VMA'S NEW STRATEGIC PLAN IS ROLLED OUT

VALVE

MAGAZINE
WINTER 2022
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The Evolving Road to Adoption and Standardization of Metal Additive Manufacturing

- VALVE BASICS: BUTTERFLY VALVES
- MINERALS AND METALS
- VALVE SELECTION FOR OFFSHORE OPERATIONS
- THE HIDDEN POWER OF DATA

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Metal Additive Manufacturing: the Evolving Road to Adoption and Standardization

In its relatively short history over the past 20 years, metal AM has proven to be revolutionary, but before greater adoption is possible, ongoing standardization efforts remain a work in progress.

COVER IMAGE CREDIT: EMERSON AUTOMATION SOLUTIONS

BY MARGO ELLIS

PRODUCTS

40 Editor's Picks

> Motor and linear actuator with integral controls
> Rocker isolation valve for critical use
> Knife gate valve with unique metal-cutting design
> Valve assemblies achieve SIL 3

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VMA VALVE MANUFACTURERS ASSOCIATION OF AMERICA

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Ringing In the New Year With Optimism as We Keep Pushing Forward

I wish all our readers a happy, healthy and prosperous 2022!

During the last quarter of 2021, I, like many in the valve industry value chain, was able to start making in-person visits again to facilities, meetings, events and tradeshows. Regardless of where I was, there was such a positive sentiment among those in the industry and excitement about new opportunities, despite the myriad challenges ahead. The articles in this issue touch on many common discussion threads I had, and also address many of those opportunities and issues.

On page 26, one tool to help address supply chain disruption is explored. While there isn't a short-term solution to these disruptions that are literally touching everyone in their business and personal life, we explore how data can be used more effectively to predict and prepare for future needs. Along those same lines, information on additive manufacturing and ways manufacturing in general is using this technology to rapidly replace parts or prototype new parts.

The timely article on mining (page 22) highlights the various areas valves play a role in this industry. With so much societal focus on energy, the need for batteries and the various types of metals used in battery production will continue to rise for the foreseeable future.

VALVE continues with its history of providing nonproprietary, peer-reviewed spotlights on different types of valves, actuators and controls for those new to the industry or wanting to expand their knowledge. This issue we look at butterfly valves (page 18) as part of our regular Valve Basics articles.

Don't miss the latest updates on what VMA is doing to help our members and industry, including a peek at our new strategic plan and the 2022 schedule of events. I'd like to also recognize all the VMA member companies, listed on page 38, for their support and contributions to the industry. We are better together, and the learning, knowledge sharing and problem-solving our VMA members collectively do to benefit their companies and our industry is impressive. Thank you! If your company isn't a member, please contact me to learn how you can get involved.

Heather

Heather Rhoderick, CAE
President

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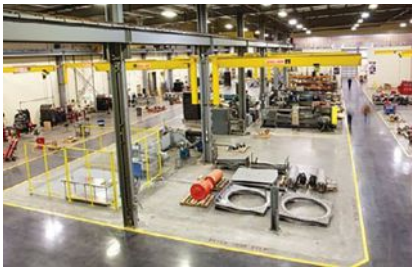
AWARDS AND HONORS

Several VMA Members Named on Newsweek's 2022 "America's Most Responsible Companies" List

VMA members Flowserve Corp., Emerson, Baker Hughes, Mueller Water Products and Crane Co. made the list of America's Most Responsible Companies. Compiled by *Newsweek* in partnership with Statista Inc., the list is based on publicly available environmental, social and governance data as well as an independent survey of U.S. residents. From a pool of 2,000 public companies, this list recognizes the 500 most responsible companies in the U.S. across dozens of industries.

"To truly live our purpose of making the world better, we understand that we have to go beyond the products and services we offer," said Scott Rowe, Flowserve president and chief executive officer. "That's why we're committed to building a culture of inclusion, giving back to the communities where we live and work, continuously improving our operations to reduce our environmental footprint, and enabling our customers to reach their own sustainability goals."

Survey participants were invited to evaluate how their company supports women inside and outside the workplace, including opportunities for advancement, pay equity, balanced recruitment, and other related topics. This listing also considers gender diversity on the board of directors and executive leadership team.



PEOPLE IN THE NEWS

MRC Global Inc. announces that **George Damiris** and **Ronald Jadin** have both joined MRC Global's board of directors.

George Damiris

Ronald Jadin

Damiris previously served as the president and CEO of both HollyFrontier Corporation and Holly Energy Partners from 2016 until 2019. From 2007 until 2015, he served in various leadership roles with HollyFrontier. Damiris holds a B.S. in Chemical Engineering and an MBA from Case Western Reserve University. He will serve on the compensation and governance committees of MRC Global's board.

Jadin previously served as the chief financial officer of W.W. Grainger Inc. from 2008 until 2018. From 1998 until 2008, he served in various finance and leadership roles with Grainger. He holds a B.A. in Economics from Yale University and an MBA from the University of Wisconsin—Whitewater. He will serve on the audit and governance committees of MRC Global's board.

DeZURIK's Jim Barker was elected president of MSS during its 2021 Annual Membership Meeting. In addition, the membership elected **David Bayreuther** of Neles Corporation as first vice president; **Fred Washburn** of Rexa, Inc. as second vice president; and **Paul Heald** of Bonney Forge as treasurer.

Barker has over 48 years of experience in the valve and fittings industry. During his 24 years of participation in MSS, he has served on the Coordinating Committee and chairs multiple technical committees. He has also served as a member and officer of the MSS Board of Directors. In addition, Barker has served on the VMA Technical Committee for 17 years.

Bruno Carbonaro

Velan Inc. announced in October that in accordance with its succession plan, **Bruno Carbonaro** has become CEO. He succeeds Yves Leduc, who led the corporation for seven years. According to the transition plan approved by the board, Leduc will become Special Advisor to the Chairman and will remain a director of the board until Jan. 12, 2022. On behalf of the board, Jim Mannebach, chairman, recognized "the substantial contributions of Yves Leduc during his years as leader of Velan under difficult market conditions and a global pandemic."

Setpoint Integrated Solutions Inc. Receives the Gold Safety Award

Setpoint Integrated Solutions has received the Gold Safety Award from ConstructSecure Inc. The safety evaluation program reviews the company's safety performance, how employees are kept safe and current safety management systems.

Emerson Receives Gold LEAP Award from Design World Magazine

John Molloy, Emerson Automation Solutions, stated, "We're honored to receive a Gold LEAP award from Design World for our #AVENTICS Wireless Auto Recovery Module (ARM) in #pneumatics. The Wireless Arm allows easy but secured access to vital valve system diagnostics and health monitoring."

Baker Hughes to Deliver Valves to New Plant in Texas

Baker Hughes has been awarded a control valves contract for the Diamond Green Diesel plant to be built in Port Arthur, TX.

Baker Hughes Masoneilan will supply 335 control valves, including 36005 V-Max ball valves, 21000 and 41005 linear globe valves, 35002 Camflex valves, 28000 Varipak micro valves and the 78400/18400 Lincoln Log anti-cavitation valve. Materials of construction will be carbon steel, stainless steel and Hastelloy, based on application requirements. Setpoint Integrated Solutions will provide onsite support.

MERGERS AND ACQUISITIONS

Neles Completes Acquisition of Flowrox

Neles' acquisition of the valve and pump businesses of the Finland-based technology company Flowrox has been successfully completed. With this acquisition, Neles expands its offering and exposure to the mining and metals industry.

The transaction includes the acquired businesses as well as customer agreements and the Flowrox trademark, which will be transferred to Neles. The acquisition was announced in July 2021 and it will be reported as of Q4 2021.

Setpoint Integrated Solutions Acquires Valsource International

Setpoint Integrated Solutions acquires Houston-based Valsource International in a customer-focused move, adding additional territory to Setpoint's Gulf Coast footprint, announced in a press release. Valsource International specializes in comprehensive control valve and pipeline repair services for maintenance, emergency and scheduled outage requirements.

Setpoint has more than 185 certified technicians spread over 11 facilities across the Gulf Coast, offering exceptional valve repair services and delivering process solutions for control, relief and automated valve requirements, along with industrial equipment including liquid level measurement, pressure gauges and more.

Severn Group Acquires ValvTechnologies

Severn Group, the global family of specialist high-end valve engineering and manufacturing companies, which includes Severn and LB Bentley, has acquired U.S.-headquartered ValvTechnologies, a designer and manufacturer of metal-seated, zero-leakage isolation valve solutions for demanding applications.

The deal, which follows the strategic partnership announced in June of this year, represents a step toward Severn Group's vision to become the leading global severe service valve specialist in the energy and industrial sectors. ValvTechnologies will retain its operational independence but will benefit from a broader pool of expertise and resources as part of the wider Group, alongside Severn and LB Bentley.

CONTRACTS AND PARTNERSHIPS

Neles and thyssenkrupp Team up to Deliver Valves for Green Hydrogen

Neles and thyssenkrupp Uhde Chlorine Engineers have signed a frame agreement for the delivery of valve solutions for green hydrogen applications, announced in a press release from Neles.

Within the scope of the agreement, Neles will deliver its segment valves to be used in electrolysis plant modules supplied by thyssenkrupp Uhde Chlorine Engineers.

Green hydrogen—aka hydrogen extracted from water using renewable energy—has been identified as a key component in the clean energy transition. Hydrogen enables huge potential in renewable energy storage, in transportation, and in increasing the use of renewable energy in some carbon-intensive industrial processes. To date, more than 30 countries have already announced their strategies to increase the share of hydrogen in their energy mix.

AspenTech and Emerson Enter Agreement on New Software Strategy

Emerson and AspenTech announced on Oct. 11 that the companies have entered into a definitive agreement to contribute Emerson's industrial software businesses—OSI Inc. and the Geological Simulation Software business—to AspenTech to create a diversified, high-performance industrial software leader with greater scale, capabilities and technologies. Emerson will also contribute $6 billion in cash to new AspenTech, which will be received by its shareholders, in exchange for a 55% stake in the new AspenTech, which will offer a highly differentiated industrial software portfolio with capabilities to support the entire lifecycle of

2022 YEAR-LONG

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

JANUARY

31- FEB 2
AHR Expo
Las Vegas
ahrexpo.com

APRIL

6-8
VMA 2022 Valve Forum Conferences and Exhibits
San Antonio, TX
www.vma.org/valveforum

MAY

2-5
OTC (Offshore Technology Conference) 2022
Houston, TX
otcnet.org

JUNE

12-15
ACE Annual Conference & Exposition
San Antonio
awwa.org/ace

AUGUST

3-4
2022 VMA/HI Market Outlook Workshop
Virtual
www.vma.org/marketoutlook

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.

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complex operations across a wide range of industry verticals, including design and engineering, operations, maintenance and asset optimization. The new company will retain the name AspenTech.

Baker Hughes and Shell Sign Agreement Toward Net-Zero Emissions

Energy technology company Baker Hughes and Shell Global Solutions BV (Shell) have signed a broad strategic collaboration agreement to accelerate the global energy transition by helping each other achieve their respective commitments for net-zero carbon emissions and advancing solutions to decarbonize energy and industrial sectors.

The memorandum of understanding intends to build on the existing relationship between Shell and Baker Hughes in key areas:

- Shell will initially provide selected Baker Hughes U.S. sites with power and renewable energy credits and the companies will negotiate renewable power for Baker Hughes' sites in Europe and Singapore.
- Shell and Baker Hughes also agreed to broader collaboration to identify other opportunities to accelerate each other's transition to net-zero carbon emissions by 2050, such as Baker Hughes providing low-carbon technology solutions for Shell's LNG fleet.
- The two companies will further explore potential opportunities to co-invest and participate in new models to decarbonize energy and industrial sectors.

Emerson to Provide Advanced Technologies for Plastics Recycling

ReNew ELP, a UK-based advanced recycling company, has selected Emerson as its digital automation partner for its new plastics recycling plant in Teesside, North East England, announced in a press release. Emerson's advanced automation technology and software will help achieve safe, efficient operation of an innovative hydrothermal process to convert end-of-life plastics back into their original feedstock to produce new plastic products, reducing waste and pollution.

Currently, many post-consumer plastics, including flexible and multi-layer plastic packaging items, such as films, pots, tubs and trays, are considered "unrecyclable" via traditional mechanical recycling methods and are instead sent to landfill or incinerated. After a short first-use cycle, 95% of plastic packaging material value, or $80–120 billion annually, is lost to the economy, according to the World Economic Forum.

NEW FACILITIES

DeZURIK-Gulf Coast Opens Automation and Distribution Center

The DeZURIK-Gulf Coast Automation & Distribution Center (ADC) opened in 2021 and is in Stafford, TX. The center maintains a large inventory of valves, actuators and accessories that allows assemble-to-order availability and timely shipment. Manual, isolation and control valves with valves in sizes up to 24 in. are available as well as complete valve assemblies designed to meet a customer's exact specifications.

Isolation and control valves are in stock for quick shipment including V-port ball valves, high-performance butterfly valves, extended service knife gate valves and bi-directional

knife gate valves. Additional items include a wide variety of actuators such as stainless-steel spring diaphragm actuators, pneumatic knife gate valve cylinder actuators and manual handwheel actuators. Also available are accessories such as positioners, air filter regulators, limit switches, solenoid valves and more.

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VMA Unveils Strategic Plan

At the beginning of 2020, VMA's Board of Directors identified the need to develop a plan to guide the organization through growth in a way that remained relevant to its members and the industry and retained current and attracted new members and event participants. The plan was developed using a compilation of feedback and comments from the Strategic Planning Committee, staff, the VMA Board of Directors and member surveys. After an 18-month planning process, interrupted by the COVID-19 pandemic, the VMA Board of Directors officially voted to adopt the 2022-2025 Strategic Plan at its October 2021 meeting.

This plan will guide VMA and its committees over the next three years to ensure that VMA moves toward its vision, delivers on the mission and serves the needs of our member companies and ultimately our industry. As part of the strategic plan development, the Strategic Planning Committee defined VMA's vision, mission statement and core values.

OUR INDUSTRY VISION

High-quality trusted valves, actuators and controls that support the production of products essential to improving the quality of life of the public and protecting the planet.

VMA MISSION STATEMENT

The VMA's mission is to serve the growth and innovation of the U.S. and Canadian industrial valve industry globally by providing a forum that enhances a positive business operating environment, increases knowledge, advances technology innovations and facilitates business and government connections for manufacturers, distributors and service providers of valves, actuators and controls.

CORE VALUES

VMA and its members value the importance of operating in a safe manner that protects the health and safety of employees and the community; strives for continuous quality improvement; protects the environment; and is respectful of workers and the intellectual property rights of manufacturers, customers and other businesses. We are committed to the professional development, education and growth of the industry at large

THE STRATEGIC PLAN IS FOCUSED ON FIVE OBJECTIVES:

Be Member-Driven—Manage the association in a way that engages members, promotes member value, commits to

diversity and demonstrates operational excellence by providing the financial, staff and member resources needed to achieve our priorities.

Encourage Industry and Member Company Growth, Interaction and Innovation—Advance member company efforts in growing their business by providing information, research, business opportunities and a platform to address and solve issues.

Be the Unified Voice of the Industrial Valve Industry—Represent the valve industry as a sector of manufacturing that is vibrant, attractive, innovative and responsible.

Demonstrate Thought Leadership and Provide Industry Expertise and Education—Educate members, end users and the industry to facilitate innovation, efficiencies in production and distribution, increases in health, safety and environmental protection; and to promote the proper use of flow control equipment throughout the world.

Represent the Industry to Policy Makers—Enhance advocacy and influence government activities to create a positive business operating environment and opportunities for industry growth.

Thank you to the Strategic Planning Committee members for all their hard work and dedication in putting the plan together:

- **Nathan Brunell**, Product Line general manager, Baker Hughes—committee chair
- **Matt Bate**, president and chief executive officer, Setpoint Integrated Solutions
- **Arie Bregman**, vice president and general manager, DFT Inc.
- **Bryan Burns**, president, DeZURIK
- **Yves Leduc**, president (former), Velan Valve Corporation
- **David Plum**, president, Marketing; Final Control, Emerson Automation Solutions
- **Ron Warren**, president and COO, Bray International Inc. VM

Committee Spotlight: Technical Committee

VMA's committees comprise member company individuals who help drive forward VMA's mission by leading the activities around various issues, events and activities. Below, we learn about the Technical Committee and chair **Stephane Meunier Eng. PMP**, national sales director for Emerson Automation Solutions. In addition to Stephane, other members of the committee are:

- **Nicolas Lourdel** (vice chair), manager, Product Development Processes, Velan Valve Corp.
- **Jerry Grant**, engineering manager, DeZURIK
- **David Escobar**, director of Engineering, Neles USA (Metso)
- **Jeff Hager**, product development, Trillium Flow Technologies
- **Thom Jessup**, sales manager, EGC Enterprises
- **Sudhir Kulkarni**, Global Engineering manager, Crane ChemPharma and Energy
- **Ross Waters**, chairman, C.G. Industrial Specialties Ltd. (CGIS)

Stephane Meunier shares his technical expertise at a Valve Basics event.

For a full list of committees and how to get involved, contact VMA President Heather Rhoderick at hrhoderick@vma.org. >

Q: Tell us about VMA's Technical Committee.

Stephane Meunier

A: The VMA's Technical Committee is made up of seasoned technical experts in the industry. Our role is to support the VMA Member community regarding any matter of technical uncertainty related to codes and standards, technical specifications or valve applications. The Technical Committee is also in place to offer an advanced level of technical education, information and discussion on current and high-profile trends in the industry; this is accomplished via the Valve Forum's Technical Track.

Q: What do you enjoy about being a part of the Technical Committee?

A: I enjoy the aspect of uninhibited collaboration from members of various industrial backgrounds and from various member companies, with the unified goal of providing high technical awareness to the equal benefit of everyone in the valve industry.

Q: How is the Technical Committee helping VMA members? And you, personally and professionally?

A: The Technical committee is helping VMA Members by providing a forum where concerns, lessons learned and technological advancements can be shared throughout the valve community. As for myself, it allows me to not only stay current with industry trends but also provides un unparalleled opportunity to network with a variety of valve professionals, from industry pillars to industry newcomers, like I once was. I am happy to have made many long-lasting relationships, both professional and personal.

Q: What future changes, innovations, technologies and opportunities are you excited about for the valve industry?

A: While still very much a mature industry, the valve industry is turning an important corner towards the age of digital transformation where availability of information at one's fingertips will change the way valves and actuators are used. The key will be mastering the interpretation of this data and making effective use of it. This will also tie the valve and actuator industry more directly to energy efficiency.

Q: How did you get into the valve industry?

A: By fluke! I was a young graduate of McGill University in Montreal, Canada with a degree in Aeronautics Engineering at a moment where the entire aerospace industry had suffered a major downturn. After an exhaustive career search, a good friend hinted that there might be an opportunity at a local valve manufacturer (Velan). I convinced myself with "I suppose it is still related to fluid flow, what difference does it make if it's around an aerofoil or inside a pipe." I never looked back since and, thanks to a few mentors who I still keep in touch with today, I have enjoyed a successful and very diverse 20-year career so far and hope for at least 20 more. They say in the valve industry: *once you're in, you can never get out* I say: "Why would you ever want to leave?"

Q: What are some hobbies or activities that you enjoy outside of work?

A: I'm a self-declared foodie, mixologist and sommelier. I love to cook and to explore new food, wines and cocktails from different places around the world. I make my own wine and have just finished my first batch of limoncello!

I'm also an avid fan of mobster-type movies, my favorite being Donnie Brasco as well as action-thriller spy-type movies such as the James Bond (Sean Connery, obviously) or the Bourne franchise.

Q: If you could write a book, what would it be about?

A: The journey of the traveling valve salesman; a collection of shorts.

Q: What is your favorite sports team?

A: Being from Montreal you'd expect me to proudly say: Montreal Canadiens! Unfortunately, I don't watch much hockey, but when I do, I cheer for the Boston Bruins.

My go-to is European football (Soccer) where I cheer for A.S. Roma in the Italian Serie A and for S.S.C. Bari (my hometown team, so to speak) in Serie C.

A Look Back on 2021

Thanks to the VMA Board of Directors and the more than 80 individuals who have worked on a VMA Committee over the past year, and the VMA staff; VMA had a strong 2021. While too many to include here, a few key highlights on what took place last year include:

- Virtual events continued throughout the year with the Valve Basics Training, Valve Forum, Market Outlook Workshop and webinars, allowing our members and industry continued access to content, issues and trends.
- Our Annual Meeting was held in person, with huge success. Past business relationships were renewed—new ones were made, and timely topics were discussed.
- A new *VALVE Magazine* website was launched, providing an easily navigable way to find all things related to the industrial valve industry.
- A Government Affairs Committee was formed and got to work immediately on key legislation affecting our industry.
- Industry and market segment data continued to be tracked and reported to our membership to help with business decisions.

For more information on these items and other VMA activities, contact VMA at hrhoderick@vma.org. VM

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C. Total Paid and/or Requested Circulation	10,018	10,127
D. Nonrequested Distribution by Mail		
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Photo Credit: Getty Images

Metal Additive Manufacturing:

The Evolving Road to Adoption and Standardization

BY MARGO ELLIS

Fusing metal powder with lasers or electron beams. Digital methods versus traditional analog machining. Dubbed a critical player in manufacturing's steady and continued march into the 21st century, additive manufacturing (AM)—or 3D printing—is a disruptor in the most promising sense of the word. Misconceptions abound regarding exactly what this technology is, but more important, the sheer magnitude of how much 3D printing will impact the future of manufacturing, particularly metal AM. In a report from Technavio, it is predicted that the metal AM material market will almost quadruple by 2025, with an increase of $7.19 billion over the next three years.

In its relatively short history over the past 20 years, metal AM has already proven to be a revolutionary technology in industry. This method of building geometries layer by *metal powder* layer from a digital model (instead of through subtractive methods such as machining) is driving change in how valves and related components are produced. The world of 3D printing still largely centers around rapid prototyping, but it's evolving. Metal AM has grown exponentially to become well established as a means of creating tooling for a range of conventional processes. Manufacturers are also increasingly adopting AM for production, even full scale. While metal AM is primarily used in aerospace, energy, defense and medi-

☐ **Valve components produced using PBF exhibit material properties the same, if not improved, in comparison to cast or wrought materials, even rivaling forgings.** Photo credit: Courtesy of Emerson

cal industries, it's gaining traction in oil and gas and other process applications where valves are used.

Compared with traditional production methods, there are numerous advantages of AM, including innovative and custom design, complex geometries, lighter weight, part consolidation, waste reduction, shorter supply chain, inventory control and faster everything: prototyping, setup, design adjustments, production, testing, assembly, turnaround and delivery.

Despite all the enthusiasm for AM, however, some of the disadvantages yet to overcome are corollaries of the benefits: gaps in design knowledge and skills, high production costs (metal powder material, although partially offset by reduced machine time), size limitations, product quality, machine suppliers and a lack of both testing procedures and structural regulations. That said, manufacturers who have committed their expertise and resources to overcoming these challenges show that they're certainly not insurmountable, as evidenced by getting certified and proven products to customers.

STANDARDS

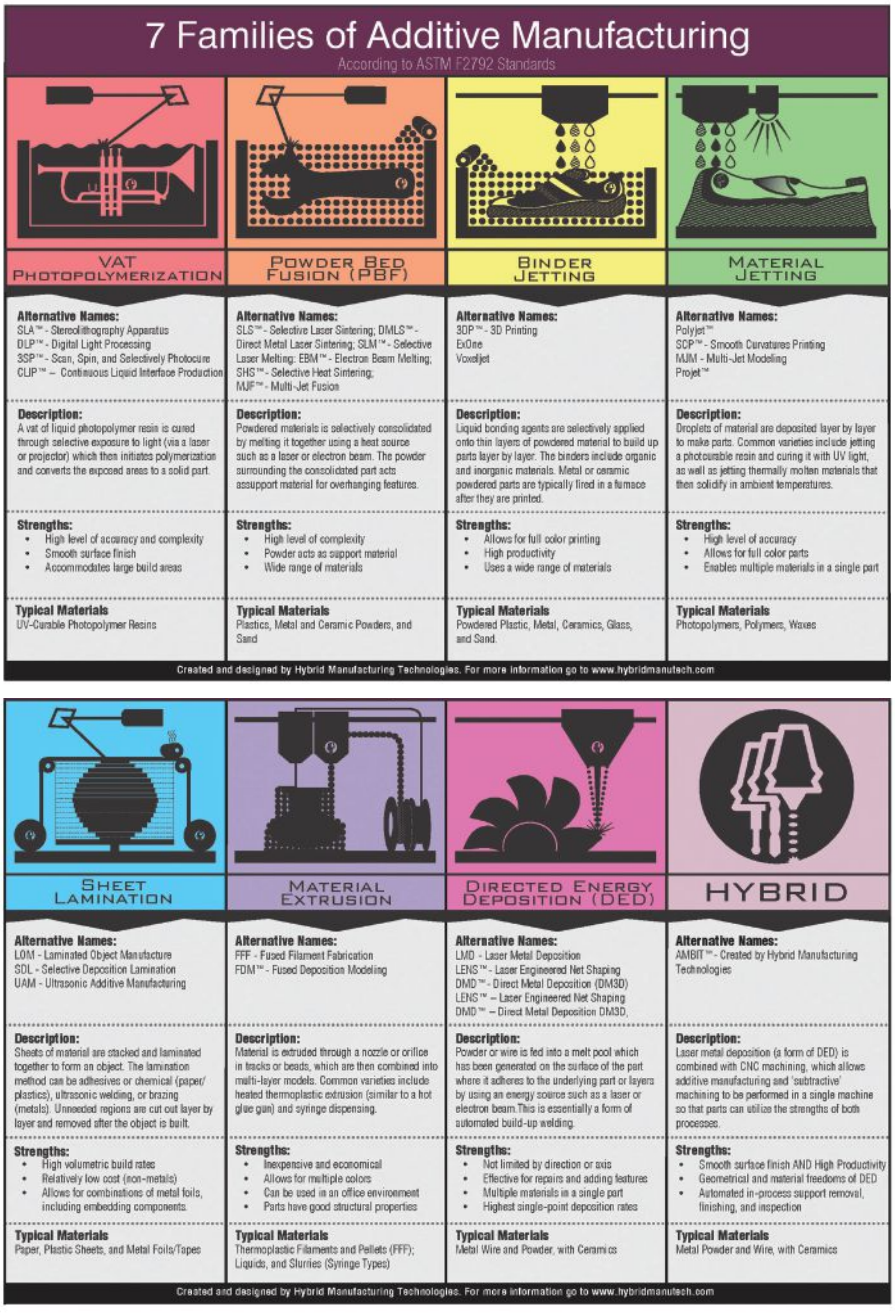
According to ISO/ASTM standards, there are seven different types of additive technology (see graphic); for the purposes of metallurgy, however, the three most frequently used methods include:

- Powder Bed Fusion (PBF)—Powdered metal is fused together using an energy source, typically a laser or electron beam. It's one of the oldest processes where material properties are well known and repeatable.
- Binder Jetting (BJT)—A binding agent is deposited onto powdered metal or sand creates the geometry. In the case of metal AM, binding is typically followed by sintering to fuse the powder.
- Directed Energy Deposition (DED)—Metal powder or wire is fed into a meltpool created by a laser or electron beam in a process similar to welding.

Employing these technologies, some valve manufacturers like Emerson and Neles are in various stages of either field testing metal 3D printed valves, as is the case with Neles—or in full-fledged production and distributing self-certified AM assembly components to customers, as Emerson is doing. At this point in the ongoing regulatory process, the framework of standardization is clearly a work in progress.

"There's quite a bit going on in the standards world. There are different regulatory codes and standards related to pressure-retaining components, which includes valve bodies," says Claire Belson, manager of Additive Customer Success, Emerson Automation Solutions. She adds, "Our materials engineers have been instrumental in creating and writing the documents that will eventually serve as guidance for standardization. As with anything new, whether it's additive or not, this kind of change elicits a need for oversight, which is all part of the process."

One such guidance document, the ASME PTB-13-2021, is a report about the state of the art of metal AM that addresses criteria for pressure-retaining metallic components, in particular. It was issued in May 2021 and is the culmination of four years of work by the



ASME Board on Pressure Technology Codes and Standards (BPTCS)/Board on Nuclear Codes and Standards (BNCS) Special Committee on Use of Additive Manufacturing that is co-chaired by a senior project engineer at Emerson. Of the criteria included in the report, only PBF technology is covered.

In the oil and gas industry, the American Petroleum Institute (API) in October 2021 published its new API Standard 20S, Additively Manufactured Metallic Components for Use in the Petroleum and Natural Gas Industries, to help drive the adoption of additive manufacturing to optimize natural oil and gas component design. "This new standard expands API's best-in-class safety and efficiency requirements and supports cutting-edge operations, helping producers to deploy new 3D printing technologies to meet rising global demand for natural gas and oil products," comments Alexa Burr, API vice president, Segment Standards and Services. Emerson was also active in developing and creating this standard with two engineers who are committee members.

The first edition of the API standard introduces three additive manufacturing specification levels (AMSLs) that define technical, quality and qualification requirements to help ensure that metallic components are fit for purpose. For this standard, of the previously mentioned technologies of metal AM, it applies to all three: PBF, BJT and DED. The API noted that the standard is the first of its kind but only the beginning of work that will be done in the AM space.

With an undetermined standardization timeline that involves not only ASME and API but organizations like ASTM, ISO, MSS and others, valve manufacturers will push on, spurred by AM's inherent creativity that's never been possible through traditional manufacturing methods. "The ability to rapidly produce prototypes has allowed us to expand our horizons in terms of being innovative. The status quo used to be that it took a long time to prototype parts, then send them to a special machine shop, have them created and get them back for testing. But now we have the ability to do multiple iterations of similar things, test them simultaneously in our state-of-the-art Flow Lab and get better results for whatever problem we're trying to solve: mitigating noise, reducing cavitation or finding a better material," Belson says.

For anyone new to AM overall, an important foundational standard is ISO/ASTM 52900: Additive Manufacturing General Principles Terminology that clarifies uniform terminology and details the many variants of the process. With such widespread interest in AM, and given the rapidly changing landscape, ASTM also created the AM Center of Excellence (CoE) in 2018. While not specific to the valve industry or oil and gas, the AM CoE brings together industry, government and academia to optimize the AM R&D and standards-development processes. Similar to API's goals, ASTM hopes to reduce AM time to market and increase greater adoption of the technology. And within all these standards-writing organizations, there is considerable overlap—ASME, for example, relies on material-related information from ASTM in its processes for many regulatory needs in this sphere.

Roadblocks to standardization that ASTM, in conjunction with ANSI, outline include a lack of historical data, consensus-based standard development that extends timeline, multiple organizations working on standards, potential for duplication, potential for conflicts hampering adoption, need for research and development and resources needed for validation experiments.

REAL-WORLD IMPLEMENTATION

When looking at industries that have embraced AM early on, like aviation, for example, Jacob Nuechterlein, president of Elementum 3D, says progress is slower-going in oil and gas for a few reasons. "There's a huge barrier to entry for (valve) manufacturers, but as the capabilities improve to where printing is faster and parts can be larger, the business case can be made for greater adoption, and eventually associated costs will come down as they're amortized," he states. In describing the business case measures, he described familiar themes of creating novel and complex products that are otherwise impossible and perennial logistical benefits like reducing the need for spare parts and warehousing them. When one-off replacement parts or components can be produced in as little as several days, there's a huge upside for manufacturers and their customers.

Jukka Borgman, director of Technology Development at Neles, who is leading field testing of the company's first 3D-printed pressure-retaining valve body, explains, "The valve body is a pressure-retaining component and thus its material properties need to be well known. However, industry standards for 3D printed materials are under development. It has been necessary to test the valve body material extensively, for example, the tensile strength and impact resistance to make sure it is safe and reliable in the process." In Neles's feasibility study, Borgman's team also optimized flow paths in noise attenuation trims and delivering improved performance compared to conventionally produced trims.

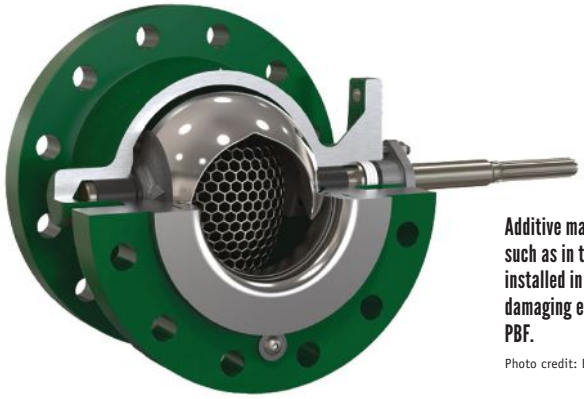
Neles T5 series ball valve with 3D-printed valve body.
Photo credit: Courtesy of Neles

"3D printing can help us to optimize valves for customer-specific needs in various applications and with all valve types," he says. In looking ahead at the next several years, Borgman adds, "We are living in exciting times regarding 3D printing and valves if someday in the future ASME releases 3D printing standards for pressure-retaining components, this would qualify metal AM as a standard manufacturing method among casting or forging for any valve component."

For Emerson's part, the company is producing titanium valve bodies via PBF technology with many currently in service across the globe. They recently received Canadian Registration Number (CRN) for approval and sale in Canada, meaning the valve bodies are authorized according to province or territory in Canada. The CRN applies specifically to boilers, pressure vessels or fittings that operate at a pressure greater than 15 psig.

With a 3D-printed anti-cavitation trim available to customers in severe service applications, Emerson also has designed and produced a custom component only possible via additive's PBF technology. The part has hexagonal chambers resembling a honeycomb that effectively break up heavy flow, thereby reducing or eliminating vibration caused by cavitation.

Belson summarizes, "The old-school way would be to produce the tubes and braze them all together. But as you can imagine, the lack of manufacturing repeatability hindered long-term reliability of the product. So we were able to make the new part using additive technology. It's printed as one component and the reliability went up exponentially. We're also able to produce it in a couple different materials, which we wouldn't have done before, and it adds viability to different erosive or corrosive processes. Now it's a full-fledged tool in our toolbox to help our customers."



Additive manufacturing allows for more customization such as in this Fisher Cavitrol Hex trim, shown here installed in a Vee-Ball valve, which helps reduce the damaging effects of cavitation and is produced using PBF.

Photo credit: Emerson

When asked about how Emerson is approaching the future of metal AM, Belson says that they are fully invested in the technology and have spent thousands of hours proving that the material is high quality, even rivaling forgings. To date, Emerson's AM facility in Singapore has produced more than 12,500 production parts and she looks forward to Emerson's production printing capabilities pushing further acceptance of AM in the industry.

And broadly for all manufacturers that are in varying stages of AM adoption, this is the hope and goal for the what's to come—greater knowledge and acceptance—especially with standardization backing both the processes and results. As the technology gains more exposure and becomes integrated as a complement to traditional methods, expect to see continued and rapid progress in the burgeoning world of metal additive manufacturing. VM

Valve Basics

An Overview of Butterfly Valves

BY MITCHELL ANDERSON

Butterfly valves belong to the family of quarter-turn rotational valves, created and first used in steam engine prototypes as early as the 18th century. Use of butterfly valves grew in the 1950s for applications in the oil and gas market, and 70 years later they continue to be widely used in numerous industrial applications.

Butterfly valves can be assembled with handles, manual gears, pneumatic or hydraulic actuation. The valve configuration consists of a stem and disc that rotate 90° from open to close in the clockwise direction. Butterfly valves are popular in many applications as they are cost effective to maintain, offer fast operation and are lightweight compared to other types of valves. Most butterfly valves use the same basic configuration, with a body, stem, disc, seat and stem seal; however, other parts may vary between the different butterfly valve types, such as resilient seated, lined, single offset, double offset (often referred to as high performance) and triple offset. These types are differentiated by the geometry of the disc, stem, seat and the material of the seating designs.

A key advantage of selecting a butterfly valve is the reduction of space and weight to a system compared with other options such as ball, check, globe or gate valves. Compared to a gate valve, installation of butterfly valves is less difficult from size and weight, and compared to ball valves, the cost to replace or repair is usually less. Butterfly valves are limited based on their application as they have an obstructed port, as part of the disc always faces the flow even when fully opened and they are not typically utilized in heavy slurry applications as a knife gate or severe service ball valve is preferred. Butterfly valves are also versatile products that can be used in both isolation and light control/throttling services.

RESILIENT SEATED CONCENTRIC

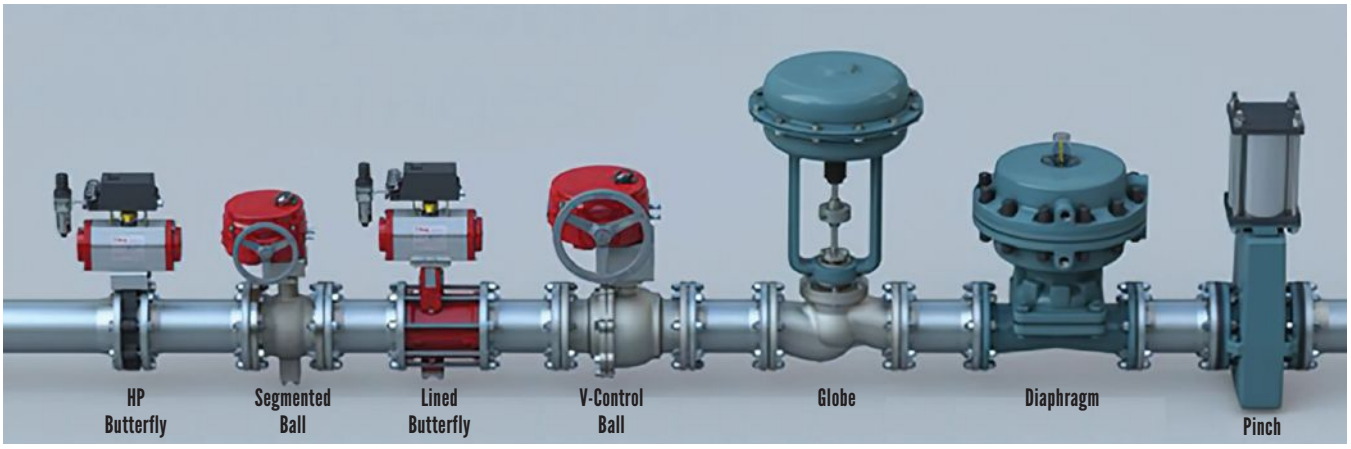
Resilient seated valves are concentric with the pipeline, as the disc is held in the center of the valve. This valve type is position seated, with continuous disc-to-seat interference. Ratings are commonly in cold working pressure (CWP) rather than class rating but fit between ASME Class 125 and Class 150 flanges. Resilient seated valves are often designed below ASME pressure class ratings, thus more cost effective for low pressure applications. Stem sealing consists of a primary seal (seat flat to disc hub), secondary seal (stem diameter larger than a hole in seat) and tertiary seal (upper stem seal).

Typical body materials include ductile iron, cast iron, carbon steel, aluminum, stainless steel and aluminum bronze. Typical seat materials include EPDM, Buna-N, PTFE, natural rubber and more. Resilient seated butterfly valves are mostly used for isolation and control applications including HVAC, chemical and petrochemical, food and beverage, power generation, water and wastewater, oil and gas, mining and dry bulk handling. They are selected based on compatibility with the media running through the pipeline and flow conditions.

Concentric

POLYMER-LINED CONCENTRIC

Lined butterfly valves are also concentric with the pipeline and designed to be utilized with harsh chemical media: These polymer-lined products offer longer life in media with higher levels of acids. Options include PTFE-lined and PFA-lined valves, both used in the petrochemical, food and beverage industry with corrosive media. One of the main differences between the lin-



ers is that in steam engine prototypes PFA liners remain flexible in contrast to PTFE liners over time based on the way they are manufactured. PFA is melted and chemically bonded while PTFE is sintered. Melting and chemically bonding creates a denser material and minimizes air pockets, resulting in flexibility and tight shutoff over long-term use for harsher chemical applications. The PTFE lined butterfly valve is typically used in water, brine, pulp stock and weak acid applications. The disc material can also vary based on application, between stainless steel, or lined stainless steel with PTFE, PFA and UHMWPE (ultra-high molecular weight polyethylene).

HIGH PERFORMANCE

High performance butterfly valves (also called double offset) have two offsets: The first offset of stem is off center to or behind the disc seating face, followed by the second offset, which shifts the stem off centerline of the pipeline. This double offset creates camming action, moving the disc away from the seat rather than across it, reducing rubbing between the disc and seat as seen in concentric and single offset valves.

The double offset is commonly used for isolation and control applications, as well as higher cycle applications when compared to a concentric design. Most applications are made for higher temperature and pressure than resilient-seated valves. The seats are designed to provide reaction force (contact stress) to disc when in the closed position. This contact stress creates the seal with the disc edge. These designs can be pressure dependent, while others use interference fit provided by a seat energizer for that pressure range. Common body materials include carbon steel, stainless steel and aluminum bronze. Common seat materials include PTFE, reinforced PTFE, TFM, UHMWPE and Inconel.

Additional seat designs for specific application can also include fully metal seated and fire safe (both soft and metal seat). The metal seated design can withstand higher temperature capabilities up to 900°F in dirty service, abrasive service and control applications with hot and dirty service. The fire-safe seated design is used in services at risk for fire, using a soft seated material for isolation while still providing a constant metal-to-metal backup seal to the disc in the event of a fire. The intent of the valve design in these applications is to provide isolation to prevent feeding the flames.

Double Offset

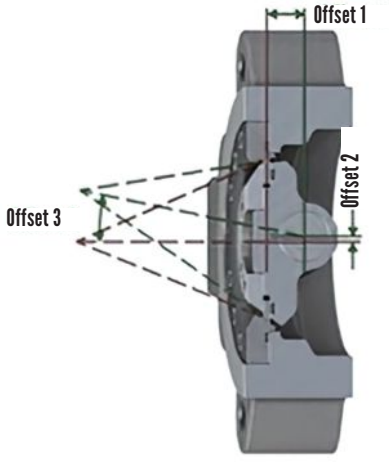
The double offset design can be configured for cryogenic applications; they are most often used in industrial gas applications such as argon, helium, hydrogen, nitrogen and oxygen. The choice of materials is based on the service, focusing on toughness and impact strength of the pressure boundary materials at process temperature. The standards for these applications include strict material specifications along with cleaning requirements for safety and operation of the valves while in service.

TRIPLE OFFSET

Triple offset valves share the first and second offset concept with high performance butterfly valves and include an additional third offset, with the seating surfaces using an inclined conical surface. This third offset enables the sealing element (seal ring) to only engage the seating surface in the final

degree of closing (and immediately disengaging from the valve seat upon opening) resulting in no rubbing between the sealing components. This valve type is torque-seated, meaning torque is applied to load the sealing elements and provide the shutoff performance. The seal ring can either be laminated layers of metal and graphite or a solid metal sheet, both of which are field replaceable. The valve seat can either be bolted in (field replaceable) or integral to the valve body. Triple offset valves are inherently fire safe and applicable to pressure classes from Class 150 up to Class 1500. This design can be used in a broad temperature range of -320°F to 1,500°F in varying configurations due to the metal-to-metal sealing.

Common body materials include carbon steel, stainless steel and aluminum bronze while common seat materials include 316 stainless steel hard-faced, nickel aluminum bronze, Stellite and duplex stainless steel. Common seal materials include laminated duplex stainless, Monel, XM-19 or Inconel metal layers with either graphite or PTFE, and solid metal options include duplex stainless steel, Inconel or XM-19. Main applications for the triple offset valves include steam-distribution, petrochemicals, tank farms, terminals, and switching.



Triple Offset

The triple offset valve configured for cryogenic service, allow for temperature as low as -420°F; it is used in LNG, liquid hydrogen and liquid oxygen service, to name a few. Extended bonnets keep the stem packing from the extreme cold temperatures.

The higher temperature designs, up to 1,500°F, use a solid seal ring and a bonnet to dissipate heat transfer to the packing and actuation. This design is mostly used in turbines, molten salt and hot air applications.

END CONNECTION TYPES

Butterfly valves have multiple options for end connection types, including wafer (flangeless), lug, double flanged and buttweld end. Some options allow for ease of maintenance, some are

suited for dead-end service and some designs have weight and cost reduction implications compared to each other.

■ **Wafer** valves are designed to be installed between flanges, with a short face-to-face dimension in relation to the pipeline diameter. These valves cannot be used for dead-end service, which requires additional isolation valves when shut down for maintenance. Wafer options are lighter and cheaper than lug style and often used in lower pressure applications.

■ **Lug** valves are designed to be bolted to one or both flanges using fasteners threaded into lug protrusions on the valve body, with a short face-to-face dimension in relation to the pipeline diameter. These valves can also be used in dead-end service depending on seat design but may be de-rated and can be heavier than wafer style.

■ **Double flanged** valves are designed with flanges on both ends of the body to secure the valve to mating flanges on the pipe with bolts or studs and nuts. They can be used in dead-end service; however, some valve types may be de-rated.


Wafer (flangeless)


Lug (flangeless)


Double Flange


Buttweld End

■ **Buttweld end** valves are designed with bevels (weld preparation) on each face to match thickness and bevel on the pipe. The two ends are butted to the pipeline and welded, used in applications where dismantling is not common, or a potential leak path between flange bolting is a concern.

AUTOMATION TYPES

Many types of actuators can control the opening and closing characteristics of a butterfly valve. The actuator provides the torque required to properly open and close the valve during service. The following types of actuators are paired with butterfly valves:

■ **Manual valve operation** is the simplest form of actuation. It uses a wheel or lever to control the position of the stem and disc. Manual operators are also very inexpensive and typically are used with smaller sized valves that have a lower torque requirement. These are especially suitable in applications where power is not present to operate the valve. The speed of manual operators is somewhat slow, so they would not be used in emergency shut-off applications.

■ **Electric valve actuators** contain a gearbox that can adjust motor speed, raising or lowering the torque. The elec-

tric actuators are easy to maintain, are relatively simple to install and are fairly quiet during operation. The position of the valve is based on the voltage or current signal input and can contain limit switches that stop the actuator when fully closed or fully open. Electric actuators are used where there is a stable power supply.

- **Rack and pinion actuators** contain springs within a chamber that operate from the entry and exit of compressed air. These types of pneumatic actuators can be single or double acting, are compact in design, relatively inexpensive and lightweight. They have quicker reaction times, allowing for their use in throttling services; they need an external supply of compressed air.
- **Scotch yoke actuators** can be

Scotch Yoke | Rack and Pinion

Electric | Handle

operated with compressed air or with hydraulic fluid. These consist of a crank and piston in a hollow cylinder. Pressure is applied to one side, and the resulting force moves the piston linearly to rotate the stem and disc. These actuators can be designed with modules for ease of maintenance by just removing one section of the actuator instead of the entire assembly. The scotch yoke is larger and more costly than the rack and pinion, but output creates much higher torque for larger sized valves. The scotch yoke also can be paired with control accessories for use in quick acting or soft closing applications.

- **Hydraulic valve actuators** use hydraulic force supplied by a fluid to control the position of the disc and stem. They are available in either single or double acting. Single acting works by the absence of fluid pressure, keeping the valve in the closed position; as pressure builds up, the fluid pushes the piston towards the valve to open. The double-acting type contains a hydraulic pump that changes the direction of the fluid to open and close the valve. These actuators are used for the very large or heavy-duty valves that require a large torque to operate; they also can be used with solenoids to better control position.

BUTTERFLY VALVE DESIGN STANDARDS

Butterfly valves have many national and international standards that dictate the design criteria, such as wall thickness, face-to-face length, mounting patterns, flange drilling, fugitive emission and more. Below are some of the common standards for the many types of butterfly valve designs.

COMMON STANDARDS FOR VALVE DESIGN

Butterfly valves offer a unique value proposition based on their weight, footprint, and cost effectiveness. They provide a variety of options from seat material, sealing designs, and range of temperature and pressure ratings. Butterfly valves offer one of the largest valve markets behind ball and gate valves. They continue to grow based on the flexibility of automation, lower torque and improved fugitive emissions performance compared to linear valves. VM

Haley Ferner holds a technical marketing position for Bray International, previously serving in roles including engineering, certifications and quality assurance with more than seven years of experience. In her current position, she assists industry managers by creating industry-focused collateral and assisting with training presentations. Ferner graduated from Texas A&M University with a Bachelor of Science in Manufacturing and Mechanical Engineering Technology.

Mitch Anderson, a valve and actuator industry veteran of more than 15 years, serves in engineering, manufacturing and quality assurance roles. Anderson holds a Bachelor of Science degree in Engineering from Texas A&M University. He has been a committee member for development of API, ISO, and ASME standards and is a current *member of the VMA Education & Training Committee*. Anderson currently is director, Butterfly Valve and Ball Valve Engineering at Bray International in Houston, TX.

		Butterfly Valve Type			
		Resilient Seated	Lined	High Performance	Triple Offset
Valve Design	ASME B16.34			x	x
	ASME VIII			x	x
	API 609	x		x	x
	AWWA C504	x			
	AWWA C516	x			
	AWWA C519	x		x	x
	MSS SP 67	x			
	MSS SP 68			x	
	EN 12516			x	
Face to Face	API 609	x	x	x	x
	ASME B16.10			x	x
	ISO 5752		x	x	x
	EN 558	x	x	x	
	MSS SP 67	x	x		
Flange Drilling	ASME B16.5	x	x	x	x
	ASME B16.47			x	x
	ASME B16.1	x	x		

Minerals and Metals Industry Demands Robust, Reliable Flow Control Solutions

BY HEIKKI KÄRKI

Major valve technology providers work with various customer industries ranging from pharmaceuticals to sugar and energy to minerals and metals. Indeed, the minerals and metals industry is increasingly found in the top positions of the list partly due to the fact that modern metals refineries resemble more of a chemical complex than a quarry, resulting in a significant need to optimize process flows.

AN INDUSTRY WITH TWO SIDES

The minerals and metals industry is made up of a broad, versatile and complex set of sub-industries, so it is useful to break it down into distinct segments. One way to look at the industry, through the eyes of a flow control supplier, is to see it as having its two main branches:

- **Concentrators and minerals processing** where slurries play a large role in flow control-related applications. In concentrators and minerals processing plants, the main unit processes—such as milling, hydrocyclone separation, thickening and flotation—are usually rather similar to each other regardless of the commodity in question. The level of challenge for flow control depends on the chemical composition of the slurry, pressures, temperatures and other process parameters.
- The second branch covers **metallurgy, chemical minerals and metals and steel,** where the majority of flow control importance revolves around standard-to-demanding utilities and process-critical valves. There is naturally more complexity and variation in the requirements for flow control, depending on the commodity. Figure 1 presents the two main categories in minerals and metals.

From the flow control industry's perspective, both markets are trending >

Going the Distance: Mining's Race to Meet Global Technology Thirst

BY DANILO GARCIA

That they want to do what? That's insane. That's the first thought that came to mind when someone told me quite a few years ago the amount of slurry a customer wanted to pump across places like the Amazon jungle, a vast desert or even across a whole mountain range. But they (direct customers and EPCs) weren't insane; they were just pushing the mining industry forward. Pushing for engineering departments at different companies globally to come up with ideas and develop the infrastructure to support the needs of an ever-evolving mining market.

The need for mining is still there, and although alternative sources of energy are evolving, different industries still rely on raw material and precious metals to be extracted from remote places. This is to respond to customer needs and their constant requests for lighter, faster, more reliable and longer-lasting products (i.e., cars, phones, fiber optics, laptop computers, power sources).

A clear example of this trend was when a well-known EPC (engineering procurement and construction) company was retained by one of the largest global mining companies to perform a full range of engineering services on a massive-scale project located in Brazil. The project was an integrated system comprising open-pit mines, a beneficiation plant, a 500+ km slurry pipeline, a filtering plant and an export terminal at the Atlantic port of Açu.

At the time, the pipeline was the longest iron concentrate pipeline in the world, in addition to moving the most tonnage. The system now extends through difficult terrain throughout its length. The 24/26-in. diameter pipeline system was designed to transport more than 25 million tons per year of iron ore from an elevation above 700 meters, through many municipal districts and eventually to terminal facilities on the coast of Brazil.

As consumers request better, faster and lighter products, these requests trickle down to suppliers of such products' raw materials.

Suppliers of raw material in the mining industry will send out bids into the market for engineering houses (EPCs) to compete against each other on projects that sometimes seem unrealistic.

However, and this is something that drove me to the industry, engineering houses will get to work on new and inventive models to extract larger quantities of raw materials in the shortest amount of time so they can turn over the keys to their customer when the projects are done.

SOME OF THESE RAW MATERIALS THAT WE MAY TAKE FOR GRANTED IN OUR EVERYDAY LIVES CONSIST OF:

- Copper is used for many things because it is a great conductor of electricity. It is used in generators, motors and electronic goods. Copper conducts heat well; therefore it is also used in vehicle radiators, air conditioners and home heating systems. Its use in the plumbing industry is also well known for its antimicrobial properties and malleability.
- Iron ore is the source of primary iron for the world's iron and steel industries. It is essential to produce steel, which in turn is essential to maintain a strong industrial base and keep construction going globally.
- Bauxite, a naturally occurring ore containing variable amounts of hydrous, is used to make alumina. Alumina and bauxite are the two main raw materials in the aluminum-making process. Aluminum with its soft and malleable properties, will go on to become cans, foils, utensils, window frames and airplane/car parts.
- Lithium, which between 2008 and 2018 saw a drastic increase from 25,400 to 85,000 tons in annual production in the major producing countries. It's used for batteries for electric vehicles, laptops and cell phones. Some lithium, in the form of lithium carbonate or lithium citrate, is used as medicine to treat the inflammation of joints and to treat serious mental illness.

This latest explosion in lithium production didn't just happen; the major producers of it (JGL Co. Ltd, Albemarle, Tianqi, SQM, and Pilbara, amongst others) had to go out and ramp up their output to satisfy consumers' thirst for the newest phone and electric vehicles and other similar products requiring lithium batteries.

And although the pandemic has slowed down or delayed some of the newer, larger mining projects throughout the world, we are still in the middle of the race to come up with better, more complex ways to extract the minerals and transport them at higher pressures, with larger pipelines, over longer distances.

Danilo Garcia is the president of RF Valves Inc. and oversees all operations of the company. He focuses on business development and sales growth in the mining/industrial/municipal sectors and travels the United States and internationally to secure business and support major projects. Garcia has more than 20 years of experience in the valve industry and has been at the helm of RF Valves for the past eight years.

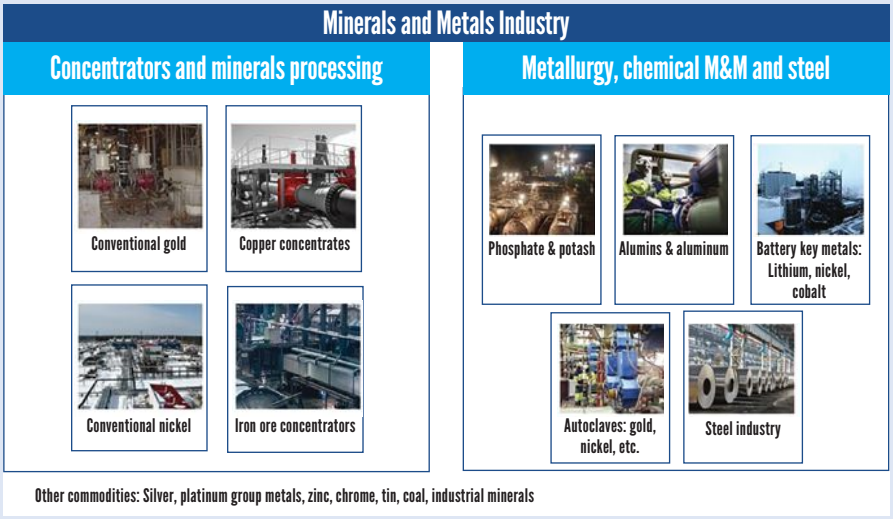


Figure 1. One way to describe the minerals and metals industry.

upwards. As ore grades are getting lower, concentrators must process more ore to achieve the same output levels of concentrate. In addition, ore chemistries are getting more complex, resulting in more advanced flow sheets, intensifying the need for high-quality flow control.

Examining the metallurgy, chemical minerals and metals and steel industries, while the reasons for a positive outlook are more diverse, one of the key trends is the global energy transition to greener alternatives. Electric vehicles, and the battery industry in general, are gaining further momentum and require metals such as copper, lithium, nickel and cobalt.

KEY THEMES IN MINERALS AND METALS AND HOW VALVES FIT IN

Making customers successful is only possible when flow control providers understand their world, so logically customers' priorities also become the supplier's priorities. Some of the most discussed themes in minerals and metals industry today are sustainability and asset optimization.

SUSTAINABILITY

The minerals and metals industry processes significant amounts of raw materials to create the various end products. Consequently, it needs heavy process equipment in large quantities, making this industry asset-heavy and energy-intensive. In turn, this means considerable usage of the world's resources. Conversely, it also puts the minerals and metals industry into a position to make a difference in achieving the world's sustainability targets. What may seem like small improvements in raw material usage or process equipment efficiency gains, can have a big positive impact to sustainability. Valves are part of this equation.

Fugitive emissions can be minimized with the right valve technology having safety and sustainability implications. In addition, a reputable flow control supplier makes sure its products are manufactured with sustainability targets set to the core of its operations. And a modern customer makes sure its supplier's sustainability agenda is not just words, but reality backed up by data, KPIs and best practices.

A rooftop bird's eye view of the Terrafame metals production plant in northern Finland. *Photo credit: Courtesy of Neles*

Another key topic, under the sustainability umbrella, that minerals and metals companies focus on is process water. Producing metals requires large amounts of process water, a topic of great interest to the general public in many regions of the world. As minerals and metals industry finds ways to lower water consumption and improve water recycling, an important aspect is to make sure related flow control equipment performs at the highest possible level. In some regions of the world, sea water is desalinated into process water, another key area in which valve professionals can help with their knowledge and expertise.

When selecting valves for the plant's process-critical applications, customers are increasingly interested the lifetime of the valves, the reliability of their valve assets and which technical features assure uncompromised safety. Products' reliability and lifetime affect sustainability but also have other, more practical and economic implications.

ASSET MANAGEMENT AND TOTAL COST OF OWNERSHIP

The most process-critical valves show the importance of asset management. A good example is the autoclave operation.

Autoclaves are used with various commodities, most notably gold and nickel. Autoclaves are large pressure vessels, operating under high pressures, elevated temperatures and often acidic environments. The slurry flowing in the pipelines is typically erosive in nature. When selecting valves for these applications, the valve vendor and the autoclave operator together must take all of this into consideration.

Figure 2 shows autoclave critical applications and suitable offerings. To successfully equip and service the severe service flow control products around the autoclave, tag-level application expertise and a matching portfolio is required.

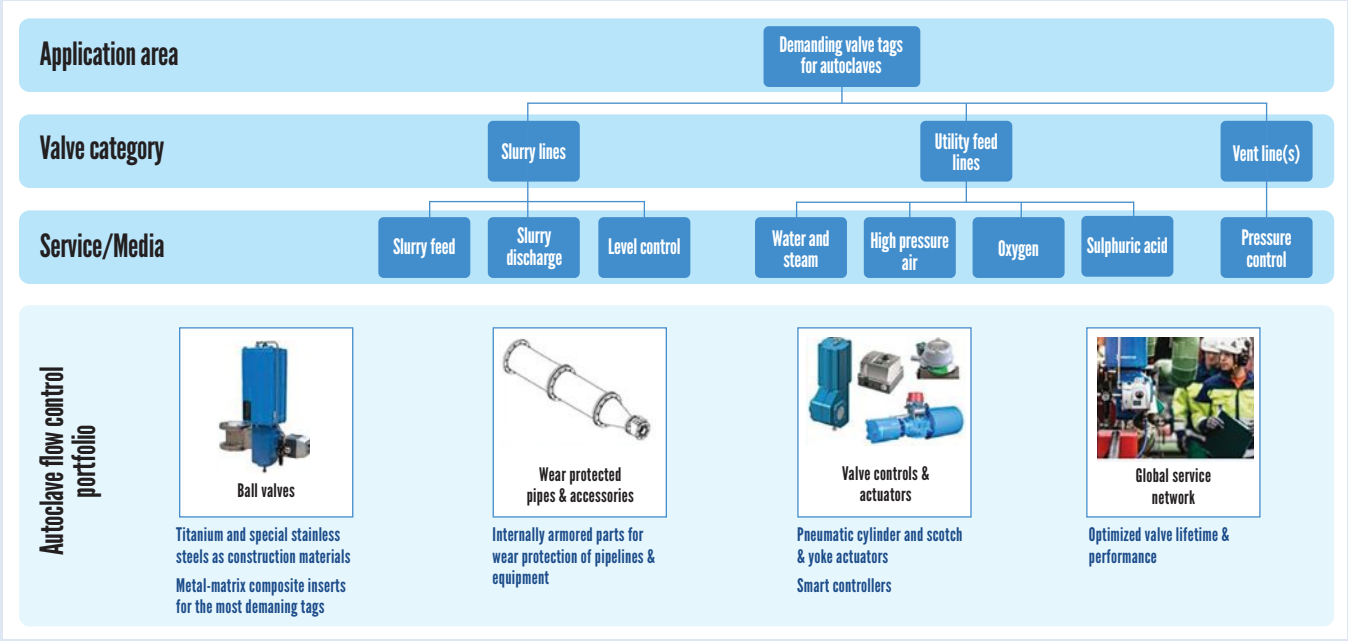


Figure 2. Autoclave Applications and portfolio

From the asset owner's perspective, two main variables should be carefully considered when selecting process-critical valves for autoclaves: materials and construction. When it comes to material selection, titanium is the industry standard for the body material of the most critical valves around autoclaves.

The trim and seat selection is an even more interesting topic: Modern manufacturing methods combined with advanced material science and metal-ceramic composite materials have been proven successful in autoclave severe service tags. The target for such metal matrix composite (MMC) material is to combine the best properties of both constituents, the metal and ceramics, into one solution. The metal alloy provides the required toughness, while the embedded ceramic particles ensure high wear resistance.

Another key element that process operators find valuable in MMC materials is that such composite materials do not require any coatings or hard-facing for the trim and seat. By removing a risk (i.e., coating failure) from the equation, autoclave operators can achieve additional performance improvement.

As to construction considerations, reliability and robustness often correlate with each other. Valve seat design is one source of complexity worth considering.

When these aspects are thoroughly considered, it has a direct positive impact on the products' total cost of ownership (Figure 3).

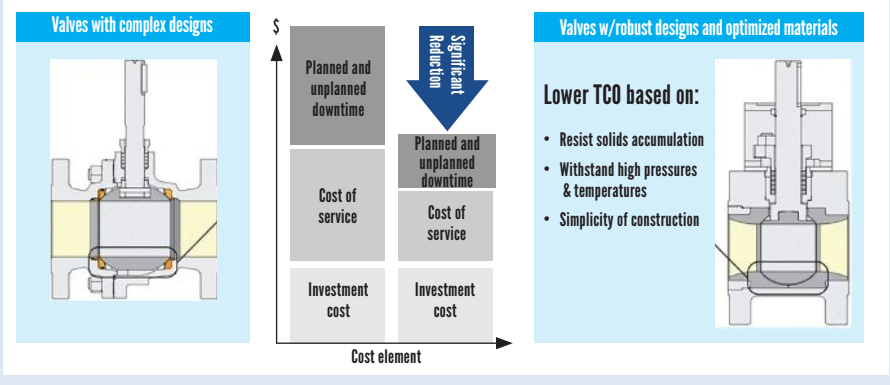


Figure 3. Detailed considerations are a must to optimize the Total Cost of Ownership.

While tangible technology advancements in valve products are the traditional source of innovation, digitalization plays an increasingly important part in the flow control industry. Valves equipped with smart controllers are digital-ready. Gathering flow data, analyzing it and providing the results for the asset owners' benefit is business as usual. Whether the outcome is seen in increased performance, safer operation or for instance in a capability to better manage inventories, customers will find that the value is linked to lowering the total cost of ownership of its valve assets.

Mining faces an interesting and complex future of achieving its ends, especially given the world's efforts toward decarbonization. With innovation and digitalization, greater efficiencies and productivity are possible while not sacrificing the necessary rigor and reliability that the minerals and metals industry demands. VM

Heikki Kärki, industry manager at Neles Corporation, has 10 years of experience with industrial equipment companies, five years in the valve industry. He works primarily together with sales, product management and technology development to strengthen Neles' position in the minerals and metals industry. In a global setting, Kärki draws from his international experience accumulated by living and working in Finland, China, and the United States.

Harnessing the Hidden Power of Data to Drive Operational Certainty

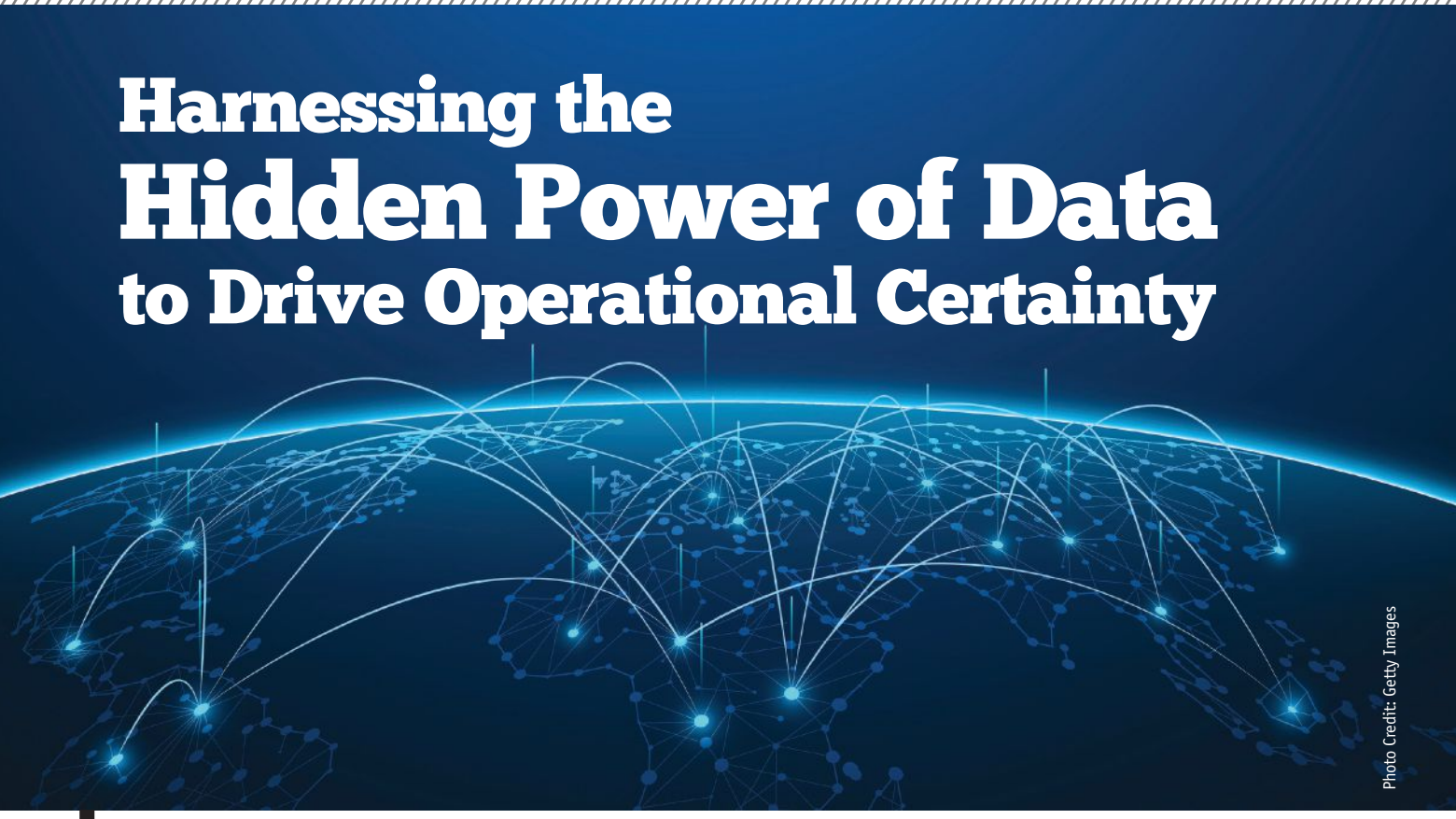


Photo Credit: Getty Images

Data is quite possibly the largest untapped resource that exists in our world today. The problem is not a scarcity of raw data, but rather a vast gap between raw data and the people, processes and tools required to turn the information into actionable insights that can enable data-driven operational certainty.

BY NATHAN BRUNELL

In 2020, the world learned how to adapt to times of instability as COVID-19 changed the availability of nearly everything. Many of us rushed to stock up on everyday necessities like food, while some fought over rolls of toilet paper and hand sanitizer in grocery store aisles. A few were fortunate enough to align timely trips to the local wholesale store so they could sit back without worry knowing that a bulk 90-pack of toilet paper sat safely in their home inventory for future use. Regardless of our situations, we each learned to prepare ourselves under new circumstances to avoid the undesirable shortages caused by limited supply.

Since this time, the world has learned to adapt to COVID. Many have returned to work and grocery stores have been largely restocked. However, shortages of labor and raw materials continue to play a critical role in our lives and personal supply chains. Cargo ships are queued up outside shipyards waiting to unload, suppliers have shortages of raw materials and workers to fulfill orders, and the electronics industry is rattled with what appears to be a multiyear shortage of electronic circuit boards. End-user operators today must diligently prepare themselves ahead of time to avoid key shortages that could put their plant operations in jeopardy.

DATA-DRIVEN OPERATIONAL CERTAINTY

While we have learned to adapt to uncertainty in our personal lives, we are largely stuck in the stone ages when it comes to managing the operational certainty of our industrial assets. We often don't have the ability to control challenges that may come our way, but we do have the ability, as well as the obligation, to anticipate and plan for them. One single poorly calibrated control valve or failing pressure relief valve can have devastating downstream effects, including inefficient operations, fugitive emissions, unplanned downtime, or even a safety incident putting at risk our most critical assets, our people.

The effects of these problems often manifest themselves in visible ways such as long lead times for spare parts, costly expedite and air-freight fees, and countless overtime hours that drain employees. However, the solution to driving certainty through these challenges is an invisible one. That solution is data.

Data is quite possibly the largest untapped resource that exists in our world today. The problem is not a scarcity of raw data, but rather a vast gap between raw data and the people, processes and tools required to turn the information into actionable insights that can enable data-driven operational certainty. As with any challenge, we start with defining the challenge itself.

TWO TRADITIONAL APPROACHES

The unpredictability of valve degradation and failure coupled with supply

chain disruption leads to unplanned downtime, extended turnarounds, costly expedite fees and ultimately a cloud of uncertainty around the entire operation. There are two typical approaches to addressing these challenges, both of which introduce waste, risk and excessive cost into the process.

The first is to react to challenges as they arise. When a valve is pulled for service, it is opened only to "unexpectedly" discover a set of spare parts is required to repair the valve before reinstallation. This reactionary approach throws supply chains into chaos as the unanticipated demand rockets from the end user, through the valve service provider, through the valve OEM and ultimately to the raw material supplier. Countless email exchanges and emergency phone calls are required to drive coordination across these four separate entities, ultimately ending in soaring expedite fees, transportation premiums and extended downtime. In an economic environment that is already struggling to keep up with regular demand due to worker shortages and supply chain disruptions, this approach only makes a big problem much bigger.

The second traditional approach is to perform inventory planning purely based on historical consumption. This approach assumes that future demand will exactly mirror historical demand. It's like driving your car while only staring at the rearview mirror. While even betting aggressively with this approach somewhat reduces the amount of unexpected expedites by guessing at required spare parts, it will never come close to eliminating uncertainty, because we know that historical demand often does not reflect what the future holds. In addition, this approach ties up valuable cash in wasted spare parts inventory that was projected to be needed that ultimately was not required. While this approach is better than nothing, it still leaves an operation left to run with a high level of uncertainty and inefficiency.

A MODERN APPROACH TO AN OLD PROBLEM

It's time to take a different approach by leveraging the power of data to intelligently forecast and predict the future and respond accordingly. The foundation for planning, and valve lifecycle management, starts with making data-driven supply chain decisions by using a valve asset management software. This is a software solution that tracks, centralizes and stores critical data points about an asset throughout its lifecycle, including repair history, service intervals, critical dimension measurements, visual inspection data and other relevant data. By tracking this data throughout the lifecycle of a valve, we can recognize patterns and trends that indicate which failure modes are likely to occur in a valve and when they are likely to occur.

For example, by tracking and trending the critical dimension of a disc in a pressure relief valve, we can determine approximately how many more months it may take for that disc to fall out of tolerance of the manufacturer's specification and proactively respond by purchasing a spare disc to be ready for the next outage. Or, by measuring friction over time, we can see the wear against a control valve stem that will shortly lead to excessive fugitive emissions.

Once we establish a foundation for data analytics with asset management software, we can layer on advanced analytics by implementing a condition-based monitoring (CBM) solution. While asset management software allows for tracking and managing assets at periodic intervals, a CBM solution enables data to be collected from a valve while operating in real time.

The truth is that valves are constantly providing clues about their degradation while they are performing their regular duties, but unless we collect this real-time data and turn it into something actionable, these clues remain only as potential. With a CBM solution, operational data can be collected and analyzed, and potential failure modes can be identified in real time.

By synchronizing this information back to our asset management software, we can immediately drive countermeasures to mitigate the identified potential

Photo Credit: Getty Images

valve failures. We can then predict which valves are going to fail, why they are going to fail, and what parts or product upgrades will be required to restore operational certainty and return the valve to its original and intended level of performance. And, most important, we can do all this well in advance of pulling the valve to perform service, which enables us to order and procure critical components early and avoid costly supply chain disruptions and premium transportation costs.

CONNECTING DATA-DRIVEN DECISIONS TO ADDITIVE MANUFACTURING TECHNOLOGY

Clearly, CBM and other advanced digital trend and prediction methods will reduce the risk of excessive downtime or inefficient operation, but there will always be situations where the unpredictable happens and sites are forced to advert operations and take immediate measures. While the concept of "digital inventory" is new to our industry, it is one that certainly has a future as a fail-safe method to prevent major events. Digital inventory is the ability to rapidly manufacture parts through additive manufacturing (i.e., 3D printing) without needing to hold low-usage parts on the shelf in inventory. Situations where customers find themselves without a critical component can literally be addressed with a single print cycle on-site or at a local 3D printer in the region.

Today, additive manufacturing is evolving at light speed. Printing capacity is emerging all over the world, and most locations have some access to a local or regional supplier. With advancements in reduction of time to qualify parts, expansion of qualified materials, and general experience levels of printing growth logarithmically, suppliers are now seeing the potential for digital inventory to become a wave of the future. Major additive manufacturers can now take the supplier constraint handcuffs off and move away from the limitations and reliance on a third party to supply materials. As suppliers push out lead times and cargo ships are backlogged to transport goods, manufacturers can take more control of their own destiny by printing trim parts and other non-pressure-containing products (code-controlled) using in-house means. Current supply chain challenges will likely continue in the coming year, but innovations are exceeding this pace and those who invest in technology will lead the way and eliminate the constraints so they can support the end user.

Our world of process control and pressure management is quickly transforming through digital advancements: predictive algorithms of CBM software, feeding asset management tools to trend urgency of need and direct output of print-on-demand parts. An amazing transformation of supply chain risk mitigation, inventory optimization and overall process and plant optimization will surely yield a direct bottom line impact to all users who are proactive enough to adapt and make critical investments. VM

Nathan Brunell is the executive leader of marketing for the Baker Hughes Valves business, with 25 years in the valve industry as a product and marketing leader.

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Understanding Torque for Quarter-Turn Valves

BY STEVE DALTON & JOHN HALSTROM

Trunnion mounted ball valve operated by a single acting spring return actuator.

Valve manufacturers publish torques for their products so that actuation and mounting hardware can be properly selected. However, published torque values often represent only the seating or unseating torque for a valve at its rated pressure. While these are important values for reference, published valve torques do not account for actual installation and operating characteristics. In order to determine the actual operating torque for valves, it is necessary to understand the parameters of the piping systems into which they are installed. Factors such as installation orientation, direction of flow and fluid velocity of the media all impact the actual operating torque of valves.

The American Water Works Association (AWWA) publishes detailed information on calculating operating torques for quarter-turn valves. This information appears in AWWA Manual M49 *Quarter-Turn Valves: Head Loss, Torque, and Cavitation Analysis*. Originally published in 2001 with torque calculations for butterfly valves, AWWA M49 is currently in its third edition. In addition to information on butterfly valves, the current edition also includes operating torque calculations for other quarter-turn valves including plug valves and ball valves. Overall, this manual identifies 10 components of torque that can contribute to a quarter-turn valve's operating torque.

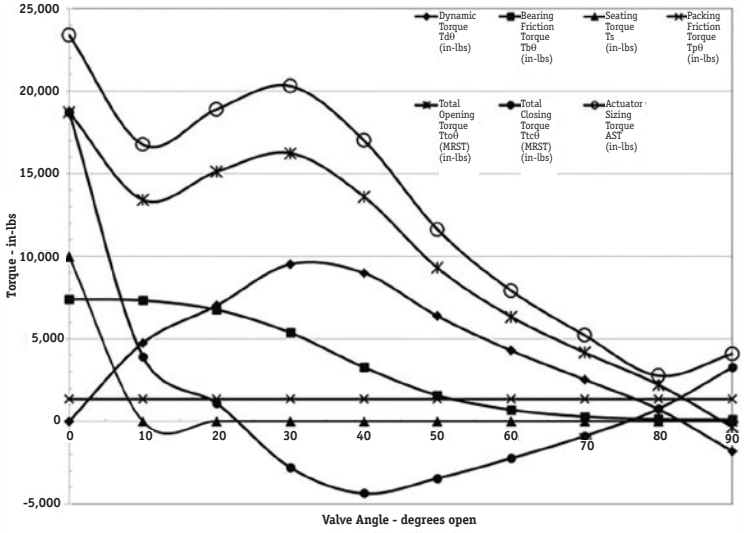
AWWA QUARTER-TURN VALVE HISTORY

The first AWWA quarter-turn valve standard for 3-in. through 72-in. butterfly valves, C504, was published in 1958 with 25, 50 and 125 psi pressure classes. In 1966 the 50 and 125 psi pressure classes were increased to 75 and 150 psi. The 250 psi pressure class was added in 2000. The 78-in. and larger butterfly valve standard, C516, was first published in 2010 with 25, 50, 75 and 150 psi pressure classes with the 250 psi class added in 2014. The high-performance butterfly valve standard was published in 2018 and includes 275 and 500 psi pressure classes as well as pushing the fluid flow velocities above class B (16 feet per second) to class C (24 feet per second) and class D (35 feet per second).

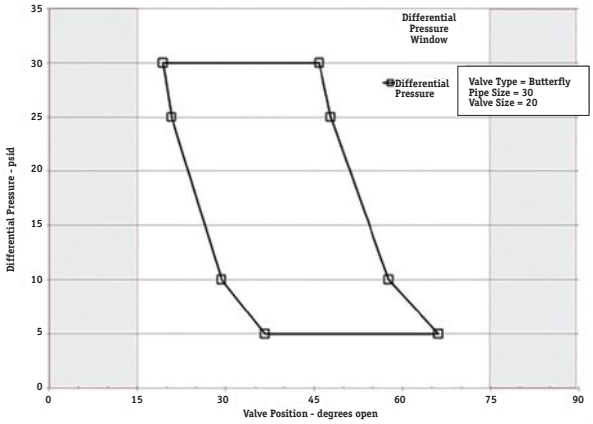
The first AWWA quarter-turn ball valve standard, C507, for 6-in. through 48-in. ball valves in 150, 250 and 300 psi pressure classes was published in 1973. In 2011, size range was increased to 6-in. through 60-in. These valves have always been designed for 35 ft per second (fps) maximum fluid velocity. The velocity designation of "D" was added in 2018.

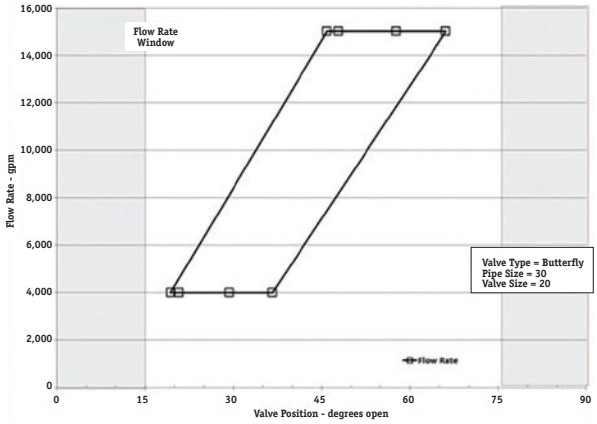
Although the Manufacturers Standardization Society (MSS) first issued a product standard for resilient-seated cast-iron eccentric plug valves in 1991, the first AWWA quarter-turn valve standard, C517, was not published until 2005. The 2005 size range was 3 in. through 72 in. with a 175 pressure class for 3-in. through 12-in. sizes and 150 psi for the 14-in. through 72-in. The later editions (2009 and 2016) have not increased the valve sizes or pressure classes. The addition of the A velocity designation (8 fps) was added in the 2017 edition. This valve is primarily used in wastewater service where pressures and fluid velocities are maintained at lower values.

The need for a rotary cone valve was recognized in 2018 and the AWWA *Rotary Cone Valves, 6 Inch Through 60 Inch*



Example torque calculation summary graph





Example butterfly valve differential pressure (left) and flow rate control windows (right)

(150 mm through 1,500 mm), C522, is under development. This standard will encompass the same 150, 250 and 300 psi pressure classes and the same fluid velocity designation of "D" (maximum 35 feet per second) as the current C507 ball valve standard.

In general, all the valve sizes, flow rates and pressures have increased since the AWWA standard's inception.

COMPONENTS OF OPERATING TORQUE

AWWA Manual M49 identifies 10 components that affect operating torque for quarter-turn valves. These components fall into two general categories: (1) passive or friction-based components, and (2) active or dynamically generated components. Because valve manufacturers cannot know the actual piping system parameters when publishing torque values, published torques are generally limited to the five components of passive or friction-based components. These include:

Passive torque components:

- Seating friction torque
- Packing friction torque
- Hub seal friction torque
- Bearing friction torque
- Thrust bearing friction torque

The other five components are impacted by system parameters such as valve orientation, media and flow velocity. The components that make up active torque include:

Active torque components:

- Disc weight and center of gravity torque
- Disc buoyancy torque
- Eccentricity torque
- Fluid dynamic torque
- Hydrostatic unbalance torque

When considering all these various active torque components, it is possible for the actual operating torque to exceed the valve manufacturer's published torque values.

WHY IS M49 MORE IMPORTANT TODAY?

Although quarter-turn valves have been used in the waterworks industry for a century, they are being exposed to higher service pressure and flow rate service conditions. Since the quarter-turn valve's closure member is always located in the flowing fluid, these greater service conditions directly impact the valve. Operation of these valves requires an actuator to rotate and/or hold the closure member within the valve's body as it reacts to all the fluid pressures and fluid flow dynamic conditions.

In addition to the increased service conditions, the valve sizes are also increasing. The dynamic conditions of the flowing fluid have greater effect on the larger valve sizes. Therefore, the fluid dynamic effects become more important than static differential pressure and friction loads. Valves can be leak and hydrostatically shell tested during fabrication. However, the full fluid flow conditions cannot be replicated before site installation.

Because of the trend for increased valve sizes and increased operating conditions, it is increasingly important for the system designer, operator and owner of quarter-turn valves to better understand the impact of system and fluid dynamics have on valve selection, construction and use.

The AWWA Manual of Standard Practice M 49 is dedicated to the understanding of quarter-turn valves, including operating torque requirements, differential pressure, flow conditions, throttling, cavitation and system installation differences that directly influence the operation and successful use of quarter-turn valves in waterworks systems.

AWWA MANUAL OF STANDARD PRACTICE M49 4TH EDITION DEVELOPMENTS

The fourth edition of M49 is being developed to include the changes in the quarter-turn valve product standards and installed system interactions. A new chapter will be devoted to methods of control valve sizing for fluid flow, pressure control and throttling in waterworks service. This methodology includes explanations on the use of pressure, flow rate and cavitation graphical windows to provide the user a thorough picture of valve performance over a range of anticipated system operating conditions. VM

Steve Dalton began his career as a consulting engineer in the waterworks industry in Chicago. He joined Val-Matic in 2011 and was appointed as president after being director of engineering. He has participated in standards-developing with AWWA, MSS, ASSE and API. He holds BS and MS degrees in Civil and Environmental Engineering along with PE registration.

John Halstrom has been involved in quarter-turn valve and actuator engineering and design, and also an active member of ASME and AWWA, for more than 50 years. He's also worked with the EPRI for the nuclear power industry.

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PFAS Chemicals and PTFE: Should the Valve Industry Be Concerned?

BY GREG JOHNSON

Legislation moving through Congress could affect the future use of thousands of PFAS chemicals (per- and polyfluoroalkyl). The house passed H.R. 2467 in July of 2021 and, though the bill is general in nature, it assigns the responsibility to the Environmental Protection Agency (EPA) for determining which PFAS chemicals will be controlled or banned altogether. While the bill has not yet passed the senate, similar legislation has already become law in eight states. It is state legislation that is most concerning to both the valve and sealing industry, since states usually do not have the resources to perform deep research into the issue and tend to revert to a shotgun approach.

Of concern to our industry is that *all* PFAS chemicals, of which there are more than 4,500, will be lumped together along with a valve industry mainstay, polytetrafluorethylene (PTFE). If this occurs, the valve industry would have to find an effective replacement for most floating ball valve seats, many gaskets and seals, as well as components that make fugitive emissions packings effective.

PTFE is used to manufacture packings for demanding corrosive services as well as ultrapure applications such as food preparation.

VALVE INDUSTRY PRODUCTS THAT USE PTFE

As a refresher, here are the primary areas where PTFE is a key ingredient in the product mix of the valve industry:

- **Ball valve seats.** Without the introduction of PTFE resilient ball valve seats in the late 1950s, the floating ball valve industry would not be the giant that it is today. These highly chemical-resistant ball valve seats assure zero or near-zero leakage in many applications in some of the most dangerous and volatile services in industry.
- **Liners for valves and piping.** These thin liners applied over otherwise corrosion-susceptible steels and piping allow the components to operate in extremely harsh service environments.
- **Packing materials**. PTFE packings have been a material of choice for decades, serving as excellent seals for a variety of service applications, including food-grade applications.
- **Gaskets and seals.** Like the PTFE packing materials, PTFE gaskets and seals fill a vital role as sealing materials for many valve types and service applications.
- **Lubricant for low-emissions packings.** Today's sealing technology relies on PTFE as an integral ingredient in low-emissions packings. Without their critically important PTFE binders and lubricants, low-emissions packings' ability to protect the environment from dangerous volatile organic compounds (VOCs) would be seriously hindered.

The ball valve industry relies heavily on PTFE seated ball valves for many applications in a multitude of industries. Replacing PTFE in all ball valves would be a difficult proposition.

PFAS PROBLEMS ARE CAUSE FOR CONCERN

There is a genuine problem with some PFAS chemicals that are primarily used in commercial applications. Harmful, cancer-causing PFAS chemicals and compounds have been found in such innocent items as stain and water-resistant products, non-stick cookware coatings and fire-fighting foam. Dangerous polytetrafluoroethylene (PFOA) and perfluoro octane sulfonic acid (PFOS) chemicals have been the primary culprit in these issues. The leachability of some of these chemicals into the water table has also been

Some valves are lined with PTFE to make their wetted areas resistant to harmful corrosion-causing fluids.

well documented.

It is important to note that *the major U.S. manufacturers of PTFE products for the industrial sector do not use either PFOA or PFOS in their PTFE manufacturing processes* and have not done so since 2002. According to Fluid Sealing Association (FSA) president, Thom Jessup (EGC Enterprises), "If made by a reliable source, today, PTFE does not contain PFOAs or other dangerous chemicals."

STANDARDS AND TESTING

One issue that is slowing an organized approach to control of PFAS chemicals in solid valve components and sealing materials is the lack of a standard for determining their level of concentration in products. Some FSA and European Sealing Association (ESA) member companies are working on a testing protocol to determine if any of the dangerous substances are present in their products. Since the issue first surfaced in the late 20th century, the measurement process for determining the percentage of PFAS present has gone from parts per million (ppm) years ago to parts per trillion (ppt) today, meaning that acceptance criteria for a proposed standard written today would be much more precise.

Many FSA members have been testing for harmful PFAS chemicals in their products for more than a decade. Hopefully, cooperative work will begin on creating a standardized test for confirming that the PTFE components like those used in the valve and sealing industries are indeed safe for their intended use. Such a standard would also give guidance to PTFE producers in developing countries, where lowest cost sometimes trumps quality assurance and health and safety-first manufacturing techniques. The EPA has proposed, but not yet implemented, regulations for imported products that contain PFOS.

"Throwing a blanket over all PFAS chemicals and the products made from them is wrong," says Ron Frisard (A.W. Chesterton), who serves as chair of FSA's Gasket Division. "What is needed is a commonsense approach to the problem." The phrase echoed throughout the COVID-19 epidemic has been "follow the science". Hopefully, those in charge of creating the rules and regulations concerning the PFAS issue will follow the science as well, and not just respond with a quick, emotional solution. VM

Fugitive emissions packings laced with PTFE lubricants have helped industry reduce hazardous emissions that have brought back blue skies to many industrial sites all over the world.

THE FLUID SEALING ASSOCIATION

The Fluid Sealing Association (FSA) is an international trade organization founded in 1933. Member companies produce and market a wide range of fluid sealing devices and products targeted to the industrial market. The FSA is always looking for new members. To learn more about the association or to help in the information effort over PFAS literacy, visit the FSA website at **www.fluidsealing.com**.

Greg Johnson is president of United Valve. He is a contributing editor to VALVE Magazine and a current Valve Repair Council board member. He also serves as chairman of the VALVE Magazine Advisory Board, is a founding member of the VMA Education and Training Committee and is past president of the Manufacturers Standardization Society. Reach him at greg1950@unitedvalve.com.

Dealing with Sand Erosion in Control and Choke Valves

BY ADRIAN CROFT

Sand erosion in control and choke valves is a significant consideration offshore. Sand can cause erosion to both the valve trim and the pressure envelope. Nothing can withstand sand erosion, but thoughtful valve and trim selection can increase the valve's life and trim and maximize the time between maintenance intervals.

Although sand can occur in a number of systems offshore, most of the issues surrounding sand erosion can be expected around the wellhead or the separator system.

A modulating control or choke valve manages the pressure drop by controlling the area through the trim. The closer the plug is to the seat, the more the trim area is restricted and, therefore, the higher the velocity of the fluid across the trim. Ultimately, the higher the velocity of the fluid with sand present, the quicker the erosion. When sand is present, the slower, the better.

The velocity of a fluid through a valve can simply be reduced by maximizing the flow passages. Larger-sized valves with large bores are often preferred but are more expensive. The pressure drop and the fluid velocity should be jointly considered to select the most appropriate valve size.

Example of sand collection on the underside of a valve bonnet.

BODY STYLES

Where sand is present, the optimum valve body style is an angle valve as it will pass the solids into the downstream pipe with minimum impingement onto the body walls.

In some cases, it is not possible to use an angle valve, and globe valves are specified. The flow should always be over the valve plug when using a globe valve. This will eliminate direct impingement onto the body wall. Additional protection can be provided by a seat diffuser, which prevents direct impingement of the fluid onto the bottom of the globe once pressure reduction has taken place across the trim.

TRIM DESIGN

Single-stage cage designs are ideal for contaminated duties. First of all, they are low-pressure recovery designs, and secondly, they have a simplified flow path.

The fluid passes from outside to in, meaning that the fluid jets impinge together in the center of the cage, ultimately ensuring that energy is reduced with minimum contact to metallic surfaces.

Where possible, multi-stage trims with 90-degree turns should be avoided in contaminated duties as sand is likely to become trapped in a 90-degree bend. Depending on the quantity of the sand, the valve can quickly become blocked.

Where a multi-stage trim is required, severe service valves are often specified. Care should be taken when selecting these trims because most designs rely on the process being turned around 90-degree bends. Care should be taken to select a multi-stage trim specifically designed to handle solids, which will allow debris, such as sand, to pass through the trim without blockage. Trims designed where the entry flow path is larger than the outlet flow path should be discouraged as they are likely to block up. Instead, trims that feature the smallest openings at the fluid entrance should be used.

TUNGSTEN CARBIDE

As discussed, sand causes erosion by impingement on material surfaces. Therefore, it follows that if the material surfaces are harder, then the rate of erosion will be reduced. Tungsten carbide is generally used in this situation due to its relative hardness. Solid tungsten carbide inserts are shrunk into the cage, plug and seat in the areas with the maximum potential for erosion. Solid tungsten carbide can be used but could be subject to cracking due to compressive loads in the valve.

In some cases, ceramic materials can

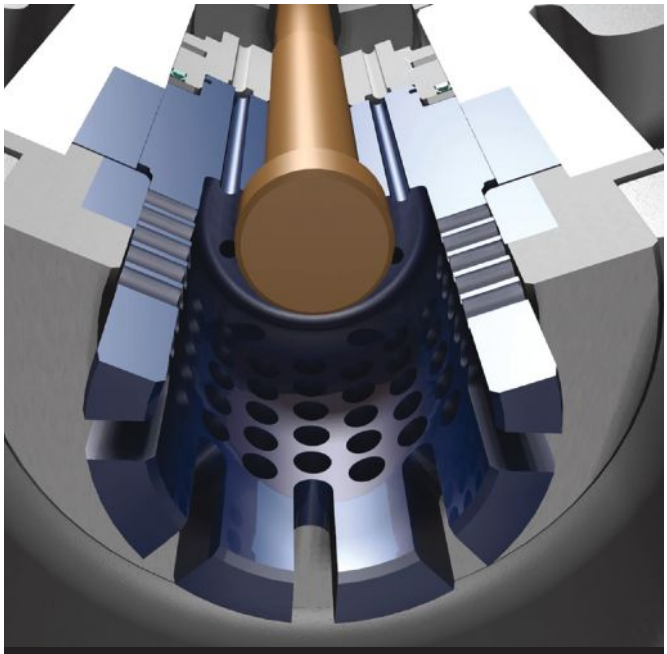
be used, but most specifications call for tungsten carbide in the oil and gas industry.

The one significant disadvantage with tungsten carbide is that it is very brittle. Imagine it like a tile in a bathroom, very resistant to wear, but if dropped, it would shatter. There is, therefore, an advantage in holding the carbide in a steel housing. In the cage, the steel outer cage also acts as a "brick stopper," so if there is any large debris in the pipe, the steel cage will protect against impact damage.

Tungsten carbide must be carefully designed to prevent stress points that can ultimately lead to stress cracking and failure of the carbide section.

When using tungsten carbide, cavitation must be eliminated. Cavitation eats away at the binder holding the carbide particles together. It also generates shock cells and can lead to vibration. Due to the carbide being so brittle, cavitation can lead to catastrophic component failure.

Severe service trims, primarily based on disc stack technology, can be manufactured in solid tungsten carbide. However, some design considerations have to be taken into account; for example, the discs need to be approximately six to 10 mm thick. This is due to the properties of the carbide in the manufacturing process. If the discs were thinner, they would be likely to crack. In the majority of cases, a tungsten carbide disc stack would have to be unitized (glued) together for additional strength.

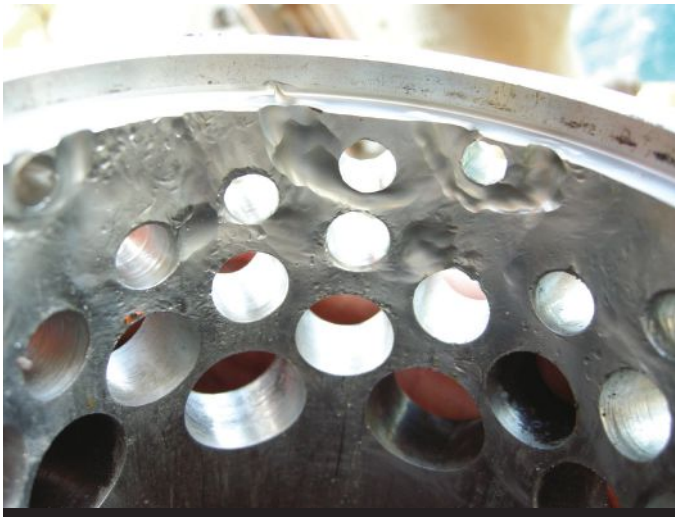


☐ Typical choke valve with a tungsten carbide trim.

PROTECTED SEAT

Conventional valve trims have an angled seating point so that when the valve is seated, the plug and seat are in contact. On contaminated duties, fluid impingement can lead to erosion of the seating face and leakage across the trim. To minimize direct fluid impingement, a protected seat can be applied. The protected seat has a lip around the valve plug. This means that the fluid does not directly impinge on the seating surface.

Additionally, the protected seat also ensures that there is a deadband so that when the plug lifts, the valve has to open further out of the seat pocket to expose the first set of holes in the cage. This additional lift means there is a reduction in velocity across the seating face.



☐ Sand erosion across a metallic cage.

SAND EROSION PREDICTION

Sand erosion and particle tracking are possible using modern Computational Fluid Dynamics (CFD) techniques. These can be used to simulate the flow patterns in the valve and then track the sand particles through the flow domain.

Prediction of Sand Erosion in Process and Pipe Components by Det Norske Veritas, Proc. 1st North American Conference on Multiphase Technology, Banff, Canada 1998, gives an equation for the erosion rate in a given small sub-area, found by the summation over all particles that hit within that defined area. This methodology can be used to predict the life of trim components. For example, a customer was concerned about the safety condition of a valve during a gas blowby case and wanted a flow limiter installed in the valve. The flow limiter's erosion rate was then calculated to determine service intervals.

There are many challenges offshore, but controlling sand and particulate erosion ensures the longevity of components and ultimately means costly interventions are reduced to a minimum, ensuring maximum oil and gas production. VM

Adrian Croft has worked in the control valve industry for more than 44 years. He has had roles in control valve engineering design, parametric design programming, applications engineering and smart instrumentation technology. Adrian's current role of control valve product manager for Trillium Flow Technologies has a wide-ranging scope and often leads to front line involvement in process industries, including power, oil and gas, LNG and petrochemicals. VM

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Curtiss-Wright has released its newest motor and actuator with integral controls, the Exlar SA-R080 rotary and SA-L080 linear actuator. The SA series of actuators offer force, precision, energy efficiency and control while minimizing the additional cabling, external servo controls and integration necessary with more traditional actuation solutions. The SA-L080 is capable of continuous force ratings up to 2,330 lb-ft (linear) and the SA-R080 is capable of torque up to 24.7 lb-in. (rotary).

Using 18-32VDC input voltage, the SA series actuators' compact form can be applied across a wide range of automation applications. In addition to integral controls, the SA series offers a corrosion-resistant and sealed housing, a stainless-steel output shaft and a wide operating temperature range, ensuring long life in rugged environments.

Emerson has introduced the first valve assemblies that meet the design process requirements of Safety Integrity Level (SIL) 3 per the International Electrotechnical Commission's IEC 61508 standard. These Fisher Digital Isolation final element solutions serve the needs of customers for shutdown valves in critical safety instrumented system (SIS) applications.

Engineering a safety shutdown valve is a complicated task. The normal and upset process conditions must be carefully evaluated and understood when choosing valve and actuator components. In addition, the proper combination of solenoids, brackets, couplings and other critical hardware must be specified and carefully matched to the selected valve. Each of these components must function individually and in concert to operate.

DeZURIK Inc. offers a knife gate valve with an innovative metal cutting design. Based on the company's successful KGC series knife gate valves, the new KGC-MC metal cutting cast stainless-steel knife gate valves are designed to provide long service life in applications requiring shearing capabilities such as those found in pulp and paper recycling and rejects cyclone applications. Wires, staples, glass or plastic are cleanly cut, crushed and cleared from the seating area.

The KGC-MC valve cuts through the media flow with no jamming problems. To withstand the high loads necessary to shear wires, staples or glass, the valves have a replaceable, serrated seat constructed of 410 stainless steel. The seat ring's teeth and teeth arrangement are designed to prevent bunching or clogging while cutting through heavy trash. These valves are available in 3-24" (80-600mm) sizes with one-piece cast stainless-steel bodies. The metal cutting valve features a high-performance packing system with wire scraper rings that extend service life.

Jordan Valve announced the release of a new product, the Mark 75A wafer style control valve. Featuring all the benefits of the time-tested sliding gate seat design in a lightweight, compact body, with the capability of handling higher pressure drops, the Mark 75A also incorporates a modular, stackable actuator to further reduce weight and footprint dimensions while providing additional thrust. Available in 1 in. through 6 in. (DN25–DN150") sizes, the Mark 75A is a high value solution suitable in a wide range of applications.

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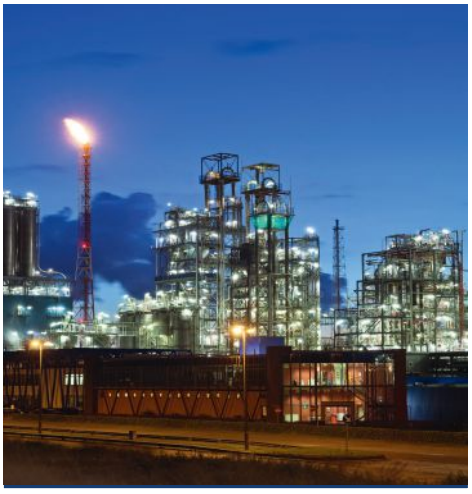

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