methods: natural gas reforming, coal gasification and electrolysis. Based on the amount of GHG emissions generated, they are broken down into five color descriptors (see image below):

- **Green** — No GHGs are generated, as renewable sources such as wind or solar provide the energy to split the hydrogen and oxygen.
- **Blue** — The carbon generated in thermal processes is captured and stored underground (CCS).
- **Gray** — Natural gas is used as a primary source (the most common form of hydrogen generation) and produces fewer GHGs than brown hydrogen.
- **Brown** — It uses black (bituminous) or brown (lignite) coal as a primary source of hydrogen; it generates the most GHGs.
- **Pink** — This hydrogen is generated through electrolysis powered by nuclear energy. It is also sometimes referred to as purple or red hydrogen.

Broadly speaking, the IEA predicts that hydrogen demand is projected to grow fivefold by 2050, primarily by road transport, maritime and aviation — and remarkably, its supply is expected to shift from almost 100% gray hydrogen to 95%



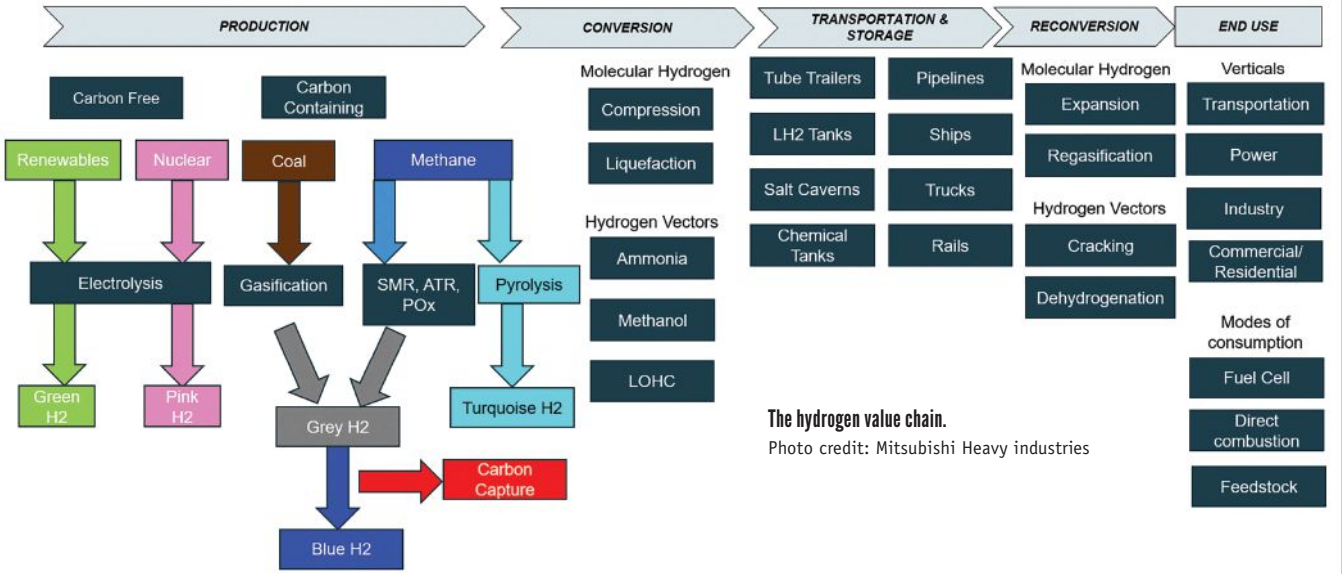
The U.S. energy landscape. Photo credit: Mitsubishi Heavy Industries and Lawrence Livermore National Laboratory

clean green production by mid-century as costs decline and policymakers favor hydrogen technology adoption.

FOSSIL FUELS STILL REIGN SUPREME

The reality is that the world is still on a path of fossil fuel demand peaking between 2023 and 2025, according to McKinsey & Company's *Global Energy Perspective 2022*. Presenter Gabriel Collins, Baker Botts Fellow for Energy and Environmental Regulatory Affairs at the Baker Institute for Public Policy, Rice University, discussed this theme in his session: "If we look at empirical evidence from the last 50 years, one of the things we see is that energy insecurity can really undermine climate goals. We didn't think about this as a climate goal in the 1970s when we had the oil shock and Wyoming became a coal super giant in global terms. But if we're looking through today's lens, it's something I think would undermine these goals. What you see over and over is during a time of crisis, whatever's installed, reliable and cheapest is going to tend to win out."

Of course, a major complicating factor that adds uncertainty to a net-zero economy and infrastructure is the war in Ukraine. Russia's role as one of the world's largest producers



The hydrogen value chain.
Photo credit: Mitsubishi Heavy industries

VMA MEMBER COMPANIES' CARBON CAPTURE AND STORAGE PROJECTS

As one piece of the net-zero puzzle and ESG initiatives, carbon capture and storage (CCS) technologies were featured in the previous Spring 2022 issue of *VALVE* Magazine, here are a few projects that VMA member companies have underway.

Flowserve Corporation was recently awarded a contract to provide control valves for a portion of Norway's first cross-border and open-source CCS facility. With an estimated 2024 completion, this facility will be the first of its kind and will help further enable the acceleration of decarbonization in Europe.

Flowserve will provide its Flowtop and Mark One control valves for the facility's onshore site in the Bergen region, which will facilitate carbon capture before it is ultimately transported to an offshore terminal and stored permanently below the seabed. Once completed, the facility will have the ability to potentially store an estimated equivalent of 1,000 years of Norwegian emissions.

Scott Rowe, Flowserve's president and chief executive officer, said, "Our strategy to diversify, decarbonize and digitize or the 3D growth strategy supports and aligns directly with Flowserve's long-standing purpose statement, to provide extraordinary flow control solutions to make the world better for everyone."

Baker Hughes's Polaris CCS project in Norway jointly explores with Horisont Energi development and integration of technologies for the Polaris carbon storage project in Norway. Horisont Energi's Polaris offshore carbon storage facility is part of its Barents Blue project, which is the first global and full-scale carbon neutral blue ammonia production plant. The Polaris project is expected to have a total carbon storage capacity in excess of 100 million tons, which is equivalent to twice Norway's annual greenhouse gas emissions.

The Borg CO_2 industrial cluster project partners on the Borg CO_2 project, which aims to capture and store up to 90% of the CO_2 emissions from industrial facilities located in the cities of Fredrikstad, Sarpborg and Halden. The combined industrial cluster is currently responsible for approximately 772,000 tons of CO_2 emissions annually. After being captured, the CO_2 will be liquified, shipped and eventually stored underneath the seabed of the North Sea. This will play an important role in contributing to the Paris Agreement goals, the United Nations Sustainable Development Goals and the Norwegian national emissions reduction targets.

Baker Hughes was also awarded a contract with Santos, a leading natural gas producer in Australia, to supply tur-

of oil, gas and commodities is already causing ripple effects in Europe where countries like Germany and the United Kingdom rely heavily on supply from Russia that has been curtailed in retaliation to sweeping sanctions.

These macro events, like COVID, Russia invading Ukraine, U.S.-China diplomatic tensions, domestic and international politics, supply chain issues and inflation, greatly impact the overall complexion of the world's energy needs and efforts of the IEA and the Paris Agreement. The volatility isn't going to go away moving forward.

Collins continued, "We will see a lot of efforts to talk about ESG, but the flip side of this, especially with some of the bigger industry players divest assets, whether it's oil sands or a coal mine, these things are rarely shut down." Reflecting the nebulous nature of this transition we're in the midst of, however, Collins also theorized, "If we continue to have high commodity prices, if anything, the pressure on this front probably intensifies for certain investment pools to loosen up on constraints and actually take advantage of market opportunities that are being presented to them."

Wrapping up his presentation to finish on a generally positive note that takes the long view, Collins said, "A tough decade lies before us, but we can do this. The very fact that humanity has industrialized so successfully and that we are forced now to confront emissions issues on this scale is in itself a cause for celebration given where we were as a species just 500 years ago. At the same time, billions of our kin still suffer from energy poverty. It's a global Manhattan Project-scale endeavor, but I'm hopeful we'll get it done despite the bumps in the road." VM

bomachinery equipment for the Moomba CCS project. The project will serve a gas processing plant and permanently store 1.7 million tons of carbon dioxide annually in depleted natural gas reservoirs in the onshore Cooper Basin in South Australia. Baker Hughes will provide gas turbine, compressor and heat recovery steam generator (HRSG) technologies to compress the carbon dioxide.

Specifically, Baker Hughes will provide PGT25+G4 aeroderivative gas turbine, MCL compressor and BCL compressor technology, which will enable Santos to compress CO2 captured at Moomba CCS for transportation and subsequent injection for storage.

This project exemplifies the range of solutions that energy and industrial companies are seeking across the energy transition and how collaboration is needed to lower emissions and enhance efficiencies from their operations, says Rod Christie, executive vice president of Turbomachinery Process Solutions at Baker Hughes. Through our advanced turbomachinery technology, we are supporting Santos to decarbonize natural gas while providing an opportunity to utilize CO_2 as a valuable input for producing reliable energy with advanced blue hydrogen.

The Importance of Strategic Account Management for Organizations Involved in the Valve Industry

BY RICHARD SANTUCCI & DAVID HUGHES

The valve industry has experienced significant disruptive events over the past dozen years, including the Deepwater Horizon oil spill incident, the oil crisis of 2014, global warming concerns, the COVID pandemic, evolving human resource shortages, current supply chain and logistics issues and recently, the war in Ukraine. These events have created a volatile environment with valve makers' customer base resulting in a need to find new and diverse ways of addressing their needs, concerns and operations. One could say that the level of loyalty a customer has with its suppliers has decreased — thus increasing the likelihood of them reducing their supplier base and evaluating alternatives.

To counter these developing trends, valve manufacturers and distributors need to find ways to increase their influence with important accounts in order to protect the share of their customers' valve and controls spend that they receive. Valve suppliers should also harness this opportunity to grow their business with these key accounts at a faster pace compared to standard market growth rates. We propose that valve makers and distributors consider the implementation of a strategic account management program as the primary way to address these issues and take advantage of the opportunities listed above.

What is strategic account management? It is an enterprise-wide initiative to develop strategic relationships with a limited number of customers in order to achieve long-term, sustained, significant and measurable business value for both the strategic account and your company.

WHY A STRATEGIC ACCOUNT MANAGEMENT PROGRAM? BECAUSE IT DELIVERS THE FOLLOWING RESULTS:

- It increases the intimacy in the relationship between the strategic account and your firm.
- It mitigates the risk of losing the account.
- It attains growth rates significantly greater than the average growth captured with standard accounts.
- It provides a single contact as customers centralize decision making.
- It leverages the strategic account leadership position in their industry to capture business currently going to competitors.

FOR THE PROGRAM TO BE SUCCESSFUL, IT MUST MEET THE FOLLOWING CRITERIA FOR SUCCESS:

- The program must be an enterprise-wide initiative involving all business functions.
- The program must comprise a limited number of customers to ensure effective resource allocation.
- The program must deliver measurable value to both the strategic account and the valve manufacturer/supplier to be sustainable.

How do we start building the program? First, we need to select the accounts that are to be included in the program. We propose that the company start with the creation of a scorecard or selection matrix that encompasses the selection criteria to be used along with a selection scoring weight for each criterion. Representatives from different areas of the business within the organization score the candidates and a selection committee with representatives from different business functions (sales, operations, legal, finance, engineering, etc.) select the accounts to be included in the program. Selection criteria could include current sales volume, potential for growth and the account's willingness to partner with the company as examples.

Once the accounts are selected, the company needs to assign the resources to be dedicated to the account. These would include strategic account managers, program managers if needed, site team leaders supporting local facilities, account-based marketers, manufacturing/operations,

Strategic Account Selection Score Card				
Potential Strategic Account:				
Selection Criteria	Selection Weight	Account Score	Account Criteria Scores	Scoring Criteria
Global Presence	20	3	60	Presence in one region = 1; Two Regions = 3; Five Regions = 5
Current Revenue	25	5	125	<1MM revenue = 1; 1 - 1.5 MM = 3; > 5MM = 5
Current Profitability	25	5	125	< 20% GM = 1; 20 - 25% GM = 3; > 25% GM = 5
Account Industry Leadership	15	3	45	Industry follower = 1; Industry leader = 3; Top 3 Industry Leader = 5
Interest in Partening with Company	15	3	45	Little interest = 1; Some Interest = 3; Strong Interest = 5
Overall Account Score	100		400	

Example of account selection matrix. Credit: S&H Strategic Sales Consulting LLC

information technology, engineering/product management, customer service and finance resources, to name a few. The team would normally be virtual and led by the strategic account manager.

Now that the accounts have been selected and the account management team put in place, the growth plan can be created. The plan must start with an understating of the current situation with the account. We call this process the situational analysis. The situational analysis should include the following:

- Analysis of the strategic account business
- Analysis of the competition's position with the strategic account
- Analysis of the valve maker/supplier's position with the strategic account

The situational analysis must uncover the customer's mission, vision, financial health, current concerns and plans for growth/expansion. This analysis should reveal the key account's organization including the key decision makers and influencers that impact valve and controls procurement decisions. The primary objective of this analysis is to match the opportunities with the products and services we may offer to enable the customer to successfully meet their goals.

By analyzing the competitive landscape surrounding the target account the company can discern how well-positioned it is with respect to their competitors by product group. We suggest the company create an analysis matrix in order to assess the competitive field in detail.

The company should also create a competitive matrix for each product and/or service group offered to the target account.

The analysis of the company's position with the target account is the third and last step of the situational analysis. This process requires an objective assessment of the relationship with the strategic account including but not limited to the following:

- Revenue
- Gross margin
- Operating income
- Revenue to sales expense ratio
- Revenue compounded annual growth rate (CAGR) over the four-year period
- Current relationship status

However, the ultimate measure of a company's position with an account is what we define as "share of wallet." This metric is attained by calculating the ratio between the company's annual revenue for each product or service group supplied and the customer's total annual spend for each product and/or service group.

Once the situational analysis is complete, the company can now easily identify what defensive and offensive initiatives need to be put in place to mitigate any loss in business and, more importantly, identify the opportunities

Santucci and Hughes leverage their combined five decades of experience in industrial sales in this recently published book. Credit: S&H Strategic Sales Consulting LLC

that can provide better than average revenue and profitability growth.

The company must also put in place a relationship-management plan. The relationship-management plan requires that all the key procurement decision makers, influencers and recommenders are identified, evaluated in terms of their function in the procurement process and rated regarding their attitude towards the company (i.e., advocate, supporter, neutral, blocker).

As the relationship becomes more intimate, the company may consider assigning an executive sponsor to the strategic account. There are several reasons to appoint a high-level company executive to a strategic account. The strategic account must feel that your company is becoming an integral part of its operation and thus, have a desire to deal in a more intimate manner with your firm. It is an opportunity to move to a planning-partner or trusted-adviser status. It opens the door for earlier knowledge of the strategic account's strategies, initiatives, concerns and plans. It provides an enhanced overall customer experience to the strategic account. It allows for accelerated product portfolio expansion with the customer. In short, it provides an opportunity to carve out a larger share of wallet through collaboration.

All plans need to be monitored and reviewed periodically to ensure that the objectives are being met. Furthermore, as events occur, the account plan may need to be modified and/or updated. The reviews must be performed internally with the account team and company leadership and externally with the strategic account. External performance reviews are also opportunities to drive a positive evolution of the relationship. The following are some of the areas to consider during the performance review.

- Identify and mitigate any issues the customer may have with the company's products and services
- Identify customer's unmet needs
- Address issues keeping the strategic account leadership team awake at night
- Find co-creation opportunities

In conclusion, a well-run strategic account program can be the vehicle for valve makers and distributors to navigate through these disruptive times, find ways to keep abreast of customers' most important needs, strategies and direction. VM

Richard Santucci, co-founder of S&H Strategic Sales Consulting LLC, was formerly a global key account director for units at Emerson Automation Solutions and Pentair PLC. He also was vice president of Latin America for a unit of Tyco Flow Control, where he doubled the business in three years while leading general management, sales, strategic planning and marketing functions. He also held numerous roles at Teledyne Analytical Instruments. He holds a bachelor of science degree in Chemistry from California State University, Los Angeles.

David Hughes, co-founder of S&H Strategic Sales Consulting LLC, was the director of Global Strategic Accounts for Emerson Electric's Final Control Business Segment. His involvement in strategic account management began when he initiated and developed the program, along with Santucci, for Tyco Valves. Prior to that, Hughes led Tyco Valves and Controls' U.S. sales and distribution business. He also managed sales for Valquip Corporation. He served on the VMA board as chairman from 2018-2019. He graduated from the University of Michigan with a bachelor's in Business Administration.

Are Bypasses Needed With Today's Waterworks Gate Valves? New Information Says They're Not Involved in the Valve Industry

BY DEREK B. SCOTT & JOHN R. HELF

Gate valves are the most common valve used in the water utility industry. As with many utility-type valves developed in the 1800s, the gate valve continues to employ many of its original features. The Industrial Revolution helped solidify the iron-bodied and bronze-mounted (IBBM) gate valve as a workhorse for controlling flow in the modern-day utility system. An important part of the larger diameter valve offerings included the use of gear actuators and integral bypasses. Gear actuation was necessary for the reduction of input torque to operate these valves. Similarly, various bypass appurtenances were necessary for the equalization of pressure differentials across the valve.

Figure 1. Iron-bodied and bronze-mounted (IBBM) gate valve with integral bypass
All photos courtesy of: AMERICAN Flow Control

Over time these metal-seated valves would give way to a much simpler design, called the resilient wedge gate valve (RWGV), which eliminated many of the operational hurdles caused by the different pressures.

Although the use of gear actuators in larger valves are beneficial, resilient wedge gate valves, introduced domestically more than 40 years ago, inherently require a much lower operating torque. For this reason, the operational need for the use of bypasses has long been questioned. In fact, today, most municipalities consider the bypass to be an added component to the system that must be maintained and accounted for, and the engineering community rarely requires bypasses. This position is based on logic and inherent field experience, but until recently, there was no empirical data to support the position that bypasses, for the routine operation of resilient wedge gate valves, are not needed.

BYPASSES DO NOT TYPICALLY LOWER THE OPERATING TORQUE OF RESILIENT WEDGE GATE VALVES

To determine the effects bypasses might have on large diameter resilient-seated gate valve operation, AMERICAN Flow Control conducted a series of operational tests on an AFC Series 2500 30-inch resilient wedge gate valve, equipped with a 2-inch bypass assembly, as shown in Figure 2. The initial flow rate in the pipe was recorded at 5,800 GPM. For this test, the 30-inch gate valve was cycled from a full-open position to a fully closed position under initial 80 psig line pressure. Operational torques were recorded six times through an automated cycle tester. Three of the recordings were collected with the bypass closed, and three recordings with the bypass open. To ensure accuracy, the valve automated cycle tester was mounted directly to the valve, eliminating the need for a manual gear actuator.

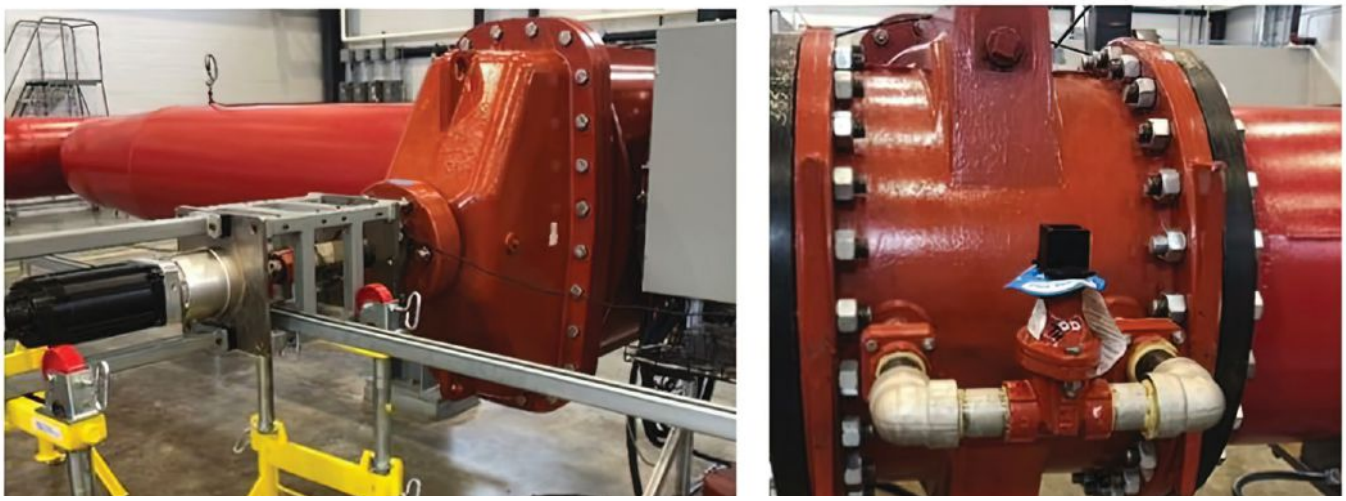


Figure 2. Operational torque testing setup for bypasses.

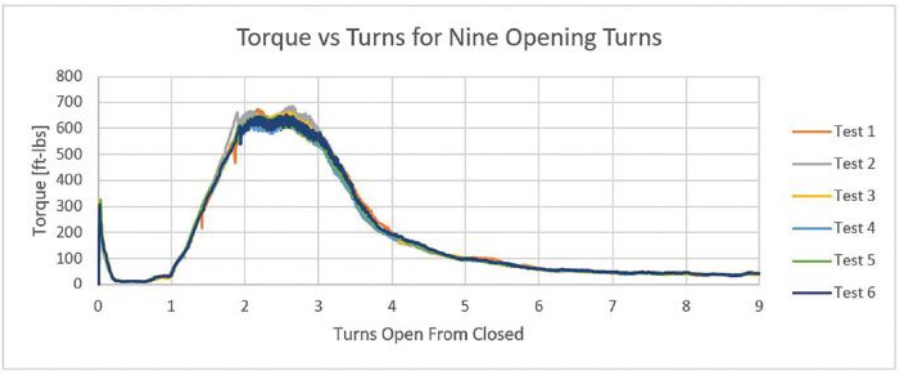


Figure 3. Empirical test data demonstrating the lack of need for bypasses on a resilient wedge gate valve

The results of the tests are presented in Figure 3.

In all accounts, maximum torque values were recorded within two to three turns while opening the valve from being fully closed. As detailed, the maximum torque values were the same, regardless of the use of the 2-inch bypass. The remaining torque values leveled off at a significantly lower value for the remainder of the valve operation cycle. The initial torque values reflect the initial cracking torque of the valve. This increase in torque is necessary to overcome the compression seal that exists between the rubber encapsulated wedge and the valve body. In summary, the difference in the average maximum torque between open and closed bypass tests differed by only 2 ft-lbs, or about 1% of the 660 ± ft-lbs of torque required to operate the non-geared valve. This information validates the long-held assumption that bypasses are not required, but more importantly, it also validates the reason they are rarely used in practice.

OTHER CONSIDERATIONS

Although reduction in operating torque has long been the primary reason for using bypasses, in rare cases a bypass is used by system operators to fill new lines, or recently evacuated lines, downstream from the mainline valve. This practice was primarily used with metal-seated valves, which were prone to seat damage when the gate was left in a near-closed position for long periods of time. In that situation, damage could occur to the soft, unforgiving copper alloy seats because of high fluid velocity and the potential of trapping debris. This damage is characterized as wire drawing, which is an erosion or scoring of the seat. Although the throttling of a gate valve has never been recommended, the occasional use of partially opened resilient wedge gate valves, with full rubber encapsulation, has become an accepted operational field practice. System-type bypasses incorporated into the pipe network and independent of the valve are considered the best design practice.

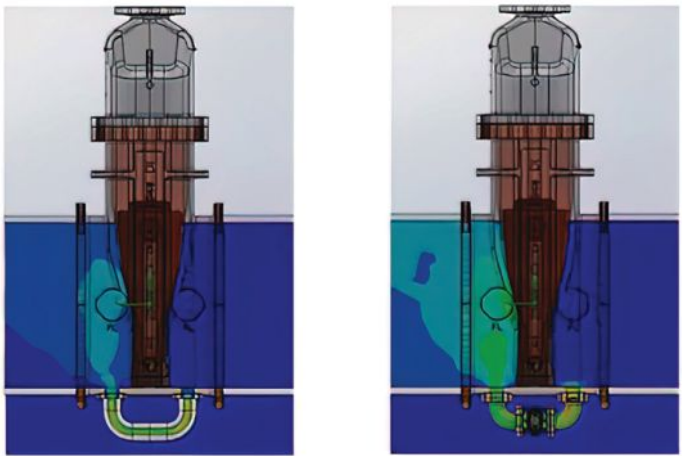


Figure 4. Comparison of bypass velocities as illustrated by flow simulation software

In cases where bypasses are used, some might assume larger bypass sizes can help prevent damage to the valve because a smaller bypass valve will have higher fluid velocities. This is incorrect. Innate to their design, RWGVs have functionally negligible resistance coefficients. Because of this, basic precepts of fluid mechanics state the velocity in the bypass will remain relatively constant, while the flow rate changes with the cross-section of the bypass. The results can be demonstrated by using modeling software, such as shown in Figure 4. In this illustration, a graphical comparison is made showing the functional difference between a 2-inch and 4-inch bypass with color representing velocity. Note bypass fluid velocities are the same.

SUMMARY

As creatures of habit, we must be reminded we shouldn't do something just because it's what we have always done. Design improvements and material changes have exponentially improved the gate valves used in today's utility system over gate valves used more than 40 years ago. Today's valves are more simplistic in design and efficient in their operation, making bypasses a convention of the past. Utilities still using bypasses simply because they always have, should reconsider. VM

Derek B. Scott is marketing and technical manager for AMERICAN Flow Control. He holds a Bachelor of Science in Mechanical Engineering and has nearly 40 years of experience in the water and wastewater industries. Scott joined AMERICAN in 1988 and is currently responsible for the division's technical and marketing functions. He has published several articles and represents the company on several standards committees, including AWWA, MSS, ASCE and NSF. He also has served on numerous stakeholder and advisory boards. He currently serves as chair of the ANSI/AWWA C515 Committee on *Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service*.

John R. Helf, PE is product engineer for AMERICAN Flow Control. He holds a Bachelor of Science in Mechanical Engineering from Mississippi State University and is a licensed Professional Engineer in the State of Alabama. Prior to working with AMERICAN Flow Control, Helf was project manager for AMERICAN SpiralWeld Pipe, a leading producer of large diameter municipal water and wastewater transmission piping. He is actively involved in AWWA and MSS standards committees.

Direct-Sealing Diaphragm Valves Offer Novel Approach

BY JEFF JENNINGS, PE, BSME

As modern industries such as hydrogen electrolysis and biotech make dramatic technical advances, engineers and researchers must sometimes turn to nontraditional process control systems. A common challenge is to find precise fluid control methods that perform reliably and are easily automated despite widely fluctuating flow rates, wide pressure ranges, extreme temperatures, mixed-phase flow and harsh chemicals.

For complex systems with particularly difficult combinations of challenges, a direct-sealing diaphragm valve or regulator is often a good choice.

BACKGROUND

Traditional dome-loaded valves, which have been available for many years, use a fluid pressure on top of a sensing element to provide a setpoint pressure. The sensing element is typically either a diaphragm for lower pressures or a piston for higher pressures. A single sensing element separates the process fluid from the dome fluid so that the pressure imbalance places the valve in the desired position.

Dome-loaded valves are pilot operated, which means that the pressure of the fluid fed to the dome is set by a second regulator called a pilot regulator. For some applications, the pilot regulator is a manual air regulator. For computer-automated applications, an electronic pressure regulator usually makes more sense. The electronic pressure regulator takes the input signal from the computer and translates it into a pressure that is fed to the dome.

In addition to being easy to use with computer automation, dome-loaded valves and regulators also tend to improve precision by delivering a more constant pressure as the valve position varies. Some dome-loaded designs benefit from the complete elimination of O-ring friction and hysteresis.

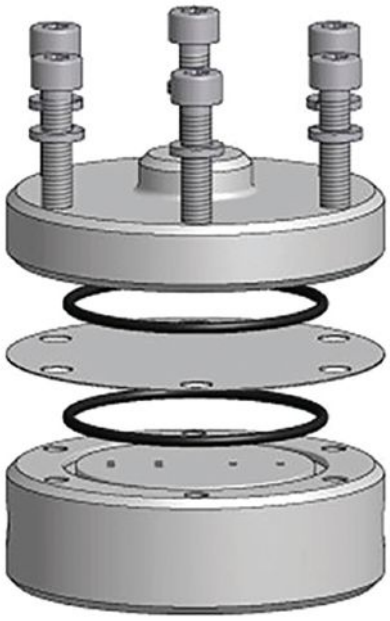


Figure 1. Exploded view of a direct-sealing diaphragm valve showing cap, O-rings, diaphragm and body with field of parallel orifices. Photo credit: Equilibar

A *direct-sealing diaphragm valve* is a newer iteration of dome-loaded fluid control technology. Also known as a dome-loaded multiple orifice valve, it uses a novel design in which a diaphragm covers a field of parallel orifices located in the body of the valve or regulator. As fluids flow through the unit, the diaphragm lifts off the orifices to release pressure. When flow is minimal, only a portion of one orifice opens to release the pressure. When flow is high, the diaphragm is pushed up to engage all the orifices.

The flexibility of this design results in an exceptionally wide flow rate range that can provide solutions for some of the most extreme fluid and pressure control scenarios. The design can hold pressure stable across ranges of 1,000:1 and even up to 100,000:1 for many processes. The frictionless diaphragm avoids all hysteresis, allowing for highly precise control in manual, open-loop or closed-loop control systems. Moreover, its reaction time is virtually instantaneous.

CATALYSIS RESEARCH DEMONSTRATES POTENTIAL BENEFITS

Catalysis research is a fast-growing field of inquiry, partly due to its value in discovering ways to make cleaner fuels and reduce emissions related to the combustion of carbon-based fuels.

A single catalysis research application can be highly complex, involving harsh chemistries, extreme temperatures, unusually high or low pressures, automation, the mixed-phase flow of gasses and liquids together and a need for stable control despite ultra-wide flow rate ranges. High precision, instantaneous adjustment and smooth operation are often required for the research to be successful.

Direct-sealing diaphragm technology can capably handle these types of applications due to synergistic design elements. These valves and regulators provide reliably stable pressure control because they are dome-loaded. Since the diaphragm is the only moving part, there is no hysteresis. At the same time, the multiple orifice design's wide flow rate range makes it ideal for mixed-phase flow.

The valve's body, O-ring, diaphragm, and bolts can be made from virtually any material, which means that direct-sealing valves can be customized for applications with extremely high or low temperatures and severe chemistries such as hydrofluoric acid.

VACUUM CONTROL OPTIONS

Direct-sealing valves and regulators were first used to control back pressure in the early 2000s. More recently, engineers and scientists have successfully used them to provide exceptionally precise and sensitive vacuum control as well as flow control.

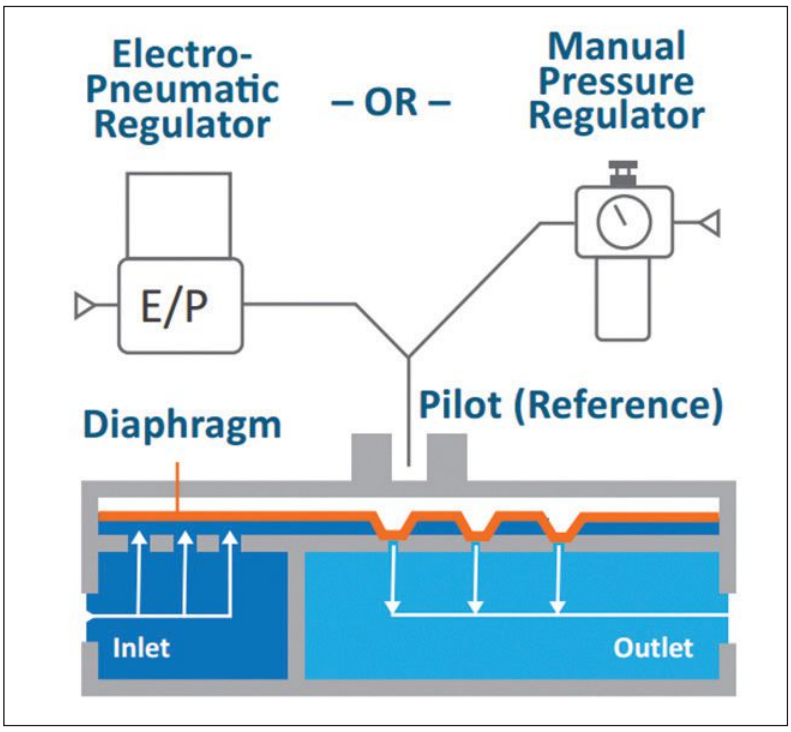


Figure 2. Schematic showing how a direct-sealing diaphragm valve works. Photo credit: Equilibar

For vacuum control systems, a vacuum pilot regulator is used to set a vacuum setpoint on the direct-sealing primary valve. It behaves like a back pressure regulator because the pressure is controlled at its inlet port. The vacuum regulator closes to increase absolute system pressure or reduce vacuum level. In essence, this vacuum control setup is a mirror image of the back pressure control setup. The pilot vacuum on the dome may be regulated using a manual or an electronic vacuum regulator and may be operated in open loop or closed-loop control schemes.

The system directly controls vacuum pressure by throttling flow between the vacuum supply pump and the process to precisely control the process vacuum to a specific setpoint. It is important to note that the direct-sealing vacuum valve is a non-relieving regulator intended for processes where at least a tiny gas flow is present at all times. It is not a vacuum breaker, which lets gas into the system to control pressure.

Glovebox pressure control, which can present multiple challenges for traditional vacuum valves and regulators, is an example of the complex types of processes that could benefit from direct-sealing vacuum technology.

In many glovebox situations, it is desirable to control pressure differential so that the dexterity of the operator's gloves is not compromised. At the same time, it is important to provide for much stronger vacuum supply in the event of a compromised glove or opened hatch. This is exceedingly important due to the combination of extreme conditions and hazardous materials. A vacuum control failure could have catastrophic results.

Direct-sealing vacuum regulators are especially well suited for these situations. Their reaction time is virtually instantaneous and they are capable of controlling vacuum pressure in a glovebox down to the range of 1 inH_2O (2 mbar). As the glovebox falls below the vacuum setpoint, the direct-sealing diaphragm lifts rapidly to increase flow and restore glovebox vacuum pressure, averting dangerous situations. Conversely, if the glovebox vacuum becomes too high, the diaphragm lowers, restricting flow and rebalancing the glovebox pressure.

Other vacuum processes that may require direct-sealing technology include work-holding applications where flow rate and pressure vary significantly during start-up and as disruptions occur in the manufacturing process. While some of these applications are tolerant of this pressure variation, others require more consistent vacuum control. Semiconductor and electronic circuit board manufacturing,

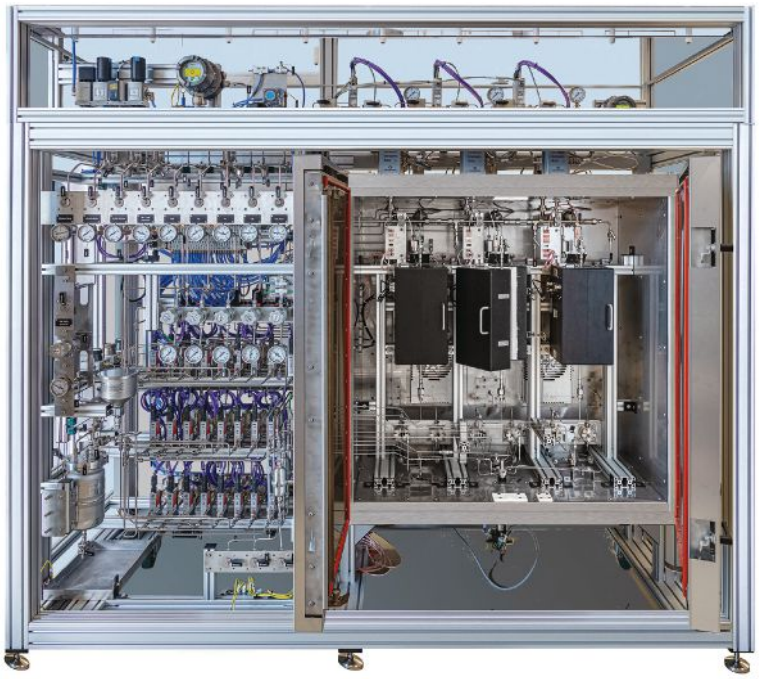


Figure 3. Catalysis system. Photo credit: Integrated Lab Solutions

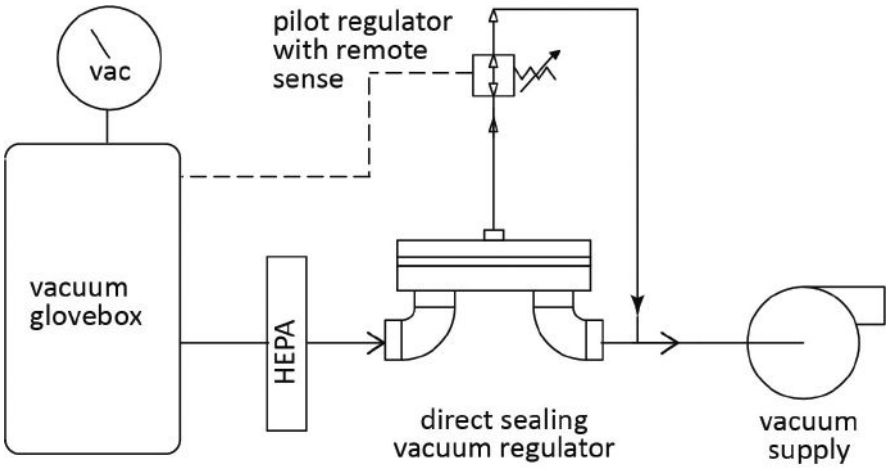


Figure 4. Schematic of glovebox vacuum control using a direct-sealing diaphragm valve. Photo credit: Equilibar

for example, often require engineers to consider methods to protect the delicate materials involved. Maximum sensitivity is a must.

FLOW CONTROL SCENARIOS

The same advantages that make direct-sealing technology useful for back pressure and vacuum control make it advantageous for flow control as well.

Direct-sealing valves and regulators offer flow coefficient ranges many times wider than traditional valves and also work well in demanding applications such as corrosive chemicals or sanitary systems. Combined, these advantages make them appealing for cutting edge flow control applications such as applications requiring extremely wide flow rate ranges or experiments involving phase change.

In the flow control setup, the valve serves as a flow control valve rather than a back pressure regulator or vacuum control valve. When the diaphragm sealing the orifices is pressed against the body of the valve, flow is blocked. By adjusting the pressure against the diaphragm, the flow is also adjusted.

For example, in a standard research setup, a flow sensor with onboard proportional-integral-derivative (PID) controller is connected to an electro-pneumatic pressure regulator (EP), which in turn is integrated with the dome-loaded direct-sealing diaphragm valve. As the flow meter indicates a need for higher flow, the electro-pneumatic controller lowers the gas pressure on the dome of the direct-sealing diaphragm valve, which in turn increases the flow.

This innovative flow control approach is not indicated for most traditional flow control applications, but it has demonstrated value in applications with highly varying differential pressure, highly corrosive environments, applications with compact space requirements where a bulky actuator is not possible and in hygienic applications requiring compliance with biopharmaceutical engineering standards.

CONCLUSION

Direct-sealing fluid control technology is more complex than traditional fluid control options. It involves using an instrument gas supply equal to the supply pressure of the fluid being controlled and a separate manual or electronic pilot regulator. For many traditional processes, a globe valve or other familiar technology is the most logical choice.

For especially demanding applications, however, direct-sealing valves and regulators can often provide fluid control solutions that were previously not possible. As a result, they have been proven to perform capably in the following difficult conditions:

- Exceptionally wide flow and valve coefficient range
- Highly corrosive gasses and liquids
- Extremely high temperatures up to 932°F (500°C)
- Cryogenic temperatures
- Extremely low flow rates (controls Cv down to 1E-9)

Because of their unique capabilities, direct-sealing diaphragm valves have successfully contributed to disruptive technologies around the world. They have proven themselves in hydrogen electrolysis systems, fuel cell research, NASA's Artemis Mission, and continuous flow chemistry setups used to manufacture life-saving medicines. There is no reason to believe the technology will not continue to expand as more and more engineers and researchers become familiar with it. VM

Jeff Jennings, PE, BSME, is founder of Equilibar, a manufacturer of direct-sealing diaphragm valves near Asheville, NC, and Vice President of Innovation for Richards Industrials, Equilibar's parent company. He invented the technology behind direct-sealing diaphragm valves and holds multiple international patents. His passion is inventing and developing fluid control technology to make radical changes to improve the world. Contact him at jeff.jennings@equilibar.com or visit the website at www.equilibar.com.

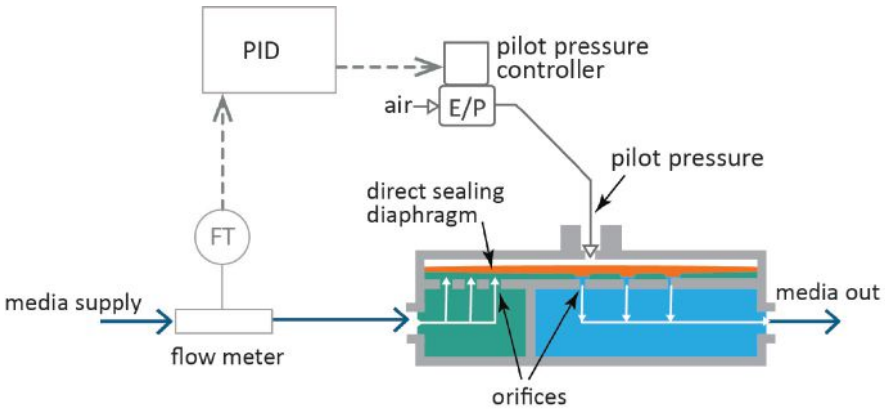


Figure 5. Schematic of flow control using direct-sealing diaphragm valve. Photo credit: Equilibar

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Neles introduces valve-sizing and selection software for all intelligent automated process valves. With its advanced control-valve selection features, the Nelprof tool allows fast and reliable selection of Neles, Jamesbury and Easyflow by Neles-branded intelligent automated process valves. First introduced in 1981, this latest version takes Nelprof to the next level with easy online access via your web browser. This tool allows control valve sizing with extensive control performance analysis and enables easy and reliable on/off valve selection and optimization of safety-critical system component selection. Neles is now Valmet's flow control business line.

Emerson's new TopWorx PD Series Smart Valve Positioner provides an intelligent, reliable and versatile solution for valve control with non-contacting sensor technology. This portfolio of compact, intelligent valve control devices communicates with advanced protocols including HART and is capable of being certified for hazardous areas. Smart communication is enabled via a 4-20mA loop signal as well as available open/close discrete inputs. By utilizing contactless internal sensors, the PD Series eliminates wear and reduces costly maintenance. Field calibration and adjustment are simplified with the PD Series LCD interface and the push button or magnetic key controls which enable local control without the need to remove the enclosure cover.

Equilibar announces the launch of the HP-ERC High Pressure Electronic Controller to provide automated pilot control of dome-loaded direct sealing back pressure regulators for high pressure applications such as core analysis or supercritical research. The HP-ERC series is designed to automate dome-loaded back pressure regulators up to 400 bar. Part of the Richards Industrials family, Equilibar provides fluid control technology and custom solutions for demanding applications, including oil and gas, aerospace, biofuels, hydrogen electrolysis, supercritical research and biotech.

EGC Engineered Solutions' new product is an advanced, low-friction, reduced-torque fugitive emissions packing set. Dynapak FE is the latest advanced, low-friction, reduced-torque fugitive emissions packing set. It is designed for peak packing performance in the refinery, chemical and petrochemical industries.

Certified to API 622 3rd addition ($^1/_8$ inch and $^1/_4$ inch) by Yarmouth Research and Technology LLC, DynaPak FE boasts at least 30% reduction in packing nut torque and 30% stem friction reduction over competitive fugitive emissions packing offerings.

Admiral Valve LLC (dba CPV Manufacturing), an industrial valve and fitting manufacturer, has reimagined the design of its O-SEAL and G-Series valve handles to deliver superior efficiency to operations in piping systems. CPV is pleased to introduce the new, functional and ergonomic handles to customers worldwide. The next generation of handles provide less hand discomfort and easy operation to workers that maintain CPV valves on a regular basis. These innovative handles will now be included with the purchase of the full-size range of CPV O-SEAL and G-Series product lines in place of the old handles. The new handles are made with an anti-slip material and utilize smooth edges, allowing for better grip and are available in four- and two-prong configurations to suit specific valve sizes.

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