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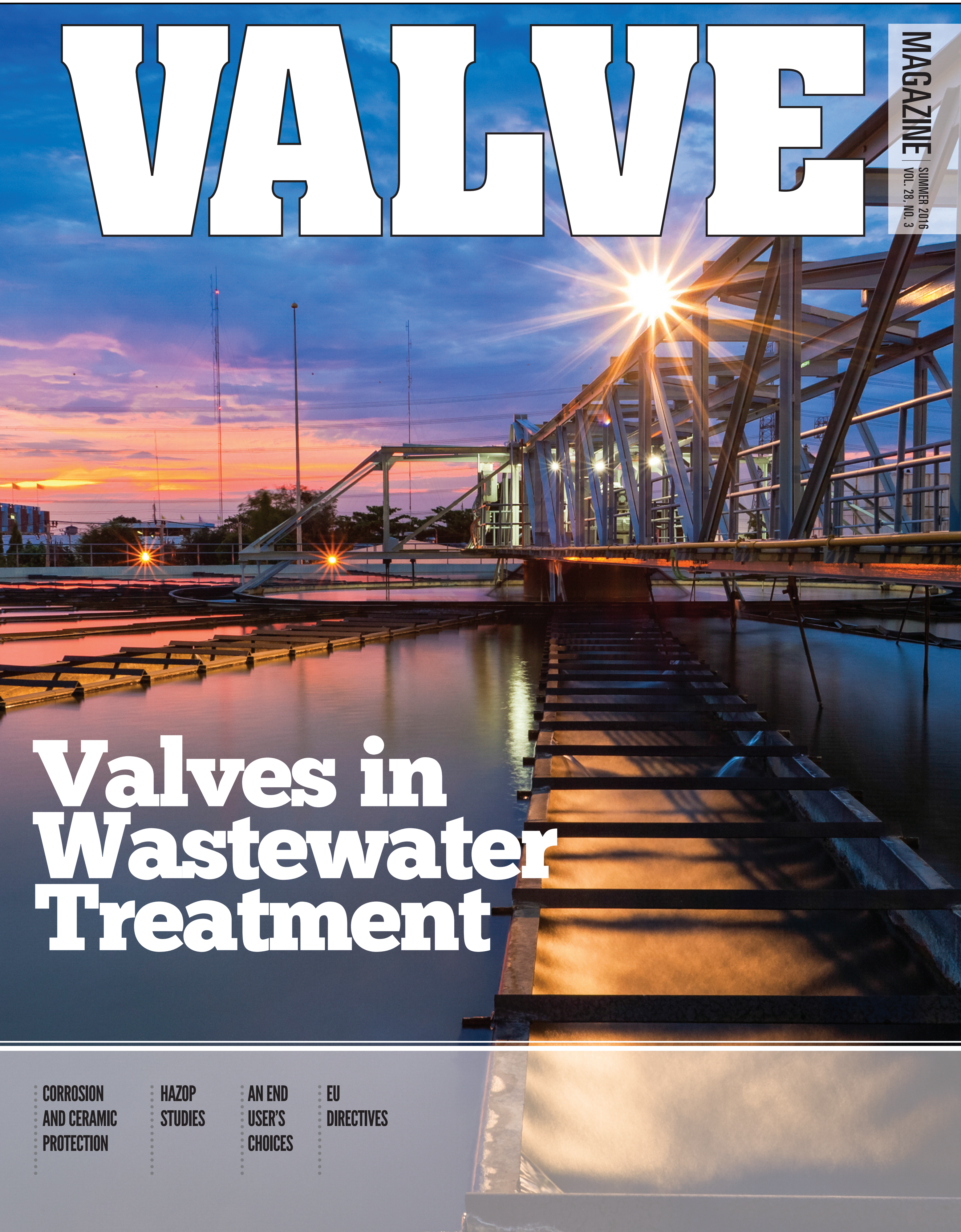
VALVE MAGAZINE

SUMMER 2016
VOL. 28, NO. 3



Valves in Wastewater Treatment

- CORROSION AND CERAMIC PROTECTION
- HAZOP STUDIES
- AN END USER'S CHOICES
- EU DIRECTIVES

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www.VALVEmagazine.com

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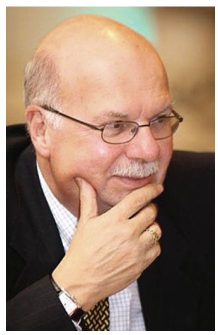
VALVE MANUFACTURERS ASSOCIATION OF AMERICA
The voice of the flow control industry

www.vma.org

Industrial Valve Issues Stretch Worldwide



I recently returned from my annual trip across the great pond of the Atlantic Ocean to be part of the European Congress of the Valves and Taps Industry (CEIR) in Lyon, France, May 18-20. Fifty-five representatives from 11 different European nations attended. What I found was that the only difference between this meeting and a VMA meeting in North America was the language; the concerns these representatives have about what's taking place in the industry and how we can all improve our businesses were quite similar. For example, the meeting featured presentations on:

- The industry slowdown
- The oil crisis
- Safe drinking water

All these topics and others that we discuss on this side of the ocean are really worldwide concerns.

Education is certainly as vital there as here. I shared with those in attendance the two new videos that are part of our VMA Careers Initiative. These films highlight the need to present manufacturing and specifically the industrial valve industry to high schoolers and technical school attendees so that they can see what a lucrative business this is. The videos received a long round of applause from our European colleagues. After my presentation, many attendees came up to me to voice their concerns with this need to develop and encourage the skills vital to our industry. If you have not yet seen these videos, please go to our website www.ValveCareers.com to view and share them with your colleagues.

A highlight of my trip this year was a visit to VMA member Velan Valve in Lyon, a truly special facility whose primary product is valves for the nuclear industry. They have an impressive operation that ships products all over the world.

The discussions about our mutual concerns will continue later this year as VMA collaborates with the British Valve and Actuator Association to share a booth at Valve World in Dusseldorf, Germany, Nov. 29-Dec. 1. That expo promises to present more valuable opportunities for finding out just how worldwide the industrial valve industry is. VM

Bill Sandler
President, Valve Manufacturers Association of America

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NEW CONTRACTS

Rotork Supplying Large Decarbonization Project

Rotork's pneumatic control systems will be part the biggest decarbonization project in Europe. The company is supplying equipment to Drax Group, the largest conventional power station in the UK, as part of the station's effort to convert to burning sustainable biomass instead of coal. The process means that station will transform from the UK's biggest emitter of CO_2 to Europe's largest decarbonization project.

A major part of the project is the introduction of new rail freight wagons, designed by Lloyd's Register Rail and capable of carrying over 70 tons of compressed wood pellets. More than 200 of these new wagons have been manufactured in the UK by WH Davis Ltd. and equipped with the Rotork systems.

MRC Global Expands Service to Chemours in Gulf Region

MRC Global Inc. announced that its subsidiary, MRC Global (US) Inc., will be the primary provider of pipes, valves and fittings (PVF) products and services to all U.S. locations of The Chemours Company. The five-year agreement added the Gulf Coast region and also includes valve automation and specialty piping products. The contract includes maintenance, repair and operation and capital projects.

Metso Enters Contract with Tata Chemicals

Metso has entered into a five-year, long-term strategic services partnership agreement with Tata Chemicals (Soda Ash) Partners to repair, rebuild and service existing pyro-processing equipment and systems in Tata's Green River, WY operation.

The contract covers rebuilding 19 existing pyro-processing units. The scope of the agreement calls for the seven calciners and 12 rotary dryers as well as several modernization and upgrade measures to improve safety, efficiency and operational flexibility at the Green River facility.

Bay Valve Service Expands into Hydro Market

Bay Valve Service LLC recently completed Phase I and began Phase II of a project in Washington state to repair valves and propose a system redesign and installation of a special plunger-style, energy dissipation valve.

The new, Phase II valve proposal calls for installation of a plunger-style energy dissipation valve from a major hydro service valve manufacturer.

NEW FACILITIES

Emerson Enters 3D Printing Collaboration

Emerson Process Management and Nanyang Technological University in Singapore announced a Research Collaboration Agreement under which they will create a new center for research and development on methods of using 3D printing for manufacturing industrial control valves.

The joint lab program is set to start Oct. 1, 2016 and continue for five years. The

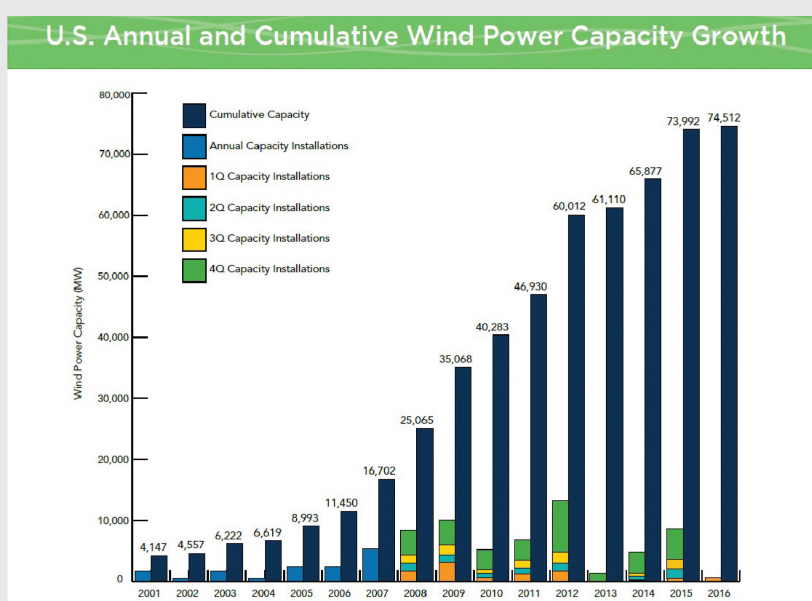
MARKET FOCUS: GROWTH IN WIND POWER

Wind power in the U.S. is continuing its rapid growth rate and nowhere is that more evident than in Texas, where 32 projects worth $14.2 billion will be pursued over the next two years, according to Industrial Information. Next up among states with the most planned projects is North Dakota (19 at $7.4 billion); Illinois (18 at $5.7 billion); Ohio (18 at $5.3 billion) and Arizona (4 at $3.9 billion).

The company says not all these projects will start as planned, but that 2016 and 2017 should be healthy years for project kickoffs partly because of the prorated federal production tax credit (PTC). That credit was extended late last year as part of the omnibus government spending bill signed by President Obama Dec. 18, 2015.

"There's certainly plenty of business for wind power developers, equipment manufacturers, labor groups and professional-services firms to pursue," said Britt Burt, Industrial Info's vice president of global research for the Power Industry.

The American Wind Energy Association said in May that "America's fastest growing new source of electricity" will supply 10% of U.S. electricity by 2020. The association gave credit to advances in technology and lower costs, as well as a mix of stable federal policy, forward-looking states and corporate and other non-utility buyers aiming to cut carbon footprint and pass savings on to users.

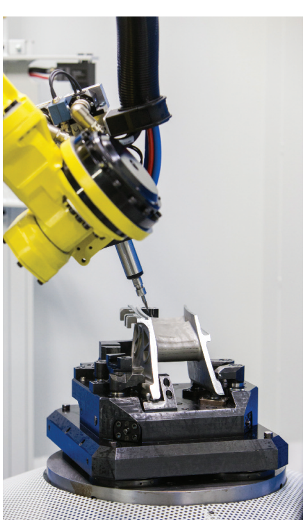


AWEA U.S. Wind Industry First Quarter 2016 Market Report research projects involve university postgraduate students and will commence in January 2017. The students expect to complete their Ph.D. research project by their fourth year.

GE Oil & Gas to Use Robotics, 3D Printing

May 26, 2016 marked the inauguration of two new, high-tech component production lines at the GE Oil & Gas plant in Talamona, Italy. A new nozzle production line is the first completely automated line for GE Oil & Gas, and a new additive manufacturing line will use laser technology to 3D-print end burners for gas turbine combustion chambers.

The official unveiling of the upgraded turbine and compressor components manufacturing facility is the result of an $11 million, two-year investment to establish the plant as one of the company's most cutting-edge production centers. The new production lines are already working and will be fully operational by the start of 2017.



GE plant robotics at work

A.W. Chesterton's new training and emissions testing facility

A.W. Chesterton Expands Training and Services Facility

A.W. Chesterton Company has expanded its facilities north of Boston with a new valve emissions testing facility, an expansive industrial training center and an industrial equipment service location to support its New England-based customers.

The New England Service Center expansion provides mechanical seals, pump and cylinder repairs as well as a wide variety of other capabilities focused on industrial equipment repair, upgrade and installation. The opening is part of the company's overall plan to provide regional servicing. A.W. Chesterton already operates centers in Louisiana and Houston.

Weir Opens New Safety Relief Valve Facility

Weir has opened a new facility to increase the global reach and competitiveness of Weir valves by establishing a manufacturing and assembly plant close to Malaysia's capital Kuala Lumpur.

The Malaysian operation already successfully supplied several large and strategic projects, focusing on severe, critical and super-critical applications.

The new manufacturing plant will provide more than 3,500 valves within its first year of operation and have a capacity of 10,000 valves per year in the next two to three years.

Sunbelt Supply Unveils Valve and Automation Center

Sunbelt Supply celebrated the grand opening of its new Valve and Automation Center with an open house on May 12, 2016 in Shanghai, China. Eighty customers and manufacturers toured the newly stocked warehouse and automation center.

Sunbelt Supply Shanghai is a joint venture with the Shanghai-based valve automation distributor, Unicus Technics. Sunbelt Supply has worked with Unicus for over a decade to support shared customers.

ATI Relocates Houston Operations

Automation Technology, LLC (ATI) has relocated its Houston area headquarters and manufacturing complex to 21225 FM 529, Cypress, TX 77443. The move consolidates ATI's operations into a new, totally climate-con-

CALENDAR 2016

AUGUST

11-12
VMA Market Outlook Workshop*
San Diego, CA
www.vma.org

SEPTEMBER

21-23
VMA/VRC Annual Meeting*
Rancho Mirage, CA
www.vma.org

24-28
WEFTEC-The Water Quality Event
New Orleans
www.weftec.org

OCTOBER

5-7
VMA Manufacturers Workshop & Tour*
Scottsdale, AZ
www.vma.org

11-13
API Tanks, Valves and Piping Conference & Expo
Las Vegas
www.api.org

18-20
Valve Basics Seminar & Exhibits
Houston
www.vma.org

NOVEMBER

29-DEC 1
Valve World Conference & Exhibition
Düsseldorf, Germany
www.valveworldexpo.com

DECEMBER

13-15
Power-Gen International
Orlando, FL
www.powergen.com

MARCH 2017

3-4
VMA Technical Seminar & Exhibits
Nashville, TN
www.vma.org

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

VALVE MAGAZINE

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welcomes articles, proposals, manuscripts, photographs and ideas from our readers. For a copy of the magazine's Author's Guidelines, contact Genilee Parente, managing editor, at gparente@vma.org.

trolled 41,000-square-foot facility.

The new facility also accommodates the company's engineering, sales and service teams. The complex houses ATI's research center for developing and testing the company's latest valve actuators and control technologies.

Cowan Dynamics Expands Production and Engineering Facilities

Cowan Dynamics has added 20,000 square feet to its existing 30,000-square-foot facility at its Montreal, Quebec-based manufacturing and engineering operations.

Cowan president and CEO Rene Wenker said the expansion entails substantial additions to production equipment, assembly and testing facilities both for existing and new products.

MERGERS & ACQUISITIONS

Garlock Purchases Rubber Fab Technologies

Garlock has acquired the business and assets of Rubber Fab Gasket & Molding Inc. through its parent company EnPro Industries.

Rubber Fab, headquartered in Sparta, NJ, is a supplier of high-performance sanitary gaskets, hoses and fittings for hygienic process industries such as pharmaceutical, bio-processing and food and beverage. The addition of Rubber Fab expands Garlock's presence and scale in the hygienic market and complements Garlock's existing sealing products.

Rotork Acquires Mastergear from Regal Beloit

Rotork has acquired the entirety of Mastergear's business and assets from

PEOPLE IN THE NEWS


Bob Arnold

ROTORK CONTROLS… Bob Arnold will retire in August from his positions as board member of Rotork PLC and president of Rotork Controls Inc. Arnold was appointed president of Rotork Controls in 1988 and has responsibility for all the company's interests in the Americas. He joined Rotork Controls in 1978.

Arnold has been active in VMA since the early 1980s. He has served on a number of committees, including the Actuator Committee, Nominating Committee, Annual Meeting Program Committee, as well as the VMA Board and the Friends of the Crawford Library Board. In 2002 he was chairman of the VMA Board.

A.W. CHESTERTON… announced that **Andrew W. Chesterton**, formerly executive vice president and chairman of the board, has been named the company's new president and CEO. He succeeds **Brian O'Donnell**, a longtime Chesterton executive, who will serve as a senior advisor on a variety of projects through the end of the year.

PENTAIR… has named **Dennis Cassidy** as president of its Valves & Controls segment and an officer of the company. Cassidy joins Pentair with more than 20 years of industry experience with a primary focus on leading strategy-based transformation programs for global oil, gas and chemical companies.

VALVTECHNOLOGIES… recently announced the appointment of **Chad Bowers** as chief information officer, **David Garcia** as director of manufacturing and **Steve Mermelstein** as regional director, Americas and director, channel management.

MUELLER WATER PRODUCTS… Patrick M. Donovan has been named president of Anvil International. The company is a subsidiary of Mueller Water Products.

Donovan succeeds **Thomas E. Fish**, who was with Anvil International and its predecessor company for 34 years, including 16 years as president of Anvil.

EMERSON… Michael H. Train is the new executive vice president and group business leader of Emerson's newly structured Automation Solutions business. He succeeds **Steven A. Sonnenberg**, who will be chairman of the business.

Automation Solutions will contain the operations and brands of Process Management, ASCO, Branson and Appleton units.

VAL-MATIC… announced that **John V. Ballun**, executive vice president and COO, will succeed **Ted J. Makowan** as president and CEO.

Ballun joined Val-Matic in 1995 as vice president of engineering and previously worked in various engineering management roles at other valve manufacturing companies.

Regal Beloit Corporation for $25 million on a cash-free and debt-free basis.

Mastergear will become part of Rotork's Gears division, and about 55 people will join Rotork as a result of the acquisition.

Schlumberger Completes Merger with Cameron

Schlumberger Limited has closed on a merger with Cameron International Corporation. Each Cameron stockholder is entitled to receive 0.716 shares of Schlumberger common stock and $14.44 in cash, in exchange for each Cameron share. Schlumberger has issued about 138 million shares pursuant to the merger. As a result, former Cameron stockholders own about 10% of Schlumberger's outstanding shares of common stock.

AWARDS & MILESTONES

Moog Finds Oldest Operating Servo Valve

Moog Inc. has declared Doug Bitner, manager for the University of Saskatchewan's College of Engineering Fluid Power Lab, the winner of its contest to find the oldest operating Moog servo valve. Bitner sent in a video showing lab equipment running with a Moog 21 Series servo valve manufactured in 1963. Moog launched the contest last September as part of a celebration of the 50th anniversary of Moog's operations in Europe.

According to Bitner, the University of Saskatchewan is noteworthy for having one of the few undergraduate fluid power labs in North America. The winning servo valve is part of a single closed-loop test system Bitner's students and instructors use for aerospace and industrial experiments.

VMA Members Among America's Best Employers 2016

Several VMA members made the final list of Top 500 companies that make up Forbe's America's Best Employers 2016. The company bases the list on questions to more than 30,000 U.S. workers employed by companies with more than 5,000 staff members. The questions are designed to determine how likely those people were to recommend their employers to someone else.

On the final list of Top 500 companies were Siemens, GE, Flowserve and Pentair.

Siemens Named One of World's Most Admired Companies

FORTUNE magazine has released its list of the World's Most Admired Companies, what the magazine calls a "definitive report card on corporate reputations." One of the companies that made this year's cut was Siemens, parent company of VMA member Siemens Industry.

The senior vice president of communications for the National Association of Manufacturers, Erin Streeter, praised the fact so many U.S. manufacturers were named, saying their presence on the list "underscores that our customers trust us to deliver quality and drive innovation and growth." VM

Mid-year Update: Tough Times, but Members Take Advantage of Varied Programs

It's been a challenging year for industry, particularly for those involved in the oil and gas field. Yet, in conversations with Valve Manufacturers Association (VMA) members, a common refrain emerges: "It's no fun going through a downturn but we've been here before and survived."

Through it all, VMA members continue to take active roles in a variety of association programs. For instance, the **Valve Industry Leadership Forum**, held in Denver last March, had a record number of people in attendance. Then in June, the **Valve Repair Council** hosted a successful and well-attended event in Houston.

Meanwhile, VMA continues its work to promote the U.S. and Canadian valve business as well as educate those who work in and around the valve industry.

This summer, VMA is gearing up for one of its most popular programs, the **Market Outlook Workshop**, Aug. 11-12 in San Diego. While only members qualify to attend, regular readers of VALVE Magazine know we provide highlights of the event in the fall issue, which mails in mid-October. The interest in what speakers have to say about the economy and how it affects end users is always very high. Another members-only meeting takes place in Palm Springs, CA, this September: the **VMA/VRC Annual Meeting**. At that meeting, the association elects next year's chairman and executive board, conducts other association business and learns about timely topics from specially invited speakers. One example is a planned presentation by Jill Rowley, president of Jill Rowley, LLC, who will address Macro Trends in Digital, Social, Mobile, Multi-Generational Workforce, Social Employees, Employee Advocacy and Social Selling. Those topics are foremost in the minds of anyone in industry.

Several VMA programs emphasize educating the latest generation about the valve industry. In addition to VMA's Careers Initiative, invitations are extended to local university students to attend both the Valve Basics Seminar and the Technical Seminar via scholarships. Here, two students from Loyola University join Arie Bregman of DFT Inc. (second from left), and chairman of VMA's Technical Committee, and VMA President Bill Sandler (right) at the 2016 Technical event in New Orleans.

Also on the meeting agenda this fall (and open to the industry) is the **Valve Basics Seminar & Exhibits**, which takes place Oct. 18-20 in Houston. This city is always a popular location for the Valves, Actuators & Controls course because of the huge number of valve and valve-related industries nearby. As a result, the association is expecting a major turnout from a mixture of end users, AECs/EPCs, distributors and manufacturers.

In addition to its own meetings, VMA will participate in two major events this fall by exhibiting at the **Valve World Conference & Exhibition**, Nov. 29-Dec. 1 in Düsseldorf, Germany, and **Power-Gen International**, Dec. 13-15, in Orlando.

Beyond the meeting world, VMA is also in the midst of other major efforts. VMA's **Careers Initiative**, which is designed to help promote careers in the valve industry to the latest generation, is receiving much attention thanks to two new videos. (View them on YouTube or visit www.Valve-Careers.com). Going forward, VMA has added a **Human Resources Workshop** to the meeting rotation and created a new HR eNews publication for members.

The association is currently coordinating requests from guidance and career counselors throughout the country for materials and speakers on industry careers.

VALVE Magazine's editorial staff has already begun planning content for 2017, as well as continuing to schedule weekly articles for **www.VALVEmagazine.com.** We welcome ideas and offers from members and end-users to write for the magazine. And be sure to check out the newest communication tool on VALVE's website—a short weekly video report by Senior Editor Kate Kunkel, who brings the audience up to date on the latest articles and events with the industry and association. VM

If you're a U.S. or Canadian-based valve, actuator or control manufacturer—or a supplier to those manufacturers—explore the benefits of membership at VMA.org > Members.

VMA WELCOMES NEW MEMBERS

Hunt Valve (www.huntvalve.com) joined VMA's ranks as the fifth full member to come onboard this year. The company specializes in severe-duty valves and complementary engineered components and system solutions for the primary metals, energy, process and defense markets. It's headquartered in Salem, OH.

Admiral Valve LLC doing business as **CPV Manufacturing** (www.cpvmfg.com) was this year's sixth new member. CPV has been equipping Navy ships for nearly 100 years and is a leading developer and manufacturer of high-pressure control and shutoff valves for aircraft carriers. It also supplies sealing systems for high-pressure valves and fittings, tube size valves and fittings, air-operated shutoff valves, stainless-steel shutoffs, and needle and check valves to a wide range of other industries. The company is headquartered in Kennett Square, PA.


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WEFTEC has New Stormwater Component

The world's largest water quality event—the Water Environment Federation's Annual Technical Exhibition and Conference (WEFTEC)—continues to grow each year. Last year's event saw 25,000 registrants and 900 vendors in the exhibit hall and more are expected this year as professionals gather for the 89th WEFTEC Sept. 24-28 in the New Orleans Morial Convention Center.

A new component this year is the first WEF Stormwater Congress, where leaders in that sector will share their expertise in 15 specially tailored sessions on issues such as flooding, stormwater and transportation systems, new research and much more. About 5,000 square feet of the 311,000-square-foot exhibit hall will contain a stormwater pavilion. Other pavilions include Innovation and 10 international pavilions.

Joe Whitworth, president of The Freshwater Trust, a non-profit organization that protects and restores freshwater ecosystems through science, technology and incentive-based solutions, is keynote speaker. His session is followed by 130 technical sessions, 29 workshops and seven local facility tours.

WEFTEC in previous years

Cutting-edge technical sessions and workshops address topics such as collection systems; resource recovery, including nutrients and energy; plant operations, treatment and management; regulations and research; residuals and biosolids; water recycling, and more.

For information, go to www.weftec.com.

API Tanks, Valves and Piping Conference Oct. 10-13

Over 65 sessions in three conference tracks have been planned for the 2016 American Petroleum Institute (API) Tanks, Valves and Piping Conference & Expo Oct. 10-13 in the Aria Hotel, Las Vegas.

The conference gives attendees the opportunity to learn about new and existing industry codes and standards as well as emerging trends in the production systems, pipelines, terminals, refining and chemical manufacturing, and storage facilities of the petroleum industry. Each day focuses on presentations relevant to upstream, midstream and downstream segments of the industry. The three tracks include one for valves and piping, which covers topics such as fugitive emissions, B16:34, corrosion protection issues, valve testing and much more.

The conference is designed for a wide range of petroleum professionals from those who design the components

to those who own or run refineries and other facilities.

The last two days of the conference also include an exhibition of the many companies that sell to the petroleum industry.

For information, go to www.api.org.

Next Valve Basics Marks Seven Years of Learning

The number of people who've received a basic knowledge or revived their knowledge of how valves, actuators and controls work through the Valve Basics Seminars now stands at over 1,500. That's how many registrants the highly popular series has seen, and the list will grow Oct. 18-20 when the next seminar is held at the Sheraton Houston Brookhollow Hotel, Houston.

The fall event marks the seventh year for the program, which began as a one-day course covering how valves and related equipment operate. The program expanded to two days in 2013 to accommodate a growing request for information, and now includes three days of knowledge-gathering by an increasingly diverse attendee list. Professionals who seek to learn at these seminars range from those just starting out to those about to make a major job change to executives, experienced personnel who want a refresher course, and engineers or designers who specify valves.

Day one of the program now includes a general introduction to the industry as well as explanations of the differences and purposes for multi-turn valves, check valves, quarter-turn valves, pressure-relief valves and manual and fluid-powered actuators. Day two continues with coverage of electric actuators, solenoid valves, controls valves and systems and the popular Petting Zoo, which is a hands-on demonstration of everything attendees are learning.

Day three provides an additional level of knowledge on the industry through coverage of issues such as packings and fugitive emissions, valve materials, critical service applications, controls, technology such as feedback and asset monitoring, and valve repair.

A tabletop exhibit is open on the first day of the conference to allow vendors to the industry to show specific products available and how they work.

In addition, different types of registration have been created so that attendees can pick which level of instruction they need.

For registration questions contact Malena Malone-Blevins at mmaloneblevins@vma.org. For information on program content, contact Abby Brown at abrown@vma.org. Information and online registration is available at www.vma.org. VM

At the Valve Petting Zoo in Chicago this past April, presenter Russ Robertson of Cameron, a Schlumberger company, explains the ins and outs of actuation to a group of attendees.

AWWA ball and butterfly valves are used to pump reuse water in Waco, TX.

Wastewater Treatment

BY JOHN V. BALLUN, P.E.

Society's desire for a clean environment shines light on the importance of understanding the essential role wastewater treatment plants have in our communities. Congress passed the Clean Water Act in 1972 to control the discharge of effluent into water systems and waterways, and provided grants to allow municipalities to meet these new requirements. Since then, technologies such as optimized treatment systems and automated valves have been used to make our country's wastewater plants technical marvels. The purpose of this article is to explain the various critical roles that valves play in the operation of typical wastewater plant processes.

THE BASICS

A place to begin this understanding is to look at the overall purpose of a typical municipal wastewater system, which is to collect wastewater generated by residents, businesses and industries, and

Executive Summary

SUBJECT: Valves in wastewater must deal with the challenges of turning what makes its way into our nation's sewers into water free of disease and ready for redistribution into waterways.

KEY ISSUES:

- Today's plant processes
- The valves and where they work
- Primary, secondary and tertiary control

TAKE-AWAY: Special valves are required to handle the debris and suspended matter in wastewater. However, other valves are used after the waste is removed—so the industry has a wide range of valve possibilities.

to process that wastewater into final outflow that meets federal and state water quality standards. Treated water meeting Environment Protection Agency requirements then can be safely discharged into water reuse systems or waterways. A successful wastewater system depends on cooperation and support from residents, municipalities, industries and regulators.

MEANS OF COLLECTION

As cities grew in size in the U.S., installing wastewater collection systems became a necessity for preventing waterborne disease. Achieving this, in turn, facilitated accelerated growth of those cities. By the year 2000, about 208 million people in the U.S. were served by centralized wastewater collection systems.[1]

Depending on the geography of the area, collection systems use gravity to pass flow through sewers or use lift stations and force mains to transmit wastewater over elevations and great distances to a centralized treatment plant. When a plant is fed by gravity sewers, it also may be equipped with station pumps to lift the wastewater and start the gravity flow process through the plant.

Lift stations collect the wastewater from a township or subdivision by gravity and then pump that wastewater through a force main to a centralized wastewater plant. These stations can be designed as either a wet well or a wet and dry well design where the dry well contains the pumps and related equipment.

The valves in a lift station are located in the wastewater basin, dry well or a separate valve vault. The three types of valves typically found in lift stations include check valves, shutoff valves and air valves. The purpose of the check valve is to prevent reverse flow when the pump is turned off. Shutoff valves are used for isolation when repair or maintenance is needed. Air valves expel air from the pump column and the force main to provide flow efficiency and minimize surges. Selecting valves for wastewater applications is similar to that of selecting pumps in that consideration must be given to the solids content of the flow media.[2]

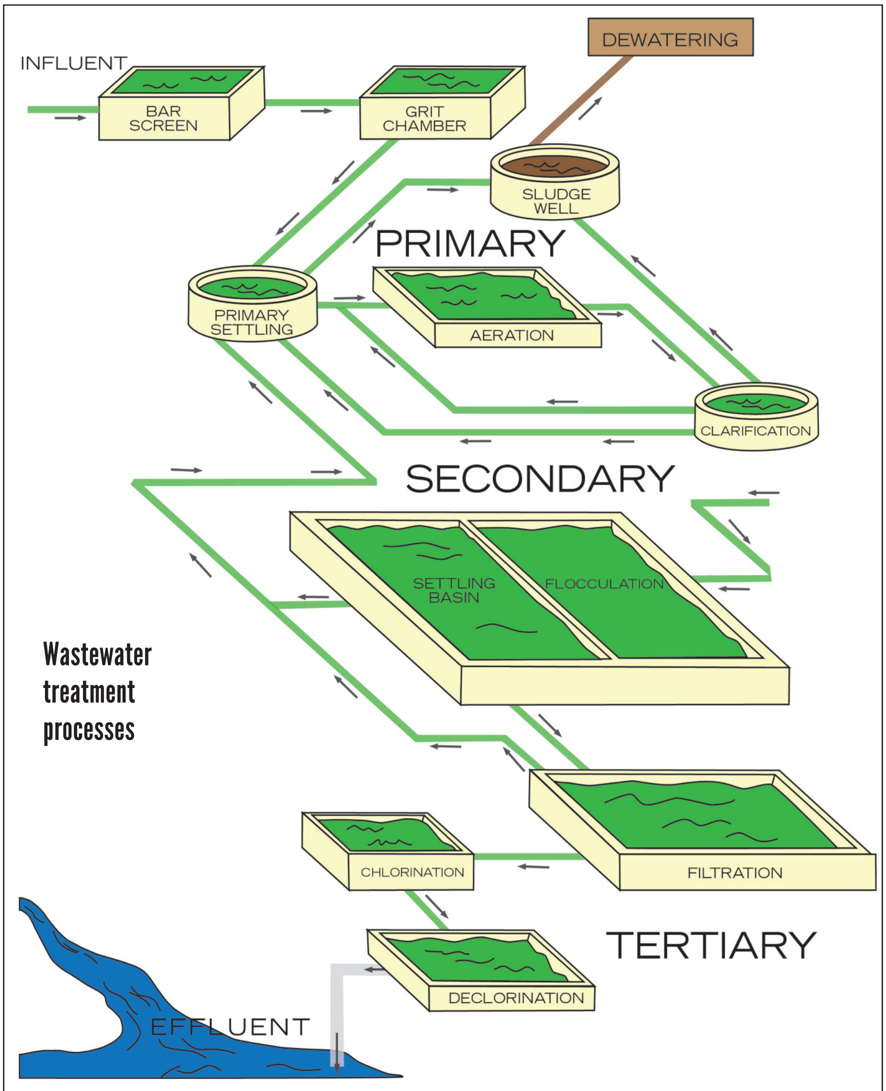
COURTESY OF ROMTEC UTILITIES

Submerged wastewater pumps in a wet well lift station with a separate valve vault

CHECK VALVES

Check valves are essential in lift stations for preventing reverse flow when the pumps are not in operation. There are as many types of check valves as pumps, so it is important to understand the essential characteristics that affect performance in wastewater service. The swing check valve is the traditional choice and is produced in accordance with American Water Works Association (AWWA) C508. These valves are made of iron with corrosion-resistant internal mechanisms. Swing check valves use a 90-degree seat and are typically provided with a lever and weight to assist with closure and provide position indication. The valves also can be equipped with springs, air cushions or oil dashpot arrangements to reduce the valve's propensity to slam.

A variation of the traditional swing check is the resilient hinge design, which has a much shorter disc stroke that can greatly reduce the slamming problems, especially for higher head applications. Additional benefits of the resilient hinge design include a corrosion-resistant disc, an encapsulated hinge pin, the option for position indication and a top access cover for ease of maintenance.



Wastewater treatment processes

A ball check valve is commonly used on smaller systems where economy is important. This valve uses a ball (as compared to a disc) as its closure member. The ball is lifted up and away by the flow during system operation and falls back to the closed position when the pump is shut down. Ball checks can be mounted in both horizontal and vertical applications.

PUMP CONTROL CHECK VALVES

When main pumping stations operate at high head or pump fluid through a very long force main (i.e., five miles), pump control check valves and special surge equipment may be needed instead of traditional check valves. Quarter-turn plug or ball valves equipped with electric, pneumatic or hydraulic-powered actuators and electrically connected to the pump circuit are used as pump control check valves. Pump control valves open and close over several minutes to slowly change the fluid velocity, thereby preventing surges in long force mains. Moreover, the use of pump control check valves can significantly save power consumption due to their low head loss.

SHUT OFF VALVES

All pumps and check valves should be equipped with a shutoff valve to allow isolation of the system and maintenance of the lift station components. Isolation or shutoff valves for wastewater service come in many varieties; however, they all must be designed to prevent clogging and wear from the flow of grit-containing fluid.

For small-diameter applications, threaded quarter-turn ball valves are an economical choice. The threaded or flanged body contains a floating ball that seals against non-metallic seats in both directions.

For larger applications, multi-turn knife or wedge gate valves are commonly used. Gate valves are usually constructed of iron with flanged connections. These valves are produced in accordance with several AWWA standards, including AWWA C500, C509 and C515, and are available in both rising stem and non-rising stem models. Rising stems are preferred because they provide indication of the valve position at all times.

A compact or short version of the gate valve is the knife gate, which is produced in accordance with AWWA C520 and gets its name because the gate is a thin metal plate or blade. With wastewater, this gate can cut through sediment. Knife gates are commonly used for suction isolation of wastewater pumps because flow control is not required. No gate valves should be used for throttling or flow control because vibrations while the gate is partially open can damage the valve.

Another shutoff valve for wastewater service is the quarter-turn eccentric plug valve, which is built in accordance with Manufacturers Standardization Society (MSS) SP-108 or

Wastewater air valves isolated by gate valves are installed in a wastewater treatment plant.

AWWA C517. The seat and plug face of an eccentric plug valve is located off-set from the valve shaft and port so that, as the plug is rotated out of the seat, it is pulled away rather than scraping against that seat. This eccentric action prevents wear in abrasive service. Moreover, if wear does occur, the actuator can be adjusted, further closing the plug to provide new seating surface and a tight seal.

Plug valves can be furnished as a direct nut type for wrench operation or, in larger sizes, equipped with a quarter-turn worm gear actuator. An additional advantage of a plug valve is that the valve can be used as a pump control valve by using electric/hydraulic actuation. These valves are also excellent in throttling applications for controlling the rate of flow.

Centrifugal pump and resilient-hinge check valve in wastewater lift station dry well

AIR VALVES

Automatic air valves are installed on the pump discharge and at high points on the force main to prevent air pockets or vacuum conditions from forming in the force main. These valves are automatic devices with floats that open to expel air when it collects in the valve body. When wastewater enters, the float lifts by buoyancy and closes the orifice in the outlet of the valve so the fluid is not expelled. Wastewater air valves often feature elongated or conical bodies to prevent clogging, a sloped bottom to facilitate drainage and Type 316 stainless-steel internal components to withstand the corrosive nature of wastewater and wastewater gasses.

The importance of air valves cannot be overlooked. They not only maintain the flow efficiency of a pipeline by venting accumulated air, but also perform many other functions, including surge control after pump power failure by admitting air rapidly to prevent the formation of a vacuum pocket during column separation. Note, however, that maintaining equipment in wastewater service is always a challenging and dirty job. One field study demonstrated that air valve maintenance can be reduced by the use of fusion-bonded interior coatings and Type 316 stainless-steel trim.[3]

Butterfly valves supplied in accordance with AWWA C504 are often used [in tertiary treatment] because of their compact size and low cost, especially in large pipe sizes.

TREATMENT FACILITIES

Domestic and industrial wastewater collected from sewer systems and lift stations flows to a centralized wastewater treatment facility. The wastewater process is typically segregated into three phases: primary, secondary and tertiary.

The primary treatment includes inlet bar screens to exclude physical debris such as rags and sticks from the wastewater flow stream. Often, several submerged wastewater pumps lift the wastewater into grit tanks that slow the velocity of the fluid so grit settles to the bottom of the tank. These pumps and associated valves need to have all of the characteristics associated with lift stations.

The wastewater at this stage still contains sediment and organic constituents that are removed in a primary settling tank using chemical coagulants. The constituents settle to the bottom of the tanks as wastewater primary sludge. Sludge is pumped from the bottom of the tank at regular intervals to dewatering facilities. The valves associated with this process must be designed to handle slurries with over 90% suspended solids. Industrial ball valves or eccentric plug valves are used to stand up to this challenge.

Some plants are faced with a serious struvite (magnesium ammonium phosphate) deposit problem in their digested sludge lines. Struvite crystals can grow rapidly and form a concrete-hard crust on the inside of pipes and equipment, choking flow. Pipe and equipment subject to struvite service should be glass-lined, which consists of applying a 10-mils-thick ceramic coating using a special high-temperature process (1400°F or 760°C) for pipes, valves and pumps.[4]

The remaining organic matter is then removed during the secondary treatment using biological processes, often either a fixed film or a suspended growth process. In a fixed film process, the biological treatment occurs while immersed over filter media such as ground rock, plastic balls or corrugated plates. The organic matter is consumed by bacteria, algae and fungi, and converted into a biomass. A suspended growth process uses injected air added to the mixture to support microbial growth and a corresponding consumption of organic matter.

Aeration systems frequently use high-power centrifugal air blowers and power-actuated control valves, typically wafer butterfly valves. The control valves for air service are designed for dry fluid service and high temperatures approaching 300°F (150°C). Additionally, blowers should be fitted with check valves that have low opening or cracking pressure and are sized so they will not chatter during low-flow operation.[5]

Tertiary treatment processes may include biological or chemical treatment for nutrient removal or tertiary filtration for particulate removal. Tertiary treatment also includes disinfection of the effluent by prolonged contact with a chemical such as chlorine in a contact basin before the output water is discharged. The final output water will be dechlorinated and may be pumped for reuse or simply discharged to a waterway. Since the sediment has been removed from the wastewater, other types of waterworks valves may now be used. For example,

An eccentric plug valve (far right) isolates a wastewater pump and check valve.

butterfly valves supplied in accordance with AWWA C504 are often used here because of their compact size and low cost, especially in large pipe sizes. Waterworks gate valves also are employed.

When pumping effluent for reuse, waterworks pumps, check valves and shut off valves can be used. Both butterfly and ball valves are quarter-turn valves that are reliable and simple to automate for this service. Quarter-turn ball valves supplied in accordance with AWWA C507 are used when head loss and energy savings are considered important. A full port ball valve has a head loss similar to a pipe of the same length.

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CONCLUSION

While many types of valves are used in wastewater treatment, one thing they have in common is that they all must be suited for fluids containing suspended solids. Some common valves such as silent check valves and butterfly valves should not be used in raw wastewater service. Instead, specially designed valves such as knife gate valves and eccentric plug valves are the go-to workhorses for wastewater applications. VM

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Ceramic Coatings Provide Corrosion and Wear Protection for Valves

EDITOR'S NOTE: A detailed characterization project was undertaken by Velan, in collaboration with the National Research Council of Canada (NRC), Boucherville, and Polytechnique Montréal to assess the mechanical and tribological resistance of promising ceramic coatings. This article reports what the team discovered and why the study was done.

BY LUC VERNHES, CRAIG BEKINS AND NICOLAS LOURDEL

Ceramic coatings extend the in-service life of equipment by enhancing the corrosion and wear resistance of the base material. Because of this, they are often applied to protect metal-seated ball valves (MSBVs) used for tough chemical applications like turning rock into gold or nickel using processes such as hydrometallurgy.

Ceramic coatings such as chrome oxide (Cr_2O_3) and titanium dioxide (TiO_2) applied by thermal spray are frequently used in energy-efficient, highly-corrosive chemical processes

Executive Summary

SUBJECT: Energy-efficient, highly-corrosive chemical processes such as hydrometallurgy have paved the way for the development of advanced ceramic coatings for the valves used, including metal-seated ball valves.

KEY POINTS:

- Background on hydrometallurgy
- Why and how R&D occurred
- Innovative technology

TAKE-AWAY: A novel n-TiO_2-Cr_2O_3 blend is a promising evolution of the current Cr_2O_3, nanostructured TiO_2, and the TiO_2-Cr_2O_3 coating materials.

including mining and ore extraction. Driven by the industry requirement for low total cost of ownership, lead engineering firms have been and continue to develop innovative solutions such as 1) a nanostructured TiO_2 coating, and 2) a ceramic blend of TiO_2 and Cr_2O_3. Most recent results indicate that an optimized balance between the hard and brittle Cr_2O_3 phases and the soft and ductile n-TiO_2 phases results in higher abrasion, sliding wear and galling resistance.

BACKGROUND

Mining is synonymous with erosion and abrasion. In mining, valves are instrumental for transporting slurry, which is a mud composed of solids mixed with water. As opposed to oil and gas flow processes, the solids in mining slurry flow are the desirable materials, whereas the liquid serves as the carrier. In mining, the ratio of solids to liquid can range from 10-80%, compared to around 0.5% to 2% in oil and gas extraction. In a solids-carrying pipeline, the transported material must be ground so it can be suspended in water to achieve a liquid-like flow pattern, with a particle size distribution that can span three orders of magnitude. To reduce friction and mitigate erosion, the flow velocity is typically maintained above the flow velocity at which solids deposition occurs.

After reaching the mineral processing plants, the desired mineral is separated from other elements and impurities that make up the rock. In some cases, this can be accomplished by traditional methods such as smelting; however, energy cost and environment policies have boosted the use of hydrometallurgy—which uses aqueous chemistry. It is within the hydrometallurgy process that we find one of the most demanding valve applications. Here, valves isolate not only pumps but, more importantly, the autoclaves where the prepared and heated slurry begins the pressure-induced chemical reaction that turns rock into precious metals.

These are usually considered severe-service conditions, and they require tailored materials and valve designs for the applications. Whereas many valve types can be optimized for severe-service, MSBVs are usually the preferred choice. MSBV sealing surfaces are inherently protected from particles present in the flow in both open and closed positions, ensuring a reliable shut-off. They are relatively easy to operate in a slurry application because the ball rotates on itself without displacing solids present in the line while tolerating the use of very powerful drive systems. This facilitates rapid closure in critical situations.

The typical MSBV design for hydrometallurgy applications consists of a floating ball in contact with a fixed seat. The constant contact between ball and seats reduces the exposure of the sealing surfaces to the corrosive product. The ball and seats are made of either titanium or duplex stainless-steel substrates protected by a ceramic coating. The primary function of that coating is to enhance the load-carrying capacity and tribological performance of the base material—how interacting surfaces will react to friction and wear. The coating extends the in-service life of the equipment, especially during ball motion phases.

WHY AND HOW R&D HAS OCCURRED

At the start of hydrometallurgy use 20 years ago, conventional Cr_2O_3 applied by air plasma spraying was the preferred coating for protecting MSBVs from the extreme abrasion, pressure and elevated temperatures inherent to the pressure oxidation (POx) recovery process used in gold processing (gold ore is mixed with oxygen and sulfuric acid in an autoclave). Over time and based on field experiments, silicon dioxide (SiO_2) and titanium dioxide (TiO_2) were added to the original Cr_2O_3 blend to improve the ductility and toughness of the coating.

Later still, high-pressure acid leaching (HPAL) was developed and used in the nickel recovery process. The process is similar to POx: Laterite ore is leached in a sulfuric acid environment in an autoclave at 4.1 bar (600 psi) and temperatures above 464°F (240°C). However, unlike POx, HPAL operates at high pressures, which, when combined with a higher chloride content, produces a more corrosive environment. (For example, titanium is susceptible to crevice corrosion in HPAL.) The Cr_2O_3 blend optimized for POx has been found to corrode prematurely when used in HPAL. Because it is relatively inert in this environment, it would seem that TiO_2 was a promising choice for HPAL. However, the mechanical and tribological performances of conventional TiO_2 are significantly lower than those of Cr_2O_3, resulting in higher wear rates.

Industry has been working to optimize coating solutions for HPAL. Several options for mitigating corrosion have been considered and tested by various companies, with generally unsuccessful results. Attempts have included the use of intermediate bond coats, such as gold and tantalum, placed between the base material and the Cr_2O_3 top coat. One engineering firm used a nanostructured TiO_2 ($nTiO_2$) coating, which has worked reasonably well. Another firm developed a ceramic blend of TiO_2 and Cr_2O_3 to obtain the corrosion resistance of pure TiO_2 and the tribological performance of Cr_2O_3.

INNOVATIVE TECHNOLOGY

For the NRC/Polytechnique Montréal study, coating materials were selected based on field experience. The novel use of $nTiO_2$ instead of its conventional counterpart was chosen based on recent and promising wear results for this material. The four tested materials were 1) Cr_2O_3, 2) TiO_2-Cr_2O_3, 3) n-TiO_2 and 4) n-TiO_2-Cr_2O_3. All coatings were applied onto titanium grade 5 coupons. The individual n-TiO_2 particles used in the powder manufacture (n-TiO_2 Millidyne) are smaller than 200 nm (Figure 1), which although finer than conventional thermal spray powders, are within the range of other nanostructured-based powders available for thermal spray processing.

NRC specifically prepared a novel blend and spraying parameters for n-TiO_2 and Cr_2O_3 for this project. The n-TiO_2 powder was mixed with a fused, sintered and crushed Cr_2O_3 powder. The deposition challenge was to ensure that the Cr_2O_3 particles melt in order to avoid particle rebound when impacting the substrate, as well as erosion of the deposited TiO_2 layer by the same particles.

The objective of the project was to assess the mechanical and tribologi-

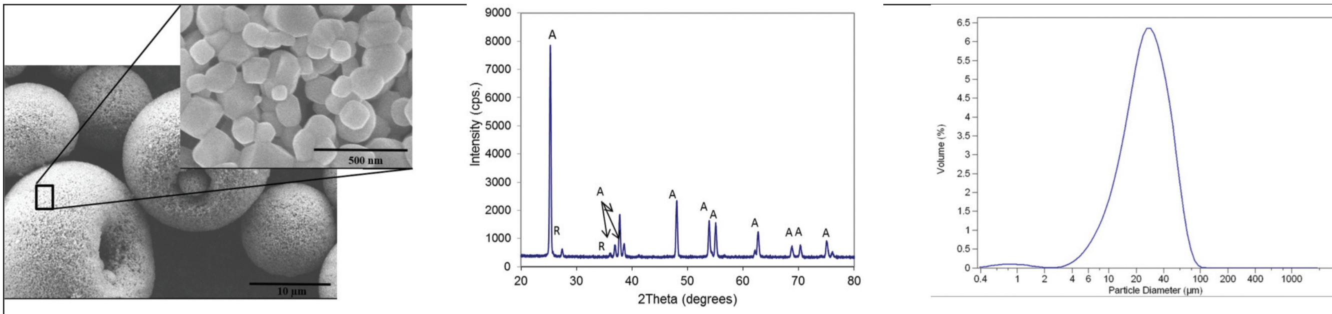

Figure 1: n-TiO_2 powder characteristics: (A) SEM micrographs, (B) XRD pattern (A: anatase, R: rutile), and (C) particle size distribution—logarithmic scale

cal resistance of these four promising ceramic coatings for hydrometallurgy applications, including the novel n-TiO_2-Cr_2O_3 blend. Hardness and shear strength were determined using micro-hardness indentation testers and universal tensile testing equipment. Wear resistance of the coatings under sliding wear, abrasion and galling conditions were measured by standard pin-on-disc tests, abrasion tests and custom-designed galling tests.

Without unveiling the entire research study, some key results are presented in Table 1. As expected, the highest micro-hardness was achieved when the hardest phase, Cr_2O_3, was used primarily for the coating. The n-TiO_2-Cr_2O_3 coating showed the second highest micro-hardness.

Table 1: Coating hardness

Coating	Micro-hardness (HV-300gf, n=10)
Cr_2O_3	1423 ± 62
TiO_2-Cr_2O_3	912 ± 42
n-TiO_2	729 ± 45
n-TiO_2-Cr_2O_3	1200 ± 49

The Cr_2O_3 ceramic material alone showed the highest hardness and best sliding wear resistance and coefficient of friction. As expected, the Cr_2O_3-TiO_2 and n-TiO_2-Cr_2O_3 blends produced hardness and sliding wear resistance between what each of the ceramic constituents showed.

These results fall into line with the microscopy observation of the wear tracks after pin-on-disc tests, as shown in Figure 2: the TiO_2-Cr_2O_3 and n-TiO_2 coatings have wide and deep wear tracks. In contrast, the Cr_2O_3 and n-TiO_2-Cr_2O_3 coatings show small wear scars on the shallow surface, indicating mild abrasive wear.

A strong correlation between hardness, friction coefficients and sliding wear resistance was observed; and such a relationship has been frequently documented in the literature.

In terms of abrasion, the results are positive and counter-intuitive. The n-TiO_2-Cr_2O_3 blends produced superior resistance under both dry and wet abrasion testing compared to the ceramic materials alone as indicated in Figure 3. The high performance of the TiO_2-Cr_2O_3 coating was attributed to the optimized balance between the hard and brittle Cr_2O_3 phases and the soft and ductile TiO_2 phases. Similarly, the results of the present study indicate that the synergy between these two materials produced abrasion performance that exceeded that of Cr_2O_3 or n-TiO_2 alone.

Previously, tests have shown that improved coating wear performance with added n-TiO_2 comes from improved coating toughness. N-TiO_2 coatings contain so-called "nanozones", i.e., regions of unmelted agglomerated n-TiO_2 that act as crack arresters.

With respect to galling, the n-TiO_2-Cr_2O_3 coating ranked first, the Cr_2O_3, TiO_2-Cr_2O_3, and n-TiO_2 ranked second, third and fourth, respectively.

Overall results indicate that n-TiO_2-Cr_2O_3 provides the best overall tribological performance compared to the other tested ceramics, namely Cr_2O_3 and n-TiO_2. The novel mix of n-TiO_2 and Cr_2O_3 provided consistently superior tribological performance to a TiO_2-Cr_2O_3 blend.

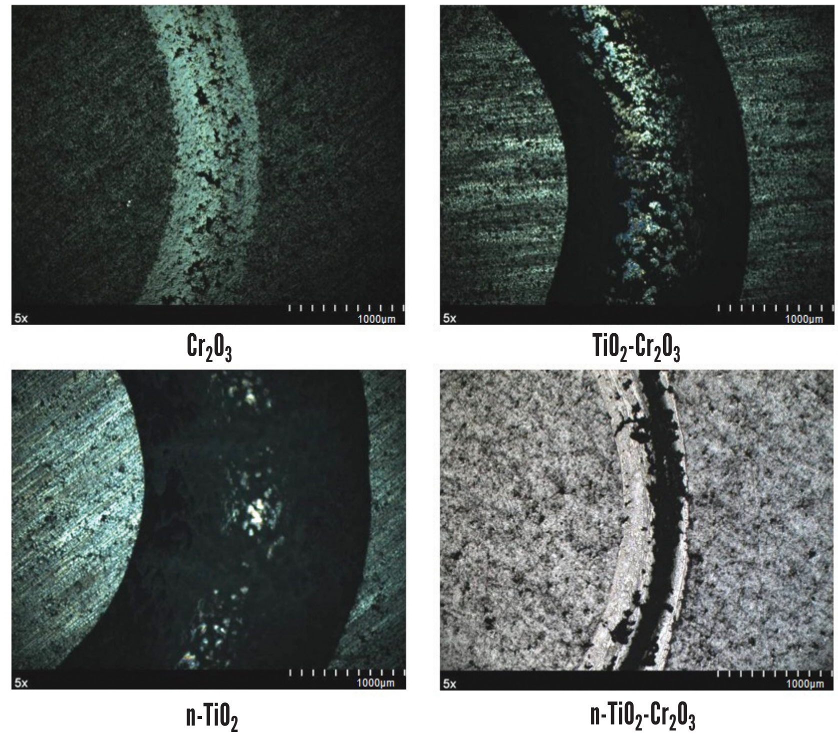

Figure 2. Wear tracks after pin-on-disk tests at X50

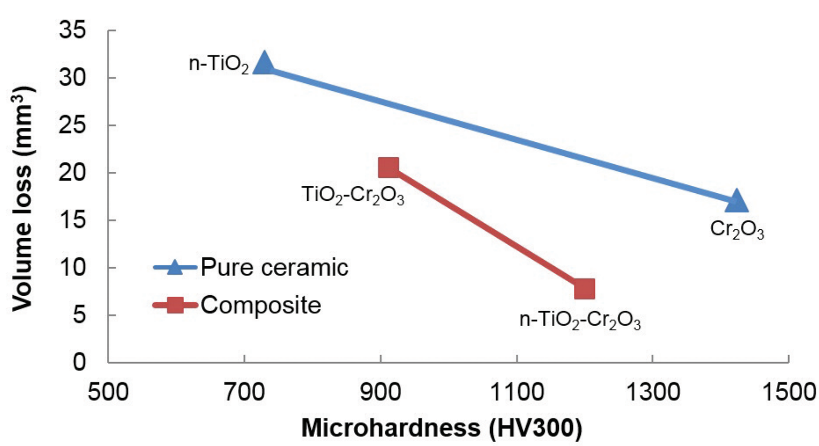

Figure 3. Dry abrasion: Volume loss with ASTM G65 D-mod method (n=2)

CONCLUSION

For highly corrosive environments that are typically encountered in hydrometallurgy processes, the use of thermal spray ceramic coating such as TiO_2 and Cr_2O_3 applied on corrosion resistant substrates such as titanium or duplex is an established solution.

Leaders are optimizing this existing technology by tuning chemical composition and microstructure to maximize strength, toughness, and corrosion resistance. The novel mix of n-TiO_2 and Cr_2O_3 provides consistently superior tribological performance to a simpler TiO_2-Cr_2O_3 blend. Consequently, this novel blend appears to be a promising evolution. Further optimization and field tests are needed for full commercial deployment.

These results reveal a significant opportunity for increasing customers' plant uptime and lowering the total cost of ownership by implementing the latest coating methodology. Nevertheless, as each application is unique, customers facing new corrosion challenges would benefit greatly by partnering with a valve manufacturer to strategically develop engineered coating solutions for their specific applications. Although such optimization will typically require testing and qualification, it pays off by increasing customers' plant uptime, minimizing total cost of ownership, and improving reliability and safety. VM

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Fundamental Forms of Corrosion

Corrosion is nature's wasteful way of returning metals to their ores. The chemistry of corrosion emphasizes the basic corrosion reaction $M^0 \rightarrow M^+$ + electron, where M^0 is the metal and M^+ is a positive ion of the metal. As long as the metal (M^0) retains possession of its electrons, it retains its identity as a metal. When it loses possession of them by any means, it has experienced corrosion. Physical forces sometimes join with chemical forces to cause a valve failure.

There are many common varieties of corrosion, which show up in a broad array of ways and forms and mostly overlap each other. The mechanism of corrosion resistance is attributed to the formation of a thick protective corrosion film on the metal surface.

The types include:

GALVANIC CORROSION

When two dissimilar metals are in contact and are exposed to a corrosive liquid or electrolyte, a *galvanic* cell is formed, and the flow of current causes increased corrosion of the anodic member. The corrosion is usually localized near the point of contact. One method to minimize corrosion can be achieved by plating the dissimilar metals.

GALVANIC SERIES:
Anodic, corroded ends

- Magnesium and Magnesium Alloys
- Zinc
- Aluminum
- Mild Steel, Alloy Steel, Wrought Iron, Cast Iron
- Stainless Steel (active)
- Ni-resist
- Soft Solders, Lead, Tin
- Brasses, Copper, Bronze, Copper-Nickel Alloy
- Nickel, Inconel
- Stainless Steel (passive), Hastelloy
- Titanium
- Silver
- Graphite, Gold, Platinum, Cathodic Protected End

Metals near the top of this list act as anodes and suffer corrosion when coupled with ones nearer the bottom. Those close together corrode more slowly. Coupled metals within one of the groups corrode the least.

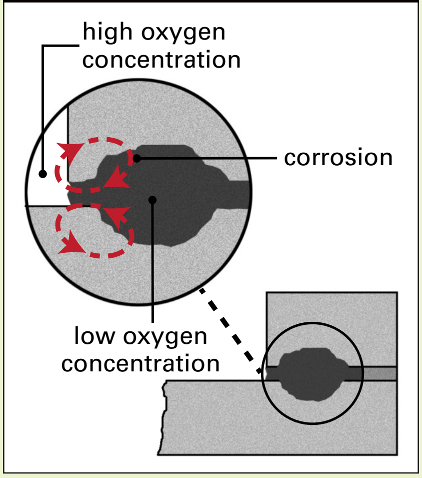
HIGH-TEMPERATURE CORROSION

To predict the effect of high-temperature oxidation requires data on: 1) metal composition, 2) atmosphere composition, 3) temperature, and 4) exposure times. It's not easy to tell what will happen in one case from the results of another. But what is known is that most light metals (those lighter than their oxides) form a non-protective oxide layer that gets thicker as time goes on. The layer forms, spalls and reforms. Other forms of high-temperature corrosion include sulfidation, carburization and nitruration.

CREVICE CORROSION

This condition can be recognized by its presence in crevices. It sets up differences in solution concentration. The crevice in Figure 1, for example, hinders diffusion of oxygen. The results are that high and low oxygen areas that are anodic cause concentration cells. Metal-ion concentration cells, much like their oxygen counterparts, also strive to balance out concentration differences. Thus, when the solution over a metal contains more metal ions at one point than another, the metal goes into solution where ion concentration is low. Crevice corrosion can be minimized by avoiding: accumulation of deposits on metal surfaces, sharp corners, gaskets joints or other conditions favoring stagnate areas of solution.

Figure 1. Crevice corrosion: schematic representation



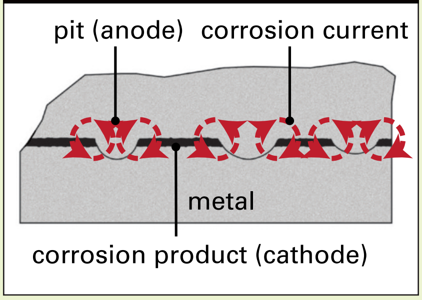
UNIFORM ATTACK

This can be seen in a general wasting away of the surface. The condition is found all too often where metals are in contact with acids and other solutions. The corrosion product may form a protective layer on the metal, slowing down corrosion. Or, as in the case of direct chemical attack, the corroded material easily dissolves in the corrosive materials. The problem can be solved by selecting a more corrosion-resistant metal.

PITTING CORROSION

When protective films or layers of corrosion product break down, localized corrosion or pitting occurs (Figure 2). An anode forms where the film breaks, while the unbroken film or corrosion product acts as the cathode. In effect, a closed circuit has been set up.

Figure 2. Pitting corrosion: schematic representation

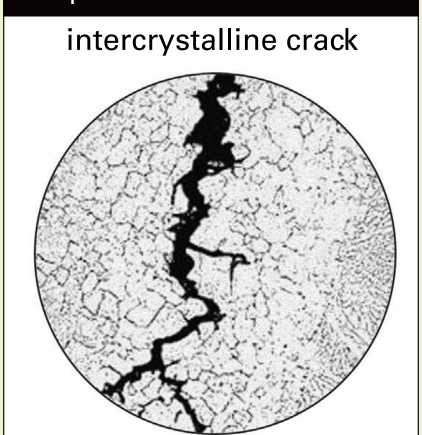


Some stainless steels in the presence of chloride are susceptible to pitting attack. The breakdown occurs because of some inhomogenity in the metal surface or rough spots.

INTERGRANULAR CORROSION

Intergranular corrosion occurs for a variety of reasons. The result is almost the same—selective attack along the metal's grain boundaries, destruction of mechanical properties, intercrystalline cracking as shown in Figure 3. Austenitic stainless steels are subject to intergranular corrosion by many corrosives if not properly heat-treated or exposed to sensitizing temperatures of 800–1500°F (427–816°C). This condition can be eliminated by preannealing and quenching from 2000°F (1093°C), by using low carbon stainless steels (C-0.03 max) or stabilized types with columbium or titanium.

Figure 3. Intergranular corrosion: schematic representation



TRIBO CORROSION

Similar in method of attack and net effects are erosion corrosion, impingement corrosion and cavitation corrosion. Here's how they do their damage:

Physical forces from wear break through the protective corrosion scale, dissolving the metal. The effect depends mainly on force and speed. Excessive vibration or flexing of the metal can also have similar effects. Cavitation, a common form of corrosion in pumps and sometimes in valves, depends on the hammer-like effect produced by collapsing air bubbles. Bubbles break down when they pass through a pressure drop area.

STRESS CORROSION CRACKING

Teaming up high-tensile stresses with a corrosive atmosphere is bound to cause trouble. Here's how it develops:

Tensile stresses build up at metal surfaces under static loading. Corrosive action concentrates stresses and causes them to exceed the metal's yield point. The result shows up as a local failure. Under continued exposure, the metal alternately corrodes and builds up high-stress concentrations. Eventually, the part may fail. Avoiding this failure can be achieved by early stress relief annealing, proper selections of alloys and design.

CORROSION FATIGUE

In much the same way that static stresses link up with corrosion to produce stress-corrosion cracking, cyclic loads work hand in hand with corrosion to cause corrosion fatigue. Metal failure takes place substantially below the fatigue limit for a non-corrosive condition.

Surprisingly enough, the combined deteriorating effect of these two bed brothers—corrosion and fatigue—is greater than the sum of their individual damages. That's why it pays to apply the best possible corrosion protection when dealing with metals under alternating stresses. VM

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Valves are a vital part of preventing catastrophic release of chemicals, which is why they are important in HAZOP studies.

The Role of Valves in HAZOP Studies

BY LI LI

Process hazard analysis (PHA) is required by U.S. Occupational Safety and Health Administration (OSHA) regulations, as indicated in Code of Federal Regulation (CFR), 29CFR, Standard number 1910.119, Process Safety Management (PSM) of Highly Hazardous Chemicals. This section of the standard contains requirements for preventing or minimizing the consequences of catastrophic release of toxic, reactive, flammable or explosive chemicals. Such releases can result in hazards from toxicity, fire or explosion. A PHA identifies and evaluates potential hazards and risks to safety, health and the environment, and identifies safeguards and additional corrective measures to improve safety.

One of the many PHA methodologies is the hazard and operability study (HAZOP). Hazard identification and "what-if" scenarios are high-level hazard identification methodologies. HAZOP is a systematic hazard identification methodology designed to identify hazardous events that could occur during operation of a facility that might be caused by deviations from design intent. In the study, the potential causes and consequences are identified, and a judgment is made as to whether additional design features should be incorporated to safeguard against identified scenarios.

HAZOP serves as one of the final safety reviews in the engineering design phase before the pre-startup safety review. It is a qualitative analysis focusing on operating facilities that involve hazardous chemicals such as using, storing, refining, petrochemicals manufacturing, moving, handling and others.

Executive Summary

SUBJECT: Valves play a critical role in keeping the nation's plants safe. As a result, they are an important part of OSHA-required hazard studies.

KEY ISSUES:

- What a HAZOP is
- How they are conducted
- What role valves have in the process

TAKE AWAY: The HAZOP team has a wide range of places where they must study the potential for failure.

U.S. OSHA 29 CFR 1910.119 PSM states that the facility owner is responsible for performing and managing the HAZOP, which must be conducted by a team with expertise in engineering and operation. The initial HAZOP is conducted during the engineering, procurement and construction (EPC) phase of a project or facility planning (Figure 1). The required core members of this team are an independent facilitator, a technical recorder (scribe), at least one employee with operation experience and knowledge of the facility (operator), process engineers and controls/instrumentation/electrical engineers. Other parties, such as mechanical and maintenance engineers, may also be included. The HAZOP is to be updated and revalidated at least every five years after the initial study is completed.

HOW THEY ARE CONDUCTED

The HAZOP can be conducted at the site or at the engineering office. The team works in an isolated, group setting where the engineers and operators evaluate the design to identify:

1. What could go wrong and the potential causes
2. Any hazardous events, previous incidents, etc.
3. Consequences for safety and the environment that would result, and the risk ranking for each consequence
4. Current safeguards in place, and what additional safeguards must be implemented to prevent an incident
5. Systematic and structured reviews of selected operations or systems (nodes), and potential process parameter deviations—by using guidewords as shown in Table 1
6. Documented discussions in HAZOP worksheets, which may be assisted with available commercial software

ROLE OF VALVES

The role of valves in a HAZOP is very important. The HAZOP team only evaluates what could happen and what the consequences would be if the valves do not work properly or they fail to work as they are intended. Outside of the HAZOP, it is the valve experts' and engineers' responsibilities to figure out what might cause valves to fail the original design intent, as well as to come up with solutions to fix the potential problems in design.

The valves discussed in a HAZOP typically include the control valves and critical manual valves. The HAZOP team identifies and documents consequences when those valves fail the design intent.

For example, under "initiating causes," the list would include:

- Flow control valve (FCV-xxx) fails open when required to be closed
- Flow control valve (FCV-xxx) fails closed when required to be open
- Pressure control valve (PCV-xxx) inadvertently closes
- Pressure control valve (PCV-xxx) inadvertently opens
- Manual valves (#xxx) inadvertently left open (e.g., after maintenance)
- Manual valves (#xxx) inadvertently left closed (e.g., after maintenance)

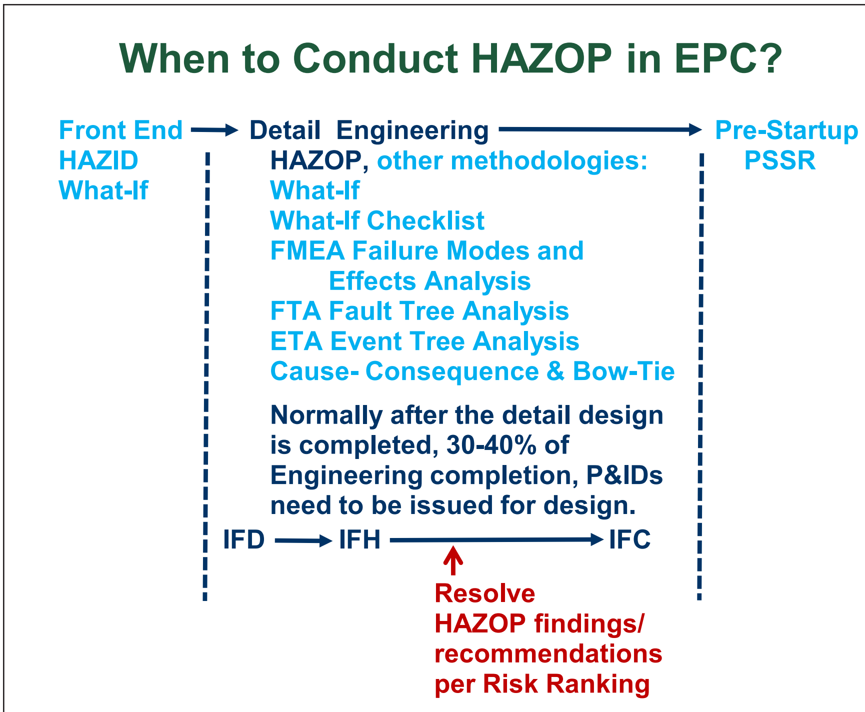

Figure 1. HAZOPs are typically performed during the EPC phase of a project.

Table 1. Potential process parameter deviations that can be reviewed by using guidewords

Typical Process Parameter Deviations	Typical Guidewords
Flow	No, Less, More, Misdirected
Pressure	High, Low, Vacuum
Temperature	High Low
Level	High, Low, Zero
Viscosity	High, Low
Impurity	More, Less, Unexpected
Change in Composition	More of, Less of
Change in Concentration	More of, Less of
Reactions	More of, Less of
Startup, Shutdown	Mode
Maintenance, Services	Mode
Human Factors	Accessibility

Many critical valves are in place for safety, which falls under "safeguards." They include:

- Pressure relief valves for protecting pressure systems and equipment
- Blowdown valves for depressurization of critical vessels
- Emergency isolation valves (EIV) for isolating critical systems, equipment or inventories
- Check valves to prevent unwanted reverse flow

Supplemental questions related to valves may be asked to facilitate discussion of the team. Some typical questions excerpted from Guidelines for Hazard Evaluation Procedures, 3rd Edition are:

1. Can bypass valves (for control valves or other components) be quickly opened by operators? What hazards may result if the bypass is opened (e.g., reverse flow, high or low level)? What bypass valves are routinely opened to increase flow? Will properly sized control valves be installed?
2. How are the positions of critical valves (e.g., block valves beneath relief devices, equipment isolation valves, dike drain valves) controlled (by car seals, locks, periodic checks)?
3. Are critical isolation valve actuators powerful enough to close the valves under worst case differential pressure conditions (including backflow) in the event of rupture?
4. Are chain operators for valves adequately supported and sized to minimize the likelihood of valve stem breakage?
5. How are the positions of critical valves (e.g., EIVs, dump valves) indicated to operators? Is the position of all non-rising stem valves readily apparent to the operators? Do control room displays directly indicate the valve position, or do they really indicate some other parameter, such as actuator position or torque, application of power to the actuator or initiation of a control signal to the actuator?
6. Are block valves or double block and bleed valves required:
   - Because of high process temperature? And/or pressure?
   - Because the process material is likely to erode or damage valve internals?
   - Because the process material is likely to collect on the valve seat?
   - For worker protection during maintenance?
7. How will control valves react to loss of control medium or signal? Do the control valves:
   - Reduce heat input (cut firing, re-boiling, etc.)?
   - Increase heat removal (increase reflux, quench, cooling water flow, etc.)?
   - Reduce pressure (open vents, reduce speed of turbines, etc.)?
   - Maintain or increase furnace tube flow?
   - Ensure adequate flow at compressors or pumps?
   - Reduce or stop input of reactants?
   - Reduce or stop makeup to recirculation system?
   - Isolate the unit?
   - Avoid over-pressuring of upstream or downstream equipment (e.g., by maintaining level to avoid gas blow-by)?
   - Avoid overcooling (below minimum desired temperature)?

The valve placement, orientation and location in the facility are the owners' responsibility, not the valve manufacturers', and all of those factors may impact safety.

After the HAZOP review meeting, a HAZOP report is generated and filed. All the findings and recommendations of the team must be documented and resolved. As general practice for projects, HAZOP action items and recommendations are usually resolved before piping and instrumentation diagrams can be issued for construction.

HUMAN FACTORS ENGINEERING

The valve placement, orientation and location in the facility are the owners' responsibility, not the valve manufacturers', and all of those factors may impact safety. For this reason, manufacturers are expected to design and improve on a valve's operability and user-friendly aspects.

ASTM F1166–07, Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities provides ergonomic design criteria from a human-machine perspective for the design and construction of maritime vessels and structures, and for equipment, systems and subsystems.

ASTM F1166–07, Section 12, Valve Placement, Orientation and Location provides valve criticality information for a variety of valves. This information recognizes the importance and criticality of valves, which are classified by three categories:

Category 1 – Critical and essential for normal or emergency operations, safety and environmental reasons. These would:

- Be used frequently (at least once in a six-month period)
- Have a high likelihood of failure, or the consequence of failure or lack of quick access would be serious
- Be valves with handwheels or handles greater than 24 inches (610 millimeters) in diameter or length

Examples include: control valves, their bypass, isolation valves; relief and de-pressuring valves and emergency shutdown; trip and anti-surge valves; liquid cargo transfer valves for hydrocarbon.

Category 2 – Not critical for normal operations, but required for routine operations and maintenance. These would be used frequently (at least once in a six-month period).

Examples are: sewage treatment valves; condensate drain valves; service oil valves; potable water valves; ship service air valves; hydraulic service; frost gas valves; manual valves for normal startup/shutdown; drains and vents (1-inch) or less with flange and cap end.

Category 3 – Normally non-operating valves that are used in particular circumstances on an infrequent basis.

Examples are valves used in dry dock only for:

- Initial vessel or structure commissioning
- Decommissioning
- During startups after extended shutdowns
- During extended shutdowns
- Isolating pressure vessels, tanks, etc., for inspections
- Tie-in valves
- Pressure testing.

EMERGENCY ISOLATION VALVES

EIVs also play an important role in safety and environmental risk assessments. During a formal risk analysis, consequences and incidents are normally calculated based on inventory and on chemical and physical properties of the released hazardous material. Correctly placing EIVs in the process system can reduce the level of potential leaking during emergency situations. Failures of critical valves can lead to catastrophic failures.

Examples of important EIVs include suction valves in piping to pumps that are fed from large towers, accumulators or feed surge drums; isolation valves upstream of fire heaters, compressors and heat exchangers; and so forth.

In accordance with American Petroleum Institute (API) Recommended Practice (RP) 2218, valves that are potentially in a fire exposure scenario should be fireproofed for both the power and signal lines connected to the valve. The valve's motor operator should be sufficiently fire-protected to provide enough time for the valve to fully open or close. Valves that fail to the safe position need not be fireproofed. However, they should be able to default to the fail-safe position when under a fire challenge.

CONCLUSION

To summarize, the role of valves in HAZOP studies and improving the safety and environment of plants is as follows:

All types of valves play an important role in the facility's safety and environmental compliance. The risks are prevented or mitigated through engineering and valve design, construction of materials, selection, sizing, placement, etc. Key tools used in the design stage include:

- Early hazards identification at the detailed engineering phases can offer great opportunities for various engineering disciplines to apply inherent safer design principles or risk tolerable solutions to prevent or mitigate the potential safety and environmental hazards.
- Correct placement and selection of valves can reduce the size of spills and prevent or lessen the potential for catastrophic losses.
- Tight shutoff valve quality will ensure reduced downtime and improved revenue savings in the life of plants.

In formal risk analysis, the resulting consequence is normally calculated and based on inventory and chemical and physical properties of the released hazardous material. EIVs also play an important role in calculating the inventory and total potential leak quantities. VM

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1. United States Occupational Safety and Health Administration, 29 Code of Federal Regulation, Standard number 1910.119, Process Safety Management of Highly Hazardous Chemicals
2. Guidelines for Hazard Evaluation Procedures, 3rd Edition, Center for Chemical Process Safety (CCPS), published by CCPS/AICHE, 2008
3. ASTM Standard, Designation: F1166 – 07 (Reapproved 2013), Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities
4. American Petroleum Institute Recommended Practice (RP) 2218, 3rd edition, July 2013

Failure analysis of a gate valve in sulfuric acid service found that valves from the same manufacturer that were made under a different lot or heat (along with valves by other manufacturers) were not affected by the damage mechanism. This supported a claim that the corrosion here was the result of improper heat treatment, rather than incompatible alloy selection.

An End-user's Perspective on Valve Selection and Risk

BY STEPHEN R. TREICHLER

I am not a valve expert, although I often play one where I work. What I am is an end user, but I believe that provides me a unique outlook on risk.

My initial introduction to industrial valves came during mechanical engineering classes in college. Such classes are where the student discovers the deep, technical "insight" behind valve design: that a valve is two opposing triangles pointing at each other on a drawing.

Yep, that was about where my knowledge began. When I asked for a few more details, the answer was, "Oh, the suppliers or the valve guys can help you with that." Fortunately, over the years I've found that to be true. I have received much support, advice and knowledge-sharing from many a valve OEM and distributor, for which I am grateful.

As the user, however, I am truly at the end of the line when it comes to dealing with the results that stem from the many decisions others make before a single valve is installed in one of my plants. This is an important point when you consider the inherent risks that design and specification decisions may have before and during installation. The user is left with the job of managing, maintaining and correcting based on what's been done.

The days are long gone when building a chemical plant or a refinery was a matter of finding a flat, salt-marsh prairie somewhere and throwing together pipes, vessels, boilers, pumps, tanks, an alarm or two, and valves, of course—then making products as fast as you could. In those days, little thought was given to considerations such as the environment, community impact, long-term cost of ownership, or even the degree of risk for those working in or near the facility.

Executive Summary

SUBJECT: Although many parties in plant start-ups and operation are involved in managing risk, the end user is the ultimate holder of what happens when a particular valve is chosen.

KEY CONCEPTS:

- The user's perspective
- Where risk lies
- What happens after the EPC

TAKE-AWAY: The greatest sources for minimizing risk are cooperation and communication.

The good news is that many of yesterday's plants are still standing, operating, and making product and profit for the owners. With improvements, upgrades and enhancements, those facilities are much safer, cleaner and efficient than when they were first built, which was often mid-20th century or before. Newer facilities are even safer.

Why is this so? Unfortunately, it's because history and tragedy have taught us many lessons. Yet from the tough lessons, processes and tools have been created to manage inherent risks and mitigate hazards that come with many of our chemical and refining processes.

With all this in mind, I ask: when is a valve no longer just a commodity? What implications arise from a simple block valve enhanced to become part of a complex safety instrumented system (SIS)? What happens when risks are out of the control of the original designer or even the valve manufacturer?

THE USER VIEW

All of these issues end up with the user, who has to deal with what was installed based on decisons made both recently and sometimes long ago. These decisions may have been technical choices based on key drivers or even the engineering/sourcing trends of the day. That's why we have to look at how risk was considered in those choices. We also have to consider what type of risk the key driver for the plant or project design was: Economics? Safety? Something else?

API 580 defines risk as the product of the probability of some event occurring during a time period of interest and the consequences (generally negative) associated with the event. In simple mathematical terms:

$$Risk = Probability \times Consequence$$

To be honest, managing risk is not that simple. We expect our equipment to run and perform at many levels. We expect it to last; yet we know it can (and probably will) either fail at some point or become inefficient as a function of wear. There are risks that we, as users, can control and others that are awaiting discovery. The industry also has the additional challenge that the bar on process safety performance and environmental compliance rises ever higher and that bar applies to every facet of the petrochemical industry… even to something as simple (well, maybe not always "simple") as a valve. We should recognize that, given this regulatory climate, users need more and more support from the OEMs and their distribution resources to meet the challenges. We should consider those challenges as we talk about where risk is today.

PRE-FEED

Managing risk starts at the beginning, before front-end engineering design (Pre-FEED). This is primarily within the use of good process safety/hazard analysis practices. A well-conducted and thorough analysis can guide the project team through choices such as valve selection and materials of construction, actuation and ancillary instrumentation. This is where safety instrumented functions are determined and where the separation of specialty versus commodity valves and decisions concerning actuation should be made. Through process hazard analysis (PHAs) and hazard and operability studies (HAZOPS), we work to mitigate the potentials for failure. This is just the first step, however. As the preliminary design work proceeds, other decisions concerning the operational environment, materials of construction and other design factors such as accessibility and ergonomics can be brought to bear.

A sad truth is that currently, operations and maintenance experts might not be invited to the party to review what the designers have created. How often has the question "How the heck will you operate this efficiently or isolate that safely?" not been asked of the user? What is even more disconcerting is to find out that designers with 15 to 20 or more years of engineering design experience have never set foot in an actual production unit.

AFTER THE THRILL OF THE EPC

At last the new facility or project is built. The years of planning, designing and building are done and the engineering, procurement, construction (EPC) process is complete. It is time to experience the joys of plant or project startup where theory will finally meet reality.

Within reliability engineering circles, this is called the bathtub curve because of the shape of what happens: At the beginning of the curve (start-up), one experiences a good number of failures. The root and contributing causes for these failures is varied; but this is when we begin to find out if the choices, decisions, mindsets of two or three years ago are in our favor today. This is also the time where the different key drivers between the owners and the EPC contract will be most evident.

This may become even more apparent with larger capital investments if the mindset of "valves are only commodities" prevailed in valve selection and procurement. Instead of stating, "We have too many valves," the question, "Do I have sufficient valves to safely operate, isolate and maintain this plant?" might be a better one. Be advised: A plant startup is a terrible time to find out how much that pair of rush-ordered and hot-shotted, 30-inch stainless-steel (SS) full port ball valves needed for a hot tap and stopple.

This also is the time when one discovers how good the materials management, construction and installation quality control was. Hopefully, we can catch things such as not installing a carbon steel (CS) valve in a service that requires 316SS, valve handle pinch-points, or wrong flow orientation during installation and before the water runs. Even something as simple as proper handling and protection of pipe and valves ordered early that are kept in the laydown yard for long periods of time can prevent many hours of corrective actions and replacements during start-up.

The other end of the bathtub curve occurs after a time of smooth operation when the user begins to deal with the effects of entropy and aging. Here, too, some of those early decisions and mindsets come to bear, especially in determining how long the flat of the curve can be. For example, the use of insufficient or incorrect coatings will promote early onset of corrosion under insulation. Wrong material choices (for example, the non-wetted CS valve components that don't see the process but are exposed to both chemicals through leaks/vapors and environmental conditions such as rain or a saline atmosphere) can lead to problems ranging from operability to loss of containment.

What also may become evident on the right side of the curve is the initial installed quality of the valve itself. This can range from casting flaws and defects and poor metallurgical treatment to incorrect or inferior components.

If the user community is diligent, these problems are generally corrected in a timely manner with little loss or injury. In a recent event at a major Gulf Coast facility, a release of hydrocarbons occurred that could have been catastrophic. The cause was traced to a tiny piece of metal—a packing follower made by a third-tier supplier (which not surprisingly is no longer in business) that broke on a number of similar make and model valves throughout the unit. Fortunately, the facility was in the process of correcting the problem when the release occurred so there were no surprises. Even more fortunately, the release was quickly contained and no one was hurt.

FUTURE RISKS

So far we've referenced some of the day-to-day risks a user may encounter. However, other risks loom on the horizon. As noted earlier, many petrochemical facilities built 40-60 years ago are still standing, operating, and making product and profit for the owners. With improvements, upgrades, and enhancements, many of these facilities are much safer, cleaner and efficient than when they were first built. However, these assets are being worked harder with increased throughputs and longer outage cycles. As no one has yet created a way to reverse entropy, the user community must be more vigilant.

Adding to the mix are other future risks: The two largest can be lumped into two groups: "Keeping Up with the Joneses" and "Keeping Up with Uncle Sam."

COMPETITION AND CONSOLIDATION

Running the nation's industries is a very competitive business. Not only are we working our assets harder, but the playing field has shifted. In the past two decades, with the many mergers and acquisitions within the petrochemical industry, some companies are no longer the household names they once were. With each consolidation, merger or acquisition, there is a resultant headcount reduction. When this happens, it is not just support services such as clerks and procurement reps that are let go. Engineering and similar technical resources also take a hit. During this time, companies adopt lean concepts, which also winnows the expertise. One last wrinkle in this picture is the final wave of boomers, who are close to leaving or have already left the ranks.

When the subject matter experts go—those with a company's expertise and tribal knowledge, those that know why certain decisions were made—they take all the combined wisdom with them. As alluded to at the beginning of this article, valve training in our engineering colleges and universities is sparse, and I don't think that has changed much from my own days, so this knowledge and expertise void will only widen.

Because of all this, users are relying more and more upon outside resources (EPCs, consultants, distributors and OEMs) for technical support.

CONSEQUENCES OF REGULATORY "SUPPORT"

The rising bar of increased regulatory expectations is the new norm. Add to this the fact that whole communities and towns and support industries now surround those plants that were plopped on isolated prairies. Closer neighbors are more acutely aware of what we do and how it could impact their lives. That means managing risk takes on even greater importance in light of possible impact on communities and the environment.

Some of what must be done to meet regulatory expectations is pretty straightforward in areas such as process safety management (PSM) and mechanical integrity (MI). In fact, the concept of MI was around long before the Occupational Safety and Health Administration (OSHA) co-opted the term through 1910.119. Simply put, MI is just darn good maintenance. OSHA expectations are only that our process equipment, including piping and controls, is appropriately designed, maintained and sustained.

Other regulatory expectations are more difficult to manage and may take more time to implement, as exhibited by the evolution of low-E valves. Newer rules, like the adoption of NSF/ANSI 61 (Drinking Water System Components—Health Effects) by many states, have caught both valve OEMs and their distributors, and the petrochemical industry off guard.

The problem can come from internal direction also. There have been a number of incidents where governmental entities such as the Environmental Protection Agency have negotiated with the appropriate internal corporate department; however, engineering or other technical resources are not brought into the discussion. If they had been, it might help to assure that unrealistic timing or unrealizable solutions are not promulgated in the form of consent decrees or other agreements.

A contributing cause to most of these regulatory examples is lack of communication between appropriate parties. This leads us to discussion of our greatest future risk: conflict.

PATH FORWARD

As we have seen, every player involved with valves, from the OEM to the EPC, the owner to the user, has a different set of drivers and mindsets when it comes to selecting and installing valves. Although some degree of risk consideration and mitigation is used in the early processes, ultimately it's up to the user to manage all of the known and possible risks so a safe and sustainable working environment can be maintained.

As we have also seen, the user community cannot do it alone. There was a positive sidebar to the hydrocarbon release example referenced previously: honest support and good information sharing with the OEM occurred up to and after the incident. Nothing was hidden and both sides were working toward a combined solution to resolve the problem. The incident could have been much worse without that degree of cooperation.

Our reducing knowledge base and ever-increasing safety and environmental expectations have created a greater need for improved partnerships and technology sharing between the petrochemical industry and OEMs, distributors …even the EPCs. After all, isn't conflict our greatest risk?

Just in this past decade, too many tragic examples where we all failed have occurred. Deep down, we know that these incidents didn't need to happen, that some risk was either not identified or mismanaged and, as a result, everyone involved failed.

As the saying goes: Those that forget the past are condemned to repeat it. Going forth, if we can't agree on the right technical and sustainable solutions, poor decisions will be made… again. Unfortunately, users will be the ones living with that risk. VM

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Caution: Horizontal Stem Installation Ahead

BY GREG JOHNSON

When it comes to linear valve installations, gravity is our friend. The most common and preferred installation for these valves is to have the stem in the vertical position. This orientation, with an assist from the laws of gravity, aligns the stem to the disc and the disc to the body guides, which keeps everything in proper orientation throughout the open and closed cycles.

For this reason, it would be terrific if every linear valve could be installed in the stem vertical position; however, the realities of plant construction often dictate horizontal stem installation applications. So what is the big deal about valves laying on their sides, backs or bellies? Aren't they supposed to operate in all positions anyway? The answer is yes, no, maybe and it depends.

American Petroleum Institute (API) Standard 600, Steel Gate Valves, Flanged & Butt-welding Ends, Bolted Bonnets states that valves built to this standard should be capable of operating in all orientations. But sometimes that "operation" comes with a painful price in terms of operational valve damage.

The latest edition of API 600, published in January 2015, included additional requirements designed to help valves operate in the horizontal position. The language in paragraph 5.6.3 states:

> *The body and gate shall have guide surfaces to minimize wear of the gate seats during operation of the valve, to accurately position the gate throughout the travel distance to its seat, and to ensure the alignment of the gate and stem in all orientations without gate binding or galling. For sizes DN 650 (NPS 26) and above, as a minimum, wedge guides and body guides shall be hardfaced and machined with appropriate tolerances and clearances to allow for proper valve operation in any orientation, including the effects of wear or galling.*

The best orientation for most linear valves is with the stem vertical. Horizontal applications, especially in large valves, can sometimes cause issues.

THE COCK AND LOCK SYNDROME

The hardfacing will help. But it is not a 100% cure for the "cock and lock" syndrome in which a valve disc rocks within the guides during the opening cycle until the disc bites into the body guide area, locking the disc in place and keeping the valve from operating. In severe cases this cocking action can disorient the stem foot-to-disc connection and create so much stress that the stem can break off. This is especially an issue for hardened (and brittle) martensitic 410ss stems.

Because of differences in manufacturing techniques, the cock and lock syndrome as well as other issues related to stem and disc misalignment were rare to non-existent 40 years ago. Back then, plants building gate valves would generally cast the valve body guides well oversize and employ a machine tool called a "slotter" to plane the guides to precision dimensions as well as create a very smooth surface finish. Today, virtually all mass-produced commodity gate valves are made with "as cast" body guides. The cast guides are susceptible to a host of dimension-killing casting problems, which can render the already non-precision-machined body guides useless for keeping the disc snug and secure, and in perfect alignment during opening and closing cycles.

Pressure seal valves used in nuclear service are usually manufactured with precision-machined guides to ensure reliability during operation. Large outer diameter waterworks valves sometimes include special design features to enhance their horizontal operability. The predominant design uses rollers on the disc and body guide-ways that ensure free movement of the disc while on its side. Scrapers are also inserted ahead of the wheel path to ensure no debris gets under the wheels.

Although the cock and lock syndrome occurs when the stem is horizontal and the flow is also horizontal (the valve is laying on one side), stem horizontal and flow vertical applications can have problems as well. The same rough guides or misaligned cast guides can cause the disc to engage the body seats at an unfavorable angle, causing potential damage to either the seats or disc. Other problems such as mismatched inside diameters of body and bonnet castings can keep discs from moving at all when in the horizontal position.

Another major issue with horizontally aligned stems occurs because of improper machining or misalignment of components during the manufacturing process. While the great majority of the individual parts may meet design tolerances for each component, occasionally the individual tolerance offsets, when added together, can cause major misalignment issues. This issue really comes to the forefront when large valves have actuators installed. In this situation, there is no subtlety to the movement of the actuator-powered stem, and it will drag or push the stem through, over or around anything in its path. Even a slight misalignment with a backseat bushing easily creates a new linear gouge. Likewise, if a misalignment with the packing gland occurs, scratching can also happen. When stems are severely scratched, the valve has to be disassembled and the stem repaired or replaced. The valve also has to be retested. All these steps mean money out of someone's pocket.

Misalignment or binding of guides can cause catastrophic results, such as this stem snapped off at the backseat area.

A disc guide has dug into the valve body guide area, causing the disc to jam and the stem to break off.

AVOIDING PROBLEMS

The best way to ensure that the valve stem is properly aligned and not prone to gouging or scratching is to perform a manual, pre-actuation, open and close cycle test while closely examining the stem for defects as it moves up and down. This pre-test should be performed with the valve in the stem vertical position for the best possible alignment. If no visible damage is seen, then the actuator can be installed. If scratches occur, it is time to cease the actuation installation and determine what is out of alignment.

Today, many large valves are shipped from offshore manufacturing plants in crates lying in the horizontal position. This extended period of time on the ocean, with an eccentric load on the compression packing, can cause the stem to literally fall out of alignment by crushing one side of the packing. Where this problem really comes into play is in the realm of low-emissions valves. If the stem has deformed the packing because of an off-center, vibration-enhanced, four-week cruise in a box, there is very little chance that packing will provide much fugitive emissions containment.

End-users or owners ideally should communicate through the supply chain when a valve will be installed in the horizontal position. This can alert the manufacturer to take extra steps to confirm the horizontal operability of the valve or even have an outside facility test the valve in the horizontal position before delivery. For those actuating a large horizontal installation valve, the stem vertical manual pre-test should be considered. Additionally, the actuation process should be performed in the stem vertical position if at all possible.

For parties repairing gate valves 14 inches and larger, a close examination of disc and body guides is in order. If the valve owner indicates that the valve may be installed in the stem horizontal position, the guides should be hardfaced to prevent the dreaded cock and lock.

In an ideal valve world, the gate valve body guides would all be finish-machined and the tolerances would be tighter. The relational dimensions between yoke bushing, stem, stuffing box, body and bonnet also would be tighter, and actuators would all be mounted in the stem vertical position. However, in the real world, we have to be vigilant and not assume anything.

One fact is for certain: The cost to remove a large stuck gate valve from a plant pipeline can be very high because expensive riggers and a crane may be needed to remove the valve for repair. For this reason, taking a few extra steps and precautions before installation or during the repair process to ensure proper gate valve operation in all orientations may be money well spent. VM

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Changes in EU Directives Affect Distributors—and Manufacturers

BY MIKE NORMAN

The European Union's (EU) New Legislative Framework (NLF), which was set forth in 2008, has sharpened the focus on importer and distributor responsibilities as they relate to importing or placing CE-marked (European Conformity) products on the market. This focus is reflected in the recasting of several EU directives that affect the valve and equipment industries, including Pressure Equipment Directive (PED) 2014/068/EC and Equipment for Potentially Explosive Atmospheres (ATEX) Directive 2014/034/EC.

Along with product manufacturers, importers and distributors are subject to specific obligations in the context of "market surveillance" (a term used in Europe that means monitoring products to ensure they conform to the law).

BACKGROUND

Since 1987, more than 27 EU product directives have come into force. These directives have the dual purpose of: 1) ensuring the free movement of goods through technical harmonization (alignment of safety objectives) of entire product sectors; and 2) guaranteeing a high level of protection and safety.

This new way of doing things (which is called the New Approach and Global Approach) was a unique and bold change to previous European methods for issuing product safety regulation. As such, it hasn't been without significant challenges during the implementation.

The New Approach and Global Approach Directives changed the product compliance world by introducing several new regulatory undertakings including:

- Harmonization of safety objectives by all European Economic Area (EEA) member states through risk-based development, rather than prescriptive solutions
- Technical harmonization of product safety through industry-developed product standards
- Recognition of private, third-party conformity assessment bodies (called Notified Bodies) for assessment of higher risk products
- Application of CE Marking on products to identify compliance with EU Directives
- Application of EEA structures for monitoring products placed on the market or put into service in the EEA under the EU Product Directives

After EU Directives were first adopted in 1987 and the new approach had been implemented for several years (including CE Marking and some recasting of initial EU Directives), the EU Commission reviewed the purpose, impact and effectiveness of the system. The result is the revision of the system, which is now commonly referred to as the NLF.

Industry trade associations, conformity assessment bodies, national authorities and the EU Commission technical working groups provided feedback. The feedback addressed variations between member states in regards to enforcement, assessment irregularities between notified bodies and inconsistencies in the technical application of EU Directives. In 2008, as a result of the EU Commission review, the European parliament adopted two regulations that affect the new approach directives. The primary focus of those rules was to:

- Strengthen the value of CE marking
- Put emphasis on member state control of notified bodies
- Strengthen market surveillance (including defining the roles for different parties)
- Align the conformity assessment modules of the global approach system

The first rule was Regulation 765/2008/EC, effective Jan. 1, 2010. The purpose was to provide a common framework for accreditation of conformity assessment bodies within the EU and set the framework for monitoring products in the European market (market surveillance). This was done to guarantee that those products meet requirements, thus ensuring a high level of protection of public interests.

Simply put, the intention of the common framework for accreditation from conformity assessment bodies, including notified bodies, is to reduce disparity and deviations of practices between those bodies.

The framework for monitoring products by all member states was strengthened to clarify responsibilities, follow up on complaints, and monitor accidents and damage to health that these products might cause, as well as verifying corrective actions and following up on notification of dangerous products.

The second rule was Decision 768/2008/EC—A Common Framework for the Marketing of Products in the EU—which also affects future revisions of new approach directives. Decision 768 sets out common principles and procedures that EU legislation must follow when harmonizing conditions for marketing products. It also includes reference requirements that are to be incorporated whenever product legislation (regulations or directives) is revised.

Included in the new directives are clear divisions of responsibility for manufacturers, importers and distributors along the product chain. For example, the directives require that manufacturers (the legal entity taking responsibility for the product) must follow the appropriate conformity assessment procedures and ensure products comply with relevant directives. They also must place the CE marking on the product.

Importers are the economic operators established in the European Union that place a product from a third country on the EEA market. The importer must ensure the manufacturer has correctly fulfilled obligations under the EU market requirements. In particular, they must ensure the manufacturer has complied with the appropriate conformity assessment procedure and the product is accompanied by the necessary documentation and CE marking. If the importer has doubt about the conformity of the product, it cannot place that product on the market.

Distributors are the parties in the supply chain other than manufacturers or importers that make a product available on the market. Distributors need to know which products require CE marking and what documentation must accompany the products. They also must act with due care (perform due diligence) and verify the product has the necessary documentation and CE marking. Distributors must be able to identify the importer or party that provided them with the product. This is required so that market surveillance authorities have a traceability chain for compliance.

The EU Commission published the 2016 edition of The Blue Guide on Implementation of EU Product Rules in April. This guide clarifies roles and many other issues related to CE marking and EU directives. It is available as a free document from the EU Commission (go to http://ec.europa.eu/DocsRoom/documents/16210).

Table 3.4: Translation from the DSD to CLP (Flammable (Liquids))

DSD	F +; Extremely Flammable R12	F; Highly Flammable R11	F; Flammable R10*		
* Substances classified as F; Flammable (R10) will be Group 1 if the intended maximum allowable temperature is above its flashpoint.					
PED	Classified as 'Group 1' fluid under PED				
FP °C	≤ 0	0 - 21	21 - 23	23 - 55	55 - 60
CLP	**Flammable Liquids***				
	Category 1	Category 2	Category 3**		

* As discussed further in Annex 1, the demarcation between Category 1 and 2 flammable liquids also takes account of the boiling point. Nevertheless, extremely flammable liquids (R12) under DSD will generally become Category 1 flammable liquids under CLP

** Substances classified as a Flammable Liquid, Category 3 will be a Group 1 fluid if the intended maximum allowable temperature is above its flashpoint.

IMPACT ON THE VALVE INDUSTRY

The good news for the pressure equipment and valve industries is that the technical requirements, which are known as essential safety requirements, have not been changed for the PED or ATEX—the two directives of most concern to those industries. This means technical solutions adopted for compliant products today will remain acceptable when the new directives go into force.

One of the most significant changes in PED affecting the equipment industry relates to the fluid grouping of media contained under pressure. The Classification, Packaging, and Labeling (CLP) Regulation replaced the Dangerous Substances Directive (DSD) 67/548/EEC effective June 1, 2016 for PED.

Flammable liquids in the PED are now defined, and that definition is aligned with the CLP, as depicted in Table 3.4 above from the European Commission Impact Assessment Study.

The conformity assessment modules for PED have seen very minor changes that will have no practical impact on manufacturers. Modules A1 and C1 have been changed to A2 and C2. Also, the notified body's assessment activity is unexpected visits at random intervals. During these visits, the notified body establishes that the manufacturer actually performs final assessment and takes samples of the product to perform checks.

Modules B (EC Type Examination) and B1 (EC Design Examination) have been renamed Module B, with product and design examinations carrying the same 10-year validity and requirements for retention of technical documentation.

The significant change for implementation of the new PED is a sharp transition date (which means no grace or transition period). Products placed on the market or put into service before July 19, 2016 must be declared compliant with 97/23/EC; however, after that date all pressure equipment must be declared compliant with 2014/068/EC.

For manufacturers operating under quality management system surveillance (Modules D/D1, E/E1, H/H1), the manufacturer's declarations and technical documentation must reference Directive 2014/068/EC after July 19, 2016. However, the notified body's certificate can still reference the old directive until the expiration date.

All technical documentation files for equipment supporting compliance with PED must be updated to reflect the new PED. Manufacturers should have this completed by the July 19 implementation date.

Manufacturers also should understand that article 48 of the PED identifies that equipment manufacturers certified according to 97/23/EC before the implementation date for 2014/068/EC remain valid after the new directive goes into force. However, this point may require clarification with customers and end users expecting certificates according to the new directive.

For the ATEX directive (2014/34/EC), the transition date to the new directive was April 20, 2016. As with the PED, this is a sharp transition date and all equipment placed on the market or put into service must be declared in conformance with the new ATEX directive. Also, just as with PED, equipment manufactured and certified to 94/9/EC before April 20, 2016 has to remain valid after the new directive goes into force. VM

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Give Your Flow Meter a Happy Home

BY RON DAVIS

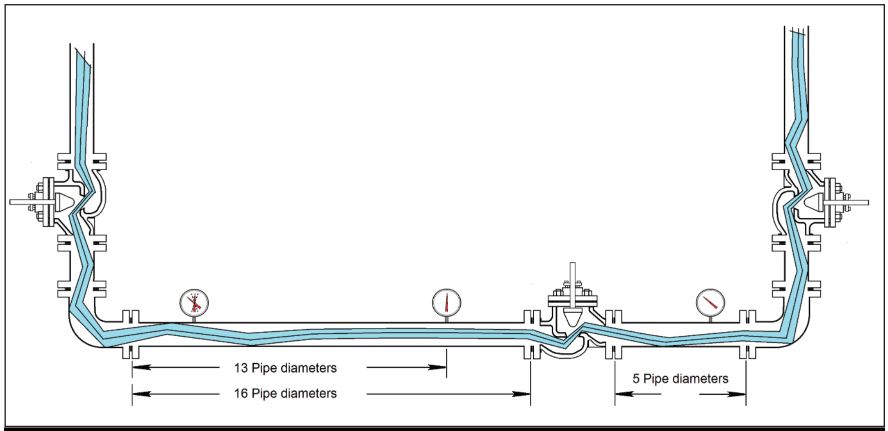

Figure 1. Control valve installed after an elbow

Increased emphasis on the need to improve process performance and reduce variability mean many control loops today are optimized. This is done through digital adaptive control and predictive control algorithms in distributed control systems or programmable logic controllers. These advanced control routines make it easy to linearize control valve performance and get the most out of assets. They do not, however, guarantee accurate and repeatable input values from all the primary measuring instruments. That's why when measuring flow, one of the easiest and most economical ways to ensure that process improvements are what we expect is to make sure our flow devices have a happy home. Let me explain:

Flow meter manufacturers, in accuracy statements for volumetric flow measurement technologies, assume an ideal, fully developed flow profile at the meter inlet. This ideal flow stream is a symmetric, swirl-free, turbulent flow profile. The actual shape of the velocity profile is determined by the viscosity of the fluid, the pipe wall roughness and the Reynolds number. Flow technologies, such as orifice, vortex, ultrasonic and turbine meters, have the same requirements.

A less-than-ideal velocity profile is one that is distorted in some way. For example, a flow stream may have a fully developed profile, but after passing through a 90° elbow, the stream might change, having two counter-rotating vortices and an asymmetric or distorted velocity profile. This nasty, unpredictable flow profile may take 50 pipe diameters of straight pipe to reconcile. Flow distortion can introduce error into the flow rate measurement.

Besides elbows, other common sources for these disturbances are tees, pipe reducers and expanders, but the worst offender is a modulating control valve.

Even control valve performance can be affected by flow disturbances. The ISA Handbook of Control Valves, 1976 shows a control valve installed after an elbow. The recommended spacing shown in that handbook is 16 pipe diameters after a 90° elbow. The requirement is five pipe diameters after the valve before the next elbow (Figure 1).

This critical spacing ensures a steady inlet pressure and flow shape at the control valve. If these are not stable and consistent, flow control will be erratic and the valve pressure drop will be unpredictable.

The recommended straight pipe run required for a flow meter downstream of a control valve is even greater. Several volumetric flow meters require 30-50 pipe diameters. These meter technologies include: orifice flange union, venture, averaging pitot tube, vortex meter, ultrasonic flow meter and turbine meter.

Differential pressure (orifice) meters derive flow rate by taking the square root of the pressure drop created by the orifice.

A non-ideal flow profile would cause unpredictable, nonlinear differential pressures across the plate. The actual amount of error created can range from -2 to +5%, depending on plate design, tap locations and beta ratio. Since the error is not easy to define and isn't always repeatable, it is very important to give the flow meter a happy home. Both the accuracy and repeatability will be unpredictable because of the erratic pressure and flow profile.

For other flow technologies, including vortex, turbine and ultrasonic, meters report flow based on measuring fluid velocity. The method each of these meters uses to measure velocity and calculate flow will vary significantly, yet each one requires the same ideal flow and pressure profile for accurate meter results. The following equation shows that the orifice flange union flow is dependent on pressure drop. If the pressure drop is unstable, so is the reported flow value.

$$Q = K\sqrt{\frac{DP}{S.G.}}$$

Q = Volumetric Flow
DP = Differential Pressure
S.G. = Specific Gravity
K = Meter Factor

$$Q = VA$$

Q = Volumetric Flow
V = Fluid Velocity
A = Area

Single-point insertion meters (Figure 2), pitot tubes and even thermal mass meters are vulnerable to this issue because they read or measure flow at a specific depth relative to the pipe wall. They reside in a velocity region that represents an average velocity of the flow stream. If the flow profile is skewed, the meter will read falsely high or low depending on the distorted shape of the flow stream.

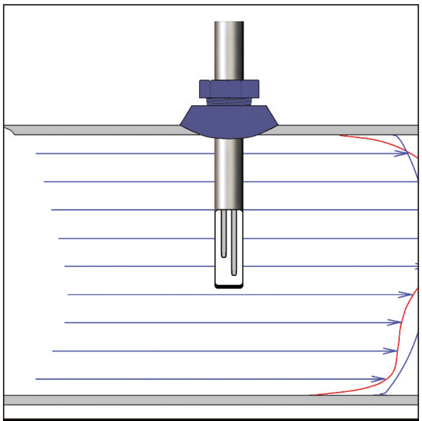

Figure 2. An example of a single-point insertion meter

If it is impossible to provide the recommended 20, 30 or more pipe diameters of straight pipe, flow conditioners can be used. These devices, sometimes called flow straighteners (Figure 3), insert into the pipe upstream of the meter and help to restore the ideal flow profile within a much shorter pipe run.

REYNOLDS NUMBER

Another concern related to flow profile is the Reynolds number, which is a non-dimensional number that defines if a stream is laminar or turbulent. At laminar flow, the Reynolds number is 2000 and below, the flow stream is dominated by viscous forces, and the flow profile is parabolic-shaped. It's as if the profile was laminated or flowing in layers. In the center of the flow stream, fluid velocity is very high compared to the velocity closer to the pipe wall, and the velocity profile changes dramatically as flow increases.

At turbulent flow, the Reynolds number is 4000 and above, and dynamic (inertial) forces dominate the flow profile causing the fluid to mix in a way that the velocities are the same across most of the pipe area. The flow profile "squares up": The fluid velocity and profile is uniform across a large cross-section of the pipe and doesn't change much as velocities increase except for the boundary layer very near the pipe wall. As fluid moves from laminar to turbulent flow (which is called transitional flow), it becomes very unstable. Its behavior will jump from laminar to turbulent at random. Most flow meters have poor repeatability if operating in this range.

Many users also assume their meters will maintain accuracy and linearity throughout the entire flow range, which is not necessarily the case. For example, vortex meters have a low-flow cutout for this reason. Below turbulent flow, they do not measure at all. Orifice plate users often have a low flow (cutout) point where they artificially linearize the transmitter output from some low-flow value down to zero.

SOLVING THE PROBLEM

If your process acts unpredictably during certain process flow conditions, these areas may be places to solve the problem.

Is the meter in a "transitional flow regime" (fluid velocity is between laminar and turbulent flow)?

Solution: This problem may not be solved if the flow meter technology has a minimum Reynolds number limitation. Consider using a smaller flow meter that can improve the measurement at lower flow rates. In extreme cases, place a second meter in a small bypass line to measure low flows. This solution is only reasonable if, for example, there are seasonal low flow scenarios such as summer vs. winter steam flow rates, which requires diverting the entire flow stream to the bypass line for a season then back to the larger line when demand increases.

Are the flow rates unusually low and possibly below turbulent flow condition?

Solution: If the flow rates are consistently low for the meter size, consider using a smaller flow meter entirely. This will improve the ability to measure at lower flow rates. If these low flows are intermittent, a "low flow cutout" can be configured in the flow meter electronics or in the control system. The flow rate can be set to zero at a minimum flow rate, or a linear output from the flow meter beginning at a minimum flow value to zero can be imposed.

Are flow measurement problems experienced intermittently?

Solution: Intermittent problems are often related to a distorted flow profile (downstream of an elbow, tee or control valve). If that is the case, consider moving the flow meter to another location having additional straight pipe upstream or move the meter completely upstream of the flow disturbance instead of downstream.

These problems cannot be solved with "self-tuning/auto-tune" control algorithms. However, knowing how the flow meter is intended to be used will provide an understanding of whether or not that meter is capable of providing what is expected. VM

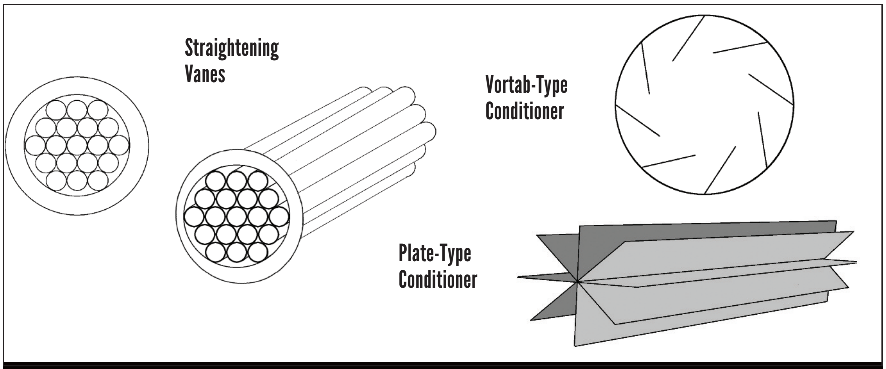

Figure 3. Examples of flow straighteners

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New Test Standards for Low-E Compliance

BY RODNEY ROTH

Creating practical, unified standards for qualifying and testing valves has been a constant struggle for the industry as it seeks to meet the fugitive emission requirements established by the U.S. Environmental Protection Agency (EPA).

The initial response by industry came from the American Petroleum Institute (API) when it added better defined and more stringent requirements as part of the 2011 edition of API 622 (Type Testing of Process Valve Packing for Fugitive Emissions.) At that time, a major change to the standard removed an allowance for performing the emissions test with packing installed into a valve.

This change, along with provisions addressing API 622 packing tests for fugitive emissions to be performed only in a fixture, created the need and opportunity for API to develop the API 624 valve type testing standard (Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions). API 624 was published in 2014 and became a mandatory requirement within API 600 (Steel Gate Valves—Flanged and Butt-welding Ends, Bolted Bonnets) and API 602 (Gate, Globe, and Check Valves for Sizes DN 100 [NPS 4] and Smaller for the Petroleum and Natural Gas Industries).

In addition to API 600 and API 602, industry expects that API 623 (Steel Globe Valves—Flanged and Butt-welding Ends, Bolted Bonnets) and API 603 (Corrosion-resistant, Bolted Bonnet Gate Valves—Flanged and Butt-welding Ends) also will have to comply with API 624 when the documents are republished by the API in the near future.

API 624 and API 622 are connected because valves tested and certified to API 624 must have packing that meets the requirements of API 622. Currently, an API task group is working on updating and better defining changes so that the two standards align more closely.

The petroleum industry has been working on low-emissions standards in several different areas, including packing and valve type testing for qualification.

Because API 624 compliance will be mandatory as part of API 600 and API 602, creating products to meet the requirement, as well as to meet other global emission standards, means packing and valve manufacturers should work closely together on reviews of their respective products. This collaboration will facilitate meeting low-emission (Low-E) performance and complying with changes in industry design codes for valves.

THE REVIEW PROCESS

Reviews for all components of a valve intended for Low-E applications should include required testing, effective tolerances and cost-effective packing installation procedures.

The review process also should study stem finish, bushing material choice, packing style, torque processes and proper lubrication of the gland flange bolting as well as the potential need to make valve design changes. Valve designs must be reviewed to better understand how potential changes might affect valve performance and effectiveness once the valve is in the hands of the end user.

All of these variables differ from manufacturer to manufacturer. In considering them, the industry needs to look beyond the basics of product design to more intricate details such as assembly procedures performed within the manufacturing process to achieve the API 624 Low-E compliance. Even more importantly, these details may need consideration under EPA consent decrees for end users with enhanced leak detection and repair programs (leakage no greater than 100 ppm for five years).

In addition to valve design considerations, packing installation processes must be reviewed and defined so that the installations are correct, efficient and effective. Valve manufacturers' and packing manufacturers' engineering groups can work closely together to define the installation process and create step-by-step written instructions to be followed. Once this has been done, valve manufacturing personnel must receive hands-on training to ensure effective sealing and Low-E warranty compliance. Moreover, the development effort does not end with training the manufacturing staff. End-user personnel and valve repair/replacement shop personnel must also receive hands-on instruction to create best practices for required maintenance procedures.

Once a joint effort is made to properly define and certify what packing should be used and what changes must be made to valve designs or manufacturing practices, the packing and valve manufacturers must monitor each other for consistency in the production of their respective products. This continual sharing of information between the two bodies will ensure any new technologies in valve or packing manufacturing that are implemented are up to date with end-user requirements. These requirements might include:

- A valve capable of achieving low emission (leakage less than 100 ppm) should be easy to operate manually (350N).
- On/off valves should require minimal maintenance over the course of a plant's life cycle.
- The equipment should meet both current and future EPA compliance requirements but not be cost prohibitive.
- It should meet global testing initiatives such as those for the International Organization for Standards or TA-Luft (Germany's air pollution requirements).

END RESULT

The ultimate goal is to be able to provide exactly what the industries we serve require and need. With regard to valves, that means:

- Valves capable of passing the required testing protocol to be certified as a Low-E valve
- Valves capable of achieving Low-E with minimal maintenance between unit turnarounds
- Five-year warranties as defined by currently active consent decrees, consent decrees now under negotiation or those being issued by the EPA
- Valves capable of handling variability in service conditions (such as mechanical cycles and thermal cycles)
- Multiple valve types that are capable of meeting Low-E compliance

With a strong working relationship in place between packing manufacturers and valve manufacturers, Low-E compliance can be achieved whether the valves are new, used or modified. This is best achieved when the two parties have the capability and willingness to transfer and share pertinent information (including new technologies) via constant and open communication. VM

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www.pdcvalve.com

QTRCO, Inc.
Tomball, TX
www.qtrco.com

REXA
West Bridgewater, MA
www.rexa.com

Richards Industries-Valve Group, Inc.
Cincinnati
www.jordanvalve.com

Rotork Controls, Inc.
Rochester, NY
www.rotork.com

- **Centork**
  Rochester, NY
  www.centork.com
- **Flow-Quip, Inc.**
  Tulsa, OK
  www.flowquip.com
- **K-TORK Actuators & Controls**
  Dallas, TX
  www.rotork.com
- **Remote Control**
  N. Kingstown, RI
  www.rciactuators.com
- **Roto Hammer Industries, Inc.**
  Tulsa, OK
  www.rotohammerinc.com
- **Rotork Controls Canada Ltd.**
  Calgary, Alberta, Canada
  www.rotork.com
- **Rotork Controls Canada Ltd.**
  Mississauga, Ontario, Canada
  www.rotork.com
- **Rotork Gears**
  Houston
  www.rotork.com
- **Rotork Instruments**
  Winston-Salem, NC
  www.rotork.com
- **Rotork Process Controls**
  Milwaukee
  www.rotork.com
- **Valvekits**
  Broken Arrow, OK
  www.renfroassociates.com

R.S.V.P. Actuators & Controls
Hempstead, TX
www.rsvpactuators.com

Score Valves
Edmonton, Alberta, Canada
www.scorevalves.com

Spirax Sarco, Inc.
Blythewood, SC
www.spiraxsarco-usa.com

- **Spirax Sarco Canada Ltd.**
  Concord, Ontario, Canada

Total Valve Systems
Broken Arrow, OK
www.totalvalve.com

Townley Engineering & Manufacturing Company, Inc.
Candler, FL
www.townley.net

UniTorq Actuators & Controls
Duluth, GA
www.unitorque.com

Val-Matic Valve and Mfg. Corp.
Elmhurst, IL
www.valmatic.com

ValvTechnologies, Inc.
Houston
www.valv.com

Velan Valve Corporation
Montreal, Quebec, Canada
www.velan.com

Victaulic
Easton, PA
www.victaulic.com

Weir Valves & Controls-USA
Ipswich, MA
www.weirvalveusa.com

Western Valve, Inc.
Bakersfield, CA
www.westernvalve.com

WEY Valve
Nettleton, MS
www.weyvalve.com

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PM International
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www.pmfirst.com

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www.res-co.com

Setpoint Integrated Systems
Baton Rouge, LA
www.setpointis.com

Sunbelt Supply Co.
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TRIFLOW Corp.
West Berlin, NJ
www.triflowcorp.com

Wolseley Industrial Group
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www.wolseleyindustrialgroup.com

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www.americanfoundry.com

Auge Industrial Fasteners
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www.augeusa.com

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LaFox, IL
www.bitorq.com

Balluff, Inc.
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www.balluff.us

BelleFlex Technologies, LLC
Ford City, PA
www.belleflex.com

Bradken-Engineered Products
Chehalis, WA
www.bradkenamericas.com

EGC Enterprises, Inc.
Chardon, OH
www.egcflexiblegraphitesolutions.com

Engis Corporation
Wheeling, IL
www.engis.com

The Flexitallic Group, Inc.
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www.flexitallic.com

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Palmyra, NY
www.garlock.com

Highland Foundry Limited
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www.highlandfoundry.com

Jet-Lube Inc.
Houston
www.jetlube.com

Key Bellevilles, Inc.
Leechburg, PA
www.keybellevilles.com

Krytox® Performance Lubricants
Wilmington, DE
www.krytox.com

Matrix Metals LLC
Richmond, TX
www.matrixmetalsllc.com

MW Industries
Rosemont, IL
www.mw-ind.com

Omaha Steel Casting Co.
Wahoo, NE
www.omahasteel.com

Precision Polymer Engineering, Inc. (PPE LLC)
Houston
www.prepol.com

Saint-Gobain Seals
Garden Grove, CA
www.seals.saint-gobain.com

Scientific Linings & Coatings
San Antonio
www.weathercap.com

Siemens Industry, Inc.
Spring House, PA
www.usa.siemens.com

Sigma Corporation
Cream Ridge, NJ
www.sigmaco.com

Solon Manufacturing Co.
Chardon, OH
www.solonmfg.com

Teadit North America
Pasadena, TX
www.teadit-na.com

Technetics Group
Columbia, SC
www.technetics.com

TST Coatings
Sun Prairie, WI
www.tstcoatings.com

VanAire, Inc.
Gladstone, MI
www.vanaireinc.com

Watson Grinding & Mfg.
Houston
www.watsongrinding.com

For information on joining the Valve Manufacturers Association, contact Bill Sandler at 202.331.8105 (wsandler@vma.org).

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www.globalfield.net

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www.candknorth.com

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www.classiccontrols.com

Cleveland Valve & Gauge/ Renew Valve & Machine Co.
Cleveland/Carleton, MI
www.clevelandvalve.com
www.renewvalve.com

Dayton Precision Services
Dayton, OH
www.daytonprecisionservices.com

Dowco Valve Company
Hastings, MN
www.dowcovalve.com

Eastern Controls, Inc.
Philadelphia
www.easterncontrols.com

Emerson Process Management - Fisher
Marshalltown, IA
www.fisher.com

Flotech, Inc.
Jacksonville, FL
www.flotechinc.com

Flowserve Corporation
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www.flowserve.com

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Point Comfort, TX
www.fpcusa.com

Furmanite
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GE Oil & Gas
Houston
www.ge.com

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  Alexandria, LA
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www.gulfcoastmod.com

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www.gulfcoastvalve.net

J&S Machine and Valve, Inc.
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Kirksey Machine
Houston
www.kirkseymachine.com

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www.metso.com

Midwest Valve Services, Inc.
Minooka, IL
www.mwvalve.com

NWS Technologies
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www.nwstechnologies.com

Pentair Valves and Controls
Stafford, TX
us.valves.pentair.com/valves

Pioneer Industrial Corporation
St. Louis, MO
www.pioneerindustrial.com

Precision Fitting and Gauge
Tulsa, OK
www.pfandg.com

Precision Pump & Valve Service
Charleston, WV
www.ppvs.com

Setpoint Integrated Solutions
Baton Rouge, LA
www.SetpointIS.com

Southeast Valve Inc.
Charlotte, NC
www.sevalve.com

Southern Valve Service, Inc.
Baton Rouge, LA
www.southernvalve.com

Thorco
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www.thorcousa.com

United Valve
South Houston, TX
www.unitedvalve.com

Universe Machine Corporation
Edmonton, AB Canada
www.umcorp.com

Valve Reconditioning Service Co.
Melvindale, MI
www.vrsinc.net

ValvTechnologies
Houston
www.valv.com

Wal-Tech Inc.
Mobile, AL
www.wal-tech.com

Watson Valve Services
Houston
www.watsonvalve.com

VRC ASSOCIATE MEMBER

Quality Valve
Mobile, AL
www.qualityvalves.com

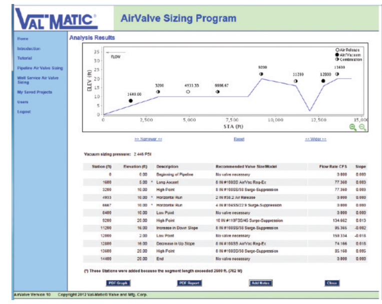
For more information on joining the Valve Repair Council, contact Marc Pasternak at 202.331.0104 (mpasternak@vma.org).

ASCO introduced ASCO Numatics Integrated Automation Solutions, customized assemblies of best-in-class electrical and pneumatic components designed to meet specific customer needs.

These compact, space-saving solutions incorporate Numatics directional control valves, air preparation products, fieldbus electronics and accessories, plus ASCO fluid control valves. They are produced in the U.S. by a factory-trained ASCO assembly team and are supported nationwide by the company's local field service.

Cowan Dynamics launched its E2H Series Electro-Hydraulic linear valve actuators. These actuators have been designed from the ground up to pack high performance into the smallest possible installation envelope. All hydraulic components and sensors are integrated into a single compact manifold block that also houses the actuator and integral oil reservoir. The control panel can be mounted directly to the manifold block or installed remotely. This self-contained actuator can be installed either vertically or horizontally and has no external piping.

Metso announced the latest addition to its comprehensive valve controller offering, the Neles NDX. The new valve controller offers accurate and reliable performance in a wide range of customer applications, regardless of industry or the brand of valves being used. The diagnostics provide up-to-date information on control valve performance, enabling improvements in process efficiency. Features include an easy-to-use performance view that summarizes control valve condition and performance on one page and the unique online valve signature that efficiently predicts the need for preventive maintenance.



Val-Matic released the AirValve Sizing Program, a Web-based software program designed to aid in selecting air valves along a pipeline. Users can enter and save design information specific to pump, water pipeline or wastewater force main to calculate the locations and sizes of American Water Works Association air valves. The program will calculate the collapse pressure, slope and gravity flow in the pipe. Recommendations are given for air valve locations, sizes and model numbers for pipeline and pump discharge locations.

ValvTechnologies introduced a fast-acting, high-cycle NexTech pulsejet valve with Eco-Pack stem packing solution for reducing fugitive emissions.

The valves are designed to send a pulse of gas through a pipeline system. The pulsejet valve is a trunnion-mounted ball valve capable of 90- or 180-degree rotation in speeds as low as 0.5 seconds or faster: this fast actuation speed is what creates the gas "pulse" through the pipeline system. Pulsejet systems can be used to clean system filters, spray chemicals in an injection type system, or pulse debris/media through a pipeline to prevent clogging.

Emerson Process Management launched the Enardo 850/950 series of wirelessly-monitored pressure vacuum relief valves (PVRVs), which provide safety and emissions control by managing the pressure in storage tanks in the oil and gas, chemical, petrochemical and pharmaceutical industries.

The pressure in storage tanks fluctuates from changes in temperature, liquid level or both. A PVRV opens and closes in response to these pressure fluctuations to ensure that safe pressure levels are maintained. However, because these PVRVs are located on the top of storage tanks, they are difficult to monitor. Emerson's new wireless solution enables immediate response to prevent problems related to safety, emissions and the quality of a tank's content.

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Weir unveiled the new SPM 2.0 valve and seat for well stimulation pumps used in shale plays. Designed and manufactured from premium-grade materials and processes, the valve and seat encompasses a one-piece design, proprietary polymers and innovative geometry.

Validated through extensive testing to perform two times longer, the SPM 2.0 valve and seat is a vital component in helping oil and gas companies maximize return on investment by delivering longer operational service life and increasing pumping hours.

DeZURIK/APCO/Hilton introduced a new high-pressure combination air valve, the ASU-CAV. This single body, combination automatic air valve features an innovative design for clean or dirty services that delivers a wider operating range and minimal maintenance. The ASU-CAV is ideally suited for clean or dirty service applications in mining, petrochemical, water treatment, reverse osmosis and high pressure (150-300 psi) wastewater.

The lightweight, low-profile design operates without linkages to assure proper operation and increased durability.

ADVERTISER Index