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# VALVE

MAGAZINE | WINTER 2016  
VOL. 28, NO. 1

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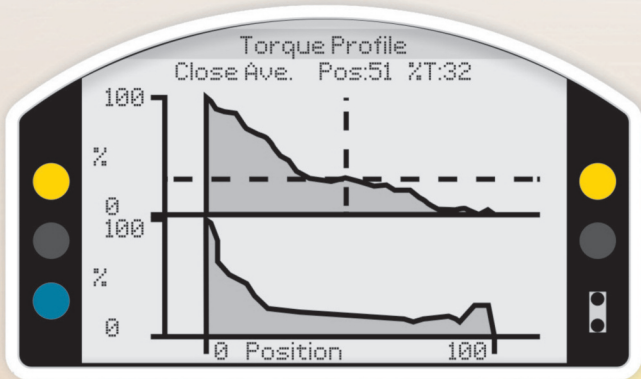
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What you might not know about Luc is that he might just be one of the last men on the planet who refuses to have a TV in his house.

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# 12 WHERE VALVES ARE USED Offshore Oil Extraction and Transportation

Valves and other equipment that face the challenges of the sea also must meet a wide variety of standards and regulations. The need for high quality products for use in this industry has expanded and continues to grow.

BY GREG JOHNSON

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This critical category of equipment is responsible for the safety of people and property in many applications. Understanding what's available is crucial to choosing the right devices.

BY MOHAMMAD A. MALEK

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Most people have accepted the reality that the world's infrastructures are in danger of attack. The key to dealing with the issues is for companies to plan and prepare their own employees.

BY KATE KUNKEL

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Many people have misconceptions about what testing for valve leaks shows and which standards they should follow. The place to begin understanding the complexities is to know the differences between the different tests and standards.

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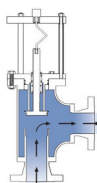
PRODUCTS



- Stem Extension Offerings
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### BACK TO BASICS: Pressure Relief Devices (Part Two)

In this issue of VALVE Magazine, part one covers reclosing devices. On VALVEMagazine.com, part two addresses the nonreclosing-type devices that ensure safety by remaining open.

- » How to Winterize Your Valves
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# A Successful 2015 Thanks to Volunteers



## The Valve Manufacturers Association of America (VMA)

has always been blessed with an exceptional volunteer base. My colleagues at other associations have told me that it sometimes takes them weeks to put together a committee of three. Here at VMA, if I put out a call for a new committee project, at least five people come forth in just a few hours. This volunteer base, as well as our 15-member Board of Directors (who are also volunteers), has made 2015 another successful year both in continuing programs and new initiatives. Here's a sample:

**Seminars and Workshops** — In 2015, VMA provided membership with eight different workshops and seminars. The programs for these events were developed by member company volunteers from all four categories of membership: manufacturers, suppliers, distributors and repair facilities. New to 2015 was a Human Resources Seminar (see below). In addition to providing programming guidance, many members also served as presenters or panelists at these meetings.

**Valve Magazine and Online Editorial** — The majority of the articles that appear in the magazine you are holding as well as our online sites are provided by our membership. A simple call or email nets someone volunteering to develop an article to share with our reader base. We are fortunate to have their expertise to add quality to these valuable information resources. In addition, many of the articles not written by membership are suggested by members. In 2015, we developed an ongoing column covering the new category of membership, distribution.

**Education** — Because of its popularity and value, the VMA Valve Basics Seminar was expanded to three days in 2015. In addition to being developed by members, this biannual seminar is taught exclusively by volunteers from our membership. The associated "petting zoo" is also run and taught by volunteer "zookeepers."

**Careers Initiative** — Last year we introduced a new Valve Careers Initiative to encourage young people in high school, community college, technical schools and other educational avenues to look at the valve industry for their future. Volunteers from our membership developed the program and the written materials, as well as the new Human Resources Workshop. The Board of Directors has already approved funding to carry this initiative into the new year with even more momentum and ideas on how to reach this valuable audience.

We are blessed to have so many people helping us to accomplish our goals. I hope both VMA members and readers of this magazine will continue to provide valuable input by giving us suggestions for activities that can be valuable to the valve industry and articles they'd like to read. Please feel free to contact me directly at [wsandler@vma.org](mailto:wsandler@vma.org). **WM**

**Bill Sandler**

*President, Valve Manufacturers Association of America*

# We Can Help You Cope With Fugitive Emissions Issues

**Fugitive Emissions Testing**

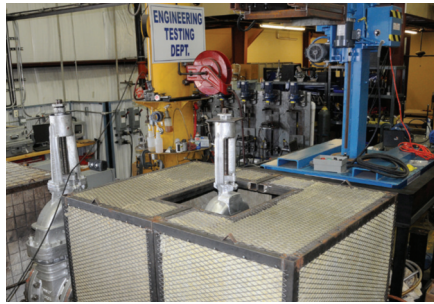
**Fugitive Emissions Re-Packing**

**“Low E” Repaired Valves**

**Packing Systems Evaluation**

*United Valve offers a variety of testing capabilities and valve upgrade services to help meet your fugitive emissions compliance goals.*

United Valve has one of the largest and most comprehensive fugitive emissions testing facilities in North America. The facilities are housed in a new 45,000 sq. ft. 40-ton crane-served engineering testing and valve repair building annex. We offer quick turnaround on FE tests with four large testing units that can handle valves up through 12” class 1500 and 24” class 150 and five smaller test units for API 602 valves. All tests are operated and monitored via our proprietary control system hardware and software. The United Valve engineering testing department is actively supervised by two staff engineers.



United can perform fugitive emissions tests per API 622, API 624, ISO 15848-1, 15848-2 or any custom or end-user test specification. In addition to the actual testing, we can provide complete metrological analysis of valve components before or after testing. Our staff can also assist your company with valve packing selection assistance, packing performance evaluation, and propose corrective actions if required.

We provide “Low-E” valve repacking services on both new and repaired valves of all sizes and pressure classes. In addition to installing a certified low emissions packing, we monitor and record all key dimensions to insure that the valve and packing will work together to provide a low emissions solution. If required, production tests with Methane or Helium can be performed on these valves as well.



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## NEW CONTRACTS

### Curtiss-Wright Teams with Furmanite for UK Expansion

Curtiss-Wright's Industrial Division announces that its Farris Engineering business has entered into an agreement with Furmanite in the UK. Furmanite will represent the Farris line of spring-loaded and pilot-operated pressure relief valves in England and Scotland. The company will act as a single point of contact for new pressure relief valve sales and after-market support as a Farris Authorized Service Team center.

### AUMA Supplying to San Francisco Water Projects

AUMA is providing more than 250 actuators to 30 individual projects as part of the Water System Improvement Program (WSIP) led by the city and county of San Francisco Public Utility Commission, one of the largest water infrastructure programs in North America.

WSIP is a major restoration initiative to upgrade a 100-year-old water supply system of reservoirs, treatment plants, valves and pipelines that stretch 150 miles east of San Francisco.

### Powell Valves Signs Distribution Partnership with Sunbelt

The Wm. Powell Company (Powell Valves) and Sunbelt Supply Co., a Floworks company, have entered into an agreement for distribution of Powell Valves in the Middle East countries of Saudi Arabia, UAE, Kuwait and Qatar.

Powell is aggressively seeking strategic interna-

tional channel partners to distribute its full product offering to global end-user customers. The recent agreement with Sunbelt Supply strengthens the company's international presence.

### Saint-Gobain Products Used for NASA Project

Saint-Gobain Seals will produce a cryogenic seal more than six feet wide for NASA's Space Launch System (SLS) project, which is commissioned for deeper space exploration—beyond low Earth orbit to an asteroid, Mars and other distant destinations. SLS' first mission, known as Exploration Mission 1 (EM-1), will go into space in late 2018.



This new large seal marks the continuation of Saint-Gobain Seals' collaboration on NASA projects, starting as far back as the Space Shuttle Program and

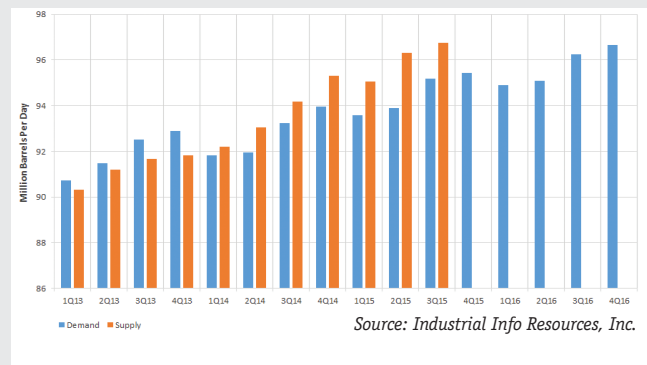
progressing with the International Space Station, Falcon 9 rocket, Atlas V launch vehicles, Delta IV Heavy rocket, Mars rover Curiosity and now the SLS project.

## MARKET FOCUS: REFINERY SPENDS GOING UP

Petroleum refiners in the United States and Canada are projected to spend about \$6.7 billion on new capital projects in 2016, according to Industrial Info Resources. Chris Paschall, vice president of global research for the petroleum refining industry for that company, said refiners have scheduled about \$1.3 billion of maintenance spending for the coming year. Scheduled refinery turnaround projects are also expected to rise after a sharp decrease in 2015, when refiners delayed projects to process the inexpensive crude oil that flooded the market.

Refiners are also preparing facilities to meet new U.S. Environmental Protection Agency rules, leading analysts to project capital spending on facilities will rise over the next three to five years. Also encouraging capital spending is cheap domestic feedstock and increasing exports of petroleum products from the U.S. to Asia.

The U.S. produced just over 4 million bpd in 2010; in early 2015 it produced nearly 10 million bpd. As a result, refinery utilization rates reached 92.6% and gasoline production increased to over 9.9 million barrels per day



even as inventories increased to a record high of 487 million barrels as of Dec. 25, 2015 (U.S. Energy Information Agency).

Paschall predicted that capital spending is likely to continue from 2017 to 2020, spurred by low oil prices and the requirement to meet more stringent condensate, naphtha, octane loss and Corporate Average Fuel Economy (CAFE) standards.

Retrofits may also be a source of capital spending as most U.S. refineries are tooled to process heavy, sour imported oil. However, there is an abundance of light, sweet oil from domestic shale resources that must be processed, and some refiners, especially on the Gulf Coast, are considering retrofits to take advantage of that oil.

### Rotork Selected for Energy Nuclear Plant

Following an in-depth modest integrity assessment, EDF Energy has approved Rotork IQ3 non-intrusive intelligent valve actuators for balance-of-plant applications within its nuclear power stations.

EDF Energy operates nuclear power stations around the world, including eight in the UK, where it hopes to build four more reactors at two sites. Balance-of-plant areas typically include the turbine hall, water treatment and cooling systems.

### CIRCOR Supplying Statoil Johan Sverdrup Development

Statoil has chosen CIRCOR Energy | Instrumentation products as part of a significant supply package awarded to MRC Teamtrade, a Norwegian unit of MRC Global Inc. The package consists of all tube products and a complete range of high-pressure valves and fittings.

Johan Sverdrup is one of the five largest oil fields on the Norwegian continental shelf. With expected resources between 1.7-3 billion barrels of oil equivalent, it will be one of the most important industrial projects in Norway over the next 50 years.

### Emerson Selected to Automate New Petrochemical Complex

Sasol has selected Emerson Process Management to help automate its \$8.9 billion petrochemical complex in Lake Charles, LA. The automation project is one of the largest in history awarded to Emerson.

When completed sometime in 2018, the

massive petrochemical complex will more than triple Sasol's chemical production capacity in the U.S. The complex includes an ethane cracker that will produce 1.5 million tons of ethylene annually, as well as six chemical manufacturing plants designed to convert the ethylene into a diverse range of chemicals.

### Curtiss-Wright Awarded BMW Contract for Actuators

Curtiss-Wright Corporation has entered into a multi-year agreement with German automobile manufacturer BMW Group to provide its Exlar brand of integrated, roller screw-driven electric actuators for use on robotic weld guns. Under the agreement, Curtiss-Wright will provide all required robotic weld gun actuators for two new facilities currently under construction in North America. The Curtiss-Wright facility in Chanhassen, MN is performing the work under this contract.

## AWARDS & MILESTONES

### Rotork Recognized with Most Admired Award

Rotork continues to hold the top spot in the Engineering & Machinery sector and has come in 10th place overall in Britain's Most Admired Companies 2015. The annual awards ceremony took place on Dec. 3 in London.

Organized by Management Today magazine, Britain's Most Admired Companies is now in its 25th year. Companies from

25 industries are graded across nine different criteria. These range from the firm's ability to innovate and the quality of its marketing to its financial performance and the strength of its management team.

### DeZURIK Honored by Two Top Projects Awards

DeZURIK is being recognized with two Top Projects Awards from Water & Wastes Digest magazine. The annual Top Projects Awards are selected to honor the industry's forward-thinkers and risk-takers, according to the publication. DeZURIK was presented with these two awards during a ceremony at the WEFTEC 2015 Conference & Exhibition.

One of the projects recognized was submitted by The City of Stevens Point WWTP/Stevens Point Brewery. The other project was the Narragansett Bay Commission in Narragansett Bay, RI.

### ITT Engineered Approved for Voluntary Protection Program

ITT Engineered Valves, LLC in Lancaster, PA has been approved by the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor for the Star Voluntary Protection Program (VPP).

Approval into VPP is OSHA's recognition of exceptional efforts of employers and employees who have implemented effective safety and health management systems and maintained injury and illness rates below national Bureau of Labor Statistics averages for their industry.

#### MARCH

### 9-11 VMA Technical Seminar & Exhibits

New Orleans  
www.vma.org

#### APRIL

### 19-21 VMA Valve Basics Seminar & Exhibits

Rosemont (Chicago), IL  
www.vma.org

#### MAY

### 2-5 Offshore Technology Conference

Houston  
2016.otcnet.org

#### JUNE

### 2-3 VRC Valve Repair Conference & Exhibits

Houston  
www.vma.org

### 7-9 Global Petroleum Show

Calgary, Alberta  
www.globalpetroleumshow.com

### 13-14 Fugitive Emissions Summit Americas

Houston  
www.fugitive-emissions-summit.com

### 19-22 ACE 16 Annual Conference & Exhibition

Chicago  
www.awwa.org

#### AUGUST

### 11-12 VMA Market Outlook Workshop\*

San Diego, CA  
www.vma.org

\*Open to VMA/VRC members only.

If you are interested in learning whether your company qualifies for membership in the Valve Manufacturers Association or Valve Repair Council, please visit [www.vma.org](http://www.vma.org) > About VMA.

# VALVE MAGAZINE

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gparente@vma.org.

## Technetics Group Awarded Communications Excellence

Technetics Group received a platinum and two gold awards at the 2015 MarCom Awards, an international competition for marketing communications professionals.

Technetics Group was recognized with a gold award for an article titled, "Spring-Energized Metal Seals Help Protect Equipment," published in the February 2015 issue of E&P Magazine. The company also received platinum and gold awards for videos covering its products and solutions for the aerospace and industrial turbine markets, respectively.

The MarCom Awards is one of the largest and most prestigious competitions of its type in the industry. Each year, it

receives 6,000 entries, with winners ranging from individual entrants to Fortune 50 companies.

## Watson Grinding Celebrating 55 Years

Watson Grinding & Manufacturing recently celebrated its 55-year anniversary. The company was founded on Nov. 4, 1960, by James L. Watson as a small grinding shop in his home garage. Today, the company is located in more than 84,000 square feet of facilities, which now include a full-scale machine shop offering specialty thermal spray coatings and an on-site metallurgical coatings laboratory. The company currently employs more than 125 people.

Watson Grinding has always been a family business, and today the company is owned and

operated by the founder's son, John Watson; son-in-law, Bob White; and grandson, Jason White. Kelly Watson, granddaughter, joined the company in 2011. James Watson passed away on Nov. 28, 2014.

## Victaulic Honored with International Business Award

Victaulic was recognized by the International Business Awards for its foundry worker safety coat. The BOGU coat, named after the Japanese word for "armor," was developed to offer improved molten metal splash protection as well as enhanced comfort and breathability.

Nicknamed the Stevies for the Greek word for "crowned," the awards were presented to winners at a gala awards banquet at the Ritz-Carlton Hotel in Toronto on Oct. 23.

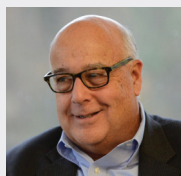
## PEOPLE IN THE NEWS

### AUMA ACTUATORS,

**INC...** After 23 years as president, **Sam Bennardo** retired on Dec. 29, 2015. Throughout his presidency, Bennardo created a family-like atmosphere for his employees, grew market share and was dedicated to business goals and customers.

**Matthew Thiel**, who joined AUMA in February 2015 as executive vice president, has assumed the responsibilities and role of president. Previously, he worked for an instrumentation company that sold products in the oil & gas, power and water markets.

**ARI-ARMATUREN USA...** has appointed **David Melcher** as president/CEO. He previously served as senior vice president of sales and marketing. **John Fain**, former president/CEO has moved to a role as Special Projects, due to health reasons.



Bennardo

The company has also named **Erik Heck** as vice president, operations. Heck has served ARI-Armaturen and its former partnership, AR Safety Systems, since 2010 as general manager of the manufacturing facility in Houston.

**FURMANITE...** President & CEO **Joseph E. Milliron** retired from his position after the Team, Inc. acquisition was announced. Milliron will continue as a member of the Furmanite Board of Directors. **Jeffery G. Davis**, Furmanite's interim executive chairman of the board, will assume additional responsibilities as interim president and CEO of Furmanite.

**SPIRAX SARCO...** **Shaun Lindley** has been appointed as vice president of sales. He assumed his role on Oct. 1, 2015 and is responsible for all sales activities in the U.S. Prior to joining Spirax Sarco, Lindley held a number of sales positions in the Newman Hattersley and IMI's CCI severe service valve manufacturing business.

## MERGERS & ACQUISITIONS

### GE Oil & Gas to Acquire Advantec

GE Oil & Gas has agreed to acquire Advantec, a provider of subsea intervention equipment and services. Advantec will operate under the existing name and management team as part of GE Oil & Gas' Subsea Services & Off-shore division.

Advantec is headquartered in Stord on the west coast of Norway. The two companies were expected to complete the transaction by year-end 2015, subject to regulatory approvals.

### Schlumberger-Cameron Union Receives Unconditional Clearance

Schlumberger Limited and Cameron International Corporation jointly announced that the U.S. Department of Justice has cleared their proposed merger without any conditions, granting early termination of the waiting period required by the Hart-Scott-Rodino Antitrust Improvements Act of 1976.

The closing of the merger remains subject to approval by Cameron stockholders and the satisfaction or waiver of the other closing conditions contained in the merger agreement.

### Furmanite Acquired by Team Inc.

Team, Inc. and Furmanite Corporation announced that the boards of directors of both companies have unanimously

approved a definitive merger agreement under which Team will acquire all of the outstanding shares of Furmanite in a stock-for-stock transaction valued at about \$335 million.

The companies expect the merger to bring in an estimated \$20 million to \$25 million in annual cost synergies within two years of closing. Before synergies, Team expects the transaction to contribute about \$400 million in annual revenue.

### KITZ Acquires Brazilian Valve Manufacturer

KITZ Corporation of Japan has acquired Metalúrgica Golden Arts or MGA (Rua Cetulio Vargas, 496, Bairro Renovacao, Veranopolis RS, Brazil), a ball valve manufacturer in Brazil. The acquisition follows agreement on the transfer of ownership between its founder and business partners, the current owners of the company, and KITZ. The contract was finalized on Oct. 16, 2015. The newly acquired company will continue to operate as MGA.

### Emerson Acquires IntelliSAW Business

Emerson has acquired IntelliSAW Inc., a provider of systems that protect electric power transmission and distribution equipment by measuring and monitoring temperature, humidity and partial discharge using advanced sensor and analytic technologies. The

CORRECTION: In the Fall 2015 issue of VALVE Magazine, the word "could" was inadvertently omitted from the article "Power Plant Isolation Valves Beat the Heat." The sentence, which appeared at the top of the first column on page 33, should have read: "For vents and drains seldom operated, this is not a problem; but for continuous process applications, service issues **could** arise." While the print edition went out before the error was detected, the verbiage is correct in the digital edition ([www.valvemagazine-digital.com](http://www.valvemagazine-digital.com)).



□ Powell Valves' state-of-the-art facility in China

IntelliSAW product line will become part of Emerson's Rosemount portfolio.

Founded in 2011, IntelliSAW is located in Andover, MA.

## NEW FACILITIES

### Saint-Gobain Seals Installs New Automation

Saint-Gobain Seals has installed a new automation machine at its Willich, Germany site. Adding this new equipment allows the business to assemble the OmniSeal brand of spring-energized seals in large quantities.

As one of 14 Saint-Gobain Seals global manufacturing sites, the Willich site has been in operation for almost 100 years and was one of the first importers of PTFE from the United States.

### Metso Opening New Valve Service Center in Sweden

Metso is opening a new service center specializing in process valve and field equipment solutions in Gothenburg, Sweden. The investment supports the company's strategy to grow its service capabilities globally. The 5,600-

square-foot (1,700-square-meter) facility comprises a valve service center, Metso sales office and training facilities. The center also will play a key role in supporting Södra Cell's Värö pulp mill expansion project.

Metso's valve technology centers and valve production facilities are located in Finland, the United States, Germany, China, South Korea, India and Brazil.

### Powell Valves Completes Infrastructure Investment in China

The Wm. Powell Company (Powell Valves) recently completed the third and final phase of a new state-of-the-art manufacturing facility in China. Powell now has cryogenic cleaning capabilities in both Orangeburg, SC and Yancheng City, China.

Phase one consisted of constructing a new 400,000-square-foot (37,161-square-meter) manufacturing facility; phase two was machinery and test equipment upgrades; and the third and final phase was construction of a 6,000-square-foot (557-square-meter) cryogenic cleaning facility.

# 2016 VMA Technical Seminar Focuses on Safety/the Environment

Keeping industry operations safe and protecting the environment will be on the minds of those who attend the 2016 VMA Technical Seminar, Exhibits & Tour. Speakers are experts in those two areas as well as officials from the regulatory agencies that keep watch over the nation's industrial operations.

The event is March 9-11 at Harrah's New Orleans Hotel, New Orleans, LA.

Leading off the conference is keynote speaker

**Douglas**

**Morris**, chief of Offshore Regulatory Programs, Bureau of Safety and Environmental

Enforcement, who will bring attendees up to date on his agency's latest regulations and regulatory initiatives aimed at improving safety in offshore oil and gas.

The technical seminar is designed for mid- to senior-level managers and engineering and technical personnel who deal with valves, actuators and related equipment in their daily professions.

The event offers a day-and-a-half of technical sessions and includes a tabletop exhibit showcasing wares of interest to manufacturers and end users. The theme of safety and the environment was chosen by VMA's technical committee. It's carried through sessions that include:

**Mike Chaudron**, executive director of sales, DNV GL Business Assurance, will talk about what has gone

into developing safety management, where those systems are today and what managers need to know about how to deal with these systems.

**Li Li**, senior health safety environmental technical specialist, Fluor Enterprises, Inc., will address the role valves play in safe operation of hazardous chemical facilities and outline what happens during a Hazard and Operability analysis.

**Stephen Treichler**,

mechanical services manager, BASF Corporation, presents his views on what users' expect concerning supplier technical support in a lean engineering culture and what issues are vital today in valve selection, hazard analysis and other aspects of the petrochemical industry.

**Afton Coleman**, FIELD-VUE SIS product manager, Emerson Process Management, will give a presentation on advantages and challenges for High Integrity Pressure Protection Systems.

**Dr. M.S. Kalsi**, founder, Kalsi Engineering & Nimish Jagtap and senior consultant for Kalsi Engineering, will focus on safety concerns in light of the Deepwater Horizon oil spill and the Fukushima-Daiichi nuclear accident.

**David Bayreuther**, vice president of Engineering for Metso Automation, USA, Flow Control, will address how consent decrees have made low-emission sealing technology a requirement and where that sealing is in terms of standards for testing.

**Henri Azibert**, techni-



□ Harrah's New Orleans Hotel & Casino

cal director, Fluid Sealing Association, will address compression packing and how it has been affected by increasingly stringent sealing needs.

**Mike Shorts**, vice president and general manager for Triangle Fluid Controls Ltd., will talk about new gasket technologies and their role in meeting tougher performance requirements.

**Jay Cameron**, P.E., HSB Global Standards, Codes & Standards, Home Office, will address non-traditional manufacturing methods and materials and case exceptions to the ASME Boiler & Pressure Vessel Code.

**Mike Norman**, director of Product Assurance, DNV

GL Business Assurance, will present an update on the EU's new approach system and its impact on the European directives such as the pressure equipment directive.

**Carlos Davila**, product manager-Americas, Crane ChemPharma/Energy, will address the latest development with U.S. industry standards.

**Rick Faircloth**, senior technical consultant-Engineering, Cameron Valves & Measurement, will focus on supply chain management for upstream operations.

Both attendees and exhibitors will find additional information and online registration at: [VMA.org](http://VMA.org) > Meetings > Technical Seminar & Exhibits

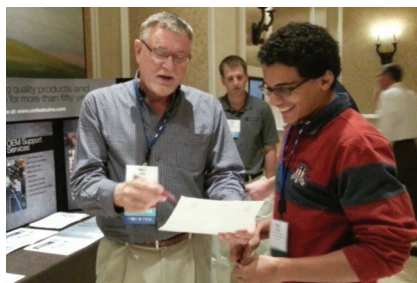
## FIRST NEW MEMBER OF 2016

The Valve Manufacturers Association welcomes **TST Coatings** ([www.tstcoatings.com](http://www.tstcoatings.com)) of Sun Prairie, WI, as its newest associate member. TST delivers engineered coating solutions to many of the world's leading OEMs, for diverse applications across a broad array of industries. The company was incorporated in 1992 as a separate business unit under The Fisher Barton Group. TST and Fisher Barton's original coating work grew out of collaborative graduate work with the University of Wisconsin-Madison.

## Next Valve Basics is April 19-21

Nearly 1,500 people have already benefited from VMA's highly rated Valve Basics Seminar, and that list will grow April 19-21 when the next event is held. April's session will be at the Embassy Suites Chicago O'Hare, Rosemont, IL.

Valve Basics is now a three-day event with day one introducing attendees to the valve and actuator industry and explaining different types of valves and actuators such as multi-turn, check, quarter-turn and pressure-relief valves as well as hydraulic, pneumatic and electric actuators. Day two covers solenoid valves, and control valves and systems. In addition, a "Valve Petting Zoo" is held on the second day so that attendees can get up close to valves and actuators and see first-hand how they operate. Day three takes attendees to the next level of understanding by introducing them to materials, fugitive emissions issues, critical service applications, data asset



☐ Instructor Greg Johnson (left), United Valve, speaks with one of the M.E. students who attended a past seminar thanks to a VMA scholarship.

and management, and valve repair.

In addition to the sessions, a tabletop exhibit is held on the first day that allows vendors who sell or provide services to valve, actuator and control manufacturers and end users to explain what they do and what they offer.

Attendees may opt to attend all three days, the first two days (Valves 101) or just the last day of 201-level courses.

For information and to register, go to [www.vma.org](http://www.vma.org) > Valve Basics.

## OTC 2016 Will be Bigger than Ever

The Offshore Technology Conference is the place where energy industry experts gather to discuss and study the latest technology in the oil and gas industry with the purpose of advancing scientific and technical know-how in the field. More than 94,700 attendees from 130 countries came to last year's event and even more are expected this year in Houston May 2-5. The event is held at the NRG Park (formerly called Reliant).



The event offers a detailed technical program that covers a wide range of topics related to offshore energy from issues regarding the latest in marine robotics and other technologies to regulations and standards and how they affect the industry to safety and environmental issues.

The exhibit hall is over 695,000 square feet including outdoor exhibits, and last year more than 2,680 companies showed their wares. The exhibit hall is open for four full days.

OTC has been growing since its inception in 1969. Last year, the conference expanded its offering to include d5, an event a day after the regular conference designed to bring together experts in production and exploration to discuss new ideas and innovations. This year's d5 is May 6.

For information, go to [www.otcnet.org](http://www.otcnet.org).

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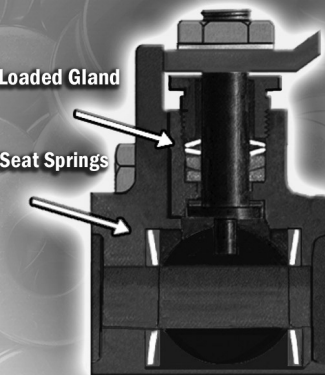
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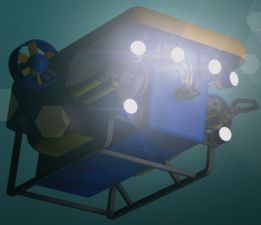
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Oil and gas equipment that's deep under the sea faces some of the most significant challenges on the planet.

# Offshore Oil Extraction and Transportation

BY GREG JOHNSON

Offshore oil facilities come to the forefront of our thinking these days only when a catastrophic accident occurs aboard a platform or other facility. That's because they are generally out to sea and out of sight. It's difficult to comprehend the varied and complex piping systems that allow a rig or a drill ship to operate successfully and safely, but they're an integral part of what's happening every day. These piping systems contain a multitude of valves built to multiple specifications to handle a variety of flow control challenges. They also control various system loops and contain pressure relief devices.

## THE SYSTEMS

The arterial heart for oil production is the oil or gas recovery piping system. Although not always on the platform, many production systems also use "Christmas trees" and piping systems that operate in inhospitable depths of 10,000 feet or more. This production equipment is built to a myriad of exacting American Petroleum Institute (API) standards and are referenced in several API Recommended Practices.

## Executive Summary

**SUBJECT:** Although the drop in prices has slowed forward momentum in the oil and gas industry, the crude we get from oceans and seas will always be a vital part of the world's energy system. The valves and components used on platforms and ships face tough environmental conditions. They also must meet a unique set of standards and regulations.

### KEY ISSUES:

- The components of offshore systems
- Challenges the equipment faces
- Which bodies and standards regulate the components
- What valves are used today

**TAKE-AWAY:** The need for high quality valves and new materials and technologies will only increase.

The drill platform or drill ship contains all of the normal trappings of an onshore oil well drilling and gathering system. However, the components, including the valves, also must have the capability to withstand the harsh corrosive salt air and water environment in which they operate. Besides having this capability, weight and size are often key valve selection criteria, depending on the application.

The crude or natural gas piping systems found on production platforms and ships are considered part of the "upstream" and "midstream" categories of the industry. [To review: Upstream is all the equipment (piping and valve-wise) from down in the drill hole to the choke on the wellhead. The choke is a regulating valve and usually the last flow control element on the Christmas tree). Midstream is everything from the choke to the refinery fence, while downstream is everything inside the fence and throughout the refinery.]

All of the wellhead valve designs are covered in upstream documents such as API 6A, Petroleum and Natural Gas Industries-Drilling and Production Equipment-Wellhead and Christmas Tree Equipment. On most large platforms, additional processes are applied to the raw fluid coming from the wellhead. These include separating water from the hydrocarbons and separating gas and natural gas liquids from the fluid stream. These post-Christmas-tree piping systems are generally built to ASME B31.3 piping codes with the valves designed in accordance with API valve specifications such as API 594, API 600, API 602, API 608 and API 609. Some of these systems may also contain API 6D gate, ball and check valves. Since any pipeline on the platform or drill ship is internal to the facility, the strict requirements in API 6D valves for pipelines do not need to be followed.

Although multiple valve types are used in these piping systems, the type most frequently chosen is the ball valve. The lightweight and relatively small footprint of this type of valve for isolation service helps greatly in the space-starved confines compared to a type such as gate valves. Ball valves also help with the weight-conscious

environs of the offshore structure. An important consideration in these cases is on-site repairability because the facilities are separated from on-shore repair shops by many miles of water.

### COMPACT VALVES

The already smaller ball valve designs were reduced even further in the early 1990s with the advent of compact-style valves. Before these compact design ball valves, the top-entry API design ball valve was a popular choice for offshore isolation service.

The compact valves are designed and built by reducing end-to-end dimensions, providing OEM-specific end connections, changing construction detail parameters and circumventing design standards such as API 608 and API 6D. The design and stress calculations of each valve are performed by the valve manufacturer. Since they do not comply with API or the American Society of Mechanical Engineers (ASME) standards, the purchaser is responsible for accepting the manufacturer's valve design and supporting design data as suitable for the service conditions.

These valves have found acceptance in the offshore field because of their reduced size, weight and design modularity. Because offshore production facilities are populated by many modular manifold systems, the design of the compact valve works well for these types of piping systems. On a floating drilling ship, where every pound of weight requires a matching pound of buoyancy, the valves have received very broad acceptance. The compact design principles are also used to build ball valves with two distinct ball and seat sets encased in one body.

In addition to ball valves, the compact design philosophy has been used for other types such as check valves. They are built with a variety of end connections, including butt-weld ends, ANSI flange adapters, threaded union and hub-type ends.

In addition to the ball valves in isolation service, more and more butterfly valves are used. These include both the lower-pressure elastomer or rubber-sealed types as well as the high-performance triple offset designs. One of the drawbacks of high-performance

butterfly valves is that they can be more difficult to repair on-site than ball valves.

### VALVE MATERIALS

Valve materials for offshore applications have to take into consideration the harsh, salt-laden environment, as well as corrosion issues encountered in hydrocarbons. To counter the ambient corrosive effects, heavy exterior coatings are applied to the piping systems. Austenitic stainless steels such as 316 and 316L are used in these systems since they are resistant to the saline atmosphere. They also can help resist fluid corrosion situations such as sour gas.

Plain carbon steels are still popular as well. One of the most common combinations of ball valve materials is WCB or A105 steel with either stainless-steel trim or electroless nickel plating on the valve trim. Higher strength materials such as 17-4 PH are used when additional component strength is needed. Since many ball valves are at the top end of the feasibility size range for floating ball valves, grease fittings are sometimes supplied. This is to allow for infusion of a lubricant to reduce the friction and coincidental higher opening torque.

Oftentimes the hydrocarbons may contain levels of hydrogen sulfide ( $H_2S$ ), also called sour gas. In high-enough concentrations, this fluid can be both highly corrosive and deadly. Protection of lives and property in these situations requires  $H_2S$ -resistant materials as specified in the NACE International specification MR0175/ISO 15156-1, Petroleum and Natural Gas Industries-Materials for use in  $H_2S$  Containing Oil and Gas Environments in Production.

A key component of gas and oil processing system piping is the emergency shutdown system (ESD). This component is the means by which the oil and gas processing system is made safe in the event of an emergency. The ESD employs a variety of key emergency shutdown valves to stop flows through the various lines. These valves are fire-safe and are often controlled by spring-loaded actuators.

### FPSO AND FLNG SHIPS

One of the trends today in offshore

production is the use of Floating Production, Storage and Offloading (FPSO) ships. These vessels are frequently converted from tankers or purpose-built from scratch. An FPSO looks like a small refinery sitting on the deck of a ship, oftentimes containing a flare system rising high above the deck. The production piping systems on an FPSO are called topsides. Since the FPSO takes over many of the operations that might be handled on a rig structure,

such as oil, gas and water separation, the same material requirements apply to the piping and valves onboard those FPSOs.

The topside oil and gas processing equipment is designed and constructed in accordance with API and ASME offshore and refinery standards. However, the standards must take into account the movement of the vessel caused by ocean conditions. Additional loadings from wave action can be

considerable and have a serious effect on the fatigue life of the piping systems. Since many of the systems are built in modular subassemblies, compact and lightweight valves are often chosen.

The cold-blooded second cousin to the FPSO is the Floating Natural Gas (FLNG) ship. The FLNG is a complete floating liquefaction unit built into a ship. The unit converts natural gas into Liquid Natural Gas (LNG) which is then offloaded to LNG tankers for delivery to other locations and gasification. FLNGs are heavily laden with piping and valves, and have the additional caveat of low-temperature piping and valve requirements as the liquefaction process operates at temperatures down to  $-260^{\circ}\text{F}$  ( $-162^{\circ}\text{C}$ ). Because of this, extended bonnet butterfly, ball, gate and globe cryogenic valves are often used.

## TYPES OF OFFSHORE FACILITIES

Many types of offshore oil and gas production structures exist. The choice of which the production company uses is based on economics, which are in turn based on water depth, projected field lifespan, and whether the equipment must be reused, to name a few. All of these structures are loaded with piping and valves. The FPSOs and FLNG ships are especially valve laden.



**Fixed Platform**—The fixed platform is a solid design with fixed length or limited adjustment height control. The fixed structure is limited in depth of water (DOW) to what can be built in the shipyard and transported to the proposed drill site via ship or barge. Fixed platforms are not nearly as popular as they once were because of the facility's one-use status (lack of mobility) and the expense of decommissioning the structure should it need to be abandoned.

**Jackup**—Jackups are the most common type of offshore drilling rig. They are usually comprised of a floating barge and a main drilling structure with legs that are jacked down to the ocean floor, causing the drilling structure to rise above the waves. Because they make solid contact with the bottom, their useable DOW is limited.

**Semisubmersible**—The operating deck of a semisubmersible sits high above the waves on submerged pontoons. The drill structure is held in position by a system of anchors. These anchors are sometimes augmented by powered systems to help maintain position over the drill target. Semisubmersibles are used around the world in water depths up to 10,000 feet.

**Drill Ship**—Drill ships are basically oil rigs supporting equipment built into a ship. The drill ships are self-powered and completely independent. Like the semisubmersibles, drill ships are used in water depths of up to about 10,000 feet. They are able to stay in position through use of sophisticated GPS systems. Because they are mobile, they can move out of harm's way to avoid severe weather events or relocate to a new field when required.

**FPSO**—FPSOs handle many of the operations contained on a drilling platform, except for the drilling. These activities include oil, gas and water separation and preparing gas and water for injection. The FPSO also adds storage of about 500,000 barrels of oil. This on-site storage capability negates the need for long offshore product pipelines because the oil in the FPSO is offloaded into transit tankers as needed.

**FLNG**—An FLNG ship contains all of the necessary processing equipment to convert natural gas to liquid natural gas (LNG) and then offload the LNG to LNG tankers. The on-site capability eliminates the need for expensive undersea natural gas pipelines that would be laid from the well to the onshore liquefaction plant.

## UTILITY PIPING SYSTEMS

Offshore platforms and ships have an infrastructural piping system just like large onshore plants. These systems are critical to the day-to-day operation of the facility as well as its safety. The valves in these systems usually do not fall under API pipeline, production or process valve standards. In United States waters, they are covered by U. S. Coast Guard (USCG) or American Bureau of Shipping (ABS) regulations. These piping systems include any type of ballast-controlling piping, especially where there are direct outlets to the sea.

Fire protection piping systems are also critical in this case, and they are specialized for the offshore environment. The firefighting system on an offshore platform begins with a series of high-pressure pumps drawing seawater to fight a potential fire. The pumps spread water throughout the vessel or structure through a lattice of pipes and deluge nozzles. Popular materials for these systems are copper/nickel alloy (see Table 1).

While weight is an important consideration on any floating offshore facility, linear valves such as gates and globes are still used in many of these utility applications. Since space is also often at a premium on drill ships and FPSOs, the non-rising

**Table 1. Offshore Facility Utility Systems**

System	Usage
firewater	firefighting
seawater	wash-down, sanitation, firefighting, ballast
sodium hypochlorite	marine growth inhibitor in seawater lines
potable water	drinking & cooking
hydraulic oil	hydraulic equipment
compressed air	multiple uses
diesel fuel	generators, cranes
aviation fuel	helicopters

stem design is often employed for gate valves.

**ABS APPROVAL**

ABS divides shipboard piping systems into three classes—I, II & III, with class I the most critical. The piping code chart generally relates more critical classifications to valves in service as the operating temperature and pressure increase.

ABS has a process whereby it approves or validates piping components, including valves. The first step in the process is called the “unit certification.” The unit certification is for a particular valve or component used in a specific installation on a vessel. It is typically a one-time approval. An ABS inspector usually witnesses parts of the manufacturing process and then approves the component’s use for a particular project.

A more generic type of approval is the “product design assessment” (PDA). This is a generic approval that provides all parties with a “pre-approved” starting point that helps to reduce backlogs and expedite final approvals. The approval is given when an engineer or surveyor accepts the assessed item for a specific user and installation.

A “manufacturing assessment” (MA) is issued for each manufacturing facility. To earn an MA, a valid PDA is required along with satisfactory demonstration that the product can be consistently manufactured according to that PDA. If a product such as a valve has both a valid MA and PDA, it can be considered for ABS Type Approval. Having type-approved valves is very desirable for the manufacturer.

**COAST GUARD AND THE CFR**

Important U.S. government regulations for shipboard piping and valves are found in the Code of Federal Regulations (CFR), Title 46, Part 56. The primary valve regulations are located in Subpart 56.20 “Valves.” The USCG is the regulatory entity for these documents.

Resilient-seated valves that fall under USCG CFR regulations are required to pass stringent test procedures. These are similar to the fire testing requirements of API 607 and API 6FA, in that the valve, without its resilient seating components, must

still provide partial sealing in accordance with specific allowable leakage parameters. These parameters are based on whether the valves are installed on board the ship in vital systems or positive shutoff service.

The critical piping systems on offshore facilities and ships have to be robust enough to handle the harsh conditions encountered from the North Sea to the South Atlantic. The need for reliable high-quality valves in these systems is paramount.

Although the offshore industry may be running at idle for a while until the price of oil creeps back up, the future of much of our energy production lies below the sea floor. An armada of safe and productive offshore ships and facilities is vital to retrieve this black gold. ❧

**GREG JOHNSON** is president of United Valve ([www.unitedvalve.com](http://www.unitedvalve.com)) in Houston. He is a contributing editor to VALVE Magazine, a past chairman of the Valve Repair Council and a current VRC board member. He also serves as chairman of VMA’s Education & Training Committee, is vice chairman of VMA’s Communications Committee and is past president of the Manufacturers Standardization Society. Reach him at [greg1950@unitedvalve.com](mailto:greg1950@unitedvalve.com).

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# Introduction to Pressure Relief Devices

## Executive Summary

**SUBJECT:** Because of the jobs they've been assigned, pressure relief devices save lives and property. They accomplish the important tasks of guarding against catastrophic equipment failure in a wide variety of ways using many designs, materials and types of valves.

### KEY CONCEPTS:

- Pressure relief devices
- Challenges the devices face
- Codes and standards that apply
- What types of valves fit the bill

**TAKE-AWAY:** Those with responsibility for choosing and specifying pressure relief need to know the forces they face and the many options available today.

BY MOHAMMAD A. MALEK

When the pressure inside equipment such as boilers or pressure vessels increases beyond a specified value, the excess pressure may result in a catastrophic failure. To avoid that calamity, pressure relief devices are used at predetermined set pressures to protect the equipment by relieving the excess pressure (Figure 1).

Figure 1. A fire-tube package boiler protected by two safety valves



This is why pressure relief devices are known as the “last line of defense” for pressurized equipment. In large measure, accidents are caused when the pressure relief devices themselves fail to perform the function for which they are designed. Still, these essential devices are too-often ignored or not understood fully by the people in the industries they are designed to protect.

### A START

Pressure relief devices have been around since the 1600s. The general belief is that the French designer, Denis Papin, was the inventor of the safety valve, which he first applied to a digester in 1682. Papin kept this safety valve closed by means of a lever and a movable weight. Sliding the

weight along the lever kept the valve in place and regulated the steam pressure (Figure 2). The device spread to other applications throughout Europe.

In the United States, use of such devices was spurred by the 1,700 boiler explosions that resulted in 1,300 deaths from 1905 to 1911. By 1915, the American Society of Mechanical Engineers (ASME) published its first boiler code, Rules for Construction of Stationary Boilers and Allowable Working Pressures, incorporating rules for construction and installation of safety valves for boilers.

Since the introduction of that first ASME boiler code, many technological developments have occurred in the design and construction of pressure relief devices. Most jurisdictions in this country and Canada have adopted rules for pressure relief devices based on national codes and standards.

### CODES AND STANDARDS

Today, all pressure relief devices for set pressure of more than 15 psi are designed, constructed, inspected, stamped and certified in accordance with the ASME Boiler and Pressure Vessel Code. Each device is stamped with a certification mark, and one of the eight certification designators (Figure 3).

The eight certification designators under the ASME Boiler and Pressure Vessel Code Sections I through XII – 2015 Edition are:

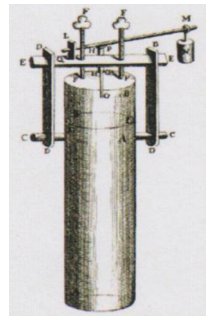
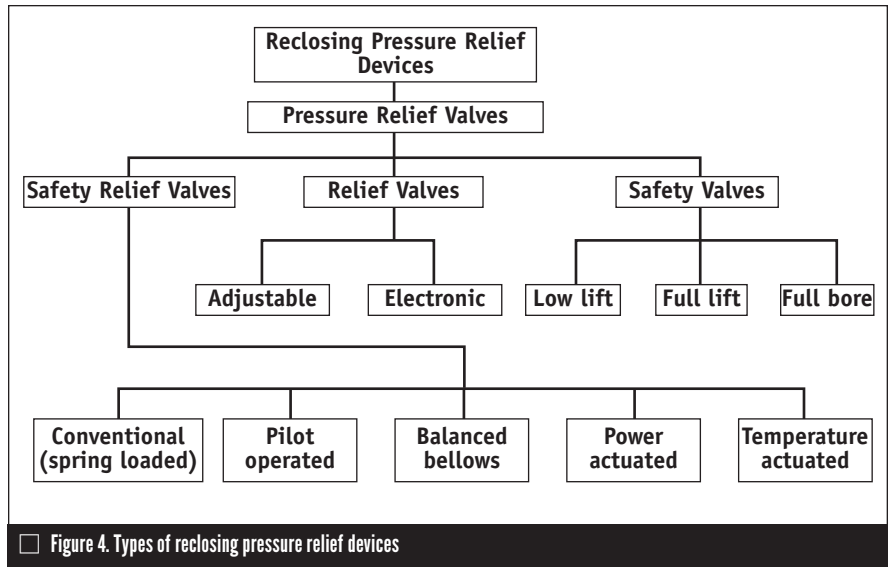


Figure 2. Early design of safety valve



Figure 3. Certification mark

- V** Safety valve for steam boilers
- NV** Safety valve for nuclear components
- HV** Safety relief valve for heating boilers
- UV** Safety relief valve for pressure vessels
- UV3** Safety relief valve for pressure vessels with more than 10,000 psi maximum allowable working pressure
- UD** Rupture disk for pressure vessels
- TV** Safety valve for transport tanks
- TD** Rupture disk for transport tanks



The ASME Boiler and Pressure Code exempted pressure relief devices that have set pressures less than 15 psi. These are known as non-ASME pressure relief devices, and they may be designed by using codes and standards other than ASME.

The performance of pressure relief devices is determined by ASME Pressure Test Code (PTC) 25-2014 Pressure Relief Devices. In addition, this code has standard definitions for the types and parts of pressure relief devices.

The American Petroleum Institute (API) has also published codes and standards for sizing, selection, installation and inspection of pressure relief devices. For example, API RP 520, Part I-2014 is widely used for sizing and selection of pressure relief devices in petroleum industries.

**TYPES OF DEVICES AND VALVES**

A pressure relief device is actuated by inlet static pressure. It is designed to open during emergency or abnormal conditions to prevent a rise of internal fluid pressure over a specified value or set pressure.

The devices are used on all types of pressurized equipment from water heaters to power generation equipment, and even in spacecrafts. The purpose of these devices is to protect a vessel against overpressure, though they also may be designed to prevent excessive internal vacuum. What they do not protect against is structural failure when the vessel is exposed to abnormal conditions, such as high temperature from fire.

Many types of pressure relief devices are available in the market today. The main types of pressure relief devices are: reclosing and nonreclosing pressure relief devices.

**Reclosing Pressure Relief Devices**

A reclosing-type pressure relief device is designed to close after operation. Types of reclosing pressure relief devices are shown in Figure 4. Pressure

relief valves are the only category of reclosing-type devices. (Nonreclosing devices include rupture disks and device pins. In Part 1 of this article we cover reclosing devices. For information on nonreclosing devices, see Part 2 on [www.VALVEMagazine.com](http://www.VALVEMagazine.com).)

The primary purpose of a pressure relief valve is to open to relieve excess pressure, reclose and prevent further flow of fluid after normal

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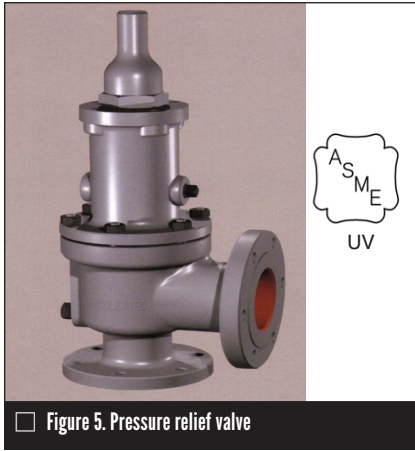


Figure 5. Pressure relief valve

conditions have been restored (Figure 5). A secondary purpose is to minimize damage to other system components through operation of the pressure relief valve itself. A pressure relief valve designed under ASME Boiler and Pressure Vessel Code is stamped with the certification mark, and one of the certification designators: V, NV, HV, UV, UV3 or TV.

Advantages of pressure relief valves are:

- They are reliable when properly sized and operated.
- They are versatile and can be used for many services.

The disadvantages of pressure relief valves are:

- The relieving pressure is affected by the back pressure (pressure that exists at the outlet of a safety relief valve).

COURTESY: GE OIL & GAS

- They are subject to chatter if built-up back pressure is too high.

The many types of pressure relief valves that exist are based on different designs and construction. Generally, they're classified as: safety relief valves, relief valves and safety valves.

A safety relief valve can be used for either a relief valve or a safety valve, depending on the application. Safety relief valves are classified as:

1. Conventional safety relief valve
2. Balanced bellows
3. Pilot operated
4. Power actuated
5. Temperature and pressure actuated
6. Conventional safety relief valves

A conventional safety relief valve is a spring-loaded pressure relief valve characterized by a rapid-opening pop action. Conventional safety relief valves are used for applications where excessive variable or built-up back pressure is not present in the system. The operational characteristics of these valves are directly affected by changes in the back pressure on the valve.

A conventional safety relief valve is shown in Figure 6. The basic elements of a conventional valve consist of:

- An inlet nozzle connected to the vessel or system to be protected
- A movable disk that controls the flow through the nozzle

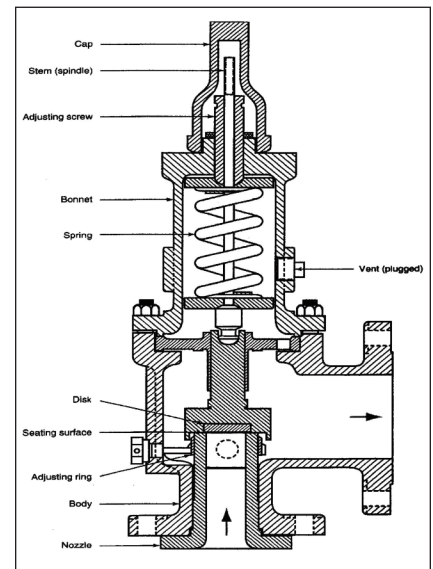


Figure 6. Conventional safety relief valve

- A spring that controls the position of the disk

The working principle of a conventional spring-loaded safety relief valve is based on the balance of force. The spring load is preset to equal the force the inlet fluid exerts on the closed disk when the system pressure is at the set pressure of the valve.

The disk remains seated on the nozzle in the closed position when the inlet pressure is below the set pressure. The valve opens when the inlet pressure exceeds set pressure, overcoming the spring force. The valve recloses when the inlet pressure is reduced to a level below the set pressure.

COURTESY: API RP 520 PART 1

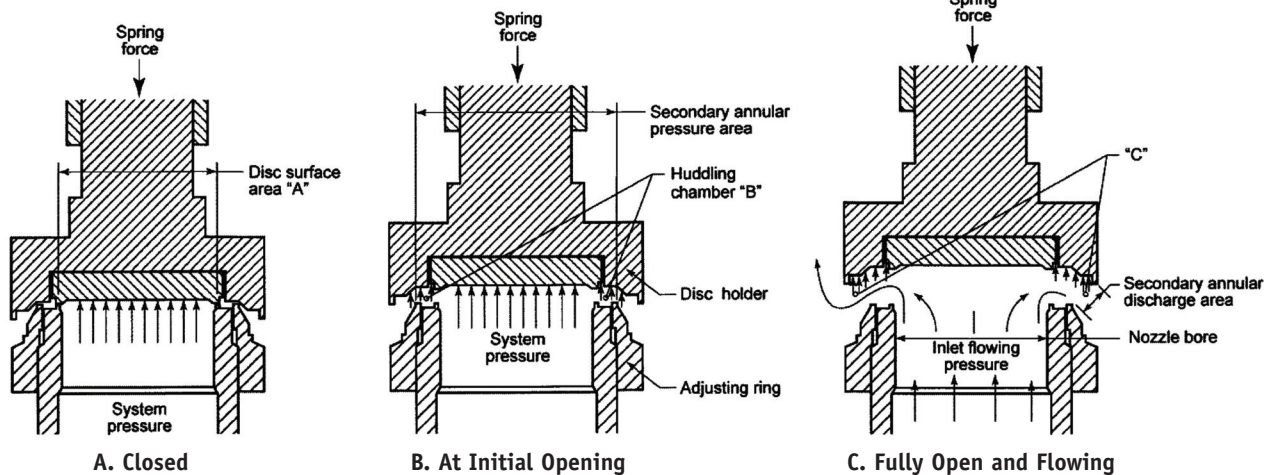


Figure 7. Working principle of safety relief valve

COURTESY: API RP 520 PART 1

Figure 7 explains the working principle of a spring-loaded safety relief valve. During normal operation, when the valve is closed, the vessel pressure is acting against the disk surface (area A), which the spring force resists. When vessel pressure slightly exceeds the set pressure, fluid will move past the seating surface into the huddling chamber B. The controlled pressure build in the huddling chamber will overcome the spring force, causing the disk to lift and the valve to pop open.

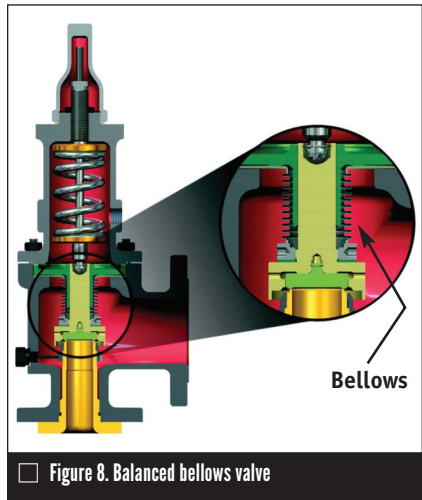
Once the valve has opened, an additional pressure buildup at C occurs. This additional force at C causes the disk to lift substantially at pop. The valve closes when the inlet pressure has dropped sufficiently below the set pressure. The pressure at which the valve resets is called the closing pressure. The difference between the set pressure and closing pressure is the blowdown.

In the design of a conventional valve, an important consideration is seat leakage. This leakage can result in continuous loss of system fluid and may cause progressive damage to the valve seating surface. Based on the seating material, conventional valves are classified as:

- **Metal-seated valves.** Metal-to-metal seats are commonly made from stainless or other hard alloy steels and are normally used for high-temperature applications such as steam and corrosive media applications for processing a wide variety of chemicals.
- **Soft-seated valve.** An alternative to metal is resilient disks that can be fixed to either or both the seating surfaces where tighter shut-off is required. They are common for gas or liquid applications. These inserts may be made from a number of different materials, but Vinton, nitrile or EPDM (ethylene propylene diene monomer) are the most common.

**Balanced bellows safety relief**

A balanced bellows safety relief valve is a spring-loaded pressure relief valve that incorporates a bellows to mini-



COURTESY, GE OIL & GAS

mize the effects of back pressure on the valve (Figure 8). The bellows offset the effects of variable back pressure, and seal process fluid from escaping to the atmosphere. They isolate the spring, bonnet and guiding surfaces from contacting process fluid.

When back pressure is variable and exceeds 10% of the set pressure, a balanced bellows safety relief valve is recommended.

The advantages of balanced bellows safety relief valves are:

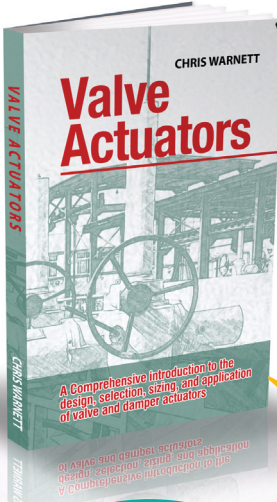
- The relieving pressure is not affected by the back pressure.
- They can handle higher built-up back pressure.
- They protect springs from corrosion.
- They have good chemical and high-temperature capabilities.

Balanced bellows safety relief valves are classified into two categories:

- **Balanced bellows.** This valve is the same as a conventional safety relief valve design except that a bellows has been added.
- **Balanced bellows with auxiliary balancing piston.** With this valve, the balanced bellows seal the body and fluid stream from the bonnet and working parts. The auxiliary balancing piston assures proper valve performance by compensating for back pressure in case the bellows fail.

**Pilot-operated safety relief valves**

A pilot-operated safety relief valve is a pressure relief valve in which the major relieving device is combined with and



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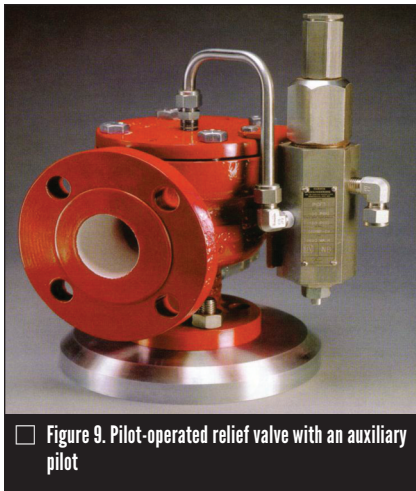
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Figure 9. Pilot-operated relief valve with an auxiliary pilot

controlled by a self-actuated auxiliary pressure relief (Figure 9).

The primary difference between a pilot-operated safety relief valve and a spring-loaded pressure relief valve is that the pilot-operated valve uses process pressure to keep the valve closed instead of a spring. A pilot is used to sense process pressure and to pressurize or vent the dome pressure chamber, which controls the valve opening or closing.

A pilot-operated safety relief valve consists of the main valve, a floating, unbalanced piston assembly, and an external pilot. The pilot controls the pressure on the top side of the main valve's unbalanced moving chamber. A resilient seat is normally attached to the lower end.

At below-set level, the pressure on opposite sides of the moving member is equal. When the set pressure is reached, the pilot opens and depressurizes the cavity on the top side so the unbalanced member moves upward, causing the main valve to relieve. When the process pressure decreases to a predetermined pressure, the pilot closes, the cavity above the piston is depressurized and the main valve closes.

Advantages of pilot-operated safety relief valves are:

- The valves' set pressure is not affected by back pressure.
- The valves operate bubble tight at higher operating pressure-to-set pressure ratios, allowing operators to run very close to the vessel's maximum allowable working pressure.

- There are reduced costs for the larger valve sizes.
- There is less susceptibility to chatter.

Pilot-operated safety relief valves are classified as follows:

*Based on type of moving members*

- A piston-type uses a piston for the unbalanced moving member.
- A diaphragm-type uses a flexible diaphragm to obtain a pressure seal for the dome volume instead of a piston and sliding piston seal.

*Based on type of pilots*

- A pop-action pilot causes the main valve to lift fully at set pressure without overpressure.
- A modulating-action pilot opens the main valve only enough to satisfy the required relieving capacity.

*Based on flow of pilots*

- A following-type pilot allows process fluid to flow continuously through the pilot when the pilot is open.
- A non-flowing-type pilot does not allow process fluid to flow continuously when the main valve is open.

**Power-actuated safety relief valves**

Power-actuated safety relief valves are valves in which the major relieving device is combined with and controlled by a device requiring an external source of energy.

Valve movement to open or close is fully controlled by a source of power such as electricity, steam or water (hydraulic). The valve may discharge to the atmosphere or to a container that is at lower pressure. The discharge capacity can be affected by downstream conditions.

Power-actuated safety relief valves are used mostly for forced-flow steam generators with no fixed steam or waterline. They are also used in nuclear power plants.

**T&P safety relief valves**

A temperature and pressure-actuated safety relief valve (also called a T&P



Figure 10. A T&P valve protecting the water heater

safety relief valve) is a pressure relief valve that may be actuated by temperature or pressure on the inlet side (Figure 10).

Such a valve is designed for dual purposes. First, the T&P valve prevents temperature within a vessel from rising above a specified limit (generally 210°F or 98°C). Second, the T&P valve prevents pressure in the vessel from rising above a specified value.

The valve incorporates two primary controlling elements, a spring and a thermal probe.

Generally, T&P safety relief valves are used for potable water heaters and heating systems.

**Relief valves**

A relief valve is actuated by inlet static pressure and a gradual lift that is generally proportional to the increase in pressure over opening pressure. Such a valve can be provided with enclosed spring housing suitable for closed discharge system applications.

Relief valves are commonly used in liquid systems, especially for lower capacities and thermal expansion applications. They also can be used on pump systems.

Relief valves are classified as follows:

- *Adjustable relief valves* feature convenient adjustment of the pressure setting through the outlet port. They are suitable for non-vented or vented inline

applications in chemical, petrochemical and high-purity gas industries.

- **Electronic relief valves (ERVs)** are pilot-operated relief valves that offer zero leakage. The ERV package combines a zero-leakage isolation valve with electric controls to monitor and regulate system pressure. These valves provide protection either in a capacity-relieving function or simply in an overpressure-protection application.

### Safety valves

The principle device used to prevent overpressure in steam plants is the safety valve. A safety valve for pressure relief generally has a working principle similar to that of a conventional safety relief valve. The safety valve is actuated by inlet static pressure and char-



Figure 11. Safety valve

acterized by rapid opening or pop action (Figure 11). A safety valve designed under ASME Boiler and Pressure Code Section I - Power Boilers is stamped with the certification mark and the certification designator V.

Safety valves are typically used for boiler overpressure protection and other applications such as downstream from pressure-reducing controls. These valves are installed wherever the maximum allowable working pressure of boilers is likely to be exceeded. Safety valves are also used for compressible gases, in particular for steam and air.

Safety valves are classified according to the lift. The term "lift" refers to the amount of travel the valve undergoes as it moves from its closed position to the position required to produce the certified discharge capacity.

Safety valves may be classified as low lift, high lift, and full lift, which affects the discharge capacity of the valves.

- **Low-lift** are safety valves in which the valve lifts a distance of 1/24th of the bore diameter.

Since the valve has a small lift, the capacity is much lower than other types.

- **High-lift** are safety valves in which the valve lifts a distance of at least 1/12th of the bore diameter. High-lift valves are used on compressible fluids, where their action is more proportional.
- **Full-lift** are safety valves for which the valve lifts a distance of at least 1/4th of the bore diameter. Full-lift valves are considered the best choice for general steam applications.

### Pressure relief valve accessories

Pressure relief valves have a number of accessories vital to their operations including:

- **Test gags** are used to hold the safety valve closed while equipment is subjected to a hydrostatic test. To avoid damage to the spindle and/or seat, care is required so the gag screw is not tightened.
- **Lifting mechanisms** are used to open the pressure relief valves

when the pressure under the valve disk is lower than the set pressure. These mechanisms are available in three basic types: plain lever, packaged lever and air-operated lifting devices.

- **Bolted caps** are available for standard pressure relief valves in addition to the screwed caps.
- **Valve position indicators** are microswitch apparatuses used for remote indication of the opening of a pressure relief valve.

### CONCLUSION

Although the options for pressure relief are wide and varied, knowing which ones are right for which applications is critical to all end-user industries. This article provided readers background on the reclosing options, but it covers only half the picture. For background on the nonreclosing side of the equation, visit VALVEMagazine.com. ❧

**MOHAMMAD A. MALEK, PhD, PE** is pressure systems manager with Stanford University - SLAC. He is also an instructor with ASME. Dr. Malek is the author of the book *Pressure Relief Devices* published by McGraw-Hill. Reach him at malekm@asme.org.

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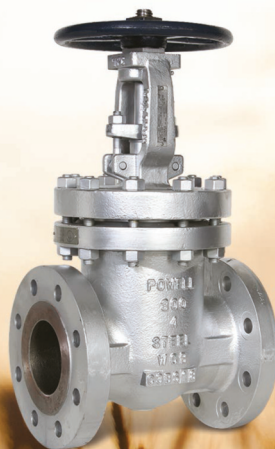
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## Valves, Actuators & Controls 101

Tuesday, April 19

Breakfast on your own. Embassy Suites offers a complimentary made-to-order breakfast.

7:30 – 8:30 am **Registration**

8:30 – 10:00 am **Welcome to VMA's Valve Basics Seminar**

### LESSON 101-1: Introduction to the Industry

**Speaker:** **Greg Johnson**, President, United Valve, Houston, TX

### LESSON 101-2: Multi-turn Valves

**Speaker:** **Matt Lovell**, Production Manager, United Valve, Houston, TX

We begin with a broad overview of the valve industry, the major valve and actuator types, and various end-user applications. Lesson 1 includes valve standards, basic piping information, pressure ratings and classes, as well as application issues that are critical to effective valve specification and usage. The stage is set for more detailed discussions on all the major valve types to give attendees valuable knowledge that can be applied in their daily PVF work. In Lesson 2, multi-turn valve types—gate and globe valves—are explained along with stems and bonnets. In addition, there will be an in-depth look at multi-turn applications.

9:00 – 11:00 am **Exhibitor Set-up**

10:00 – 10:15 am **Morning Beverage Break**

10:15 – 11:00 am

### LESSON 101-3: Check Valves

**Speaker:** **Jeff Kane**, Sales and Marketing Manager, DFT Inc., Exton, PA

Our check valve expert details the unique qualities of check valves, explains how they work and why correct sizing is so essential for this valve type. Also included is a discussion of several specific check valve applications.

11:00 am – 12:00 pm

### LESSON 101-4: Quarter-turn Valves

**Speaker:** **Robert Michael**, Director Product and Quality Compliance, Sunbelt Supply, Pasadena, TX

We progress up the valve chain, and move on to the more complex quarter-turn valve types, including plug, ball and butterfly, as well as the different options among these three broad product types. In addition, the presenter chooses several applications to address in more detail.

12:00 – 1:30 pm **Exhibits Open / Lunch in the Exhibit Hall**

Valves, actuators, controls and other products used in the flow control chain will be represented in our tabletop exhibition, providing attendees with the opportunity to ask exhibitors about the products and services they provide.

*All attendees who get signatures indicating they have visited each exhibitor are eligible to enter a drawing to win a mini iPad! The drawing will take place at 5:50 pm in the Exhibit Hall.*

1:30 – 2:15 pm

### LESSON 101-5: Pressure-relief Valves

**Speaker:** **Gabe Salwan**, Manager, Valve Group Sales-Americas, Curtiss-Wright, Brecksville, OH

We learn how pressure-relief valves perform, their critical role in plant safety and important maintenance guidelines.

2:15 – 3:15 pm

### LESSON 101-6: Actuators – Hydraulic and Pneumatic

**Speaker:** **Russ Robertson**, Product Manager, LEDEEN, Valve Automation, Cameron, Houston, TX

This lesson focuses on pneumatic-type actuators with a brief discussion pertaining to hydraulic actuation. It includes a description of the basics of manual and pneumatic actuation and how various types are applicable to linear and rotary valve actions. Multiple pneumatic actuating mechanisms are presented along with the purpose and the effects of adding springs to an actuator. It is intended that each attendee leave this session with an understanding of how each actuator type may apply to their specific needs along with knowing what questions need asking when selecting an actuator.

This session also covers mounting standards and safety considerations.

3:15 – 3:45 pm **Exhibits Open**

3:45 – 4:45 pm

### LESSON 6: Actuators – Hydraulic and Pneumatic (cont.)

5:00 – 6:00 pm

**Exhibits Open / Wine and Beer Reception in the Exhibit Hall**

Valves, actuators, controls and other products used in the flow control chain will be represented in our tabletop exhibition, providing attendees with the opportunity to ask exhibitors about the products and services they provide.

*All attendees who get signatures indicating they have visited each exhibitor are eligible to enter a drawing to win a mini iPad! The drawing will take place at 5:50 pm in the Exhibit Hall.*

Wednesday, April 20

Breakfast on your own. Embassy Suites offers a complimentary made-to-order breakfast.

8:00 am **Registration**

8:30 – 9:15 am

### LESSON 101-7: Actuators – Electric

**Speaker:** **Chris Perdsock**, Central Midwest Area Sales Manager, Rotork Controls Inc., Kansas City, MO

The focus here is on multi-turn and linear electric actuators, their basic designs, common options and applications. The presenter also discusses actuator controls and their requirements, digital controls and their benefits, as well as the benefits of open digital protocols.

9:15 – 10:15 am

### LESSON 101-8: Solenoid Valves

**Speaker:** **John Molloy**, Sales Training Manager, ASCO Numatics, Florham Park, NJ

Solenoid valves are defined and explained, along with guidelines on how to make the best selection of a solenoid valve. The presenter also discusses the functions of a solenoid coil, how 2-, 3- and 4-way solenoids operate, and various applications for solenoid valves. In addition, this lesson will also include information about limit switches and proximity switches.

10:15 – 10:30 am **Break**

10:30 – 12:00 pm

**LESSON 101-9: Control Valves**

**Speaker:** *Josh Crompton, Engineering Instructor, Fisher Product Training, Emerson, Marshalltown, IA*

Our presenter defines control valves, explains what they do and describes typical control valve styles, including variations, types and applications. The discussion will also include valve sizing and selection, cavitation and flashing, and a brief overview of controllers, control systems, and pertinent safety standards.

12:00 – 12:45 pm **Lunch**

12:45 – 5:00 pm (includes two 10-minute snack breaks)

**Valve Petting Zoo—Hands-on Instruction**

We divide attendees into nine equal groups, so each group has an opportunity to visit tables where the product types covered in each lesson—plus a bonus table with packing and sealing materials—will be displayed. Our industry experts will point out the various components of these products and demonstrate how they work. Attendees are encouraged to pick up and examine the valves, actuators and other products, and ask questions in a small group setting—all designed to help clarify what was learned during the previous lessons.

5:00 pm **Certificates Awarded**

**Valves, Actuators & Controls 201**

**Thursday, April 21**

*Breakfast on your own. Embassy Suites offers a complimentary made-to-order breakfast.*

8:00 am **Registration**

8:30 – 10:00 am

**Lesson 201-1: Valve Packings & Fugitive Emissions**

**Speaker:** *Rodney Roth, North America Strategic Accounts Manager - Stationary Equipment, A.W. Chesterton, Houston*

One of the most important issues facing the valve industry today is the control of fugitive emissions. Unwanted emissions are both harmful to the environment and costly to end users. This topic will focus on how the packing industry and the valve industry are working together to create solutions to this issue. Items discussed include fugitive emissions regulations, packing design, low-emissions packings, valve packing systems design and testing standards.

10:00 – 10:15 am **Morning Beverage Break**

10:15 am – 12:15 pm

**Lesson 201-2: Valve Materials**

**Speaker:** *Tom Waldmann, General Manager, Technical Support Dept., KITZ Corporation of America, Stafford, TX*

Valves use many different materials. Selecting the proper materials of construction is critical to the success of the valve in service. This comprehensive program will cover basic metallurgy, properties of metals as they relate to valves, material descriptions and characteristics, and typical material selections for a variety of service applications.

12:15 – 1:00 pm **Lunch**

1:00 – 3:00 pm

**Lesson 201-3: Critical Service Applications and Valves**

**Speaker:** *Robert Michael, Director, Product and Quality Compliance, Sunbelt Supply, Pasadena, TX*

Valves have become more sophisticated as they are applied to many new applications and service conditions. This module includes high-performance valves such as metal-seated ball valves and triple offset butterfly valves, and the services in which they are used today. A description of some of the unique coatings and construction details of metal-seated ball valves will be discussed.

3:00 – 3:15 pm **Afternoon Snack Break**

3:15 – 4:00 pm

**Lesson 201-4: Valve Data, Feedback & Asset Monitoring**

**Speaker:** *Paul Souza, Product Application Specialist/Training Manager, AUMA Actuators Inc., Cannonsburg, PA*

This presentation will cover some of the more advanced control valve applications. Included is a discussion of maintenance strategies, condition monitoring, sensors, indication and smart positioners.

4:00 – 5:00 pm

**Lesson 201-5: Valve Repair**

**Speaker:** *Greg Johnson, President, United Valve, Houston*

Is your valve repairable? If so, what procedure should be used to repair it? These are some of the questions that will be answered in this valve repair basics module. Among the topics to be discussed are initial tear-down and inspection, evaluation of repairability, basic repair procedures, repair specifications and data collection.

5:00 pm **Certificates Awarded**

**Program Pricing**

<p><b>Full Registration / April 19-21:</b>  <b>First registrant from company</b>  <b>\$1,150</b>  <b>Additional registrants</b>  <b>\$1,095</b></p>	<p><b>101 Courses / April 19-20:</b>  <b>First registrant from company</b>  <b>\$795</b>  <b>Additional registrants</b>  <b>\$750</b></p>	<p><b>201 Courses / April 21:</b>  <b>First registrant from company</b>  <b>\$525</b>  <b>Additional registrants</b>  <b>\$490</b></p>
<p>Above registration fees include daily breakfast, lunch and breaks, plus Tuesday afternoon reception, printed seminar materials and VMA Certificate of Completion.</p>		
<p><b>Exhibit hall entry only / April 19 from 12:00–1:30 pm; 3:15–3:45 pm; and 5:00–6:00 pm</b>  <input type="checkbox"/> <b>\$95</b> Includes lunch, afternoon break and reception; it does NOT include entry into educational sessions</p>		

# VALVE BASICS

Seminar & Exhibits 2015



## HOTEL INFORMATION

The Valve Basics Seminar & Exhibits will be held April 19-21 at the **Embassy Suites O'Hare-Rosemont** (5500 North River Road, Rosemont, IL 60018). Accommodations at the hotel have been arranged at the discounted conference rate of \$179 per night plus taxes. To make reservations, go to: <http://group.embassysuites.com/VMAValveBasicsSeminarandExhibitionSpring2016Seminar>. For technical assistance please call 847.678.4000 and mention VMA Valve Basics. The cut off for making hotel reservations at the discounted rate is March 28, 2016.

## PROFESSIONAL DEVELOPMENT HOURS

Attendees completing the 2-day Valve, Actuators & Controls 101 course (April 19-20) will receive 12 professional development

hours. Those completing only day 3 of the course (April 21), or the 201 program, will receive 6 professional development hours. And attendees who complete all 3 days will receive a total of 18 hours. Certificates of Completion will be given out at the end of the program on Wednesday, April 20 and again on Thursday, April 21. Attendees leaving before the end of the course will not receive full credit and certificates will be mailed out from the VMA office reflecting the reduced credits earned.

## CANCELLATION AND SUBSTITUTION POLICY

- Cancellations received up to 30 days before the event are refundable, minus a 5% registration service charge.
- Cancellations received between 15 and 29 days before the event are 75% refundable.
- Due to hotel and other event guarantees, cancellations received between 0 and 14 days prior to the event are non-refundable.
- All cancellations must be in writing to [mmaloneblevins@vma.org](mailto:mmaloneblevins@vma.org).
- Substitutions are allowed up until April 15. Please advise Malena Malone-Blevins ([mmaloneblevins@vma.org](mailto:mmaloneblevins@vma.org)) of any

substitutions so we can verify your payment and make up a badge in advance for the person attending in your place.

## ONLINE REGISTRATION

Attendees are strongly encouraged to register for this event online. Just go to [VMA.org](http://VMA.org) > Meetings > Basics Seminar & Exhibits, or [www.vma.org/?ValveBasics](http://www.vma.org/?ValveBasics).

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You may fax your completed registration form (with credit card information) to 202.296.0378, or scan in the form and send as an attachment to [mmaloneblevins@vma.org](mailto:mmaloneblevins@vma.org). (Credit card registration payments will show up on international customer invoices in U.S. dollars.) If paying by check, mail to: Meetings Manager, Valve Manufacturers Association, 1050 17th Street, NW, Suite 280, Washington DC 20036.

## QUESTIONS

Contact VMA Education Coordinator Abby Brown ([abrown@vma.org](mailto:abrown@vma.org)) for program information, and contact VMA Meetings Manager Malena Malone-Blevins ([mmaloneblevins@vma.org](mailto:mmaloneblevins@vma.org)) or call 202.331.8105 x310 for questions about registration or hotel reservations.

### Here's what past attendees have said about VMA's 101 courses:

*"The valve petting zoo was outstanding. I learned a great deal by seeing how valves actually function/ operate."*

*"Great introduction to the valve industry! It turns out actuators are quite interesting—it's another career choice for me to consider."*

*"Whole event/seminar was really informative and helped me to learn more about valves and their applications."*

*"...provided extremely valuable, real-life applications that aren't found in school."*

## INTERESTED IN EXHIBITING?

Are you a U.S. or Canadian valve, actuator or controls manufacturer; a U.S. or Canadian distributor or supplier to the valve industry; or an OEM-authorized service and repair facility? If so, you may be eligible to exhibit at the Valve Basics Seminar & Exhibits.

**COST:** VMA/VRC members—\$625; non-members—\$725; includes 1 tabletop and 2 exhibit personnel; additional personnel above 2—\$95 each.

PLUS, exhibit personnel receive discounted fees for attending the seminar. If you are exhibiting and attending the 101 and/or 201 courses, please register using the EXHIBITOR registration form.

Find out more about our cost-effective tabletop display:

- Review the Exhibitor Prospectus by going to [VMA.org](http://VMA.org) > Meetings > **Basics Seminar & Exhibits**. Then, click on the link to the Exhibitor Prospectus.
- For additional information, contact Malena Malone-Blevins ([mmaloneblevins@vma.org](mailto:mmaloneblevins@vma.org)) or Abby Brown ([abrown@vma.org](mailto:abrown@vma.org)).



Tabletop exhibits are open on Tuesday afternoon only. The hours are:  
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# Cybersecurity: Protecting Critical Infrastructure

BY KATE KUNKEL

It's hard to imagine an issue more front-and-center on most people's minds today than cybersecurity—in particular, what will happen if the world's infrastructure systems are attacked. Dr. Curtis Levinson of the Center for Strategic Cyberspace + Security Science, opened his remarks at a recent symposium by pointing out, “the water supply, dams, tunnels, the power grid and highways are all vulnerable to cyberattacks. This is not a national issue, it is international. The grids are interconnected. Imagine trying to survive and recoup from a concerted cyberattack on infrastructure.”

Add to this possibility how fast things happen and the problem becomes even more ominous. James Comey, director of the Federal Bureau of Investigation (FBI), has said there are two types of big companies in the U.S.: “Those that have been hacked and those who don't know they're hacked.” He has pointed out that it takes an average of 225 days from the time a cyberattack happens until a company becomes aware of it. For many companies, that means the public relations nightmares of stolen personal and financial information. The ramifications of an attack on critical infrastructure and utilities, however, could be much more devastating—an abundance of power could be stolen or water could be tainted in 225 days.

Yet these attacks are occurring. A recent survey by the Ponemon Institute found that nearly 70% of critical infrastructure companies suffered a security breach in the last year. What's more, the Department of Homeland Security's Industrial Control Systems Cyber Emergency Response Team said cyberattacks on industrial targets such as water and wastewater treatment plants increased more than 25% from 2011 to 2014.

Meanwhile, utilities today face the economic choice of upgrading equipment to better serve the public or installing cyber security. When pipes are breaking and valves are leaking in aging and outdated systems, it's hard to justify spending money on cyber defense.

## Executive Summary

**SUBJECT:** Many people agree that it's not a question of “if” an attack may occur against the world's infrastructure systems, but when. For that reason, understanding some of the issues involved and preparing as an organization that will be affected by what happens is critical.

### KEY ISSUES:

- What may happen
- Where the vulnerabilities are
- What individual organizations can do

**TAKE-AWAY:** The key is developing programs like the ones companies created for natural disasters, then stressing policies and procedures to employees.

Nevertheless, protecting critical infrastructure from cyberattacks weighs heavily on the minds of governments and utilities as more and more digital technology replaces analog equipment, which makes attack more likely.

### APPLICATION PROGRAMMING INTERFACES

In any discussion of cyberattacks, one area that bears close inspection is the use of application programming interfaces (APIs), which came into popular use in 2010. API is a new way of integrating applications from a single system and moving them across networks and borders. This means many devices, applications and people can now be integrated into ever-bigger, broader systems. While this is beneficial for leveraging information, skills and equipment, it also means more vulnerability. Not all of the people on that API may be ready, able or qualified to be what is essentially a system administrator.

An example given at the same cyber security symposium where Levinson spoke was the way today's phones operate for users: Smart phones are integrated into every aspect of users' lives, from personal banking, security controls and thermostats at home to managing sensitive material on the job. Meanwhile, many employers allow and some encourage employees to use their own devices on the job (BYOD—bring your own device) for everything from monitoring devices in the field to transmitting operations data.

The concern is that, besides privacy concerns for individuals, there are a myriad of ways APIs can be used to hack workplace computers or systems, and smart phones become part of the vulnerability.

The same problem exists for monitors and calibration tools in industrial control systems. During a recent event for valve, actuator and control manufacturers and end users that broached the subject of cyber security, participants noted that manufacturers of control systems have built security into their equipment through firewalls and network switches. However, as Peter Zornio, chief technology officer at Emerson Process Management, cautioned, "We come up with a new tech-

nology, the thieves come up with new hacks. Cyber security is a journey, not a destination."

As a result of the issues, manufacturers are working with security companies such as Intel to strengthen the protection built into control systems. However, these added layers of security come at additional cost, and it is not unusual for utilities or even processing plants to opt not to purchase them when installing new systems simply because of the price tag.

"It's like paying for insurance," Zornio explained. "Unless something happens, they might not want to spend extra on cyber security because safety budgets also cover personal and plant safety, and those are more tangible expenditures."

### WATER AND WASTEWATER

Operators of many of the industries where valves are used must be able to monitor the flow and analyze the data coming from all the points in a smart technology system. However, this is also where cyberattacks can happen, which is concerning in light of the new world of terrorism.

For example, in the field of water and wastewater, it's not likely that a garden-variety hacker would want to disrupt a water system. But there is a fear that terrorist groups or unfriendly nation-states with an agenda would seek to disrupt or destroy a city by tapping into smart devices for purposes of anything from changing the amount of chlorine going into the system to shutting off or opening up valves that control flow, causing loss of water, floods and more chaos.

One safeguard, according to Mark Fabro of the Canadian Water and Wastewater Association, is information sharing—in this case between utilities and from manufacturers to utility owners.

"We used to have threat intelligence reports from law enforcement, but they were not specific, and it was difficult to take action on them. Now, threat intelligence services send out notices, but we have to sort through the noise."

Fabro urged industrial control manufacturers to share information from operators who have experienced problems and to send it through their chan-

nels to other operators. "If a hack happens through the control system, it's important for owners to communicate that to the manufacturer," he said. "That manufacturer needs to get the info out to other owners. Everybody has different architecture, so it's a matter of taking the info and putting it into each system's context. Fast."

### POWER GENERATION

In the power generation field, one cybersecurity concern today springs from the reality that homes and businesses are increasingly capable of producing some of their own electricity, whether by solar, wind or in some areas, geothermal. Most of these structures are hooked up to the grid so that excess electricity produced at the site is fed back into the grid. In turn, when renewable resources are unavailable, electricity from the grid supplies the needs of the home or business.

While there are safety systems built into the meters and power conditioners in these remote power-producing homes or businesses, they are vulnerable to cyberattack. The possibility of an attack on one home or business sending power back into the grid is relatively low, but the lower level of security leaves this avenue one that could be breached. The concern is compounded by the fact that basically all power plants are feeding into a central grid today and the potential for disruption compounds exponentially, reaching from regional to international.

An example was presented at the cyber security conference noted above. In 2003, trees and hot weather in Ohio set the stage for a string of events that left 50 million people throughout all of Ontario and eight U.S. states in the Northeast without power for days. While this particular event occurred from natural causes and an aging electrical grid, the grid is now even more vulnerable to failure, according to former Ontario energy minister Bob Chiarelli.

"The blackout really tested the system," Chiarelli said, and "while there have been improvements on both sides of the border, we are in fact more vulnerable now than ever before." In light of the kind of breaches that occur when foreign countries invade the

cyber security system of other countries' embassies, energy companies get worried about the energy systems, he pointed out.

The issue of cyber security is considered so important to the power industry that North American Electric Reliability Corporation (NERC) now holds an annual grid security conference that focuses on key cyber and physical security issues and training for enhancing the security and resiliency of the North American bulk power system. NERC is a not-for-profit international regulatory authority whose mission is to assure the reliability of the bulk power system in North America, which serves more than 334 million people.

The conference includes cyber and physical security perspectives from NERC, the U.S. Department of Energy, the Department of Homeland Security, the FBI and industry experts. Even with this kind of intense scrutiny, many analysts worry that power generation and distribution are the most likely targets for cyberattacks.

## THE HUMAN FACTOR

There are many ways attackers could get through protective systems, but one of the easiest for them is the human interface.

According to a joint survey by Intel and the Aspen Institute<sup>1</sup>, cybersecurity companies consider BYOD and device diversity to be a significant potential point of attack. An important concern is lack of awareness by users as well as their use of unofficial online and social media services. A hacker's way into a local water treatment or power generation plant can be as simple as an employee opening an attachment in an email.

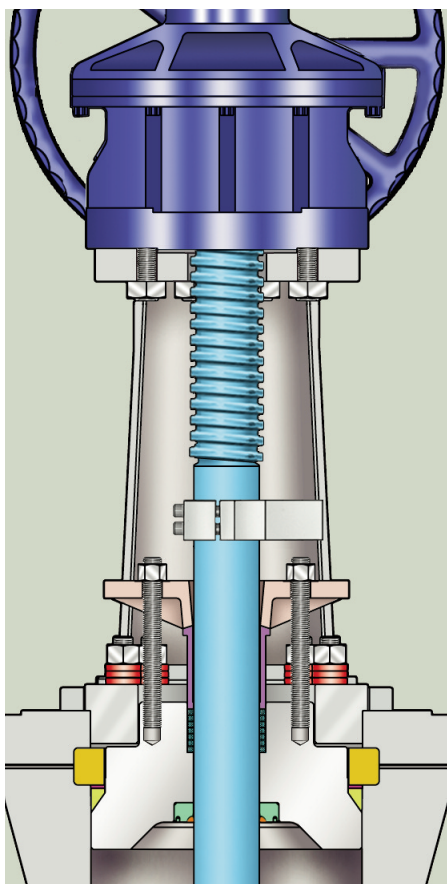
This threat can be mitigated with quality training and the development and implementation of a cybersecurity protocol for employees as well as contractors or subcontractors that have virtual or physical connection to the systems of the utility or plant. Random penetration tests at various facilities have revealed that many employees, even when told not to open attachments, have done so on work computers when they believe the

e-mail is from a colleague or trusted person. Many also are not aware that something as simple as using a USB stick can be a tool for infecting an entire system through malware.

At the aforementioned infrastructure cybersecurity conference, Robert Wong, chief information and risk officer for Toronto Hydro, encouraged utilities to use ongoing training and penetration tests, which consist of a fake "hacker" posing as a colleague or outside contractor or a customer. This hacker entices test subjects to open or download a file or to use a USB stick so that the effectiveness of security barriers can be tested along with awareness of and compliance with security protocols.

## DISASTER PREPAREDNESS

While training to prevent intrusions is critical, so is preparing for what happens should portions of the infrastructure, including small utilities, get hacked. Just as disaster training is conducted for physical emergencies, so, too should it be used for preparing for cyber infection. When a denial of



## ANSI Approval for Pressure Seal Bonnet Valves and Cryogenic Valve Service Standards

**SP-134-2012, Valves for Cryogenic Service, including Requirements for Body/Bonnet Extensions, and SP-144-2013, Pressure Seal Bonnet Valves,** have

been approved by the American National Standards Institute as American National Standards.

**SP-134** defines the requirements for material, design, dimensions, fabrication,

non-destructive examination, and pressure testing of stainless steel and other alloy cryogenic service valves with body/bonnet extensions.

**SP-144** establishes design and construction requirements for steel and alloy valves having pressure seal bonnets in the size range of NPS 2 (DN 50) through NPS 50 (DN 1250) and Pressure Classes 600, 900,

1500, 2500, and 4500. SP-144 applies to gate, globe, and check valves and may be used in conjunction with other valve-specific standards.

For further information on MSS membership or MSS standards, please contact Bob O'Neill, MSS Executive Director at 703-281-6613 or at [www.mss.hq.org](http://www.mss.hq.org).



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service, ransom or any other kind of attack happens, everyone in the organization should know what to do.

The basic protocols, according to Levinson, include:

1. Having a written incident response strategy. With today's rapid development, if the strategy hasn't been updated in the last one to three months, it may be useless.

The plan should focus on dealing with breaches that would include consumer and employee data theft, theft of intellectual property and denial of service or ransom hacks. For example, what exactly is the plan if the website disappears? How should a company reach out to customers whose personal information has been compromised?

2. Practicing the plan. The responders must practice responding, which means actually running through the steps. Because hacks happen in minutes, response has to be immediate to be effective and to keep everyone calm.
3. Communicating with employees and

identifying the types of communication shared with them as well as the public, shareholders, customers and other stakeholders. A direct line of communication should be established with "first responders," and this communication should not be shared outside that chain.

4. Making all first responders come together physically when possible. This ensures they understand this is "crisis mode" with no diversions.
5. Planning how to get things back up and running as soon as possible. While this may endanger forensics later in the process, finding out exactly what happened and how is not as important as getting back to business after ensuring cessation of the spread of the malware.
6. Knowing who is responsible for what. Every responder must know where and with whom the buck stops.
7. Developing a recovery plan, which is especially important for utilities because the public depends on them for water, power, wastewater treatment and delivery of gas and oil.

#### References:

1. Critical Infrastructure Readiness Report: Holding the Line Against Cyberthreats ([www.mcafee.com/us/resources/reports/rp-aspen-holding-line-cyberthreats.pdf](http://www.mcafee.com/us/resources/reports/rp-aspen-holding-line-cyberthreats.pdf))
2. Surveys referred to are the 2015 Scalar Security Study (<https://www.scalar.ca/en/resources/executive-summary-of-the-2015-scalar-security-study/>) and the 2015 Aspen Institute survey noted above in reference 1.

#### CONCLUSION

Many agree that it's a matter of when, not if, an organization is the object of a cyberattack. For that reason, it's critical that those connected to infrastructure be proactive with defense by ensuring employees understand the importance of vigilance and have training in defense. For utilities and other critical infrastructure entities, the key to recuperating after the attack is a solid plan before that attack and practicing the response in preparation. ❧

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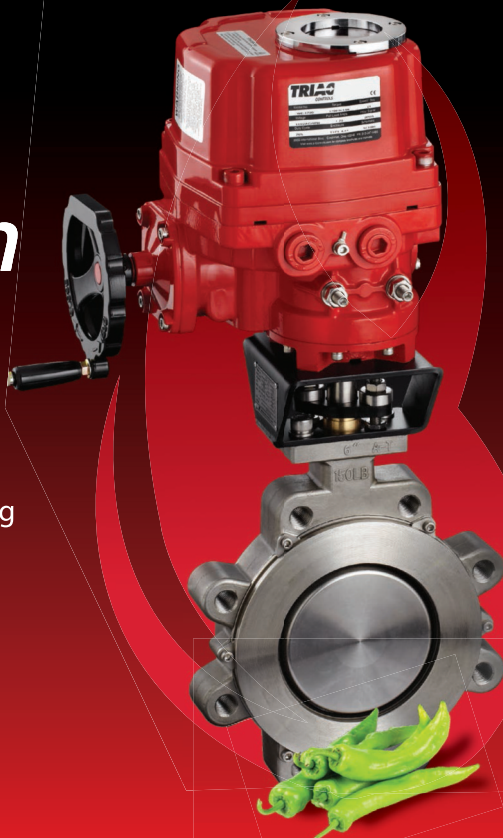
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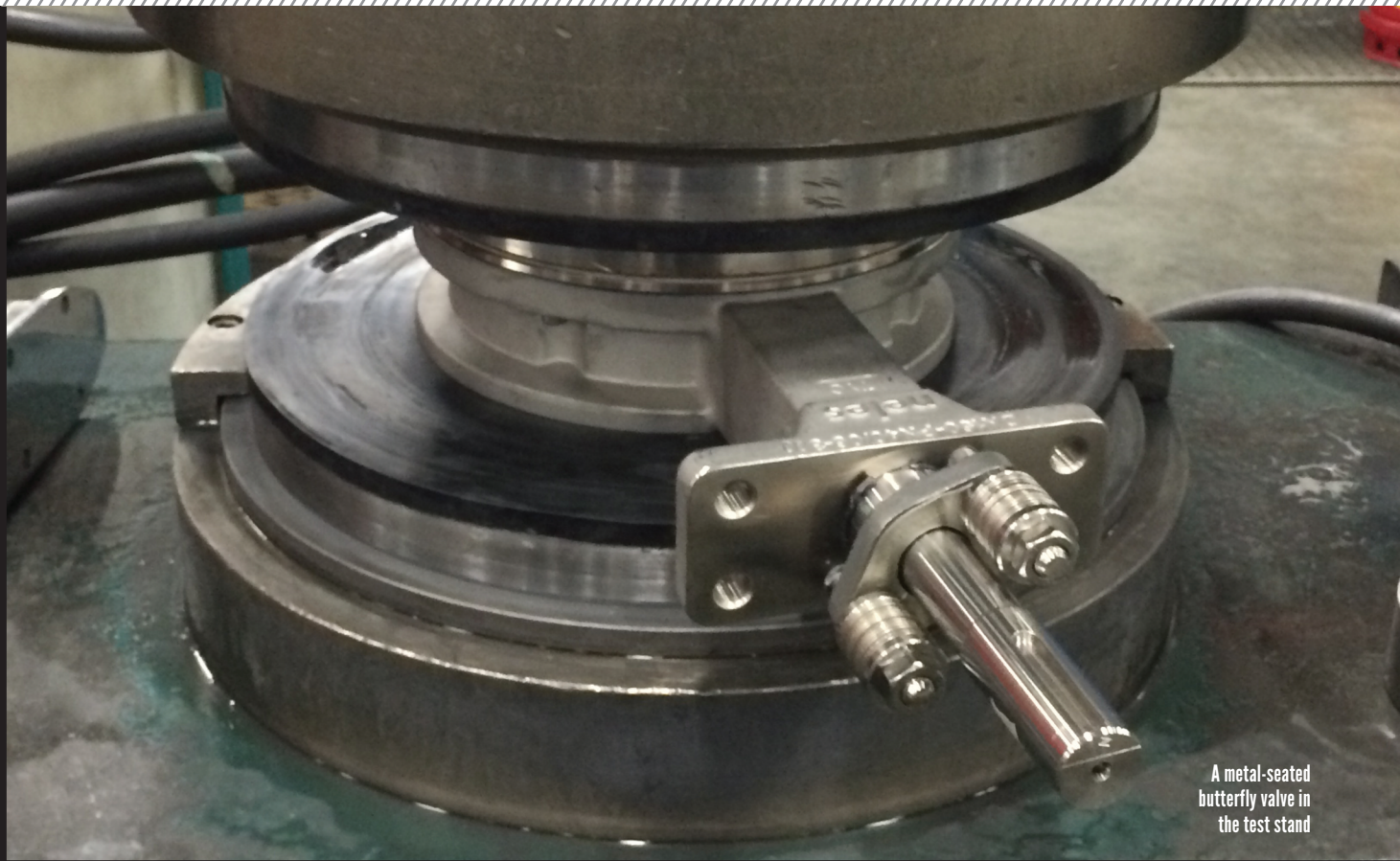


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A metal-seated butterfly valve in the test stand

# Mistakes and Misconceptions in Valve Leak Testing

BY DAVID BAYREUTHER

Normally, valves are pressure tested by the factory to check for leaks before they're shipped. The type and method of testing conforms to one or more of many different standards. The purpose of these tests and the expected results are often misunderstood and misapplied, resulting in unnecessary delays and unanticipated costs.

This article identifies the most common mistakes. Its primary purpose is to inform and guide end users and engineers that write valve specifications so those parties can avoid some of the mistakes.

## THE STANDARDS

Numerous valve standards define leak testing requirements. Often, the difference between them is unclear, which leads to confusion over which one to use and why. The place to begin is to understand the two types of leaks undergoing tests:

- **External** is leakage from pressure inside the valve out to the atmosphere. This is verified by the shell test, and no leakage is allowed at pressure equal to or greater than the valve rating.
- **Internal** is leakage around the valve seat or through the closure member when the valve is closed. Internal leakage is normally contained within the piping system. Such leakage can

## Executive Summary

**SUBJECT:** Valve leakage is one of the most pressing issues in the industry, which means testing against the possibility of those leaks has become a vital part of the process of manufacturing and putting valves into the field. Yet there is much confusion in the world about what standards must be followed and how tests should be conducted.

### KEY CONCEPTS:

- Internal and external leakage issues
- Some of the standards
- Why people get confused
- The mistakes that get made

**TAKE-AWAY:** Using the toughest tests are often the answer.

be external when a valve is used to dead-end a pipe. Internal leakage is checked with a seat leakage or a closure test. The allowable leakage rate depends on the valve test standard.

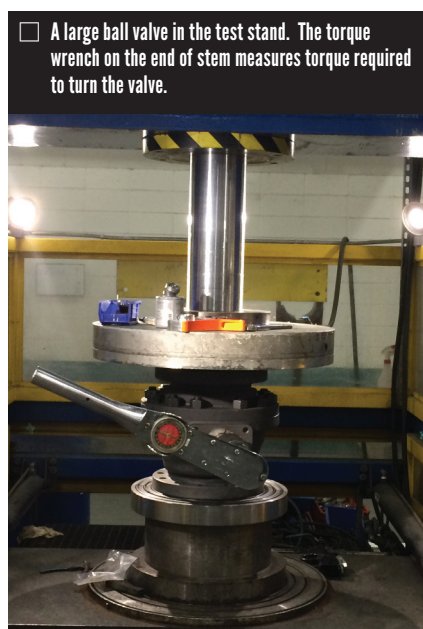
External and internal leak test methods are defined in the numerous standards, and there are too many to cover in a single article. Below, however, is a brief explanation of some of the more common standards:

- **American Society of Mechanical Engineers (ASME) B16.34, Valves – Flanged, Threaded and Welding End:** This is the most widely used valve design standard. It contains charts that identify the working pressures used in conjunction with other test standards, such as API 598. ASME B16.34 contains test methods, but does not define allowable seat leakage.
- **American Petroleum Institute (API) 598, Valve Inspection and Test:** This is the most widely used test specification in the world. It covers many types of valves, but was developed primarily for consideration of isolation valves. The standard includes leakage rates and testing criteria for both metal-seated and resilient-seated valves.
- **Manufacturers Standardization Society (MSS) SP61, Hydrostatic Testing of Steel Valves:** This is similar to API 598, but has subtle differences in test holding times and leakage rates. It was one of the first valve test standards, but is no longer widely used. However, it also was the basis for the more recent standards.
- **International Standards Organization (ISO) 5208, Industrial Valves, Pressure Testing of Valves:** This is ISO's primary valve test standard, and covers many types of valves. It has 10 levels of allowable internal leakage, and the acceptance criteria is to be negotiated between the purchaser and manufacturer.

- **American National Standards Institute (ANSI) FCI 70-2, Control Valve Seat Leakage:** This contains detailed test procedures and leakage rate classes for control valves. The leakage classes are also occasionally referenced by other documents and used as acceptance criteria. It has six different leakage levels from Class I up to Class VI. An important note here is that ANSI FCI 70-2 is for internal testing only. It does not define external testing, and it refers users to API-598 for testing isolation valves.
- **International Society of Automation (ISA) S75, Hydrostatic Testing of Control Valves:** This provides a procedure for external testing of control valves. Closure testing and acceptance criteria are out of the scope of this document and usually are covered by referencing ANSI FCI 70-2.

#### SHELL TESTING

Usually, the first step in the production process for an assembled valve is the external test, known as a hydrostatic shell test. This test validates the soundness and strength of the valve body. It also pre-stresses the valve body, which aids in avoiding fatigue with cyclic pressure. For safety, this test is normally done with water at



□ A large ball valve in the test stand. The torque wrench on the end of stem measures torque required to turn the valve.

one-and-a-half times the valve body pressure rating. It also is typically done with the valve fully assembled and in the partially open position.

For shell testing, API-598 refers to ASME B16.34 for body pressure rating, which varies by body material. For example, a Class 150 valve in carbon steel (e.g., WCB) is tested at 31 bars. The same valve in stainless steel (e.g., CF8M) is tested at 29 bars. EN (European Committee for Standardization) and DIN (German Institute for Standardization) standards consider the body pressure rating only. For all body materials, a PN10 valve is tested at 15 bars and a PN40 is tested at 60 bars. It is not uncommon for customers conducting business internationally and used to working with EN and DIN standards to claim the wrong test pressure was applied when a valve is shell tested per API or ASME.

In addition, even a test as simple as the shell test has issues including:

- **Sensitivity:** In some cases, valve body castings have porosity too small for water to leak through, which is commonly called micro-porosity. This is most likely to occur in Monel and bronze castings. To detect this type of casting defect, the valve must be tested with air first, and the valve immersed in water or the exterior covered with soap solution. Such porosity can be blocked, in which case it will not be detected if the valve is pressurized with water first since the water is sufficient to block the leak path. Valve standards do not mention this additional test, but it is wise to use such tests with higher-risk cast materials going into hazardous and lethal gas service.
- **Clamping forces:** Split body valves are typically compressed in a hydraulic press to seal off the ends for pressure testing. If not carefully controlled, the clamping force can easily exceed the body joint gasket load generated by the bolted body joint. When this happens, the body joint gasket can be over-compressed, leading to loose body

joint bolts and possibly external leakage.

- **Special clean valves:** Valves for use in services such as oxygen, chlorine and hydrogen peroxide require an extra level of cleaning and inspection to ensure their safe use. Water inside the fully assembled valve can introduce undesirable and unsafe contaminants, and any residual water remaining after the test can be hazardous when installed into service. For example, residual water remaining in valves for cryogenic service can freeze and prevent valve operation. In such cases, it is best to test the valve body prior to valve assembly.
- **Corrosion:** Residual water inside carbon steel valves can lead to crevice corrosion, a particularly aggressive type of corrosion that can damage critical sealing surfaces and result in both internal and external leakage. Attempts to remove the water through baking or heating the valve at elevated temperatures are generally ineffective.
- **Chloride content:** Concerns regarding stress-corrosion cracking of stainless steel has resulted in restrictions in the chloride content of test water, defined in several standards. Typically, the limit is around 50 parts per million (ppm), and some standards go as low as 30 ppm or lower. Low chloride levels are particularly difficult to consistently achieve if the factory is using a public or city water supply.
- **Safety:** When considering the problems of testing with water in special clean valves as well as the risk of corrosion, it is tempting to believe testing with air is a better choice. Sometimes this is true. However, since air is compressible, the volume of air contained that is compressed within the test valve can be very hazardous if something ruptures and the energy is suddenly released. According to the American Society for Nondestructive Testing's Nondestructive Testing Handbook, exposure to a relatively

**Table 1. Shock Wave Overpressure**

> 5 psi (0.34 bar)	Eardrum rupture
> 15 psi (1 bar)	Permanent lung damage
> 35 psi (2.4 bar)	Fatalities

small shock wave of air pressure can lead to the following injuries:

- **Service repairs:** A question exists of whether or not, after a valve has been repaired, the shell test must be repeated. If the original pressure-containing shell has not been altered during maintenance, it is not necessary to repeat the shell test since the soundness and strength of the valve body remains unchanged. These were already verified in the original factory test. However, if severe corrosion has occurred or if weld repairs have been performed, then a shell test is needed.

**INTERNAL TESTING**

While the arguments regarding external leakage or shell testing appear to be significant, they are less complex than discussions over internal leakage. With internal leakage, it is imperative to understand that terms such as zero leakage and bubble tight are often misinterpreted—creating common mistake Number 1. The expressions “bubble tight” and “zero leak” should

**Table 2.**

Leak rate (std. cc/sec)	Reference leak rate	Comment
$1 \times 10^{-8}$	Leak 1 cc every 3 years	There is diffusion of helium through glass per square cm of surface area.
$1 \times 10^{-7}$	Leak rate of 3 cc per year	This is about the size of 3 marbles or game dice.
$1 \times 10^{-6}$	About 1 cc every 2 days	Breathing on a leak this size can provide enough moisture to temporarily close the leak for a few hours.
$1 \times 10^{-5}$	About 1 cc per day	A wetting agent or soap needs to be added to the test water in order to visually detect this size of leak.
$1 \times 10^{-4}$	About 1 cc every 3 hours	Visual bubbles rise in water.
$1 \times 10^{-3}$	4 cc per hour	A leak of this size is readily detectable in water during a short duration test. This has the sensitivity level of typical factory air tests.
$1 \times 10^{-2} +$	Too much!	This is audible.

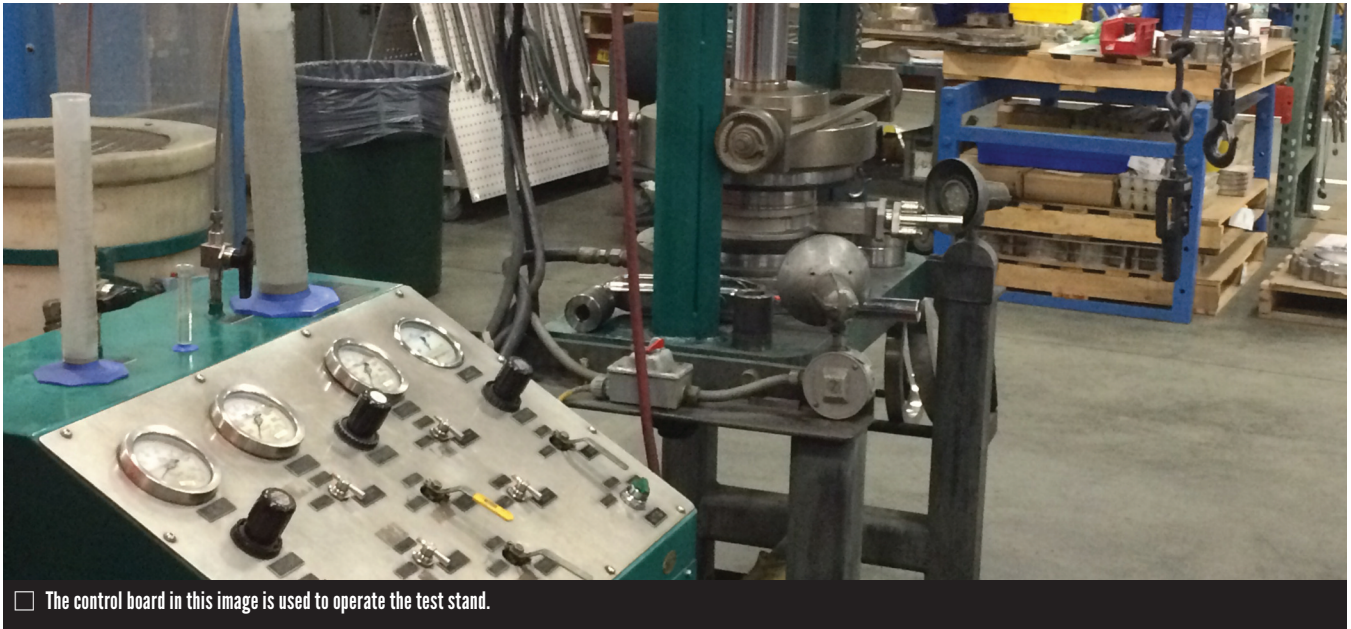
be further vetted. Table 2 defines measurable leak rates and explains them in everyday terms.

Most valve internal leak testing is done with air for a relatively short duration, from a few seconds to a few minutes. This is sufficient time to allow quick visual observation of a significant leak without being overly burdensome and impairing the factory's capacity to build and ship valves.

While it is possible to observe bubbles rising in water with a leak rate of  $1 \times 10^{-4}$  standard cubic centimeters (cc) per second, factory tests are short in duration so the sensitivity of typical factory leak tests is around  $1 \times 10^{-3}$  standard cc per second. This is roughly equivalent to four cc (four game dice or marbles) of leakage per hour. Generally, this amount of leakage is insignificant because it would take years for the gas to simply fill the volume of pipe downstream from the valve.

Extending the duration from a few minutes to an hour brings the sensitivity of the test into the  $1 \times 10^{-4}$  standard cc per second range. This is equivalent to one game dice or marble volume of leakage in three hours, which is not a significant decrease in leakage considering the additional time it would take to test the valve.

Frequently, an inexperienced technician will apply a soap solution to the closure element and wait an hour or



□ The control board in this image is used to operate the test stand.

more before observing some foam developing. This test method is achieving  $1 \times 10^{-5}$  level of sensitivity, equivalent to one game dice or marble of leakage in one day. Considering some of the hazardous gasses the valve may be required to contain, it is reasonable to expect body joints and other static seals in the valve to be leak free when tested using this method. However, it is not reasonable to expect closure elements, which are dynamic seals, to achieve this level of tightness.

There are many different valve types and types of closure design, with equally varying materials of construction. Thus, many test standards exist to address the unique behaviors of each.

## THE WHYS

Failure to read and understand the reasoning behind the test methods leads to the second most common mistake, which is believing the factory test is done to prove the valve will work at its rated pressure. API and ISO standards do a thorough job of identifying the risk of this way of thinking. Each contains an important note warning that high-pressure testing of resilient seat valves can degrade performance in low-pressure service. The real purpose of the factory internal leak test is to verify the quality of the product; it is not to validate the strength of the design. The internal leak test should be appropriate for the type of valve,

and it should be the most discerning and difficult test that valve must pass. Resilient-seated valves can have pressure-energized seals, meaning higher pressure increasing the sealing forces, potentially masking any dimensional or surface finish flaws. For such valve types, a low-pressure test is more difficult to pass and is a better indication of quality build.

For isolation valves, ASME, API and ISO standards are suitable when the valves are used in on/off service. They can also be the appropriate choice for control valves that are expected to provide isolation in service. For exam-

ple, butterfly valves are frequently used for both control and isolation. If the standard factory test is based on API or ISO, there is no need to conduct an additional test per ANSI FCI 70-2 because the quality of the valve assembly has already been verified.

## IN THE FIELD

The third common mistake is believing the factory production test is an indication of how the valve will perform in service. Often, end users will specify that the valve be tested under their process design pressures and temperatures. While this is not a problem in a laboratory equipped to conduct such tests, it is not practical to do this in a typical factory environment. Such tests are a validation of the valve design, not of the build quality.

Life would be simple if all valves were limited to no leakage for the duration of a test. But this is not technically possible. For valve pressure testing, it is wise to use the standard practice employed by the manufacturer. The manufacturer does not want to ship defective product and is naturally motivated to use the most discerning test methods with the least risk of damage to the valve. **VM**

□ A ball valve being tested. Note the leak offline from the top of the valve, which is used to measure the leak rate during the internal test. The stopwatch is used to measure the test time.



**DAVID BAYREUTHER** is vice president of Engineering for Metso. He is a 30-year veteran of the valve industry and has been active in standards development organizations, currently as a member of ASME, API, ISO, and MSS. Reach him at [david.bayreuther@metso.com](mailto:david.bayreuther@metso.com).

# Finding and Developing the People We Need

BY GENILEE PARENTE

If industry is to address one of its most significant problems—the lack of skilled workers—it must face two realities: 1) the millennial generation, which in 2015 surpassed all other groups as the largest in the labor force, is significantly different than the generations that preceded it, and 2) the toolbox for attracting and retaining millennials is different as a result.

Maureen Crawford Hentz, director of talent for A.W. Chesterton Company, says the key is finding ways that allow millennials to be part of a group. “One of the first things you have to realize is that with millennials, the group comes first and individual achievement within that group comes second. In previous generations, that dynamic was flipped,” she says.

Hentz recently shared with VMA what went into the Love Where You Work program she helped to create for her company.

## MILLENNIAL PSYCHOLOGY

Hentz says one of the biggest differences between generations is that millennials have been team trained.

“Note that I do not mean they are team oriented; Millennials are no more team oriented than other people. However, they have been socialized in their learning processes to work as teams, which contrasts with Generation X and Boomers, whose members were trained to bring themselves up by the bootstraps,” she says.

A second major difference between generations is that millennials have a formulaic orientation towards success, Crawford Hentz explains.

“They’ve been brought up in an environment where there are defined points in time and tasks to accomplish to go from point A to point B—processes that help them move forward. If you’re taking karate, for example, you start with the white belt, then you get yellow, orange, etc., until you get to black,” she explains.

To appeal to the formulaic mentali-



ty, companies must develop a way for employees to measure or note the steps they take as they take them.

Another big difference between millennials and their predecessors is differing views on social responsibility. Millennials both expect a company to have a social conscience and will seek out those that do when considering places to work.

“Many people in this age category had mandatory social service projects in school or mandatory volunteer hours as part of their training,” she says. “They expect their employers to exist for reasons beyond the bottom line.”

Millennials also see their individual efforts differently than Generation X and Boomers. They judge themselves not as much on specific results, but in terms of efforts and where they are in the process.

“Millennials tend to value their efforts being rewarded whereas Xers

and Boomers want the results rewarded,” she says.

## ENGAGEMENT AND MENTORING

All of these realities about who millennials are go into how to put together a mentoring program and why such programs work.

Chesterton’s Love Where You Work program, for example, is based on the concept of, “You drive, We assist.” What that means is that the program “is not a cradle-to-grave experience. It’s more a range of different programs that employees can choose that helps them develop into who they want to be and what the company needs them to be good at, for the future,” Crawford Hentz says.

Two of the key programs at Chesterton are on-boarding and mentoring.

On-boarding is what happens when a person first joins the company. Employees get a passport that outlines various activities—everything from

safety training to “meet and greets,” which are informational interviews with company insiders. Activities have point values, and employees must earn 100 points in their first 90 days, then can participate in the activities they pick.

“These activities are built for both extroverts and introverts. They are designed both to explain the company, its history and its corporate thinking and causes, and for individuals to begin to assess where they fit into the picture,” she says.

## MENTORING

The second component of Love Where You Work is a formal 12-week mentoring program, which is designed both to deepen the engagement process and to help the company develop its mentoring capability.

As with onboarding, components are self-selected: Employees choose a wide range of options—from ride-along programs where employees get out into the system by choosing to spend time with a particular person to formal training sessions.

People have to apply both to be mentees and to be mentors and the two are matched up based on the mentee’s goals and what skills the mentor has. The key is the interaction, growth and development that occurs between the two. To kick off the 12-week program, the mentor and mentee attend training together to get comfortable with their new roles. After that training, the mentors and mentees meet periodically and participate in activities together or discussions about activities.

“Any activity can be developmental as long as it’s discussed afterwards,” Hentz says. “Too often in business we spend so much of our time doing, we don’t leave time for talking and analyzing what we’re doing,” she points out.

Mentoring is beneficial to industry and to Chesterton for another critical reason: It helps the company identify and build capacity for all employees to be mentors.

“We believe that mentoring is a skill that goes way beyond supervising,” Crawford Hentz says. “Supervisors are task-oriented. They are obligated to be more directive. Mentors

can help a person identify obstacles, get beyond them and set new milestones or goals for themselves,” she adds.

## MEASURING THE RESULTS

Love Where You Work has only been around about a year, but Chesterton and Crawford Hentz are seeing positive results.

“It’s a new way of seeing things, so people were dubious at the beginning. That first group of mentors/mentees was tapped to participate and without exception, they said they signed up because when the president asked them to do something, they considered it an honor,” Hentz says.

However, each group has become much more specific about how much they value the program and what it’s done to help them personally.

“We have people saying things such as: It was the best thing I’ve ever done. It took me out of my comfort zone and gave me confidence. It helped me know what I was worth to the company,” Crawford Hentz says.

As more and more people apply for

the program, the company has integrated the Lominger Competencies, which allows a company to pinpoint specific skills it needs from employees and how those develop as a result of participation in mentoring.

“If we’re doing this right, what we’ll see is that employee competency ratings will go up during performance appraisals,” she says.

## APPEALING TO EVERYONE

Mentoring and employee engagement is not just about millennials. It’s about all employees. “We have one mentee who had been here 21 years; we had a mentor that had been here just three,” Crawford Hentz says.

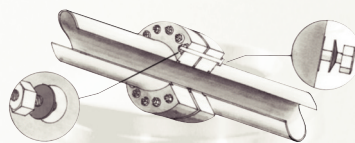
The program is designed to get the entire company’s talent pool to become more engaged in their jobs, to set their own goals and to create steps for attaining those goals.

“We stress to our staff that development is not about becoming a new person but becoming a better version of yourself,” she concludes. ■

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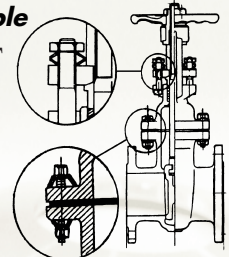
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LIVE LOADING VALVE  
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# How Low Prices for Oil Affect Distribution

BY KATE KUNKEL

*EDITOR'S NOTE: When this column was initially written, oil was at \$50 per barrel. By Jan. 4, 2016, oil was hovering around \$36 per barrel. As a result, more U.S. shale oil companies are literally hanging on for life. They are making only enough money to pay interest on large amounts of debt incurred during the drilling heyday, but not enough money to replace older wells that are drying up. This situation is even more severe in the oil sands of Canada. For distributors of valves and attendant equipment, this means another blow to the market.*

As oil's low prices dominate the economic landscape, the effect on producers, suppliers and oil-producing countries escalates. While layoffs in the field and supporting industries are taking a serious chunk out of the budgets of places such as Alberta, Canada, which depends on oil for its livelihood, the effects don't stop there, and they reach into the field of distribution. As Rhys Mendes, an economist at the Central Bank of Canada, pointed out to members of parliament, the relationship of

energy-related supply chains is such that: "Thirty per cent of all goods supporting the Alberta oil sands come from other provinces."

The same holds true in the United States, where more than 100,000 jobs have been lost in the oil patch, and many of the people still working have taken pay cuts. Rig counts are down and projects not yet begun have been mothballed.

A recent study by MDM-Baird Distribution Survey noted that, even though the industrial sector generally is flat, expectations are for moderate growth in most sectors. For distributors and manufacturers with exposure to oil and gas, however, the outlook is less optimistic. Most analysts are convinced that \$100 per barrel oil is far into the future, from 2 to 5 years away. While low oil or low energy costs are considered to be a net positive in the U.S. economy, the loss of jobs will affect purchasing power throughout that economy.

To learn how the drop in oil prices is affecting VMA distributor members, VALVE Magazine conducted a survey in November 2015.

The survey asked members to identify the factors that influence the state of their businesses; 60% said the low price of oil is having an impact not just on the bottom line, but on the

way business is conducted. As one respondent said, "Business opportunities are more competitive; there are more manufacturers in the mix. End users are pressing for lower cost and threatening to bid every opportunity." This was echoed by another respondent, who said, "We're having to give up a percentage of gross margins and getting pressure to increase terms."

Respondents for whom more than half of business comes from the oil and gas sector reported declines in 2015; those with less exposure reported flat revenues. None of the respondents said they expected growth for 2016.

While upstream business is decreasing across the board, some respondents reported an uptick in midstream activity, including improved chemical businesses. Several respondents said power industry spending is down, and many customers have put projects and non-essential maintenance activities on hold.

The general downturn has resulted in distributor discussions about pricing and costs with their own suppliers, the manufacturers. One respondent noted, "We are pressuring them to meet commitments, hold prices and reduce lead times so we can be as competitive as possible."

## MERGERS AND ACQUISITIONS

The MDM Baird study showed that much of the revenue growth for MDM's Top 40 Industrial Distributors was driven by acquisition. According to the report, merger and acquisition activity is on an upward trajectory, and there is more competition for good companies whose worth is based on more than new product lines. Don



Fritzinger, president of Singer Equities, noted that acquirers are considering information technology platforms and other unique service offerings a company may bring with it. "At the end of the day it's all about diversification," he said. "If you're diversified geographically, you're diversified with your product mix, you're diversified with your services, you can generally steer around some of the icebergs."

Meanwhile, 60% of VMA distributor member survey respondents said they felt mergers and acquisitions are affecting the distribution industry and those effects are not necessarily positive. One respondent said, "Bigger organizations spend more time on the bottom line and less on customer service." That affects bottom line because to keep the bottom line favorable requires a reduction in workforce, the respondent said. However, another respondent sees a positive impact through consolidation: Mergers have helped stabilize weaker conditions in upstream markets and have positioned companies better for mid-stream markets, the person said.

#### STATE OF DISTRIBUTION TODAY

While the economic impact of \$50 and lower oil and the dismantling of coal-fired plants have created challenges for distribution in the valve industry, other considerations provide opportunities, the VM survey found.

One respondent noted that manufacturers are off-loading responsibility for technical and application product support, inventory and service to distributors. That means customers depend more on distributors for value-added services manufacturers may not be able to do in-house.

Another respondent pointed out that this increase in value-added needs has created a need for growth in technical distribution and away from supply chain/supply store mentality. Manufacturers are struggling to keep technical resources, and many customers depend far too much on their suppliers for technical know-how. However, distributors and manufacturers are not always able to direct enough attention to the technical aspects of products, leaving a gap in knowledge.

## Sixty percent of VMA distributor members responding to a recent survey said the low price of oil is having an impact not just on the bottom line, but on the way business is conducted.

#### THE NEAR FUTURE

In a recent webinar by ITR Economics, Dr. Alan Beaulieu addressed the challenges currently facing industrial distributors. He said that with the U.S. dollar sitting very high against other currencies, exports go down. That means it is not only the U.S.-based distributors but also the manufacturers that are struggling.

According to Beaulieu, if the economics of Europe and China improve, it could have a negative effect on the American dollar, which would have a positive effect on U.S. exports. Beaulieu expects that Europe will strengthen enough in 2016 to have some impact on the U.S. dollar.

Beaulieu also pointed out that, while the current state of business to business is painful and the ratio of wholesale inventories to new orders is higher than what's ideal, "it's not as

painful as what you've lived through before, and we expect the recession to ease in March 2016. New orders should bounce back then," he said.

Beaulieu also pointed out that, if you are in the business of selling into the defense market, developments are positive. "Defense expenditures are going up so there is more opportunity for bid and negotiated work going forward," he said.

Beaulieu urged manufacturers and distributors to take the time to figure out a set of competitive advantages to ride through the current slowdown and make good money until the next anticipated recession in 2019. "You have to know what sets your firm apart. If you don't know, your clients don't know," he said. **VM**

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## Q: CAN DUPLEX STAINLESS STEELS BE HARDFACED WITHOUT ADVERSELY AFFECTING THE BASE MATERIAL PROPERTIES?

BY DON BUSH

**A:** The issue of whether hardfacing adversely affects the properties of duplex stainless-steel base materials depends on several factors.

Hardfacing (a standard term for a wear-resistant weld overlay) is commonly used for seat and guide surfaces on valve trim of all styles. The work-horse hardfacing alloy in the valve industry is generically known as “alloy 6,” although it is often called “Stellite 6” (Stellite is a registered trademark of Deloro Stellite Company, part of the Kennametal group). This alloy is commonly specified by customers around the world on valve specification sheets. Because it is the most common, we’ll focus our discussion initially on hardfacing with alloy 6.

This material is a cobalt-chromium-tungsten alloy with about 1% carbon. A carbon level this high results in a microstructure consisting of a network of carbide particles in a soft matrix. The

hardness can range from 35-45 Rockwell Hardness (HRC) depending on the application method and the amount of dilution (the amount of mixing with base metal). Because of the presence of the carbide network, the overlay is somewhat prone to cracking, although resistance to cracking is very good for an alloy of this hardness level.

For small, simple parts, cracking is not a usually a problem. However, in larger and more complex parts, cracking can occur from the buildup of thermally-induced stresses caused by solidification shrinkage and thermal expansion and contraction.

Increasing the preheat temperature (the minimum temperature of the adjacent metal prior to starting any new weld pass) reduces this tendency. For some base materials, this is an acceptable solution to the cracking problem. However, it is not a viable approach for hardfacing duplex stainless steels.

Because of the compositional make-

up and the duplex microstructure (half austenite and half ferrite) of duplex stainless steels, these materials are highly prone to a number of phase transformations that can cause embrittlement or loss of corrosion resistance. The transformations happen at relatively low temperatures, which is why these materials as a group are limited to a maximum service temperature of 600°F (316°C) in the American Society of Mechanical Engineers (ASME) codes.

For this reason, some parameters for welding of duplex stainless steels are commonly recommended. These include limiting the maximum heat input (current times voltage, divided by travel speed) and interpass temperature (maximum temperature of the adjacent metal before starting any new weld pass). The use of these parameters is absolutely necessary when trying to meet the requirements specified in National Association of Corrosion

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Engineers (NACE) MR0175/ISO 15156 and Norsok M-630, as well as many end-user specifications. Even when such specifications are not imposed, these parameters should be used to avoid compromising the properties of the base material.

This is where issues arise. Small, simple duplex stainless-steel parts can be hardfaced with alloy 6 using proper duplex stainless-steel welding parameters without too much trouble. However, when parts become larger or more complex, alloy 6 will crack unless the preheat temperature is increased. If that temperature is increased to the point that cracking is alleviated, the interpass temperature required to avoid adverse effects in the duplex stainless-steel base metal will be exceeded. In other words, once the size or complexity of the part reaches a certain level, you can either have alloy 6 hardfacing without cracks, or you can have unaffected duplex stainless steel, but you cannot have both.

Some claim they can successfully hardface large, complex duplex stainless-steel parts with alloy 6 using prop-

er welding parameters, but they are likely misapplying the interpass temperature rule by assuming that each layer produced on the inside or outside diameter of a part by a spiral weld process is a single "pass." That is not the case—one revolution in such a process is one pass, and the weld progression must stop any time the temperature ahead of the pass exceeds the interpass temperature, even if the layer is not complete. If improper practices are followed, the "interpass temperature" isn't measured until after the completion of the layer, which results in the part preheated excessively by the welding heat input. This excessive preheat prevents cracking, but it also adversely affects the properties of the duplex stainless-steel base material. Unfortunately, this degradation of the base material isn't outwardly apparent, and it may not manifest itself until the component is in service.

The way to solve the cracking problem while maintaining the proper duplex base material properties is to use a hardfacing alloy that has enough ductility to be applied without crack-

ing and to use the appropriate welding parameters. Two hardfacing alloys that exhibit such ductility are alloy 21, commonly called Stellite 21, and Ultimet (Ultimet is a registered trademark of Haynes International). These alloys have far less carbon than alloy 6 (nominally 0.30% and 0.06%, respectively). As such, they provide much better ductility and resistance to cracking than alloy 6.

Even though these alloys are both inherently softer than alloy 6, they still provide excellent resistance to sliding wear, galling, liquid flow erosion and cavitation damage because they are cobalt-based. Because of its inherently corrosion-resistant composition (Co-26Cr-9Ni-5Mo-2W-0.08N), Ultimet has the added benefit of providing corrosion resistance on par with the superduplex stainless steels and super-austenitic stainless steels in many environments, particularly seawater and other high-chloride environments. ❧

**DON BUSH** is a principal materials engineer at Emerson Process Management—Fisher Valve Division ([www.emersonprocess.com](http://www.emersonprocess.com)). Reach him at [don.bush@emerson.com](mailto:don.bush@emerson.com).



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# Variable Frequency Drives in Electric Actuators

BY JUSTIN LEDGER

Electric actuators are vital for operating a wide variety of valves and are used in many industrial applications. Most of these actuators offer a single output speed, which may or may not be the most desirable solution for the needs of a specific application. An alternative is an electric actuator provided with an integral variable frequency drive, which allows various, speed-dependent solutions.

## BASIC DESIGN

There are many different ways to run an electric motor with variable output speeds. Variable-frequency drives (VFDs) require 3-phase voltage at the motor. This voltage must be changeable both in terms of frequency (speed) and amplitude (voltage level determining torque). However, the main supply voltage provided by a plant is constant in terms of frequency and amplitude and can be either 1-phase or 3-phase. This voltage conversion takes place in two steps—rectifying/smoothing and inversion.

During the first of these steps, the incoming plant voltage is converted into DC voltage using rectifier diodes. This voltage is smoothed further through capacitors, which are used as buffers for the energy. During the inversion stage, fast “electronic” switches connect the DC voltage in a precisely defined rhythm to the three motor terminals. By switching very quickly and selecting the proper voltage very quickly (pulse-width modulation), a 3-phase voltage system internal to the actuator is established.

## WHY USE VFDS?

There are many reasons why VFDs are used, beginning with the fact they can start up slowly and consistently.

In certain applications, valves sometimes have to overcome a large differential pressure. When these particular valves are operated quickly over the entire stroke, turbulences and vortices may be created within the piping. Ultimately, this can result in

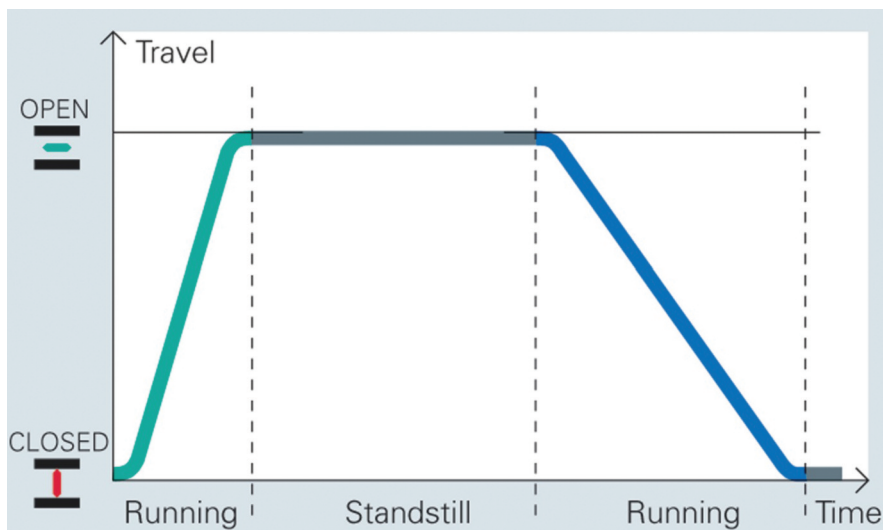


Figure 1. Different speeds for open/close direction can be selected and programmed.

large stresses and represents a hazard for valves, piping and connected components. In addition to these large stresses, other potentially undesirable or damaging side-effects include possible cavitation and water-hammer, which can spread throughout the entire piping system. These unwanted and unnecessary effects can be prevented by controlling the operating speed of the valve. By opening the valve slowly at first, pressure compensation can occur. Once the valve reaches a predefined position, the actuator can be operated at increased speeds and still meet the overall required valve stroke operation time.

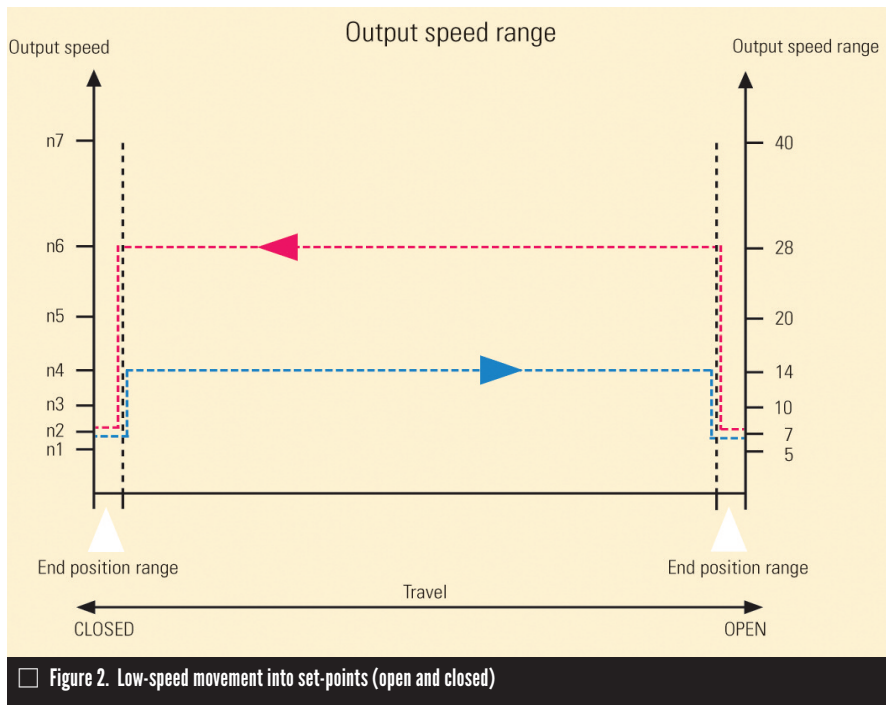
VFDs also are used because they can help close tightly without over torque. Moving the valve at full-speed into the valve seat fulfills a “tight shut-off” requirement. However, this can come at the expense of a high dynamic torque for both the valve and the actuator. Once the actuator motor is shut off electronically, kinetic energy continues to apply torque to the valve until the actuator and valve ultimately come to a stop. To prevent this kinetic energy torque, brakes at the motor can be used. Still, this can create added cost and maintenance on the actuator. Actuators with a VFD can control the output speed, and therefore slow down before reaching the end position. By doing this, the kinetic energy is signif-

icantly reduced, which likely will extend the life expectancy of the valve and actuator.

VFDs also can vary speeds throughout the stroke or direction. Depending on the application, there may be advantages associated with varying the operation speed of the valve and actuator at different positions throughout the valve stroke. For example, it may be desirable to keep process flow variables such as pressure, temperature or flow rate, at a fixed level, which is sometimes known as linearizing the valve characteristics. With fixed-speed actuators, this can be accomplished through switching the actuator on and off, or pulsing the signal. Unfortunately, this can result in many startup current spikes that can cause increased heat and ultimately premature failure of the actuator motor.

A VFD can also be programmed so that the speed in the closing direction can be different from the speed in the opening direction (Figure 1). This might be desirable, for example, in slowly lowering a decanter. Such an operation would be used in sewage treatment plants to avoid swirls in the activate sludge basin followed by a faster operation to raise the filled decant arm and allow fast filling of the basin for the next process operation.

Another benefit to using a variable

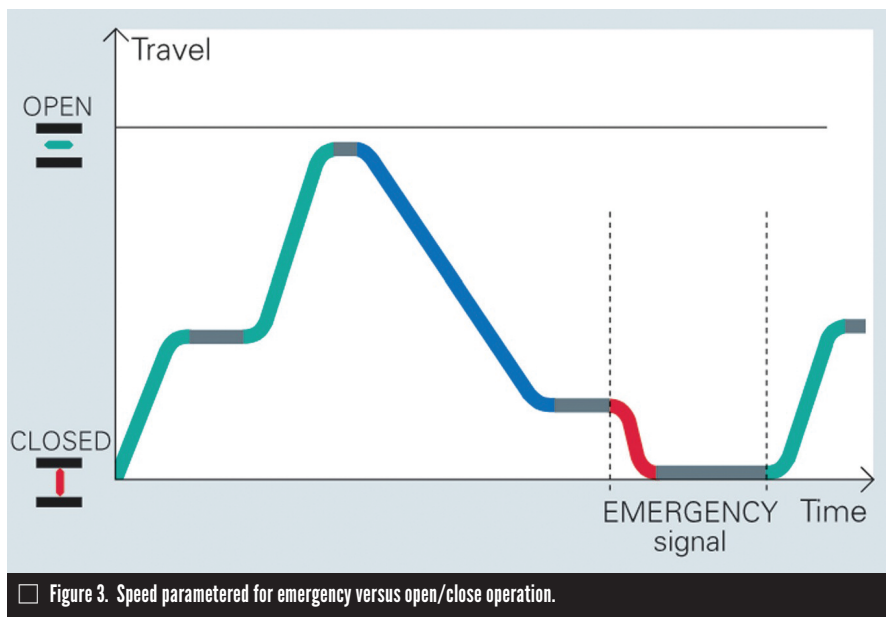


frequency drive is the output speed is slowed down as a set point is approached (Figure 2). By doing this, overshooting and hunting for the set point will be reduced, which equates to reduced load on the system components.

VFDs also offer different speeds for normal versus emergency operation.

Plant engineers must design systems for normal operation as well as for emergency conditions. The two situations often have two totally different scenarios for valve and actuator operations. During normal conditions, it may be desirable for the actuator to

precisely and slowly modulate a valve to maximize a predefined operating parameter. This slow operation may not be desirable during an emergency condition, however. VFDs allow both operations to be accomplished easily by predefined intelligent programming. When the actuator receives an emergency input signal (or loss of control signal) different speeds can be preprogrammed for single or both directions of travel (Figure 3). It also is possible to predefine a specific speed versus a position curve for the actuator to prevent the valve from closing or opening too quickly.



VFDs can be used with various available power supplies. Occasionally, actuators need to have the ability for operating during a power failure. In the case of a conventional 3-phase actuator, it typically would not be cost effective to have a 3-phase backup power supply. Similarly, conventional 1-phase AC motors are equipped with starting capacitors that have a large starting current draw. Because of this, a big, expensive, 1-phase backup power supply would be necessary. By design, a VFD has a very small starting current. Therefore, it can convert a 1-phase backup power supply into a variable 3-phase voltage to operate the actuator motor from a small, cost-effective backup power supply.



## CONCLUSION

Although they may not be needed for all applications, VFDs provide solutions that a single-speed actuator may not be able to offer. Actuators with an integral, variable frequency drive may have a slightly higher initial cost as compared to a conventional single speed actuator, but given the benefits associated with this technology, the higher cost may end up as an overall cost savings in the long run. Ultimately, understanding the specific application requirements will help determine if these drives are suitable solutions for the challenges of that application. **VM**

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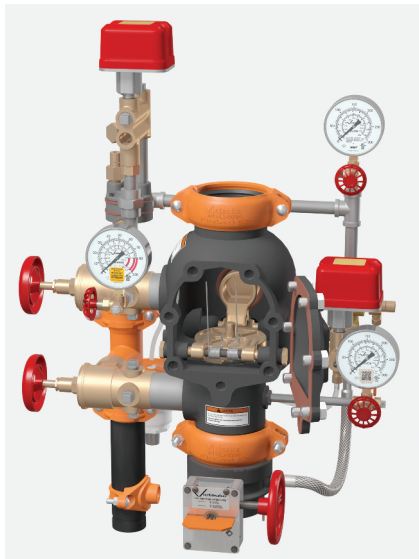
For more information on joining the Valve Repair Council, contact Marc Pasternak at 202.331.0104 (mpasternak@vma.org).

**CIRCOR Energy**

announces that KF Valves, a CIRCOR business located in Oklahoma City, has expanded its capability to manufacture stem extensions and reduce lead times to better serve buried or underground pipeline demands for customers. The stem extension offerings are available for Series P3/M3 and Welded Body valves. Special valve coatings are also available for underground installation where maximum corrosion protection is required.



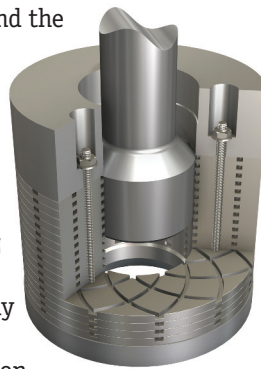
**Victaulic** introduces the new FireLock NXT Series 768N Dry Valve. The new valve provides simplified set-up and maintenance for fire protection contractors and fitters while maintaining the core features and benefits of the original technology.



In addition to the redesign, the new dry valve will also feature a QR code on the front of the valve, which will allow fitters to instantaneously access short videos on installation, set-up and maintenance.

**Flowserve** introduces the Valtek DiamondBack, featuring technologically advanced anti-cavitation trim design for severe service applications. The product enables control valve users to eliminate high-pressure drop cavita-

tion damage and the associated noise. In addition, the design can be produced in a range of materials, including tungsten carbide, effectively mitigating the effects of erosion.



The product passes slurries and entrained solids to 15 mm (0.5 in) without plugging.

**Curtiss-Wright's Industrial Division** has launched a new changeover valve from its brand family of Farris Engineering.



Designed in conjunction with its sister business, Phönix, and sold under the Farris name, the optimized change-over valve is a three-way

globe valve used in combination with Farris pressure relief valves wherever a shutdown cannot be tolerated. For critical services, a second changeover unit can be added at the outlet of the relief valves allowing for collection of toxic or aggressive effluent into a closed collection system.

The COV is offered with metal seating, Model 320B, or an optional bellow sealed stem, Model 370B, for toxic or lethal service.

**Pentair Valves & Controls** has expanded its Vanessa Triple Offset Valves product line with the launch of the Series 30-RS. The new manual



triple offset valve is designed to address the need for zero leakage isolation in non-critical applications in the oil and gas and process industries.

The series is specially designed for applications that require non-critical fluids isolation in lower pressure or temperatures. Its bolted-on seat allows for positive isolation when pressure is applied from the shaft side, thus minimizing the risk of dangerous mechanical failure compared to other bolted-seat designs.

**Balluff MICROmote** optical precision tube sensors are designed to detect free-floating air bubbles in transparent liquids. These air bubbles have dimensions smaller than their tube's inner diameter.

The ability to detect free-floating air bubbles results from a uniform illumination of the tube's liquid column. This uniform illumination is created by a concentrated arrangement of multiple light beams, each with an individual uniform intensity distribution, surrounding the tube. When a small air bubble enters the sensing field it induces a significant signal jump on the sensor's receiver elements.



**ASCO Numatics** has introduced the Numatics 488 Series Repairable Round Line Cylinders that come with magnets and bumpers as standard features. The series also is available with optional adjustable cushions, and it has more mounting and thread-type options than competitive products in its class.

With construction that is more robust than non-repairable cylinders, the series is more durable and reliable to accommodate the high cycle rates found in packaging and automotive applications.



CONTINUED ON P. 48



## “Is my company eligible to join the Valve Manufacturers Association of America?”

**VMA is the only association that exclusively supports and represents the interests of the U.S. and Canadian industrial valve, actuator and controls industry.**

We offer four types of membership for companies based in the U.S. or Canada, and that meet other criteria.\*

- **FULL MEMBERSHIP** U.S. and Canadian manufacturers of valves, actuators and controls
- **ASSOCIATE - SUPPLIERS** Companies that supply products and services to U.S. and Canadian manufacturers of valves, actuators and controls
- **ASSOCIATE - DISTRIBUTORS/CHANNEL PARTNERS** Companies that take title to and stock valves, actuators and controls manufactured by at least one VMA member
- **VALVE REPAIR COUNCIL** OEM-certified service, repair and maintenance firms for U.S. and Canadian manufactured valves, actuators and controls

If your company does qualify, here are some of the benefits you will enjoy:

- **Significant discount off of advertising in VALVE Magazine**, on VALVEMagazine.com, VALVE eNews and other VMA publications!
- **Free listing in VMA's Product Finders** (located on VMA.org).
- **Invitations to an array of VMA meetings and networking events** open only to members, including the VMA/VRC Annual Meeting, Valve Industry Leadership Forum, Market Outlook Workshop and Manufacturers Workshop. Plus, reduced rates for exhibits at the Valve Basics and Technical seminars, and the biennial Valve Repair Conference.
- **VMA's popular members-only newsletter, QuickRead**, delivered to your computer every Friday!
- **Participation in VMA's statistical and economic programs**, providing you with data not available anywhere else.



**Join today and you'll find out why 95% of VMA members renew each year!**

*\*To determine if you qualify to join VMA, go to: [VMA.org](http://VMA.org) > About VMA > Qualifications.  
To determine eligibility for the Valve Repair Council, go to: [VMA.org](http://VMA.org) > Valve Repair Council.*

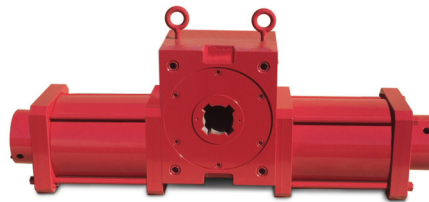
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**Garlock** introduces the PS-Seal to the North American market. Specifically designed for use on rotating shafts at high circumferential speeds, high pressures, vacuum environments and temperatures of -130°F (-90°C) to up to +500°F (260°C), the PS-Seal prevents intrusion of damaging abrasive and aggressive media in a wide variety of food and pharmaceutical applications.

The seals operate reliably in extreme conditions because of the use of Garlock's patented GYLON material, which also ensures FDA approval and SIP/CIP compatibility.

**Moog** has released its Moog Spec-Tork custom pneumatic and hydraulic rotary actuators to meet OEM torque and speed specifications. The actuators satisfy special customer requirements that vary from Moog's standard actuators. For example, the Spec-Tork can meet applications that might include: rotations of less than 90°, special cushions for high-speed requirements, electro-hydraulic actuators and systems, integral valving and special mounting flanges.



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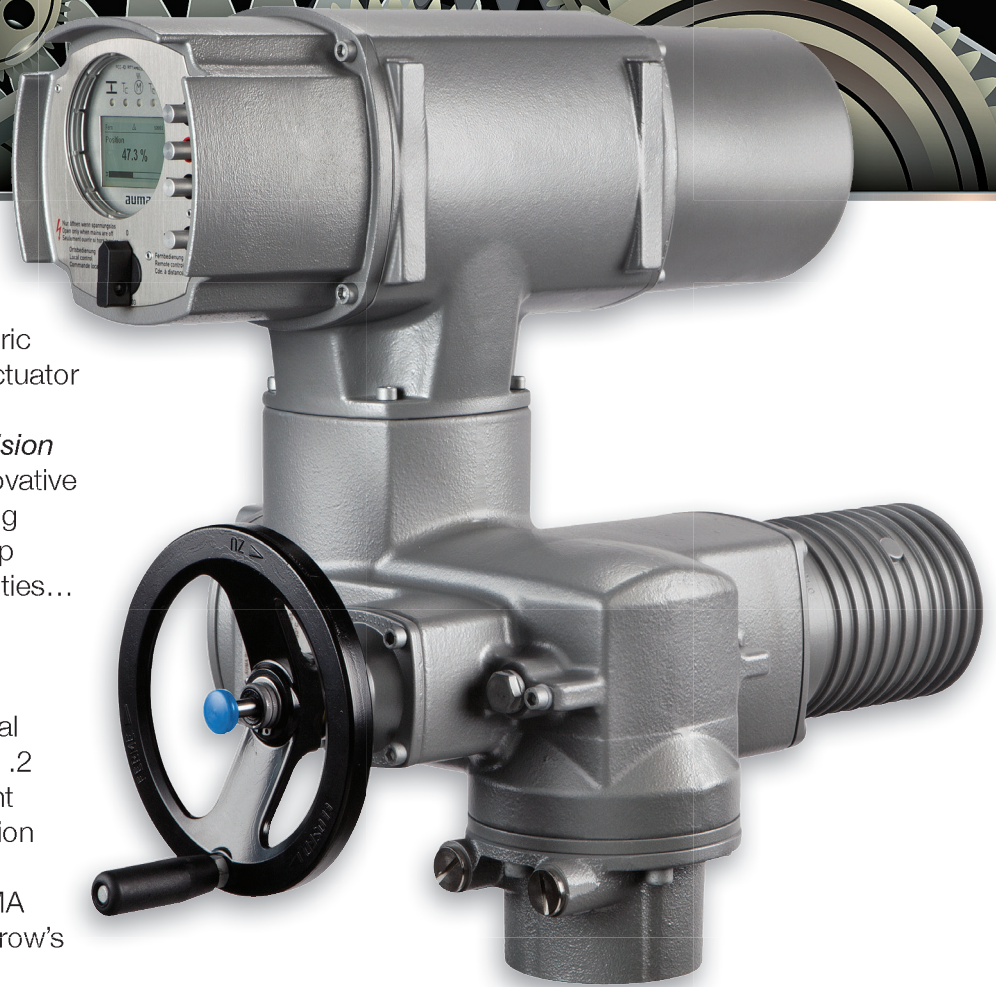
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(1) Outside County	7,884	9,169
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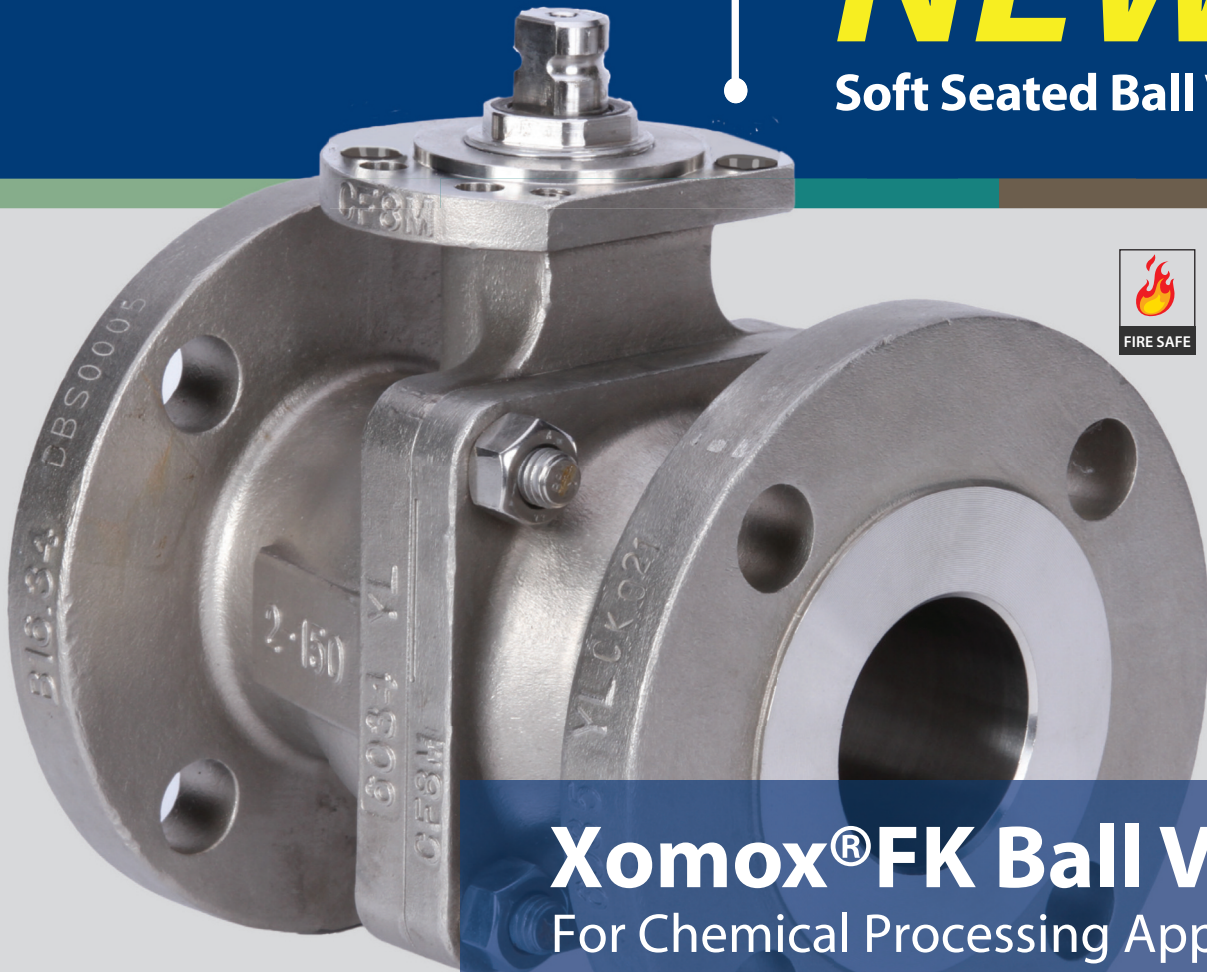
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