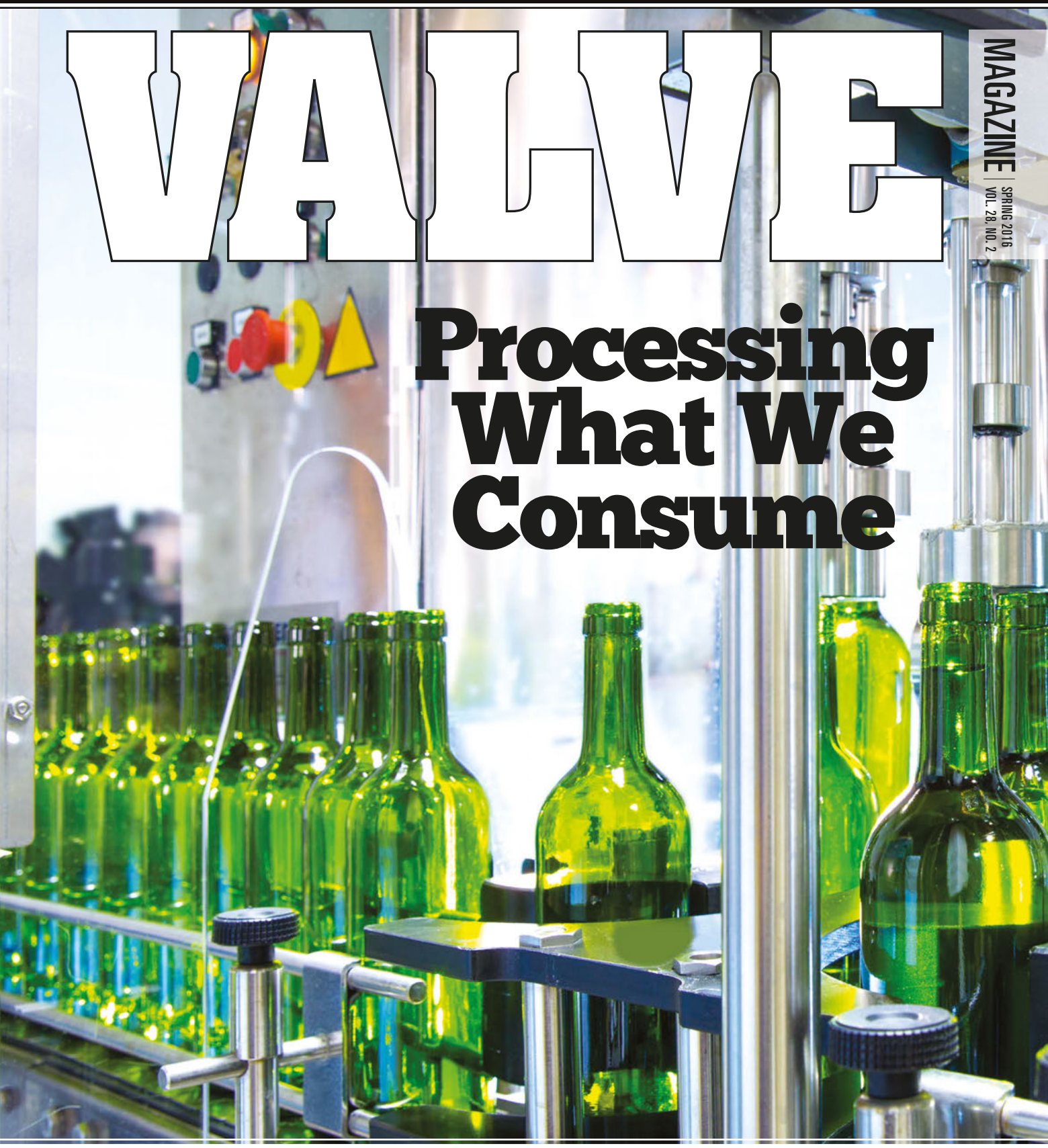
VALVE REPAIR EVENT COMING TO HOUSTON IN JUNE

VALVE

MAGAZINE | SPRING 2016 | VOL. 28, NO. 2



Processing What We Consume

- THE BASICS OF STOP CHECK VALVES
- THROTTLING LIMITS FOR GLOBE VALVES
- VALVE SELECTION PRACTICES
- EMISSIONS ABATEMENT BY REPAIR SHOPS

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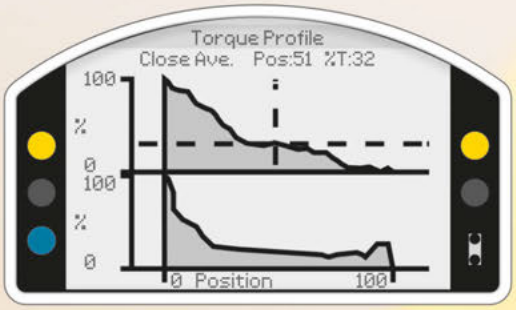

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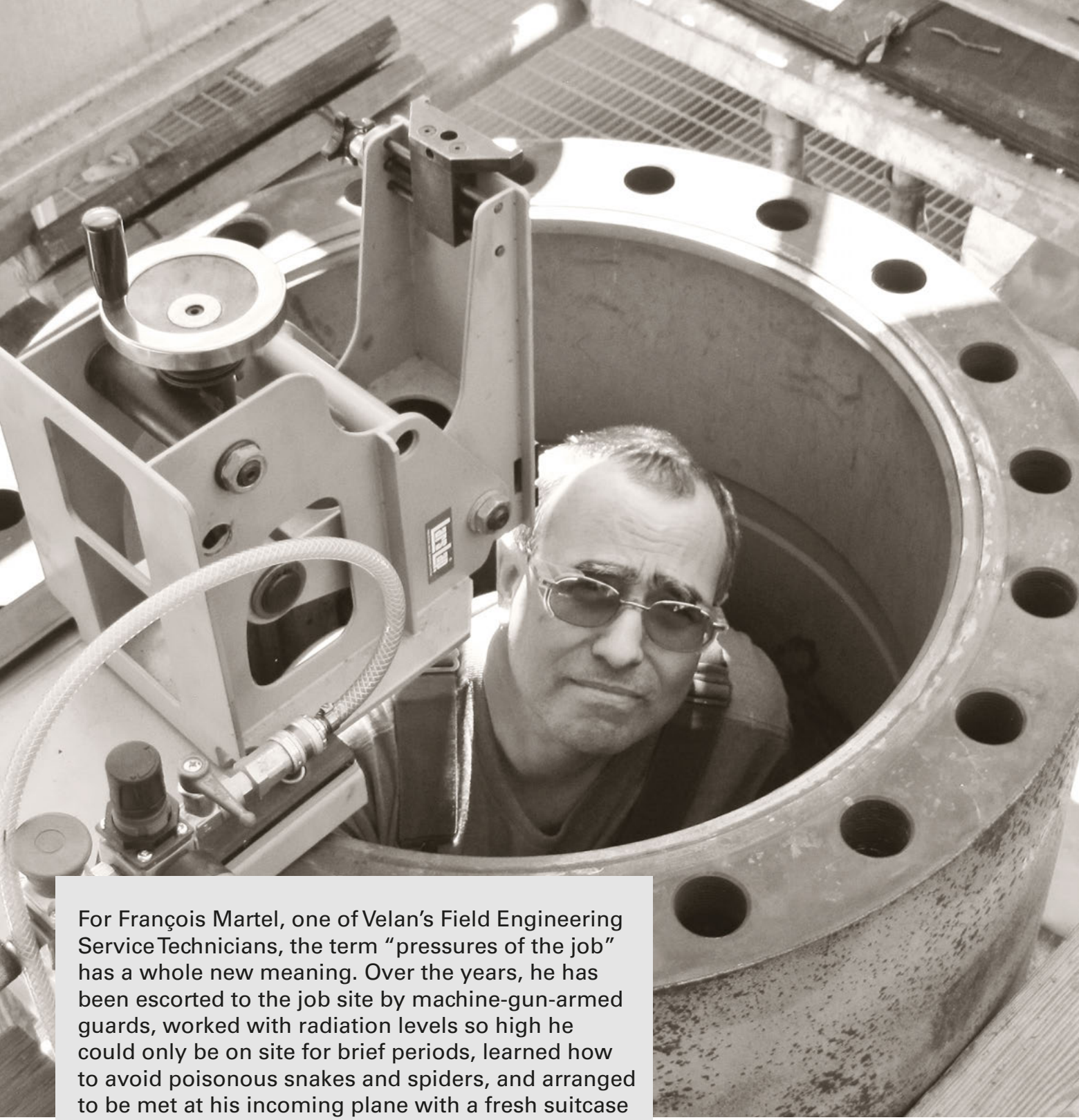
Keeping the World Flowing



For François Martel, one of Velan's Field Engineering Service Technicians, the term "pressures of the job" has a whole new meaning. Over the years, he has been escorted to the job site by machine-gun-armed guards, worked with radiation levels so high he could only be on site for brief periods, learned how to avoid poisonous snakes and spiders, and arranged to be met at his incoming plane with a fresh suitcase of clothes so he could travel to another project half way around the world.

What you might not know about François is that he likes challenges off the job too. That's why he's just signed up for scuba diving lessons so he can explore a whole new underwater world when he's not literally up in the air.

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VMA MAGAZINE
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Codes and Specifications for Mitigating Corporate Risk
Experience has shown that material test reports can contain significant errors; they are not always a reliable source for identifying material used in new construction. This is where positive material identification and "trust but verify" come into the picture.

VALVE MAGAZINE

www.VALVEmagazine.com

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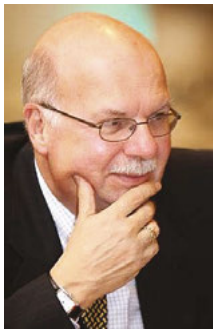
VMA VALVE MANUFACTURERS ASSOCIATION OF AMERICA
The voice of the flow control industry

www.vma.org

Up for a Few, Down for Many



The year 2016 will not be a banner one for the industrial valve industry. I'm basing that reality on our recently issued "Market Forecast of Industrial Valve Shipments in the United States for 2016," presentations at our recently completed VMA Leadership Forum in Denver and discussions with industry leaders.

The Market Forecast showed 2016 as almost flat (see page 6). The only end-user industries indicating growth are water and wastewater, chemicals and commercial construction. Others are seeing either no growth or declines in shipments. This reflects what was said by industry leaders at the leadership forum, who described 2016 with phrases such as "challenging," "tough" and "no projects." Leaders also mentioned that these market conditions are not limited to the U.S. and Canada—they exist in many places around the world.

Our economic consulting firm ITR Economics' remarks at the Forum pretty much echoed what our industry leaders have shared with me, namely that we'll see declining growth in the leading indicators related to our industry for 2016. ITR went on to say that "U.S. industrial production, our benchmark for the U.S. economy (along with the Gross Domestic Product) is in decline. The average production over the last three months has declined 2.4% over the last four months."

We will continue to monitor 2016, and members are invited to join us in August in San Diego at our Market Outlook Workshop where we'll learn from 11 end-user industry experts about the outlook for 2017 and beyond.

Also, I'll share with you the outlook for our European counterparts in the summer issue of **VALVE Magazine** because I will have just returned from their Annual Congress in France.

Don't forget to check out our fall issue of **VALVE Magazine** for coverage of the workshop. It will report on what the experts are saying will happen and hopefully provide valuable data you can use to make sound business decisions in light of what's happening. VM

Bill Sandler
President, Valve Manufacturers Association of America

We Can Help You Cope With Fugitive Emissions Issues

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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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COMPANY CONNECTIONS

United Valve and FluoroSeal Form Service Agreement

FluoroSeal Inc. and United Valve LLP jointly announced creation of a strategic valve service agreement for factory-authorized service on FluoroSeal products. The scope of the agreement includes authorized valve repair, valve modification and other opportunities as directed by FluoroSeal. The agreement will provide that company's customers an outlet for approved valve service work outside its Montreal location, specifically in the refining and petrochemical-rich Gulf Coast area.

Emerson Automating LNG Complex

Cameron LNG has tapped Emerson Process Management to help automate its new liquefaction project through addition of three trains to facilitate export of domestic natural gas to international markets. Emerson's portion of the project is about $20 million.

The new trains will give the Hackberry, LA facility the flexibility to export up to 12 million metric tons per year of U.S.-produced natural gas. The plant also can continue to import LNG for domestic use or re-export LNG from other countries.

GE Oil & Gas and Diamond Offshore Enter Landmark Service Agreement

GE Oil & Gas and Diamond Offshore Drilling, Inc. announced the offshore drilling industry's first-of-its-kind contractual service agreement, which transfers full accountability for blow-out preventer (BOP) performance to GE Oil & Gas. Under this model, Diamond Offshore will compensate GE Oil & Gas only when the BOP is available.

The 10-year collaborative arrangement will include GE purchase of the BOP systems aboard Diamond Offshore's four drill ships, which are currently located in the U.S. Gulf of Mexico, for a total of $210 million.

Velan Creates Partnership with AIV Europe

AIV Europe recently announced a new partnership with valve manufacturer Velan. AIV is a distributor for the chemical, oilfield, petrochemical, pulp and paper, refining, power and water treatment industries.

AIV Europe will initially offer Velan pressure seal valves in gate, globe and check styles, 2–14 inches, 900–2500 pound, Classes, A105, F11 and F22.

Siemens Partners with Pentagon's Largest Helicopter Repair Facility

The U.S. Army Corps of Engineers Engineering and Support Center, Huntsville, AL, has selected Siemens to be its long-term partner to address water and energy infrastructure needs and improve energy efficiency at the Corps Christi Army Depot (CCAD). The project is being funded by savings generated through energy conservation measures.

Corps of Engineers support center

Located on the Texas coast, CCAD was established in 1961 as a Tenant Command of Naval Air Station Corpus Christi.

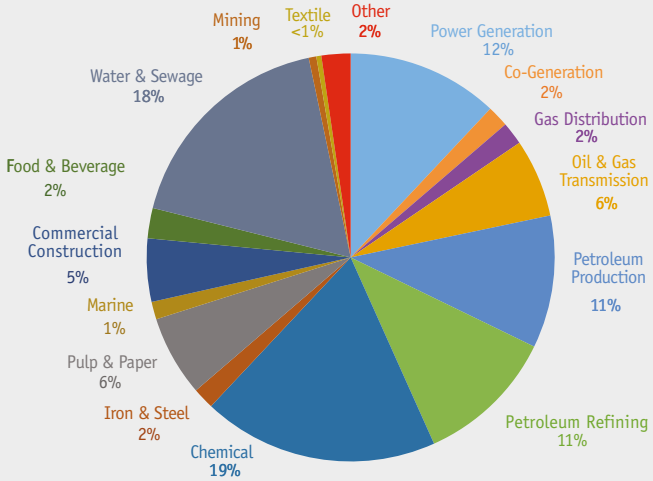
Flowserve and Veolia Group Come to an Agreement

Flowserve Corporation

MARKET FOCUS: U.S. INDUSTRIAL VALVE SHIPMENTS

For the first time since 2009, VMA's annual forecast shows that growth in valve shipments for this year will be almost flat. The annual forecast found that shipments will be up just $3 million over 2015 to be about $4.5 billion.

The industry was at about $4 billion when it crested in 2008, then tumbled, and it's been climbing steadily since that time. This year will be the slowest since 2009 because of recent downturns in the petroleum and power industries. One bright spot, however, is commercial construction, an industry that is growing and now makes up about 5% of the industry.



Source: Valve Manufacturers Association (www.vma.org). Percentages rounded up or down for purposes of this pie chart

Of the 15 end-user industries VMA tracks, the two that have the greatest market share will gain even more this year: Chemical now makes up 18.7% of the market compared to last year's 17.8% while water/wastewater holds 17.8% compared to 16.9% in 2015. The next largest industry, power generation fell about 0.4% last year while petroleum production fell by 1.5%. Petroleum refining, on the other hand, gained slightly to become about 11.1% of the industry compared to 10.8% last year.

Exports, which have helped industry growth over the last few years, will gain only slightly this year, rising by $5 million in 2016 to $955 million while domestic shipment will lose some ground (from $3.512 billion in 2015 to $3.510 billion in 2016).

announced a new agreement with Veolia Group that makes Flowserve a preferred global supplier of deep-well submersible pumps, clear-water single and multistage pumps and associated services. The agreement is in effect through August 2018.

Garlock Awarded Distribution Rights in China

Garlock Sealing Technologies has signed an exclusive agreement with Mesa Engineered Tank Products that entitles Garlock to exclusive distribution rights of Mesa ETP products in China.

Mesa ETP manufactures products for refineries, terminals and storage tank facilities. The company is a division of Mesa Industries, headquartered in Cincinnati with additional offices in Houston and Monrovia, CA.

AWARDS & MILESTONES

Val-Matic Celebrates 50 Years

Val-Matic Valve & Mfg. Corp. is celebrating 50 years in business in 2016. Val-Matic was founded in 1966 by Andrew Nuter and Ted Makowan and started with only a silent check valve product line. The company has since grown to 14 valve product lines for the water and wastewater, industrial, commercial building construction and plumbing industries. Val-Matic operates two manufacturing facilities in Illinois.

ASCO Announces Brand Transition

ASCO Numatics, a business unit of Emerson, is now doing business as ASCO. The transition to the new name will be made globally. It will not affect customer purchasing processes or sales channels.

The company said the ASCO name will leverage the power of its ASCO and Numatics brands to better serve customers while simplifying the way it does business.

Victaulic Named a Top Manufacturing Plant in North America

The Victaulic factory in Forks Township, PA has been named one of the top eight manufacturing plants in North America by Industry Week. The company was the recipient of the 2015 IW Best Plants Award, a program that recognizes manufacturing facilities each year that exhibit outstanding operations, strong leadership, leading-edge technology and excellent quality.

The new Manufacturing & Technology Conference & Expo May 3-5, in Rosemont, IL will honor the eight plants at an awards ceremony.

NEW FACILITIES

Saint-Gobain Opens Production Facility in Belgium

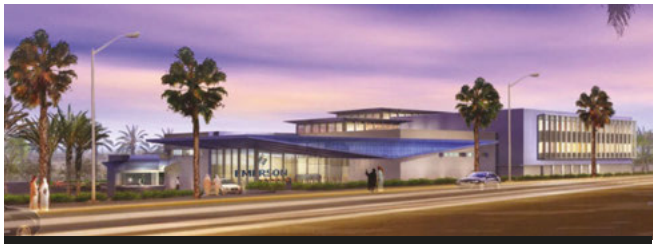
Saint-Gobain Seals has opened a new large diameter seal production facility at its Kontich, Belgium site to further improve quality and reduce lead-times significantly for large diameter, polymer OmniSeal seals. With this new production facility, Saint-Gobain Seals aims to strengthen the service to the energy sector for applications such as floating production storage and offloading turret swivels, large engineered valves, wind turbines, compressors and turbines.

The dedicated area includes a new compression-molding press, sintering ovens, a large diameter computer numeric code lathe, flexible forming and welding technology, special transportation racks and a large table for assembly and inspection.

Emerson Building New Tech and Training Center

Emerson Process Management broke ground for its new technology development, customer training and project support facility in Dhahran Techno Valley in Saudi Arabia.

The 11,370-square-meter (122,386-square-foot) facility will provide services and support to the oil and gas, mining and other process industries. It will house offices, training facilities, a service and light manufacturing workshop, and laboratories focused on control systems, flow metering technologies, and research and development. The facility is scheduled for completion in May 2017.



Emerson's technology and training center

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

SEPTEMBER

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

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

OCTOBER

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

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

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

GE Moves Headquarters to Boston

GE announced it has selected Boston for its corporate headquarters location. The headquarters will be located in the Seaport District of that city. Employees will move to a temporary location in Boston starting in the summer of 2016, with a full move completed in several steps by 2018.

GE has a significant existing presence in Massachusetts with nearly 5,000 employees across the state in businesses including oil and gas, aviation and energy management.

SALES, STARTUPS & ACQUISITIONS

MRC Global Signs Agreement to Sell OCTG Business

MRC Global Inc. entered into a definitive agreement to sell its U.S. Oil Country Tubular Goods (OCTG) business to Sooner Pipe, LLC, a subsidiary of Marubeni-Itochu Tubulars America, Inc., for $48 million, subject to certain adjustments.

Watson Valve Launches Watson Valve Services, Australia

Watson Valve Services Inc. announced the start-up of Watson Valve Services, Australia. The company will now have the ability to support the supply of its severe service valve products to non-U.S. domestic sites from its Australian-based service agent, Process Plants International (PPi) under the new name, Watson Valve Services, Australia.

The company's Houston Headquarters will support PPi with access to continued engineering, technical and laboratory support.

MW Industries Makes Multiple Acquisitions

MW Industries, Inc. announced the acquisition of Servometer, BellowsTech and USA Fastener Group. Located in Cedar Grove, NJ, Servometer designs and manufactures miniature bellows, flexible shaft couplings, electrical contacts and bellows assemblies.

BellowsTech, located in Ormond Beach, FL, markets edge-welded bellows and assemblies.

USA Fastener Group of Houston is recognized for its wide range of fastener products and machining capabilities.

PEOPLE IN THE NEWS

VALVTECHNOLOGIES… appointed **Colleen Henneke** as chief financial officer. She has 30 years of financial management responsibilities, most recently as chief accounting officer and vice president, operational finance at Axon Energy Products.

VAL-MATIC… announced that **Ted J. Makowan**, president and CEO, retired on April 6, 2016 but will continue to serve on the board of directors. Makowan founded the company with Andy Nuter in 1966. In addition, **Gene Antongiovanni**, vice president of manufacturing, also has announced his retirement. Antongiovanni's leadership contributed to Val-Matic's success for more than 14 years.


Makowan

FORUM ENERGY TECHNOLOGIES… announced that Valve Solutions president **Steve Twellman** is stepping down from his current position but will remain with Forum in a global business development role. **Keith Barnard** has joined Forum as the senior vice president for production and infrastructure. Also, senior vice president **Carl Daniel** will be moving to the Middle East to assume the role of vice president of regional operations.

PBM… has named **Mark Nahorski** president. He has served as COO of the company since 2010, and has 25 years of valve industry experience. Nahorski succeeds **Stuart Zarembo**, PBM's chairman & CEO. Zarembo served as chairman of the VMA board in 1999.

VELAN… recently announced that executive vice president **Ivan Velan** has decided to reduce his work scope, but will remain with the company as special advisor to the president. Also, **Martin Allen** joined Velan's management team on Feb. 1 as executive vice president, manufacturing operations and global supply chain; **Rob Velan** is the new vice president, customer services and distribution; **Dan Velan** became vice president, marketing and product strategy; **Wolfgang Maar** is now executive vice president, global sales and international operations; and **Shane Velan** is the new director, strategic planning and information technology.

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Valve Careers Initiative Shows Young Job-Seekers: "It's Your Move!"

BY JESSICA BELLO

Industrial companies, including those that involve valves, have been concerned for years about the growing shortage of talented workers. They realize the gap will only widen in the future as employees at all levels in the industry retire, leaving positions open that often can't be filled by those with the required skills.

It's the reason that Valve Manufacturers Association (VMA) launched the Valve Careers initiative, a movement now in its second year of existence and going strong. The latest effort is a direct appeal to young people through two videos designed to highlight the wide range of opportunities in the valve industry and get them to act.

THE NEED

The videos and the initiative itself exist to address several components of what's needed. Two critical elements are training and retention. But before companies can address those needs, they have to learn how to grab the attention of those with the right skills and get them to consider joining the industry.

As Ben Dollar, principal in the Human Capital practice of Deloitte Consulting LLP told VMA executives at the Valve Industry Leadership Forum in Denver, CO, "Manufacturing still suffers from a perception of being dirty, dumb and dangerous." Dollar emphasized the need to talk about the culture of valve manufacturing, a culture those already working in the industry know is anything but dirty, dumb or dangerous. To get that point across, however, the valve industry has to develop a very loud voice that will reach the masses of young people looking for a career that is challenging, rewarding, impactful and technologically advanced. That's where VMA's Valve Careers initiative and the recently produced videos come in: Both are designed to educate and inform young people about careers in the industry by connecting member companies and those already in the industry with the talent pool.

When it comes to finding an interesting and well-paying career, "It's Your Move!" say people working in the valve industry.

SEEING A SOLUTION

The videos highlight what valve manufacturing is all about: why valves are so vital to the modern world, why the industry offers a wide range of opportunities today, and why young people should see themselves in valve manufacturing. One video ends with a group of valve manufacturing employees saying "It's your move," thereby encouraging the viewer to take action to learn more about careers in the industry.

The valve industry has realized that the days of workers showing up at the doorstep seeking jobs are long gone. They know they need to be proactive in finding, educating and enticing young talent to consider positions in the industry. As Dollar discussed in his presentation, manufacturing can expect a skills gap of about two million jobs over the next decade. While the issue cannot be solved entirely by the companies within industry, the gap is something that needs to be addressed immediately and aggressively.

One way the valve industry can help is by sharing its stories directly with the public. The Valve Careers videos, as well as the initiatives' social media tools and website are three channels for doing that. Companies themselves also need to get out into the community and connect directly with high schools and colleges to talk to them about why a career in valve manufacturing is a fantastic option. Valve Careers is working to provide resources and tools to enable this effort. Together, the industry and VMA can go a long way toward closing the skills gap.

For information on the initiative, go to www.valve-careers.com. To view the new videos, search for "Valve Careers" on YouTube, Facebook, Twitter and LinkedIn. VM

Jessica Bello is VMA's careers program coordinator. She welcomes questions on the Valve Careers Initiative. Reach her at jbello@vma.org.

VMA GAINS THREE NEW MEMBERS

VMA recently welcomed three new companies to its membership ranks. They include:

Score Valves (www.scorevalves.com) joined VMA as a full member. The company specializes in butterfly valves and a complete line of double and triple offset designs for the oil and gas, petrochemical, pulp and paper, mining and other related industries.

Joining as the newest distributor/channel partner is **PM International Suppliers, LLC** (www.pmfirst.com). The company supplies pipes and fittings, tubing, valves, flanges, bars, sheets and forgings to numerous users throughout the world. It specializes in exotic materials and delivers to a wide variety of industries including offshore petrochemical, geothermal, chemical, aerospace, desalination, powers plants, water treatment and more.

Omaha Steel Castings Co. (www.omahasteel.com) has joined VMA as an associate (supplier) member. The company produces high-quality steel and stainless-steel castings for a vast array of end users.

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Valve Repair Meeting Features Three Shop Visits

Before attendees for the 2016 VMA/VRC Repair Meeting even begin to fine-tune their valve repair skills at sit-down sessions, they have the opportunity to visit facilities in the area where valves, actuators and controls are repaired and serviced. Kirksey Machine, Metso Automation and Gulf Coast Modification have invited attendees to tour their facilities.

The Valve Repair Meeting focuses on issues specific to keeping valve assemblies operating at peak efficiency as well as trends on what's happening in the industry and pressures the companies in valve repair and service face.

The meeting itself is June 1 to 3 at the Sheraton Houston Brookhollow Hotel, Houston. The tours take place the first day of the meeting in consecutive order so that attendees can see three different set-ups.

On June 2 and 3, attendees will hear a number of speakers address what's happening in today's repair and service world and network among their peers. Topics and speakers include: An update on the latest activities at the National Board of Boiler and Pressure Vessel Inspectors by Joseph Ball, director of the pressure relief department for the National Board; gasket designs and bolt training by Syed Arif, Lamons; valve live loading by George Davet, Solon Manufacturing Co.; fugitive emissions by Rodney Roth, A.W. Chesterton; and the latest developments with API standards by Rich Davis, Flexitallic.

A large valve being disassembled for repair.

A vital part of the meeting is a full day of table-top exhibits, where vendors with products that support the industry show off their latest offerings.

A special discounted room rate is offered to attendees but only until May 2.

For information on the meeting, go to VMA.org > Meetings > Valve Repair Meeting. Address registration questions to Malena Malone-Blevins at mmaloneblevins@vma.org or 202-331-8105.

Uniting the World of Water

ACE 16, the annual meeting of the world's water professionals, takes place June 20-22 at McCormick Place West, Chicago.

ACE is put on by the American Water Works Association. The conference brings together experts from around the world to exchange ideas about the world's water supply.

Leading off this year's conference is Jim Cantore, the on-camera meteorologist for The Weather Channel. His presentation is followed by three days packed with special sessions, roundtable discussions and presentations from experts who will cover over a dozen tracks of specialty areas such as the business of running water facilities, advances in water treatments, water quality challenges, practical applications for water conservation, the latest in technology and innovations, best practices and leadership challenges in the industry, and regulatory/standards updates.

Last year's event drew over 11,500 people from around the world. In addition to sessions, a large exhibit hall features the products of 500 companies who offer services to the water industry and hundreds of products, including valves and related equipment.

For information, go to www.awwa.org.

Largest Oil & Gas Show in North America

The Global Petroleum Show provides a comprehensive look at how the oil and gas world operates today, bringing together people from 84 countries. This year's show is June 7-9 in Stampede Park, Calgary, Alberta.

New to the event is a natural gas pavilion, a fracking innovation zone, a global logistics area and a number of companies showing digital oilfield innovations such as drone technology and mobile devices software.

Over 1,500 exhibiting companies showcase products and services on a 650,000-square-foot floor, and free educational sessions are held on the show floor throughout the event. Meanwhile, the International Energy Marketplace forum brings together local and international organizations to explore opportunities around the world.

The show is held in conjunction with SPE Canada Heavy Oil Technical Conference and the Indigenous Conference on Energy.

For information, to go www.petroleumshow.com.

Food and Beverage Processing

BY KATE KUNKEL

When wandering the grocery store aisles, it's easy to forget that for every colorful package that sits on the shelves, a myriad of processes go into preparing the foods inside. Whether it's cereal, breakfast pastries, cookies or canned peaches, everything must be either steamed, dehydrated, pulverized, pasteurized or otherwise treated to fit into the cans, boxes and cellophane packages.

For every one of those processes, valves are employed in many ways, especially in the management of steam, the single most critical component of food processing. With the very safety of the food supply at risk, regulation of the quality and quantity of steam is a challenging job for valves, actuators and control systems.

STANDARDS

Because safety is involved, many regulations and standards are in place around the world. Yet there are few specific guidelines and none that are accepted worldwide to manage the quality and purity of the steam that comes into direct contact with the food or processing that food. In the U.S., there are basically three mentions in current regulations: Accepted Practices for a Method of Producing Culinary Steam, the FDA Code of Federal Regulations and a National Organic Standards Board review.

Executive Summary

SUBJECT: Putting products on grocery shelves requires many complex processes and many of those processes are controlled with valves and related equipment.

KEY ISSUES:

- Types and levels of steam
- Valves for different steam grades
- Where clean is needed

TAKE-AWAY: Because safety is involved, the valves in this industry must be top grade, especially when they control steam that may come into direct contract with the product.

GRADES OF STEAM

Several grades of steam are used in food processing and each has its own level of contamination risk. Each also presents its own challenges for the equipment in process control.

Plant Steam

Industrial or plant steam is the lowest grade of steam. It is the starting point for all steam used in food and beverage processing, but it's the steam that doesn't come into direct contract with the food or drink product. In other words, it's used in heat exchangers or used for hot water generation, in boiling pans and other areas. Softened water, reverse osmosis-treated or dealkalized water is generally used for plant steam. This well-treated water is easy on valve materials and causes few corrosion issues. The typical valves used in these systems are standard-issue for the steam and power industry. They include gate, globe and check valves. Some applications may also allow the use of quarter-turn valves as long as their design contains no pockets where fluid or debris could collect.

Even though plant steam does not come into direct contact with the food or beverages, it still needs to be at the correct pressures, and it must remain clean, dry and free from other gases and air. This is achieved by the use of plant steam control systems containing pressure control valves, filters and steam traps.

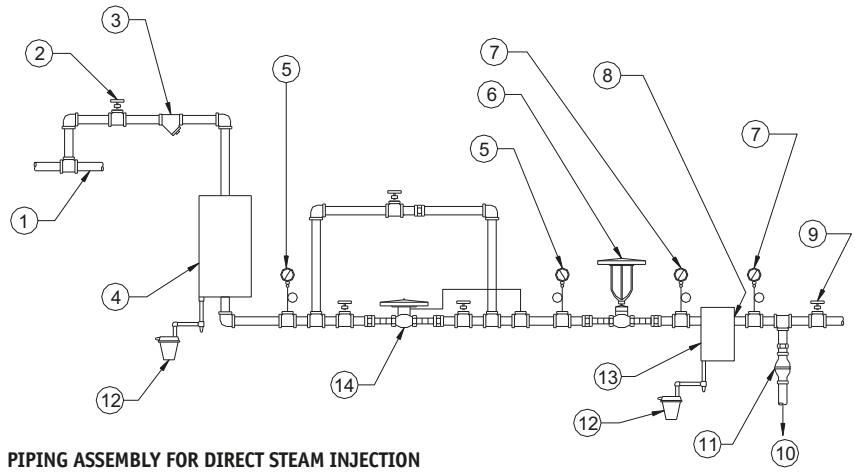
While no hard and fast rules about plant steam materials exist, some food and beverage manufacturers stipulate any steam products, including pressure regulation valves, that supply steam either directly or indirectly to a beverage or food product must be constructed of a material sufficiently inert to preclude contamination of the food. For this reason, austenitic stainless steels such as 304ss, 316ss or 316Lss are often used.

Filtered or Culinary Steam

The next level of steam is filtered or culinary steam. Culinary steam is used in applications used to sanitize the processing system. These are called "Clean in Place" (CIP) procedures, and they are employed to ensure the proper level of hygiene in pipes, valves, fittings and related components in the food processing systems themselves. Air and steam filters are often integrated into an overall system for the CIP process with appropriate valves, drains, pumps, pressure gauges, pressure relief valves and associated controls.

There also are portable products designed specifically for CIP. Similar to a power washer for a car or sidewalk, these systems use super-heated steam with power nozzles to sanitize and eliminate hazardous food-borne bacteria. Dry vapor-steam is the most efficient cleaning solution for food and beverage facilities because most pathogens can be eliminated at 160°F (71°C). Many of these systems produce constant hot dry steam ranging from 212-240°F (100-116°C).

Moisture reduction control systems consisting of steam traps and filters are employed to keep the steam as pure as



PIPING ASSEMBLY FOR DIRECT STEAM INJECTION

1. STEAM MAIN
2. STOP VALVE
3. STRAINER
4. ENTRAINMENT SEPARATOR
5. PRESSURE GAUGE
6. STEAM THROTTLING VALVE (AUTOMATIC OR MANUAL) OR ORIFICE
7. DIFFERENTIAL PRESSURE MEASURING DEVICE
8. STAINLESS STEEL FROM THIS POINT
9. SAMPLING MEANS
10. SANITARY PIPING TO PROCESSING EQUIPMENT
11. SPRING LOADED SANITARY
12. CONDENSATE TRAP
13. FILTERING DEVICE
14. STEAM PRESSURE REGULATING (REDUCING) VALVE

© 3-A Accepted Practice for a Method of Producing Steam of Culinary Quality, Number 609-3

☐ Figure 1. An extract from the standard detailing the system components required for culinary steam

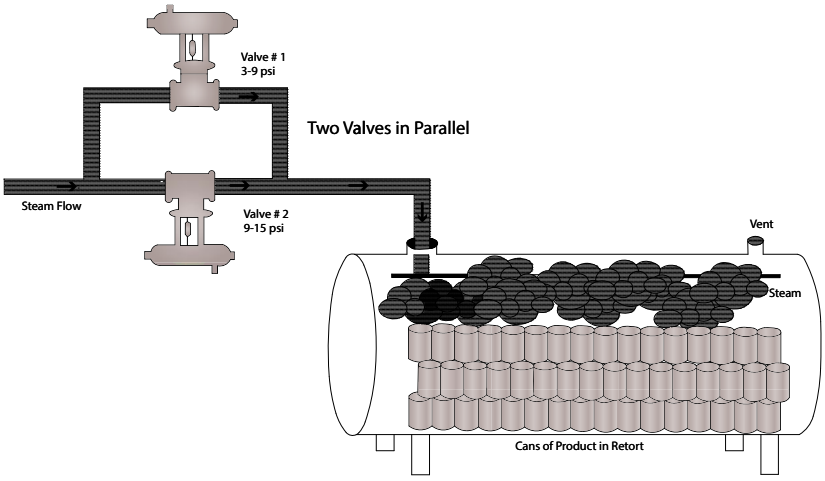
☐ Chocolate heater in a factory

possible. When additional moisture is required in the fluid stream (for example, when chocolate or heavy grease are involved), moisture control systems and valves are used.

Clean Steam

The highest grade of steam is clean steam, and it is typically raised from purified water in a dedicated clean steam generator. This is the area in which the foods or beverages are in direct contact with the steam. To create clean steam, a secondary generator with a controlled feed water system is used. Clean steam requires the use of stainless-steel pipework and components that eliminate the potential for corrosion of steam traps, valves and pipeline equipment.

As in other sanitary process piping systems, a paramount concern in food and beverage processing is the need for ease of cleaning. For this reason, the inside of all piping components, including valves, must be very smooth and free from crevices or pockets that might entrap fluid or debris or be difficult to remove via standard cleaning processes. This limits the use of many as-cast components because of their inherent surface roughness. It also requires electro-polishing or other processes to ensure that the bore of the fluid stream is free from potential areas of fluid entrapment.



Used with permission from Richardson Industries

Figure 2. Sterilization of cans

Standards and specifications for sanitary process lines are detailed in documents created by the 3-A Standards organization (Figure 1). This is a standards organization whose membership is made up of industry professionals as well as governmental agencies such as the Food and Drug Administration.

Most food-contacting valves are made of 316 stainless steel for corrosion resistance (or 316L if the valve has welded end fittings), although other alloys are used for certain applications. An important difference between general application valves and those made for food service is that the food-related valves tend to be forged or machined out of bar stock, rather than cast. This is because cast

valves are more likely to have pores, while forgings are more dense with no hidden cavities.

WHERE CLEAN IS VITAL

Typical segments of the food processing area where the steam might come into contact with the food are:

Retorts

Retorts are vessels in which jars, bottles or cans are heated to cook and sterilize food products (Figure 2). Precise temperature control is crucial here so that the fragile containers in the retort do not rupture. Yet these containers must be thoroughly heated to ensure no bacteria survive.

Bubble-tight steam shutoff is essential to prevent overheating and to keep steam from entering the retort between cycles. A globe-style control valve with 3–15 psi signal controls the flow of steam sent to the equipment to sterilize canned or bottled products.

There also are times when two valves are used in this application. In this case, the valves operate at different pressures. An example is when the system requires fast start-up and then tight temperature control. The first valve would complete the entire span within a 3–9 psi range. Once the retort is up to temperature, that valve begins to throttle back and a 9–15 psi valve will open and complete its span within that range. Once the retort is up to temperature, the 9–15 psi valve will throttle back and perhaps shut entirely, leaving the 3–9 psi valve operating to handle the flow.

Flash Steam Peeling

Another area where steam comes into direct contact is in flash steam peeling systems (Figure 3). In these systems, vegetables such as potatoes, carrots and other root crops are fed into a peeler in batches. High-pressure steam is introduced, which causes rapid heating of the surface layer of the food. When that pressure is then instantly released, the resulting steam forms under the skin of the vegetable, causing it to flash off.

Valves required here would be those for maintaining the steam pressure and temperature from the boiler as well as valves to open and close when needed to dump waste or debris. Sliding gate or diaphragm control valves are often used in this process.

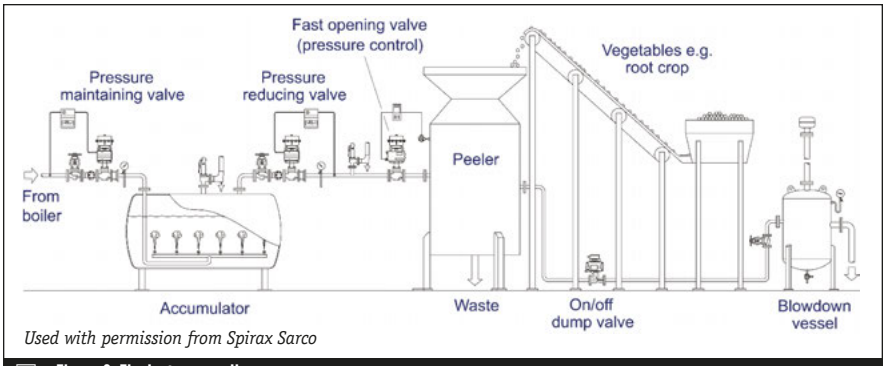


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Figure 3. Flash steam peeling

Blanching

Another process for removing skin is blanching. Blanching equipment is

used to take the skin off vegetables such as carrots, green beans and peas by scalding. Blanchers also heat the vegetables to de-activate natural enzymes that cause spoilage.

In steam blanching, the product is transported by a chain or conveyor belt through a chamber where steam is directly injected at about 212°F (100°C). Usually temperature in the headspace (the unfilled space above the container contents) is measured and the flow rate of steam is controlled.

Forced convection blanchers are made of nested chambers, which allow recirculating steam with a fan that interconnects both chambers. The fan forces the flow of steam through a packed bed of product conveyed by a mesh belt. Another technology is individual quick blanching (IQB), which was developed to minimize product treatment involving lack of uniformity. In IQB, a single layer of product is conveyed through the steam chamber and each "individual" piece of product immediately enters in contact with the steam.

Generally, in blanching processes, a pressure relief valve with a pressure regulator is used to ensure a constant low-pressure flow of steam, while a control valve throttles the flow based on a temperature setpoint.

INDUSTRY FORECAST TO GROW THROUGH 2022

The U.S. food industry is forecast to grow at a steady rate of 2.9 percent compound annual growth rate through the year 2022, according to a recent report from PMMI, the Association for Packaging and Processing Technologies. The fastest growing two segments are meat and snack foods.

The 2016 Food Packaging Trends and Advances also reported that the U.S. trails the global market—global growth is forecast at almost twice the U.S. rate. The report says overall growth of the food industry, including food packaging, is driven by emerging markets such as Argentina, Brazil, China and India.

It also says that the most innovative food industry segments (snack food, meat, fruits and vegetables, and pet food) are using tools such as films that keep products fresher longer, recycled or biodegradable materials for packaging and single-service portioning.

Chicken Processing

When processing poultry, jacketed tanks are heated with steam to cook large quantities of chickens. Good control and fast response are needed to adjust to load changes. Ideally, valves used here would be self-regulated. One common option for this application is a temperature-regulated sliding gate control valve.

Evaporation

Evaporation is used to concentrate food products such as orange juice,

fruit roll-ups and similar products.

The efficiency of the evaporation process can be increased by using thermo-compressors that recycle the vapor as a heating medium. For example, the process vapor can preheat incoming feed liquor. In these cases, each effect operates at a progressively lower pressure.

Programmable logic controllers are normally used to adjust pressures, temperatures and flowrates. Condensate contamination detection may be required to ensure the condensate can be returned to the boiler feed tank.

Typical final control elements used for this process often include globe-bodied control valves.

Direct Steam Injection

Direct steam heating can be used for heating products if the steam is of culinary quality and the product can be diluted. This heating may be combined with other methods such as jacketed vessels, but steam injection is efficient, inexpensive and provides needed agitation.

The steam may be injected using sparge pipes for low-pressure steam or injector nozzles for higher pressures. In-pipeline injection also is increasingly common.

Conveyor Dryer

Some methods of drying food require production of hot air. Because many food plants already have steam on site, steam is often used to heat the air using air heater batteries.

Conditioning of process hot air may be required because the air used to supply equipment such as fluidized bed dryers or belt or tunnel dryers may come into direct contact with the food product. Valving in these processes also must be clean and is subject to the 3-A specifications. Specially manufactured gate, globe and check valves with electro-polished interior surfaces are often used here.

CONCLUSION

While many of the valves used in food and beverage processing are in steam lines, these certainly are not the only processes that use valves. For example, cryogenic (or flash freezing) can be done dockside or on huge fish processing ships. Valves used in this process must be especially robust to handle the cryogenic temperatures. Butterfly valves, often with stainless-steel bodies, are frequently used to control this flow, and the valve seats are generally metal because it is more durable in these harsh conditions.

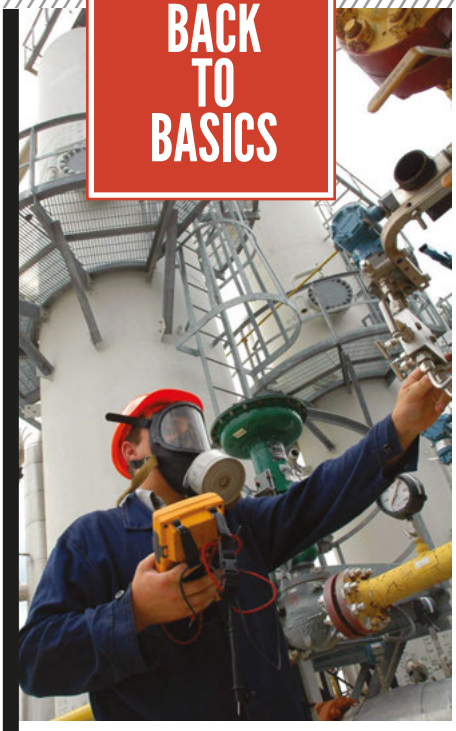
Homogenization of everything from milk to peanut butter is also an area in which valves play an essential role. In this case, poppet valves are used for moderately abrasive products such as vegetable oils, and ball valves are used with abrasive products such as peanut butter and pigments.

What all of this shows is that modern food processing could not occur without a full range of valves, actuators and controls, and as processing methods improve, so does the equipment that makes those methods possible.

It's not something the average person thinks about when they sit down to a bowl of ice cream, but the food and beverage industry, like many valve industries, can only get bigger. VM

Kate Kunkel is senior editor of VALVE Magazine. Reach her at kkunkel@vma.org. Greg Johnson, president of United Valve (www.unitedvalve.com), also contributed to this article.

BACK TO BASICS



Stop Check Valves

Executive Summary

SUBJECT: Using stop check valves is like having two types of control going at once—regulation of flow and prevention against reverse flow.

KEY CONCEPTS:

- Where they are used
- How they're designed
- Standards that apply

TAKE-AWAY: Their functionality, design and materials used allows stop check valves to be a great choice in industries where safety is critical.

BY CARLOS E. DAVILA, PE

Stop check valves are vital to several industries to protect boilers and other equipment.

These valves are a modified version of the standard globe stop valve, which has the valve stem permanently affixed to the globe disc. In the stop check configuration, the stem head floats in the globe disc (i.e., it is not attached) (Figure 1). Stop check valves have two main purposes: 1) as a globe valve, they isolate or regulate flow and 2) modified as a check valve, they prevent reverse flow. In other words, they are generally used as a globe valve to start or stop the flow of the media, but they also act as a check valve to automatically close should pressure be lost, thus preventing backflow that could possibly cause damage to equipment such as boilers or pumps.

Figure 1. Globe disc

Because of this, having a stop check valve is like having two valves in one. The internal disc, which is not attached to the stem, performs as a lift check allowing it to freely move up and down when the stem is raised to adjust the opening and closing. This controls the flow rate, but when backflow occurs, the disconnected disc functions as a piston check and quickly closes, thus preventing reverse flow into the boiler. If needed, the stem can be manually lowered for flow to be stopped or completely shut off.

END USE OF STOP CHECK VALVES

These valves are mostly used in power plants, in applications such as boiler circulation, steam generation and boiler feed water, turbine cooling, starter water and safety systems. They also are used in other applications where piping designers want to combine the properties of a globe and check valve. Such applications might include high-temperature service, heat recovery steam, high-pressure safety service, geothermal service, utilities, petroleum production and refining, safety systems, shutdown cooling, and hydrocarbon processing.

In boiler applications, valves and boilers have been connected for over 150 years. The valves used are so critical that the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code covers how valves should be used. The first valves on a boiler output line are usually stop-check valves, which are known here as non-return valves or boiler stop valves. They are vital when more than one boiler is connected to the main steam header, and they should be installed in the pipeline between each boiler and the header. They also should be placed so that the pressure in the boiler is under the disc.

Another boiler application is to use the stop check as a blowdown valve. The blowdown valve allows removal of excess water from a boiler, which is required occasionally. Blowdown stop check valves are still in use on stationary boilers.

DESIGNS

These valves are available in two basic pattern designs, T pattern and Y pattern. In the T pattern, the stem is perpendicular to the pipeline. This allows the internal disc to move up and down vertically in the valve. The weight of the disc helps it to close quickly, providing minimal reverse velocity when the valve closes. However, because of its weight, it requires a higher flow velocity to get the valve fully open and could also add to the valve pressure loss.

The newest design, which is similar to the T pattern, is the Y pattern, where the stem and disc are angled at 30 to 45 degrees. This pattern design is most commonly used on top of boilers and comes in a straightway or an angle flow path. The Y pattern, with its angled stem and disc, allows a lower full-open flow velocity. However, more attention to the disc guiding is required for trouble-free operation.

The straightway design results in a straighter flow path, which reduces turbulence and creates less fluid friction. That means less potential for erosive damage to the valve, which converts to lower pressure loss and better overall flow characteristics for the piping system. These types of valves should be

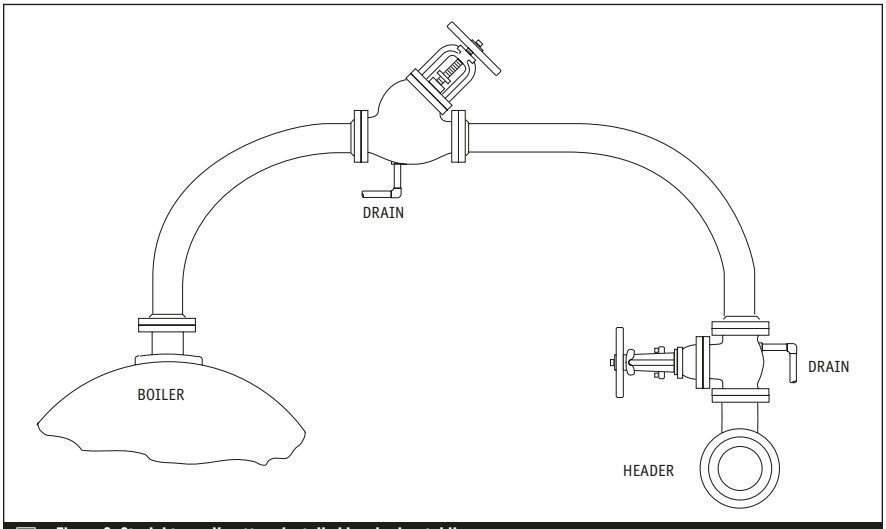


Figure 2. Straight-way Y-pattern installed in a horizontal line

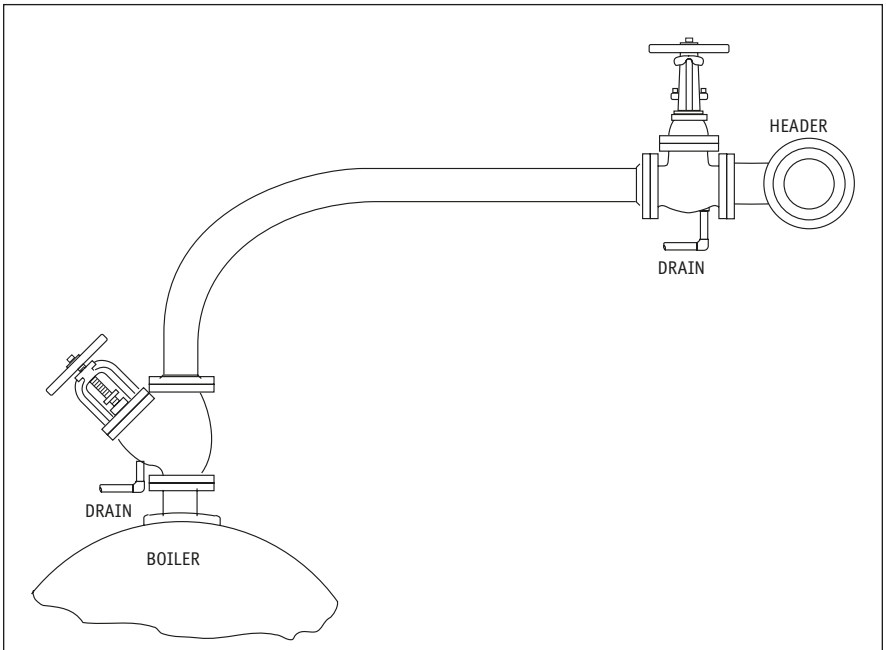


Figure 3. Straight-way Y-pattern installed in a vertical line for upward flow

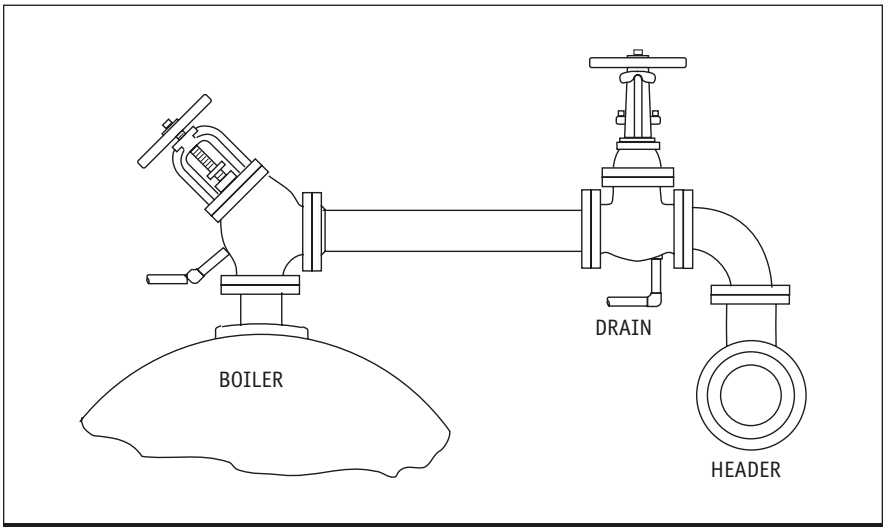


Figure 4. Angle Y-pattern installed for upward-to-horizontal flow

installed in horizontal (Figure 2) or vertical (Figure 3) lines for upward flow.

The angle valve design is used for upward-to-horizontal (Figure 4) or horizontal-to-downward (Figure 5) flow. But in both cases, the flow is turned 90 degrees in the valve to allow the angle valve to serve as both a flow control device and a 90-degree piping ell.

Since valves have a cylindrical-shaped floating disc member that is the only pressure-actuated part, it is important they be sized to provide proper full disc lift during the valve's service life. If too large, the disc may flutter, increasing the valve wear rate and limiting its service life. If the valve is too small, it will provide a much higher pressure loss and high velocity, which also could reduce service life. If the disc is light and properly guided, it can provide maximum lift at minimum velocities for quick opening and low pressure loss. Additionally, the disc should be designed to prevent spinning, which results in low wear and long service life.

Bonnet designs for stop checks are basically the same as for globe valves. They come in a variety of designs for different purposes. Small bronze valves, which have the inside-screw-rising-stem, are very popular. However, in this design, the stem threads are contained within the pressure/fluid envelope of the valve bonnet and exposed to the process fluid. This can result in damage when exposed to corrosive fluid. These type of valves are normally used for water or low-pressure steam. On valves for corrosive

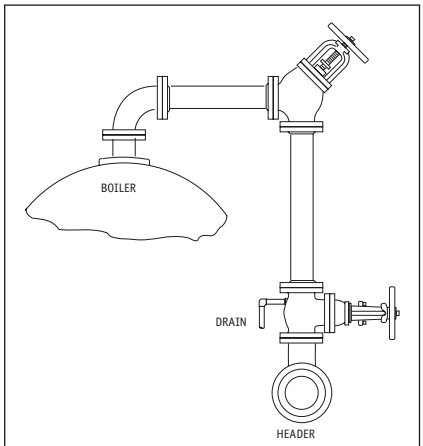


Figure 5. Angle Y-pattern installed for horizontal-to-downward flow

service, the bonnet design has the stem threads outside the pressure/fluid envelope, which helps to prevent corrosive damage to the threads. Such a design is called the outside screw and yoke (OS&Y) (Figure 6) and is used in larger industrial globe valves.

End connections for most valves are either flanged to ASME B16.5 or butt weld conforming to ASME B15.25. Other connections can be furnished as specified by the customer.

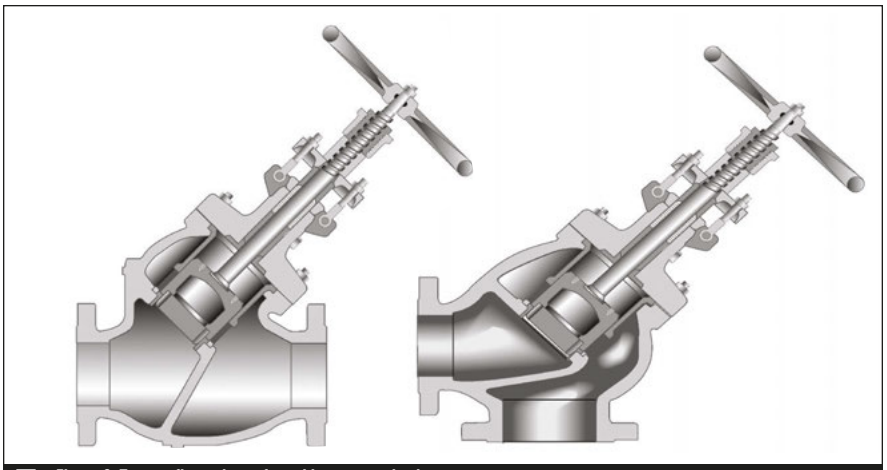


Figure 6. Two configurations of outside screw and yoke

FEATURES

In boiler applications, valves are designed to perform several very important functions including:

- They act as automatic non-return valves. In case a boiler fails, the valve can prevent gross backflow of steam from the main header to the boiler.
- They isolate a boiler when ceasing to fire and when the boiler is blown down. The valve automatically closes to prevent backflow of steam to the boiler.
- They assist in returning the boiler to operation after a shutdown.
- Although the check valve feature should not be relied upon for primary shut off, it can restrict the backflow from the header into the boiler that has been shut down and opened or suffered a pressure containment blowout.

STANDARDS

Many of the standards on stop check valves are related to globe valves, and there are many of those types of standards. API published a standard on globe valves recently that discusses valves larger than NPS 2. API 623, which was published in 2013, covers stop check valves. Subjects covered include:

- The pressure is to be equalized in the bonnet above the disc to the downstream side.
- Design should have a suitable disc or bottom guiding to allow the disc to move freely during check valve operation. This will prevent any failures of the flow return prevention feature of the valve.
- Testing is to be in accordance with the requirements of API 598 for both globe and check valves and meet the acceptance criteria of both types of tests. Valves must meet both valve test criteria on the shell as well as the seat leakage requirements
- Valve design has to be suitable for installation with the stem in the vertical orientation or where the stem is within 45 degrees of vertical orientation.

Other industry standards that are applicable include:

- SME B16.5—Pipe flanges and flanged fittings NPS 1/2 through NPS 24 Metric/Inch
- ASME B16.34—Valves flanged, threaded and welding end
- API 598—Valve inspection and testing
- API 602—Steel gate, globe and check valves for sizes dn 100 (NPS 4) and smaller for the petroleum and natural gas industry

- API 623—Steel globe valves—flanged and butt-welding ends, bolted bonnets
- BSI 1873—Steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
- ISO 12149—Bolted-bonnet steel globe valves for general-purpose applications
- MSS SP-80—Bronze gate, globe, angle and check valves
- MSS SP-85—Gray iron globe and angle valves, flanged and threaded ends
- MSS SP-118—Compact steel globe and check valves (chemical and petroleum refinery service)

MATERIALS

As with globe valves, the trim components in stop check valves are usually bearing the brunt of the fluid flow during the closure operation. Industry standards allow for end users to specify the trim materials required for specific applications. In these standards, trim items include the body and disc seating surface and stem. Additional items can be specified by the end user or can be the manufacturer's standard material.

Choosing the correct trim materials is critical for maximum operation and longevity of any valve, especially stop check valves.

Choosing the correct trim materials is critical for maximum operation and longevity of any valve, especially stop check valves, which are similar to globe valves, and have high fluid friction and intricate flow path. As the disc moves closer to the body seat surface, the velocity and turbulence increases, creating a potential for cavitation and erosion, which could result in a leaking valve and excessive wear thereby reducing service life. These types of defects can appear as a thin slice in the body seat, disc or both. This initial small leak path can widen and become a major leak.

On some bronze valves, the trim is either the same material as the valve or a similar bronze alloy with greater strength. On iron valves, the usual trim material is bronze. The industry designation for this trim on iron valves is "IBBM," which is defined as "iron body, bronze mounted." Steel valves are offered in a variety of trim materials, as needed by the service. However, they usually will have one or more of the trim components made of 13% chrome martensitic stainless steel. Hard facings such as Stellite are also used, as well as 300 series stainless steels and copper-nickel alloys. Positive shutoff and long seat life is provided by an integral hard surface seat. A popular trim in steel valves is API trim #8, 13% Cr./hardface.

CONCLUSION

Stop check valves provide a comparatively economic and efficient solution where isolation, regulation and prevention of backflow are required performance characteristics for a piping system. VM

Carlos E. Davila, PE is product manager, Engineered Check Valves for Crane ChemPharma & Energy. Reach him at cdavila@cranecpe.com.



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VALVE {Ed}

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The Limits of Standard Manual Globe Valves for Throttling

BY RICHARD VON BRECHT

A common practice in process services is to use manual globe valves with hand wheels for regulating flow. These valves are relatively simple, rising stem devices that use a screwed stem to drive a disk into a seat horizontal to the flowing stream. For the most part, this practice has been effective. However, significant instances have occurred where these valves failed, particularly when they are used as maintenance bypass valves around control valves. Standard manual globe valves should be used with caution.

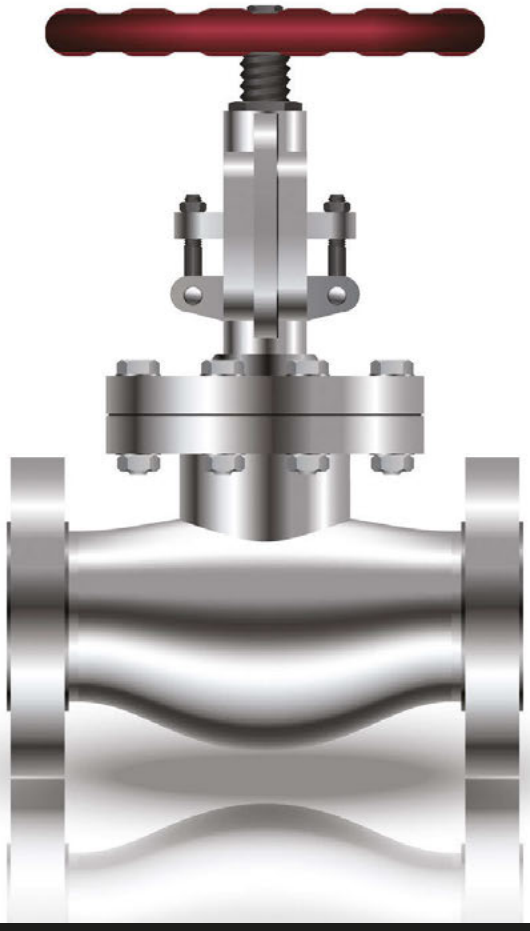
Manual globe valves are made to conform to a number of standards. Valves four inches and smaller are usually forged and manufactured according to American Petroleum Institute (API) Standard 602 requirements, while the larger globe valves are built according to API Standard 623.

These standards define the minimum stem and port diameters as well as the stuffing box requirements. The use of API standards tends to make these valves interchangeable between the various suppliers.

FAILURES

Since they are basically a value product (the device provides a minimal functionality at a low cost), the construction of manual globe valves doesn't usually exceed the minimums required by the standards to any significant degree. As such, they have provided acceptable performance under moderate operating conditions. However, as higher pressure drops are encountered or they throttle liquids near their vapor pressure, failures can occur. Below are the types of failures experienced:

- Packing is damaged and emits volatile organic compounds
- Seat is damaged so the valve leaks
- Valve disk separates from the stem
- Stems break
- Stem fires occur with lighter hydrocarbons
- Pipe is damaged with lost pressure containment



Executive Summary

SUBJECT: Manual globe valve failures have occurred when those valves are faced with higher pressure drops or when they throttle liquids near vapor pressure, especially in situations where they are used as maintenance bypass valves around control valves.

KEY CONCEPTS:

- Ways they can fail
- How to figure stability
- Guidelines and considerations

TAKE-AWAY: Manual throttle valves should have the same trim characteristics as the control valves they bypass.

RECOMMENDATIONS BY APPLICATION STANDARDS

Though they are mentioned in several application standards, the guidelines for when and how to use manual globe valves are ambiguous. They run from highly recommending the use of globe valves as a throttling device to measured caution.

The best guideline for manual valve selection is API RP 615. Section 5.3 of that standard promotes the use of globe valves as a control device but section 5.3.3 outlines some of the problems that can occur when a globe valve is improperly applied.

VALVE FAILURE MECHANISM

Experience has shown that these valves may become unstable at a stem travel of 20% or less. Control valve studies have shown that unguided globe valves at these lifts will go into resonance. This happens in both gas and liquid services. The resonance or plug vibration is caused by alternating high-pressure zones generated on either side of the plug, which is known as vortex shedding.

The natural frequency of the plug is a square root function of its stiffness and the reciprocal of the weight.

$$\omega = 0.15\sqrt{\frac{kG}{W}}$$

ω = *Natural frequency of the plug*
k = *Stiffness*
G = *Gravity constant*
W = *Weight of the plug*

For the sake of discussion, the stiffness can be approximated by:

$$k = \frac{3 x E x I}{l^3}$$

E = *Young's Modulus*
I = *Area moment of inertia*
l = *Length*

The length is inverse to the travel, (i.e., the lower the travel, the lower the frequency and the easier it is to achieve lock-in[1]). Increased turbulence on the downstream side because of high noise or flashing drive the plug to a higher amplitude. This can eventually lead to mechanical fatigue of the stem. What's more, if the first harmonic of the system is reached, the valve can fail within a few seconds.

Also, the natural frequency (among other things) is proportional to the length taken to the one-and-a-half power. Therefore, unless the area moment of inertia is adjusted, the tendency will be such that, as larger globe valves are used, higher and higher lifts are required before stability is achieved, which makes them less usable. This is the case for automatic control valves, where only the smallest valve uses unguided plugs.

The direction of flow also has a significant effect. Damage occurs more frequently when valves are mounted in the flow-to-close position. This is likely because a more uniform flow field is generated around the plug, which leads to strong vortex shedding.

TYPICAL GUIDELINES

Unlike the situation with thermowells, which have shown to be prone to inline vibration failure, there is no known relationship so far that can predict when a valve plug will fail from flow-induced vibrations. As a result, the application of these valves is limited to guidelines: i.e., rules of thumb.

The guidelines usually recommend that the valve be at least 20% open when in use. However, besides preventing their practicality for low-flow applications such as startups, the normal valve trim allows as much as 60% of the total valve capacity to be operating at that stroke. Other vendor-specific guidelines limit the total pressure drop to values such as 200 psig.

Guidelines also recommend that the sound pressure level be held below 85 dBA, but testing has shown resonance occurring well under this level.

This problem cannot be resolved with adding a restriction orifice in series with the valve. Most of the problems occur at relatively low flow rates, so a restriction orifice designed for these conditions limits the valve capacity—it will not pass enough flow at the design conditions.

SIMPLE EVALUATION

Two relationships commonly part of control valve evaluation can be used to estimate when the downstream turbulence is significant to over drive the valve vibration.

For liquids, the following formula should not be true for valve lifts between 20% and 5%:

$$\frac{\Delta P}{(P_1 - P_v)} \geq 0.5$$

For gases, the following formula should not be true for valve lifts between 20% and 5%:

$$\frac{\Delta P}{P_1} \geq 0.6$$

ΔP: *Valve differential pressure*
P_1: *Inlet pressure (absolute)*
P_v: *Vapor pressure*

The usual flow characteristic of a standard manual globe valve is a logarithmic-shaped curve known as the quick-opening characteristic. Since only the lower portions of the curve are evaluated, the Cv at the lower 30% of the stroke can be approximated linearly at the following:

$C_{v@X} = 2.52(C_v)(X)$
X: *Percent stroke*
C_v: *Valve capacity at full open*
$C_{v@X}$: *Valve capacity at X percent open*

Using the estimated $C_{v@X}$ of the bypass valve, the circuit pressure drop can be calculated. This in turn allows the determination of the valve ΔP.

The application of these equations in and of themselves does not ensure the globe valve will not fail in the long term. A low-amplitude vibration can lead to mechanical fatigue after several tens of thousands of cycles. For temporary bypass services, this might be acceptable. Still, the safest course would be to use a guided plug valve that was specifically design for the service.

FINAL THOUGHTS

Below are some general considerations to use when selecting manual throttling valves:

- Globe valves should be installed flow to open since less turbulence is generated with flow in this direction.
- Substituting ball valves for globe valves in throttling service is not necessarily a solution. They have a high recovery coefficient, which makes them less suitable for severe-service applications where cavitation and high noise occur.
- The valves need to be sized like a control valve with the reducers, Fp (piping geometry factor), etc., included.

- If the control valve is something other than a guided globe valve or a simple rotary valve, reconsider the selection. The capacities should be the same, taking into account the valve recovery factor.
- Adding orifice plates in series to reduce the pressure drop across a bypass valve doesn't address the problem of low lift. On the other hand, for pump warmup services, these plates can be a suitable solution.
- Guided plug valves are more robust but not a complete solution. There also are a limited number of suppliers.

Because manual globes are a value product, the following problems have been observed:

- High closing torque from the thrust force acting on the disc
- Flow capacity that is nonlinear with stroke
- Stem bending
- Frictional forces at the stem threads, which adds to torque requirements
- Deterioration of packing after a few cycles with rotating stems
- Stem galling with the mating components
- Gland packing leaks
- Leaks in threaded seat ring design at high-pressure applications

Because of the issues enumerated above, this recommendation from Process Industry Practices PCECV001 should be given strong consideration:

"Manual throttle valves should be selected for control valve bypass manifolds to provide approximately the same capacity and trim characteristics as those of the control valves that they bypass." VM

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FOOTNOTE

1. Lock-in is a state where once vibrating starts, it continues long after the conditions that started it are replaced with different values. Often to return to a non-vibrating state, the flow rate has to be less than third or half the previous value.

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What Internal Best Practices Can Do for Valve Selection

BY JEANNIE LEWIS

As time goes by, technology moves forward, lessons are learned and industry requirements evolve. Personnel come and go, and facilities are bought and sold. The by-products of this evolution are changes to both industry best practices and corporate requirements.

While change can improve safety and reliability, it also complicates the already challenging task of selecting the right valve. Replacement in-kind is not always the correct solution. Add to that complication the looming reality of today's gap in industry expertise, and it's easy to see why corporations and facility engineers need and want guidelines to help them make consistent decisions. To provide this guidance, many corporations go in search of best practice collections.

Executive Summary

SUBJECT: An alternative option to using general industry or engineering-based best practices when choosing valve solutions is to develop an internal program.

KEY CONCEPTS:

- Why an internal program is needed
- What it can do
- How to develop one

TAKE-AWAY: With so many skilled people retiring, organizations need a way to transfer knowledge and aid employees in making the right valve decisions.

WHAT'S A BEST PRACTICE?

A best practice can be defined as a technique or methodology that, upon rigorous evaluation through experience and research, demonstrates success and can be replicated. Industry standards, such as documents produced by the American Petroleum Institute (API), provide minimum industry requirements. Recognized and generally accepted good engineering practices (RAGAGEP) requires these practices meet minimum industry requirements, but they may be more stringent based on the experience and unique attributes of a facility or corporation. Best practices typically use or direct users to a published industry standard to set baseline requirements and then clarify options or provide additional requirements above the industry standard based on company preferences and experience.

A best practice collection includes sections of documents for each area of expertise needed within a corporation such as safety systems, pressure vessels, inspection, mechanical integrity, etc. Of all the sections, the subject of piping and valves is typically one of the most complicated and debated subjects because of the sheer quantity of components needed for a piping system. Because of this, it's one of the most customized subjects from facility to facility. In addition to documents to define piping and valve requirements, the majority of best practice collections include a set of piping classes—pre-engineered groupings of components and valves selected for a given service with specific design conditions.

The two most common options considered are general industry best practices and engineering, procurement and construction (EP&C) firms' best practices. Unfortunately, while general industry solutions are typically affordable, complications arise when solutions do not fully align with the corporation's philosophy. When that happens, separate documents need to be created and distributed throughout the organization because general industry standards themselves can't be customized. The end result is an internal document that references a general industry best practice that then references an industry standard. This is challenging not only for a user to understand but also for an organization to maintain over time.

The other option most often used—EP&C firms' best practices—might appear at first glance to be an ideal solution because they are usually in line with the current RAGAGEP requirements. However, once the project reaches an end, these documents are rarely modified or kept up to date. As a result, after a few years have passed, facilities are often left with multiple sets of thousands of pages of detailed best practices that may or may not be in alignment with current RAGAGEP. The onus is then put on the engineer to make correct decisions despite changing industry and corporate requirements.

A third option is to develop and maintain internal, corporate best practices.

WHAT AN INTERNAL PROGRAM CAN DO

Internal best practices provide the ability to define requirements in alignment with the corporate risk profile and provide a forum to capture and transfer knowledge throughout the organization. As a result, the organization benefits from improved facility safety, mechanical integrity and efficiency over the long term.

Unfortunately, while customizable internal best practices are the ideal solution, many organizations have tried and failed because of the amount of time and expertise needed to develop and maintain an internal collection. In addition, efforts to develop internal practices fail because of the overwhelming amount of legacy information typically present at a site. Included in this legacy information are hundreds or even thousands of legacy piping classes and valve data sheets for each facility in the organization. To compound the problem, each of these legacy piping classes, and sometimes specific valves, exist on the facility's drawings. This makes deciding to consolidate and switch systems to a standard set of master corporate piping classes difficult because of the time involved and the incorrect assumption that adopting a new system will require thousands of site drawings be redrawn.

WHAT OSHA RECOMMENDS

In June 2015, the Occupational Safety and Health Administration (OSHA) published new guidance for industry standard 29 CFR Part 1910.119, Process Safety Management of Highly Hazardous Chemicals with interpretations for Process Safety Management (PSM) and RAGAGEP, including clarifications and interpretations regarding:

An engineer assesses the piping in a nuclear power station

- What RAGAGEP is and what its sources are
- "Shall" vs. "should"
- The use and acceptance of internal employer documents as RAGAGEP
- Considerations for maintaining compliance with the standard

In this recently published memorandum, OSHA provides not only clarification that appropriate internal standards are considered acceptable RAGAGEP documents, but also why OSHA recommends facilities develop and use internal standards.

The memo states that facility internal standards can serve a number of legitimate purposes, including:

- Translating the requirements of published RAGAGEP into detailed corporate or facility implementation programs and/or procedures
- Setting requirements for unique circumstances for which no published RAGAGEP exists
- Supplementing published RAGAGEP that only partially or inadequately address the employer's needs
- Controlling hazards more effectively than available codes and standards
- Addressing hazards when the codes and standards used for existing equipment are outdated and no longer describe good engineering practice[1]

Internal best practices also offer these additional benefits:

- Promote safety, manage risk and improve reliability
- Capture corporate memory
- Transfer knowledge

Regarding that first point, internal corporate best practices force an organization to discuss, determine and define the corporation's requirements. In doing this, organizations can address the overall process of life-cycle management (LCM), which can be defined as the process of managing the entire life cycle of assets including design, construction, in-service use, repair if required and retirement. The LCM process for fixed pressurized equipment, including pressure vessels, piping and tankage is shown in Figure 1[2].

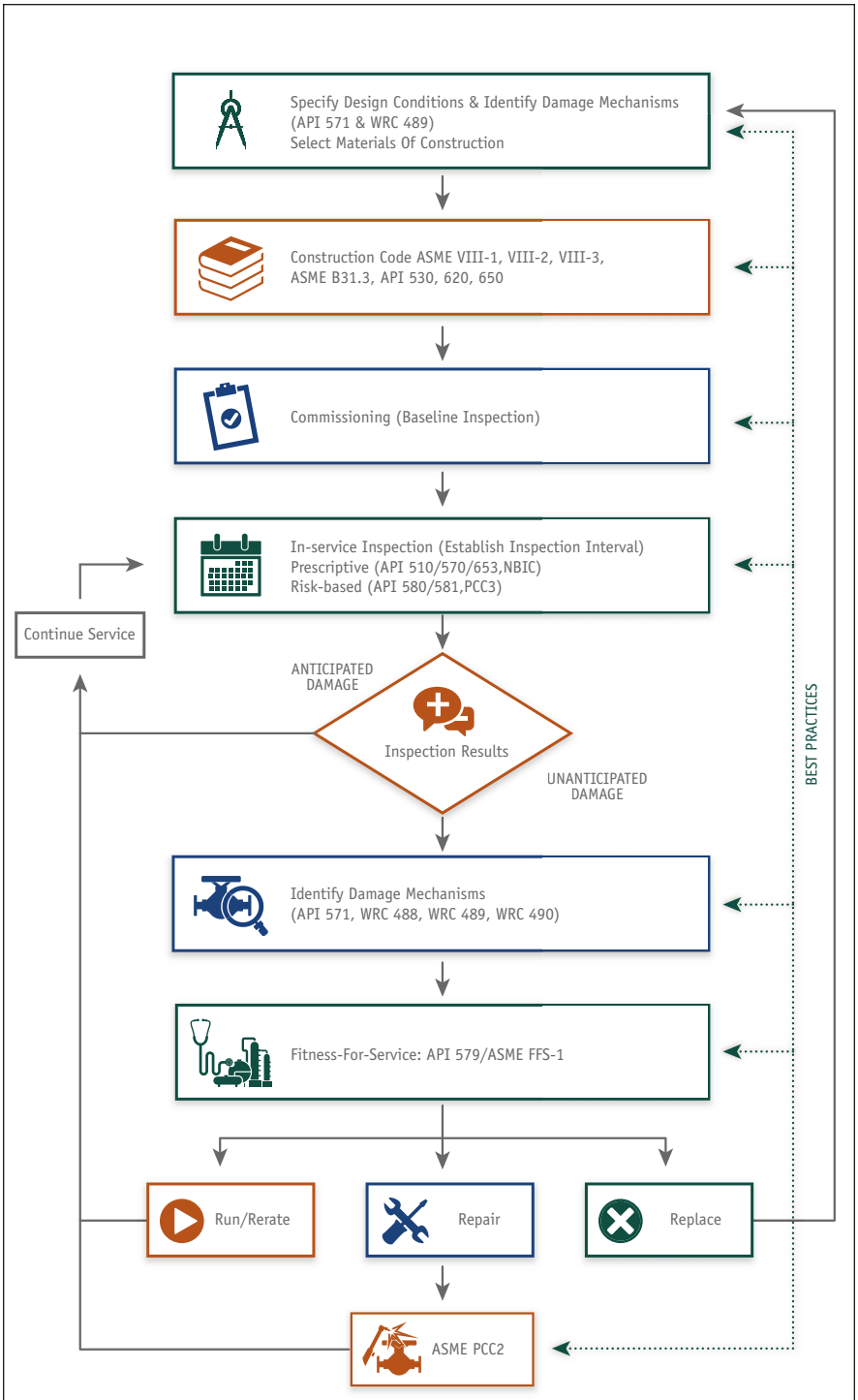

Figure 1. The life-cycle management workflow

This chart shows that identifying the initial damage mechanism and making design decisions during the early stages of equipment and component life can affect the amount of damage later in life (when paired with in-service inspection techniques and programs). Depending on the amount of damage, a fitness-for-service assessment can indicate whether to continue to operate, repair or replace the piece of equipment. Organizations using a customizable internal best practice collection can improve reliability by taking a lessons-learned approach when unanticipated damage is identified and can modify future designs to prevent the same damage.

Regarding corporate memory, this

can be defined as the total body of knowledge, comprised of both documented and undocumented memories and experiences, created over the course of an individual organization's existence. An internal best practice collection provides an ideal forum to document this memory and capture lessons learned as the organization's experience grows.

Once corporate memory is placed in a common location accessible to everyone in the organization, the knowledge can be transferred. For organizations with multiple facilities, this information is transferred not only from employee to employee, but also from facility to facility. In this way, an organization can take advantage of internal knowledge sharing across sites, and a lesson learned at one facility can be used to prevent another facility from making the same mistake. This concept is vital to industry as it nears a potential gap in industry expertise. It can ensure that the skills of an organization's most experienced employees are not lost as these members leave the organization.

To illustrate the above concepts, consider this example. An organization consistently finds cracking in the grooves of its ring-type joint (RTJ) flanged valves. While RTJ flanges are an acceptable industry design and have historically been a common design practice for this organization, the cost of repair or replacement from this unanticipated damage shows a need for a change in corporate philosophy to use raised-face (RF) flanges instead. This corporate memory was captured by modifying the internal best practice regarding flange connection requirements, and the master set of corporate piping classes was then modified to remove RTJ flanged valves and replace them with RF flanged valves. The corporation then transferred this corporate knowledge throughout the organization, which led to modified designs, improved reliability and corporate cost savings because of reduced unanticipated damage with RTJ flange connection points.

HOW TO DEVELOP AN INTERNAL PROGRAM

Corporations typically have a number of options when developing an internal best practices collection. The organization can write new documents, write overlays to general industry best practices, update outdated legacy collections, consolidate legacy collections, purchase an up-to-date collection from a third party or use a combination of these solutions. The most important factor to consider before making a decision is to remember a best practice collection needs to be continually updated to align it with changing industry requirements so it is considered an acceptable RAGAGEP solution.

This need for an update means the organization should consider not only the time and effort involved to create the collection, but also the long-term investment required to maintain it. For this reason, it is vital that if a collection is purchased from a third party, the organization has the ability to customize and modify that collection over time.

As part of the corporate best practice collection, each organization should include and develop a single set of master piping classes. As with the overall collection, a decision needs to be made as to what the organization wants to use as a starting point, and piping classes have to be modifiable

over time to maintain alignment with industry and corporate requirements.

As mentioned earlier, piping classes add a layer of complexity because the class name typically is added to the facility drawings. To avoid the time and effort of updating all these facility drawings, a corporation can perform a piping cross-reference to relate the legacy piping classes to the new set of master piping classes. This cross-reference is a matrix relating similar legacy piping classes. Before performing a piping cross-reference, an organization should define its corporate requirements for piping systems, such as which valve trims should be used for which service, when valves will require NACE requirements, what the minimum corrosion allowances are per material, etc. Such action is needed prior to executing a piping cross-reference because it is important to relate the legacy piping class to the class meeting the current requirements rather than the original design of the legacy class. For example, if a legacy piping class for an Aggressive Environmental Service (AES) did not require NACE valves, but new corporate philosophy does require them, the legacy piping class should be related to a master piping class requiring NACE valves.

To maintain a collection, a subject matter expert (SME) should be assigned to each document and to the piping classes. The organization should assign rules for reviewing and reaffirming the content to maintain alignment with RAGAGEP and industry best practices, and a multi-year review schedule should be developed to support this effort.

Because maintenance can be time consuming and requires the most experienced and usually busiest personnel, it may be advantageous for the SMEs to use additional internal and external expertise to maintain the collection. It is also the reason why many organizations choose to purchase a customizable best practice collection from a third-party vendor that will keep it up to date, allowing the organization's employees to focus on other tasks until they are needed to help with updates.

CONCLUSION

Change in technology, requirements and people is inevitable for all organizations so they need the best tools for keeping up with that change. While it takes a commitment from the organization to develop and maintain internal best practices, the end result is a corporate tool to provide guidance to the employees who make critical decisions each and every day, including knowing exactly which valve to order. VM

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Fugitive Emissions—Issues and Opportunities

BY GREG JOHNSON

Fugitive emissions, ppm, consent decrees and low-E packings: These are the words that make up a lexicon unknown in the valve repair world 25 years ago. This new vocabulary is one that anyone who deals with valves needs to learn so that the industry is prepared for what's to come.

Regular readers of VALVE Magazine are already familiar with fugitive emissions (FE) control issues in the valve industry. What they may not realize is that the companies that service and repair valves are also now in the fugitive emissions abatement business. Any company that handles volatile organic compounds (VOCs), greenhouse gases or other nasty substances frowned upon by the Environmental Protection Agency (EPA) when released into the atmosphere must deal with these issues.

Many new valves are now required to have their fugitive emissions containment integrity verified by American Petroleum Institute (API) or International Organization for Standardization (ISO) standards. When EPA consent decrees are involved, a five-year, no-leak guarantee is often required by the government.

Repair companies also are facing these issues. Any repaired valves in FE service will have to be repacked with low-emission (low-E) packing as part of the repair process.

Valve repair shops are now part of the emissions abatement picture.

WHAT MUST BE DONE

The first step service and repair companies should be taking is to check with end-user customers to see if they have approved vendors for low-E packing. If not, those repair companies should confirm that their own packing vendors can provide them packing that has passed the API 622 graphite packing test procedure. Most reputable packing manufacturers have done this and have the certificates to prove it.

If a company follows the API RP 621 valve repair procedure, it also is in a great position to leverage the extensive documentation requirements of that recommended practice into a vehicle for quality assurance verification, which could make the company a valuable partner for a user. In RP 621, there are requirements for individual measurements on key fugitive emissions containment components such as the stem finish, stem straightness, stem run-out, and stuffing box finish and dimensions. The most important thing is all this key data must be provided on every valve repaired.

This means customers will have a detailed package of dimensional data (all key to better fugitive emissions containment) for each repaired valve in the plant. A good salesman for the repair company should be able to use this information to bolster the ability to offer a better total cost of ownership for a client's repaired valve inventory. For the repair company, this could equate to repairing more "commodity" type valves that are currently uneconomical to repair because the cost of new valves is so low.

Low-E packing installation is similar to standard packing except for certain details, and the devil is in those details. The packing manufacturer's installation instructions must be followed to the letter, because that manufacturer, as well as the repair company, may be on the hook for the five-year, no-leak warranty.

One of the biggest differences in low-E packing from standard packing installation is the amount of torque required to properly seal the packing area and limit leakage to less than 100 parts per million (ppm). The days of tightening packing gland bolts with a combination wrench are gone. Repair and service companies now have to use a calibrated torque wrench and load the packing to an exact recommended torque. Also, hardened-steel flat washers are required under the packing gland nuts. After torqing the packing, a metal tag with the packing type, date of repacking and recommended packing torque must be attached to the gland.

Although the learning curve for low-E repacking is not steep, future standards revisions may make it costlier and potentially more complicated. Right now, the RP621 valve repair document is undergoing its standard every-five-years revision in API. Fugitive emissions issues have placed a stamp in many paragraphs of the new

document, even though it is still under revision.

If approved as it now reads, the revised recommended practice will require a repair shop not only to adhere to additional dimensions and tolerances on key components such as stem, stuffing box and packing gland, but also perform a production test following packing installation. This is to help verify that the repaired valve can achieve low-E performance. As drafted today, the required test will be a low-pressure (100 psi) methane test. The confirmation of leakage below 100 ppm will need to be verified via a VOC sniffing device. These machines are costly to purchase, but they can be rented by the week or month.

The proposed shell and packing production test requires the valve to be stroked three times and both the gasket and packing area to be sniffed. Since methane will burn rather fiercely, appropriate safety measures must be followed. This is not the kind of test that can be performed in proximity to any sparks or open flames. Methane does not play well with welding arcs or grinding sparks. As a result, a dedicated, segregated test area is the safest choice for testing.

ON TO NEW AREAS

The discussions surrounding fugitive emissions and packing thus far have centered on linear (multi-turn) valves, but API is now in the process of writing a quarter-turn valve-testing standard. This new standard would include various packing materials, including Teflon. After it is published, the key tenants of the document will undoubtedly be adopted by the end-user community and applied to repaired valves as well as new ones.

The Association of Wellhead Equipment Manufacturers is also developing a standard that will be applied to the upstream and midstream sectors of the oil and gas industry. EPA has recently targeted fugitive emissions from these valves, which have been ignored in the past.

The most important thing for the valve service shop management team to do right now is become educated, and there are many opportunities available for that. This June, for example, there will be a Valve World-sponsored fugitive emissions summit in Houston. Speakers will discuss virtually every aspect of the subject over a two-day period. An exhibition of fugitive emissions-related products and services will be part of the event. Also, the Valve Manufacturers Association, as part of its Valve Education program, offers fugitive emissions as part of the Basics Seminar curriculum. The next course is Oct. 18-20 in Houston.

Proposed new recommended practices will mean repair shops must adhere to additional dimensions and tolerances on some of the key components they handle.

Meanwhile, the API subcommittee on piping and valves will be discussing fugitive emissions standards as part of its agenda at the upcoming Spring Refining Meeting in Chicago in May. The API meeting (which costs to attend) is open to the public.

The subject of valve fugitive emissions control is only going to get bigger and bigger. The best defense against what's to come is education. Valve service companies will be working alongside users and manufacturers to educate themselves on what needs to be done to play a meaningful role in helping to make the air we all breathe as clean as possible. VM

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Hardfacing Alloys and Processes for Advanced Ultra-Supercritical

BY MATTHEW YAO AND RACHEL COLLIER

Editor's note: *Kennametal, Velan and Carleton University formed a research team to evaluate new hardfacing alloys and application processes for advanced ultra-supercritical applications. This article is based on what that research team has discovered.*

Cobalt-based Stellite 6 has been the workhorse for providing improved wear resistance and service life in valve components installed in power generating facilities for over 75 years. However, documented failures at combined cycle and supercritical power stations suggest that new materials and new (or refined) hardfacing processes are needed as the industry continues to move toward the higher operating temperatures in ultrasupercritical (USC) and advanced ultra-supercritical applications (A-USC).

This article provides an overview of work done to evaluate suitable alternatives to Stellite 6. In addition, it identifies improved cobalt-based alloys, particularly Tribaloy T-400C, and a newly developed alloy, CoCrMoSi, which, when applied using innovative hardfacing processes, could guard against premature failure and increase the service life of components in demanding USC and A-USC applications.

HARDFACING ALLOYS

High-temperature valves isolate, relieve pressure and/or control flow for the systems in which they are installed, serving as pressure vessels for the flow of liquids, gases and slurries. Steam valves, for example, regulate the flow and pressure levels of steam and heated water vapor.

Cobalt-based hardfacing alloys such as Stellite 6 (Co-29.0%Cr-4.5%W-1.1%C) are often used on seating faces to minimize wear and prevent both seizing and galling. The Stellite hardfacing overlays provide excellent mechanical wear resistance and good corrosion resistance at temperatures up to 1200°F (649°C). At higher temperatures for USC and A-USC applications (which can exceed 1300°F or 700°C), the hardness of Stellite 6 begins to diminish to a point where it is not sufficient to maintain adequate wear resistance (Figure 1).

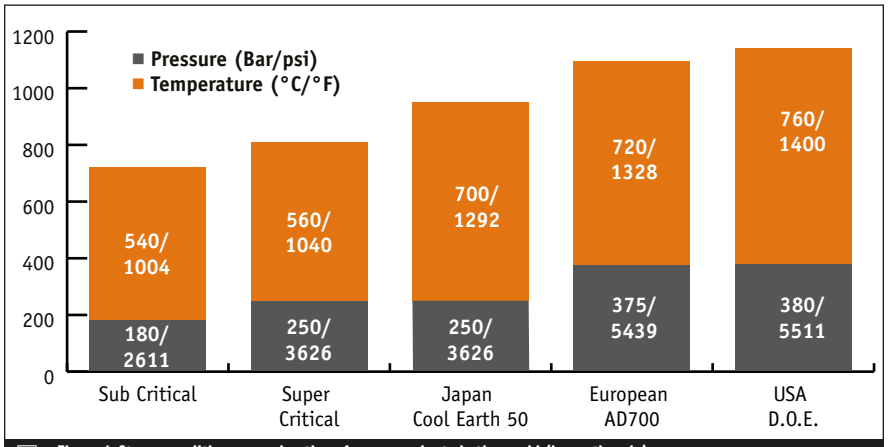


Figure 1. Steam condition approximations for power plants in the world (in centigrade)

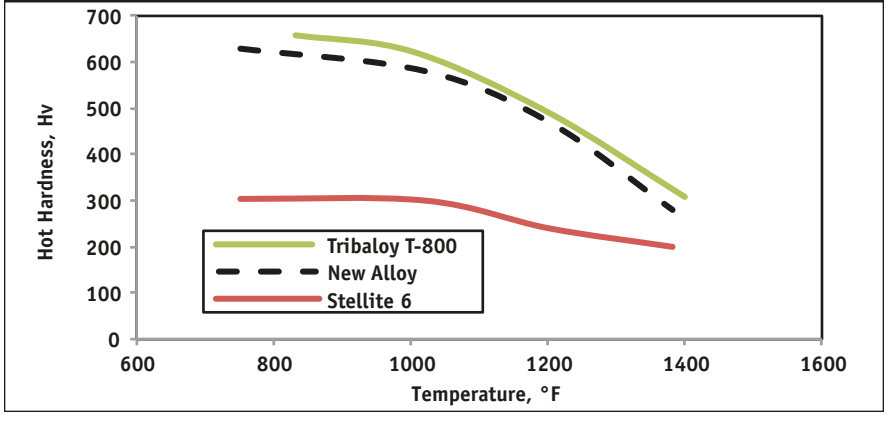
Because of this, cobalt-based Tribaloy alloys and newly developed cobalt-based alloys are becoming increasingly popular. These alloys consist of cobalt, chromium and molybdenum, and they tend to stand up better under high abrasion and high corrosion applications. They are typically used in valves on the high wear surfaces such as stems, balls, seats, gates, discs, plugs, some bushings and possibly some of the flapper valves.

Tribaloy T-800

Cobalt-based alloy Tribaloy T-800 (Co-17.5%Cr-28.5%Mo-3.4%Si) is strengthened by intermetallic Laves phases and is believed to be stable up to 2240°F (1230°C). One consideration with this material is that it is hard to modify the microstructure by subsequent heat treatment after casting or making a hardfacing deposit[1,2]. The melting point of Tribaloy T-800 is about 100°F (40°C) higher than that of Stellite 6.

Figure 2 demonstrates that Tribaloy T-800 maintains higher hardness at elevated temperatures. The hardness (about 300 Hv) of T-800 at about 1400°F (760°C) is about the same hardness level of Stellite 6 at 800–1000°F (427–538°C). This indicates that Tribaloy T-800 and similar alloys could be good hardfacing alloy

Figure 2. Hot hardness of Stellite 6, Tribaloy T-800, and a new alloy



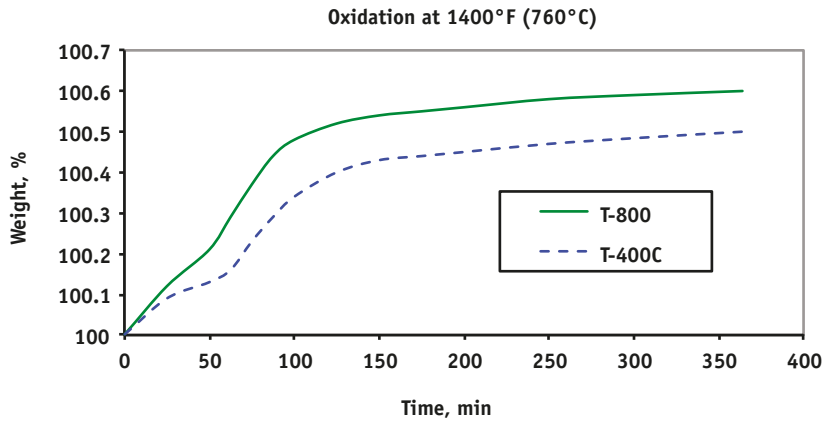


Figure 3. Excellent oxidation resistance of Tribaloy T-400C

alternatives for USC and A-USC applications. However, while the T-800 provides excellent wear and corrosion resistance, it is extremely brittle and the welding of T-800 hardfacing overlays is very difficult.

In high-temperature applications, excessive oxidation may result in binding of moving parts. Lack of ductility often results in cracking. Therefore, it is advantageous to have access to a Laves phase alloy with enhanced oxidation resistance and ductility (Figure 3)[3,4]. (We performed thermal gravitational analysis at 760°C for 200 minutes to evaluate the oxidation resistance[3]).

Tribaloy T-400C

An improved cobalt-based alloy Tribaloy T-400C (Co-14.0%Cr-26.0%Mo-2.6%Si) is more oxidation resistant than Tribaloy T-800[3]. T-400C is also less brittle than T-800, so the weldability of T-400C is improved. Fourteen coatings were tested to evaluate the steam oxidation and solid particle erosion[5,6]. Tribaloy T-400C was the only coating to perform well in oxidation and erosion at 1400°F (760°C). Based on this data, T-400C is considered a better hardfacing alloy alternative versus T-800.

OTHER ALTERNATIVES

A-USC applications need a more ductile and oxidation-resistant Tribaloy-type of alloy than that provided by available Laves phase T-800 and T-400C alloys because insufficient oxidation resistance and ductility can cause defects in welding or casting. An alternative hardfacing alloy that has high microstructure stability, high melting point and high hot hardness while maintaining excellent oxidation resistance, wear resistance and a weldability similar to (or better than) Stellite 6 and Tribaloy T-400C would be highly desirable. Such a new alloy is currently being evaluated. By modifying the composition of Tribaloy T-800 and Tribaloy T-400C, the new alloy (CoCrMoSi) is designed based on an electron vacancy calculation scheme known as PHACOMP (an acronym for phase computation).

The average electron hole number, N_v, is given as follows:

$$N_v = \Sigma(x_i n_v^i),$$

where x_i is the atomic fraction of element i and n_v^i is the electron hole number of element i. Elemental values of n_v^i for the Co-Mo-Cr-Si alloy system have been documented in literature[7].

We determined that for cobalt-based alloys, the critical electron hole number is 2.74, above which the alloy composition would develop several intermetallic phases. Cr, Mo and Si have an adverse effect by increasing the electron hole number. For Laves-phase-strengthened cobalt alloys, the Cr level must be high for corrosion resistance; high Mo level is provided in the alloy to impart wear. Si is provided to enhance wear resistance in combination with Mo. However, higher Cr, Mo and Si contents result in a higher electron hole number, facilitating the formation of intermetallic phases producing a more brittle alloy. Therefore, the new alloy is based on the average electron hole number calculation required to balance wear, corrosion and oxidation resistance, ductility and weldability (Figure 4).

Figure 4. New hardfacing alloy designed based on electron valance number

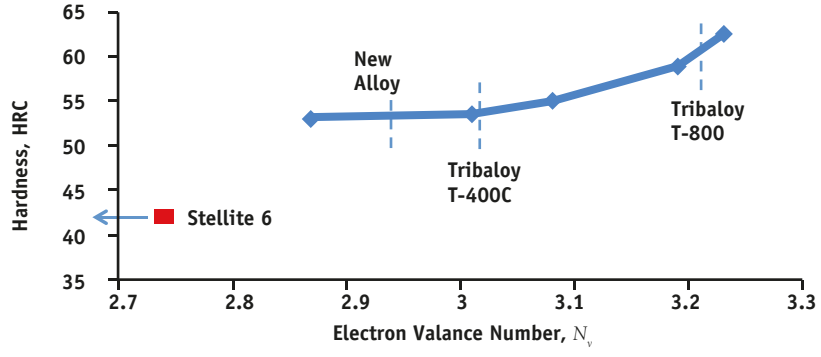
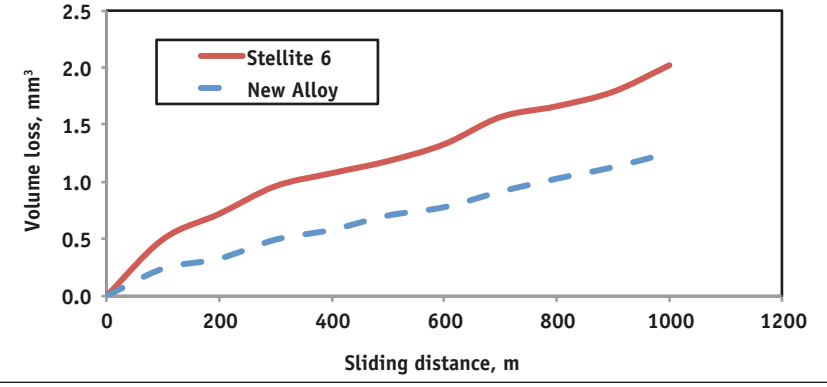


Figure 5. Wear loss as a function of sliding distance



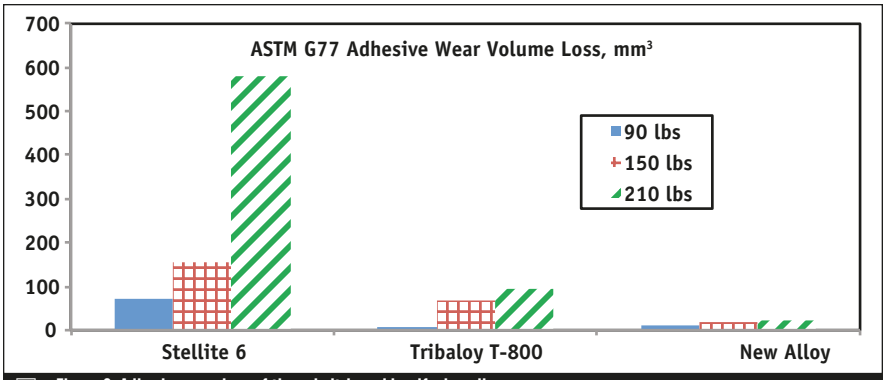


Figure 6. Adhesive wear loss of the cobalt-based hardfacing alloys

The wear resistance of the new alloy and Stellite 6 was studied by using a pin-on-disc apparatus under dry conditions. The wear loss of the new alloy is less than the wear loss of Stellite 6 hardfacing alloy (see Figure 5, page 37). The wear resistance of the new alloy was also evaluated by conducting the block-on-ring test according to ASTM G77 (Figure 6). The new alloy performs much better than Stellite 6, and also outperforms Tribaloy T-800 at higher load levels (150 and 210 pounds). The results lead to a conclusion that Tribaloy T-400C and the new alloy can be used as hardfacing alloys for USC and A-USC applications.

Table 1 summarizes the characteristics of the cobalt-based hardfacing alloys discussed in the work featured for this column.

HARDFACING PROCESSES

Gas tungsten arc welding (TIG) and plasma-transferred arc welding (PTA) are the most common hardfacing processes for depositing cobalt-based alloys. ASME Section IX provides rules for the qualification of hardfacing procedures, and for the performance qualification of hardfacing welders and welding operators. Hardfacing overlay is considered a special process as defined in QW-251.4, with separate essential and non-essential variables in the applicable process tables of QW-250. Keys to success in welding hardfacing overlays include:

1. Effective maintenance and soak of adequate preheat
2. Not exceeding qualified interpass temperature limitations
3. Adherence to qualified heat input parameters
4. Slow cooling of completed components

All of the Stellite and Tribaloy alloys are a challenge to weld. The reason is that the large volume fraction of alloy carbides and Laves phases that make them so wear-resistant also make them highly intolerant of thermal stresses.

Meanwhile, over the past 10-15 years, the power generation industry has seen renewed concern about hardfacing applications because of a rise in in-service failures, including extensive cracking, disbonding, and even liberation of cobalt-based hardfacing in high-temperature valves[8-11].

Evaluations of service history and failed components have led to an understanding that metallurgical changes within the microstructure during welding and high-temperature service exposure contribute to failure of the cobalt-based alloy hardfacing deposits. Cracking has been shown to be related to the formation of the brittle intermetallic Co-Fe sigma (σ) phase caused by high iron dilution. Multiple hardfacing layers, combined with a buffer layer, are often used to address the high dilution problems.

Various materials such as Stellite 21 and Inconel 625 are being used as buffer layers with inconsistent results in terms of Stellite 6 alloy hardfacing failures. Multiple hardfacing layers can achieve low dilution, which is typically contractually required for nuclear and defense applications. Table 2 presents the dilution for a typical setup of the TIG and PTA hardfacing processes. In third layers, the dilution can be controlled at a 5% level. Recently, a new process called Ultraflex has been introduced as a hardfacing alternative to TIG and PTA processes. One layer of Ultraflex can control the dilution to below the desired 5% level[12].

Table 1 – The characteristics of cobalt-based hardfacing alloys

Hardfacing Alloy	Oxidation Resistance	Wear Resistance	Brittleness	Weldability
Stellite 6	Good	Fair	Fair	Good
New Alloy	Better	Better	Fair	Good
Tribaloy T-400C	Better	Good	Fair	Fair
Tribaloy T-800	Good	Better	Very	Poor

Table 2 –Typical hardfacing dilution for a typical setup

Layer	TIG	PTA	Ultraflex
1st	15-20%	10-15%	<5%
2nd	10%	8%	<5%
3rd	5%	5%	<5%

Ultraflex is based on a powder metallurgy process where coating or hardfacing is applied to substrates in a "green" state and then heated to fuse the coating into a dense, uniform, metallurgically bonded layer with almost no porosity. In the Ultraflex process, carbide and metallic powders are mixed with a liquid medium to form a slurry or paste. This slurry can be applied to parts either through mechanical means such as dipping, brushing and troweling or by flow-coat methods. Once the slurry is applied, it is then dried to remove the excess moisture. Multiple coats can be applied to achieve the desired thickness of the final coating, typically in the 0.005–0.030 inch (0.12–0.75 mm) range. Once the coating has dried, the entire part is then heated in a vacuum furnace to fuse the coating. Figure 7 (see page 39) shows a typical Ultraflex cobalt-based alloy coating buffer layer on which Stellite 6 and other cobalt-based hardfacing alloys may be

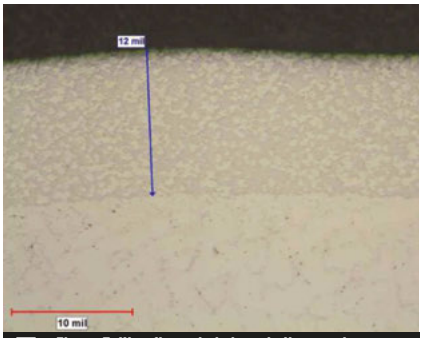


Figure 7. Ultraflex cobalt-based alloy coating buffer layer

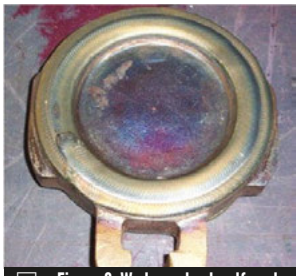


Figure 8. Wedge valve hardfaced with cobalt-based alloy

Figure 9. New alloy PTA Deposit

deposited by common hardfacing processes such as TIG and PTA. Figure 8 shows a wedge valve hardfaced with the cobalt-based alloy. In Figure 9, the new alloy is deposited by PTA process and the sound microstructure is shown.

CONCLUSION

Wear resistance and service life can be significantly improved in USC and A-USC applications for valve components hardfaced using the T-400C or the new alloy (CoCrMoSi) and applied with the Ultraflex, TIG and/or PTA processes. VM

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Controlling our Water Systems

BY AMERICAN WATER WORKS ASSOCIATION

Editor's Note: *Actuators and controls are a critical process of how we move water through our supply and waste systems. This article is an excerpt of one chapter in Cylinder and Vane Actuators and Control—Design and Installation, which was produced by the American Water Works Association last year. What appears here in Part I of this article is an explanation of the types of actuators, how they're used and torque considerations. Part II of this column, which is on www.VALVEMagazine.com, continues this discussion by explaining further the types of characteristics the different types have.*

WHAT ACTUATORS ARE USED

Three basic types of hydraulic and pneumatic actuators are used in the water and wastewater industry: linear cylinder, rotary cylinder and vane actuators. Understanding the mechanics and the physics behind how each type performs its intended functions helps users determine which actuators best suit their particular needs.

The primary function of cylinder actuators is to produce linear motion to restrain or operate the closure member of valves and gates. A cylinder actuator consists of a pressure-retaining barrel bolted between head and cap ends (Figure 1). The piston includes seals on its outside diameter to contain pressure between the piston and either end of the cylinder. Important dimensional information for cylinders is the bore or inside diameter of the barrel, the stroke or maximum travel of the piston and the rod diameter, which changes with cylinder bore and operating pressure.

When supply pressure is directed through one of the ports and applied to one side of the piston, the opposite side vents to drain, creating a differential pressure across the piston. The differential pressure is applied over the area of the piston, resulting in a force or thrust on the rod. It is important to recognize that the areas on either side of the piston are not the same. The pis-

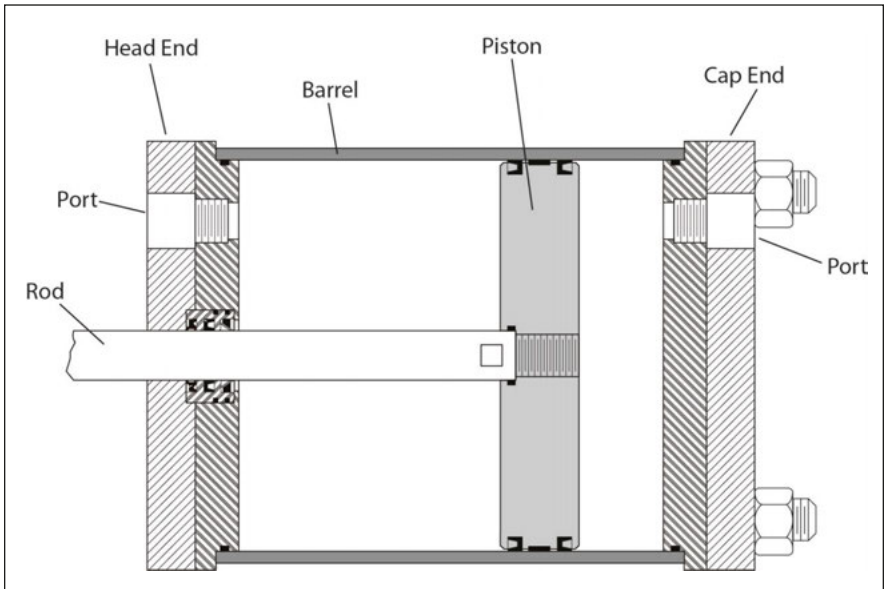


Figure 1. Cylinder actuator make-up

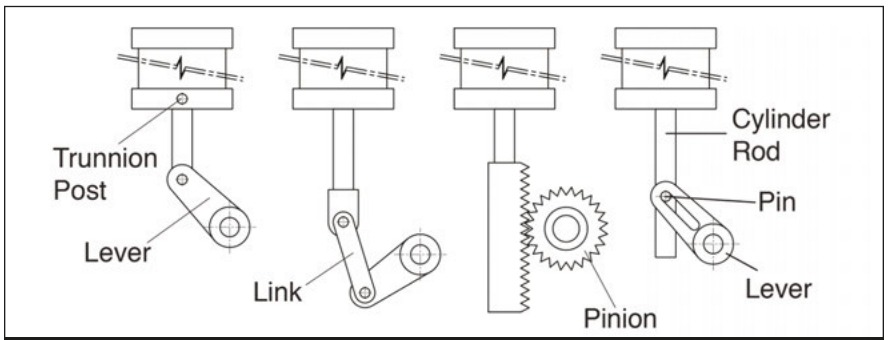


Figure 2. Converting thrust into torque

ton area on the left side of the figure is reduced by the cross-sectional area of the rod. Hence, a cylinder will produce more thrust when pressure is applied to the cap end than the head end.

In a linear cylinder actuator, the head of the cylinder is rigidly mounted to the valve body and the rod is attached to the valve stem or closure member to mechanically create thrust, operating the valve or gate closure member in a linear manner. Thrust is the linear force on the valve stem or slide gate, generally expressed in units of pound-force (lb-F) or Newton (N). During lifting (opening) of the gate, the head end of the cylinder will be pressurized, with reduced area and reduced thrust. A quarter-turn cylinder actuator converts the linear cylinder thrust into torque using one of the mechanisms shown in Figure 2 (page 40).

Torque is a twisting or turning movement on the valve stem or shaft, generally expressed in foot-pounds (ft-lb) or newton-meters (N-m). The required torque must overcome the frictional and flow-induced forces in the valve to permit mechanical operation of the valve. The lever mechanism uses a special cylinder whose head pivots about a trunnion or post. The cylinder rod is attached to a simple lever with a rotatable pin. As the cylinder rod extends, it pushes on the pin end of the lever, thereby rotating the lever 90 degrees. The link-and-lever mechanism is similar except a link is used between the rod and the lever to provide an additional mechanical advantage when the link is perpendicular to the lever.

This mechanism produces high lateral side loads on the cylinder rod, so the pin must be supported along its travel by a guide slot in the actuator housing or with a support bar. The rack-and-pinion mechanism has a straight gear rack attached to the cylinder rod. As the cylinder rod is extended, the rack rotates the pinion gear. This mechanism also produces high lateral side loads on the cylinder rod, so the rack must be supported along its travel. The scotch-yoke mechanism consists of a cylinder rod and pin that travel in a slot contained within the lever. In most scotch–yoke mechanisms, the cylinder rod is extended across the housing to provide support for lateral side loads.

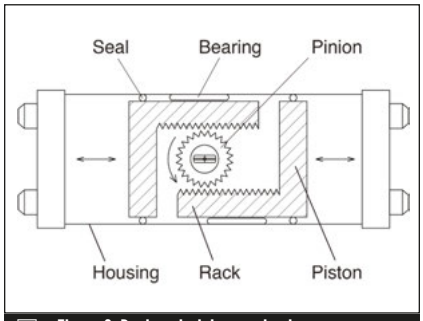


Figure 3. Rack-and-pinion mechanism

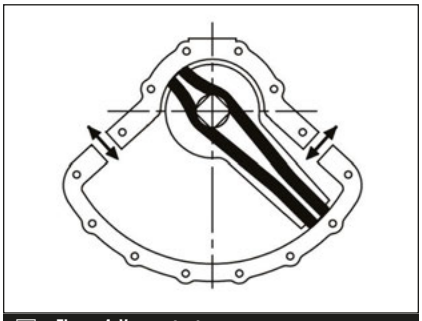


Figure 4. Vane actuator

Another version of the rack-and-pinion mechanism (Figure 3) consists of linear racks that mate with a rotating splined-pinion gear inside the cylinder. As air pressure is applied to either end, the pistons in the actuator are sealed against the cylinder housing, driving the two racks and rotating the pinion gear. This type of rack-and-pinion actuator is relatively compact and typically used on smaller valves.

Vane actuators (Figure 4) act like a lever and directly produce torque through a 90-degree arc to rotate the valve stem when there is supply pressure on one side of the vane. The vane is enclosed in a pie-shaped housing and has resilient seals around its periphery to maintain the differential pressure necessary for converting the applied pressure to torque. Hence, the vane actuator is compact and has only one moving part.

THRUST CALCULATIONS

Slide-gate cylinder actuators are required to generate thrust to lift and lower the slide gate (see Figure 5, page 42). The thrust should be provided by the gate manufacturer with consideration given to the weight of the gate, the weight of the stem and the friction on the frame due to the differential pressure acting over the area of gate. Thrust values can vary greatly depend-

Figure 5. Slide gate

ing on the types of seats and gate wedges employed in the valve design, so the thrust requirements from the manufacturer are needed to properly size the actuators. Typically, the maximum thrust required to operate a vertical slide gate occurs while opening the valve, during the release from the wedges and lifting the weight of the gate. The force is, in part, empirically determined by the manufacturer and normally presented in the following equation (AWWA C560). The 1.5 factor applied to the P1 term represents the thrust needed to overcome the friction from the wedges used to seat the gate.

$$F = (D_w \times f \times A \times H) + (1.5 \times P_1) + P_2$$

Where:
F = total force required to open, lb (N)
D_w = weight density of water, 62.4 lb/ft^3 (1,000 kg/m^3)
f = friction factor of slide against the seat = typically 0.35
A = area of the gate opening, ft^2 (m^2)
H = differential head of water at gate centerline, ft (m)
P_1 = weight of slide, lb (kg)
P_2 = weight of stem, lb (kg)

When cylinder actuators are sized for slide gates, a sizing safety factor of at least 1.3 should be applied to the overall thrust.

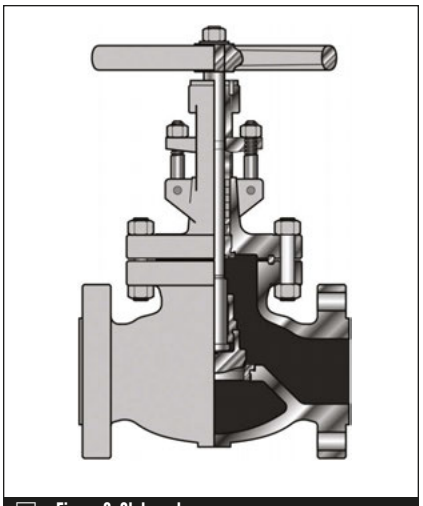


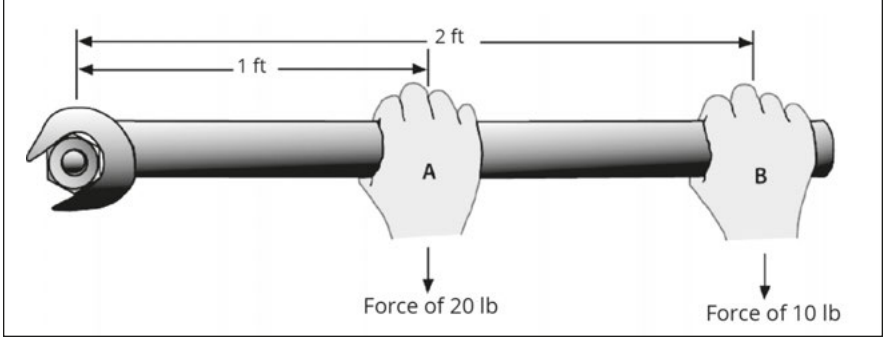
Figure 6. Globe valve

Globe valves (Figure 6) are linear valves that require operating thrust calculations similar to those for a slide gate, except that there may be flow-induced thrust greater than the differential pressure force, depending on the shape of the flow path and the flow conditions. As with the slide gate, the maximum thrust is generated during the unseating condition where the differential pressure is the greatest. For flow over the globe plug, unseating would be the maximum force. But for flow under the globe plug, the differential pressure would be trying to unseat the plug.

TORQUE CHARACTERISTICS

Quarter-turn actuators generate torque to rotate the valve stem. Torque is defined as rotational twist or turning moment on the valve stem or shaft, expressed in units of foot-pounds (ft-lb) or Newton-meters (N-m). As Figure 7 (page 42) shows, the torque produced by a wrench is found by multi-

Figure 7. Torque produced by a wrench



plying the applied force by its distance from the bolt. Valve torque is generated from several factors within quarter-turn valves that relate to valve design. Some of the torque components and their source include:

- *Seat torque*—friction between the seal and the seat
- *Bearing torque*—shaft friction due to differential pressure on the closure member
- *Packing torque*—seal friction around the valve stem or shaft
- *Dynamic torque*—flow-induced torque occurring in the mid-range of valve operation due to unbalanced differential pressures across the closure member
- *Hydrostatic torque*—unbalanced static pressure force across the closure member when only one side of the pipe is full of water and the shaft is horizontal
- *Shaft-offset torque*—unbalanced pressure across an offset closure member
- *Center-of-gravity torque*—unbalanced gravity forces acting on a nonsymmetrical closure member with a horizontal shaft

These torque components are combined to calculate the two required maximum torques for actuator sizing. Break torque is the amount of rotational resistance that must be overcome to initiate valve motion when the valve is in the closed position.

The torque may be higher during seating or unseating of the valve, depending on the valve design. The break torque is typically the sum of the seat, bearing, packing, hydrostatic, shaft-offset and center-of-gravity torques. In general terms, break torque is proportional to the square of the valve size (diameter) and the differential pressure. Run torque is the amount of rotational resistance that must be overcome to sustain motion during valve travel.

For larger valves, dynamic torque can play a significant role, and because it varies with valve angle, the maximum run torque is often reported with the valve angle at which it occurs. The run torque is typically the sum of the hydro-dynamic, bearing, packing, shaft-offset and center-of-gravity torques. In general terms, run torque is proportional to the cube of valve size and the square of flow rate. Hence actuators for large valves at high flow conditions will usually be sized on run torque. Run torque is combined with other friction torques to produce the total valve torque, which varies with valve position (Figure 8). AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis, provides the methodology for predicting valve operating torque and represents the current method used for the water industry by many valve manufacturers. VM

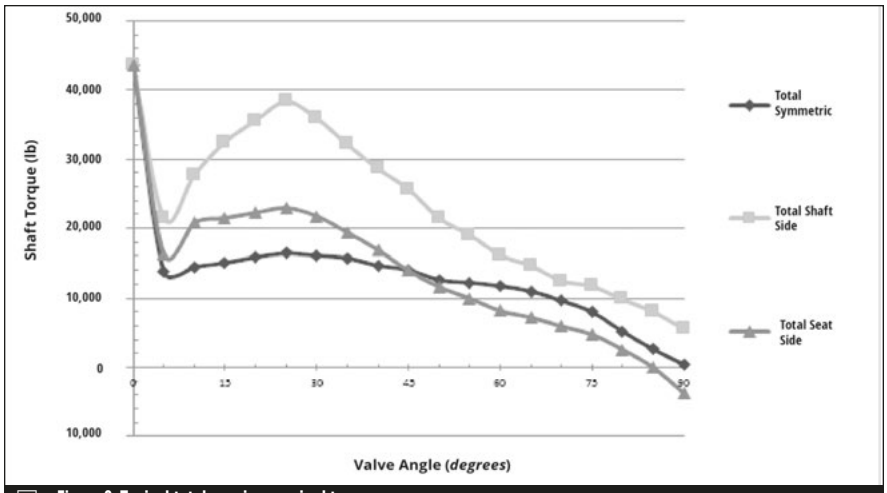


Figure 8. Typical total opening required torque

For a continuation of this discussion, go to www.VALVEMagazine.com, where you'll find information on position characteristics, sizing considerations and more. For information on this report, go to www.awwa.org.

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

Victaulic announced the launch of its Refuse-to-Fuse™ system for high-density polyethylene (HDPE) pipe. Featuring a range of couplings and fittings, the system offers installation up to 10 times faster than fusing while meeting or exceeding the performance capabilities of traditional fused joints.

For decades, HDPE installers have primarily relied on heat fusion to join HDPE pipe. Victaulic's couplings offer a better option because they are installed with common hand tools in any weather condition, resulting in quick, simple pipe connections. Assembled with a standard socket or impact driver, they do not require special equipment or certified crews.

Cowan Dynamics announced availability of linear hydraulic and pneumatic actuators with up to a SIL 3 safety rating. The rating is designed to provide customers reliable actuation solutions in critical applications without compromising their Safety Instrumented Systems.

It was achieved by certifying the products to IEC 61508 and was obtained from Exida Certification Services after passing rigorous Failure Mode Effects Diagnostic Analysis.

Metso has launched a groundbreaking intelligent partial stroke test (PST) system called Neles ValvGuard VG9PST. The solution helps customers diagnose performance of emergency shutdown (ESD) valves, improve the cost efficiency of installations that use an external solenoid valve, and ultimately, eliminate costly spurious trips risk. The new solution has unique features such as increased pneumatic capacity, and it is targeted for oil and gas industry customers, bringing advanced features for their ESD valve diagnostic needs. It offers additional safety by disabling all the testing and calibration if the input signal from the distributed control system falls below certain levels.

ASCO offers the Sentronic HD, a new addition to the Sentronic range and a solution for any application requiring high accuracy pressure regulation, such as in the automotive, process and medical industries. This higher precision solution provides improved installation, maintenance and diagnostic options.

Key features include a new electronics platform: Ethernet TCP for flexible installation options; DASHD software for user-friendly control available on the integrated web server; improved diagnostics; and high pressure of less than 0.25% hysteresis for control and stability. The product can also offer economic value by reducing cycle time and media wastage in flow applications, as well as operating with a low power consumption.

Emerson Process Management's line of Rosemount 8800 Vortex flowmeters now offers HART Protocol Revision 7, which allows for easier identification in the field, commissioning and configuration. The Locate Device feature of HART 7 displays a visible code on the device's LCD screen, which allows for quick field identification.

Once connected to the device, or while viewing from the control room, it allows a detailed device name to be viewed or loaded into the flowmeter. It also offers greater flexibility for device configuration. In addition to the latest HART 7 features, the 8800 Vortex flowmeter now provides sensor signal strength as a display and output variable.

ITT Corporation Engineered Valve brand has launched the Pure-Flo Advantage Compact Stainless (ACS) actuator. Designed specifically for the BioPharm and Food & Beverage industries, this product will withstand the rigorous conditions and is designed to satisfy customers' pneumatic actuator needs. The development of the ACS actuator is based on ITT Engineered Valves years of experience working with customers and understanding the requirements of the BioPharm industry. It is the latest addition to the Advantage Actuator product line.

Rotork has introduced a new model in its IQ range of non-intrusive intelligent electric actuators. The new model has an optimized combination of valve stem diameter acceptance and torque output to facilitate economical automation

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!
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CONTINUED FROM P. 46

of valves and penstocks typically found in the water and effluent treatment industries.

The actuator incorporates the full range of advanced reliability, functionality and asset management features, including a range of data logging capabilities. Local position indication, valve and actuator status, asset management and diagnostic operating information is available to download or viewed directly at the actuator.

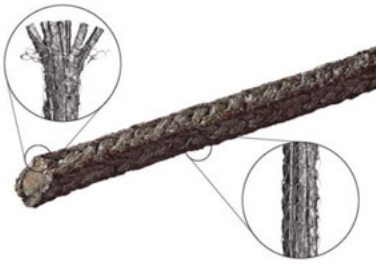
Spirax Sarco has released an extensive range of de-superheaters that offer an effective solution for steam conditioning and enhanced thermal energy transfer. The available options enable a wide range of solutions for industries including combined heat and power, oil and petrochemical, chemical, food and beverage, and pharmaceutical.

The de-superheater is ideal for when the precise control and reduction of superheated steam temperature is required. Because there are no moving parts, it's virtually maintenance free.

ValvTechnologies announced the extension of bi-directional sealing technology to its 5/8" bore V Series high-performance metal-seated ball valves.

This fully bi-directional, zero-leakage metal seated ball valve is designed to provide 100% zero-leakage for customers in the fossil power and nuclear generation markets.

Most metal-seated ball valves are a uni-directional design specifically targeting globe valves. The V Series designs can be used in bi-directional applications where gate valves are used without the worry of internal damage typical of other metal-seated ball valve designs.



EGC Enterprises now offers the Thermafoil 2236–CLE (Certified Low Emission), a high-temperature, high-density, die-molded valve stem packing ideal for refining, petrochemical and chemical plants. EGC's Low-E solution is based on a partnering agreement with Teadit for use of its fugitive emissions test approved Style 2236 braided product.

The packing is self-lubricating, non-hardening and dimensionally stable while, at the same time, resistant to gasses, fluids, heat, pressure and most chemicals. Its high-temperature flexible graphite and Inconel filament jacket afford mechanical stability while advanced construction provides leakage control and high integrity emissions containment.

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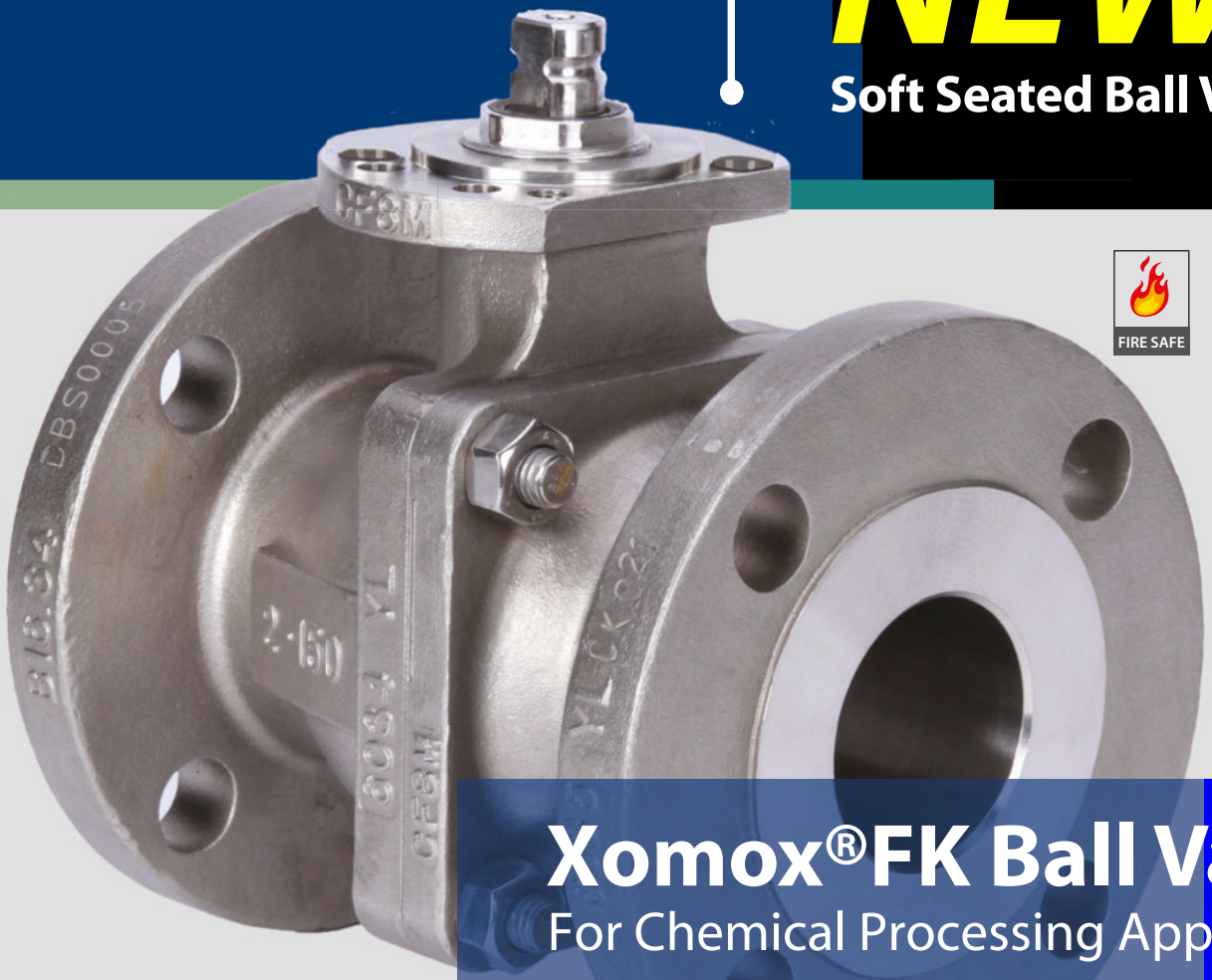

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