HIGHLIGHTS FROM VMA'S ANNUAL MEETING

VALVE MAGAZINE

FALL 2015 | VOL. 27, NO. 4

2016 MARKET FORECAST:

The Perfect Storm or a Summer Squall?

CHLORINE PIPING HAZARDS

VALVES FOR SUPERCRITICAL PLANTS

BASICS OF VALVE ACTUATION

THE UNDERVALUED MOUNTING KIT

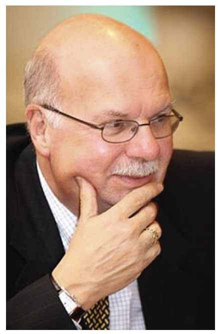

VELAN VELAN VELAN

VALVE MAGAZINE
FALL 2015 | VOL. 27, NO 4

COLUMNS

DEPARTMENTS

Distributors Jump onto the Bandwagon



As we near the second anniversary of opening VMA's membership to our distributor/channel partners, we are pleased to report that we now count 13 of these important partners as part of VMA membership:

AIV, LP
Andrews Industrial Controls
Ci Valves & Actuators
Classic Controls
DistributionNOW
Edgen Murray
FCX Performance, Inc.
MRC Global
RES Energy Solutions
Setpoint Integrated Systems
Sunbelt Supply
TRIFLOW Corporation
Wolseley Industrial Group

We created a column—The Distributor Channel—to cover issues in distribution, and we want to dedicate more space in future issues. We encourage companies in this category to contact editor-in-chief Judy Tibbs (jtibbs@vma.org) with ideas for editorial content.

I am also pleased to report that our distributors and channel partners are attending and participating in our meetings as well as explaining their services through tabletop exhibitions. More than half the companies listed above had representatives at our annual meeting last month in Naples, FL. At that meeting, we also held a special session on "The Customer's Relationship with the Distributor" with featured speakers from MRC Global and the Columbia Pipeline Group, and we've asked for distributors and channel partners to present at our VMA Valve Basics Seminar.

I encourage all companies involved in distribution that meet the criteria for membership to join VMA so you can network directly with the manufacturers of the products you represent. Information on distributor/channel partner membership, criteria for membership and applications for joining can be found on our website at www.vma.org under "About VMA." VM

Bill Sandler
President, Valve Manufacturers Association of America

VALVE MAGAZINE

www.VALVEmagazine.com

VALVE Magazine (ISSN No. 1057-2813) is the official magazine of the Valve Manufacturers Association of America (VMA) and is published quarterly by VMA, located at 1050 17th Street NW, Suite 280, Washington, DC 20036-5521; 202.331.8105; Fax: 202.296.0378. Advertising queries: 540.374.9100. Periodicals postage paid at Washington, DC, and at additional mailing offices.

POSTMASTER: Send address changes to **VALVE Magazine**, P.O. Box 1673 Williamsport, PA 17703-1673. Subscriptions are free to qualified readers in the United States and Canada; $40 per year to unqualified readers in the United States and Canada; $60 per year for all subscribers outside the United States and Canada.

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

www.vma.org

MERGERS, SALES & ACQUISITIONS

Schlumberger and Cameron to Merge

Schlumberger Limited and Cameron jointly announced a definitive merger agreement in which the companies will combine in a stock and cash transaction. The agreement was unanimously approved by both companies' boards of directors.

The transaction mixes the portfolios of the companies into a "pore-to-pipeline" products and services offering to the global oil and gas industry. On a pro forma basis, the combined company had $59 billion in 2014 revenues.

FCX Performance Acquires Process Control Services

FCX Performance, Inc. has acquired Process Control Services, Inc. (PCS). Based in Plymouth, MI, PCS provides instrument start-up, repair, installation and calibration services; in-house depot repair; turnkey plc programming; and control panel fabrication. PCS personnel are located in key FCX markets including Detroit, Cleveland, Milwaukee, Columbus and Pittsburgh.

Weir Group to Acquire Delta Industrial Valves

The Weir Group PLC has agreed to acquire Delta Industrial Valves Inc., a U.S.-based manufacturer of knife gate valves for mining, oil sands and other industrial markets, for $47 million. Based in Niles, MI, Delta employs 70 people and generated $6.2 million in earnings over the last year.

The acquisition extends Weir Minerals' presence in the mining and oil sands markets by expanding the division's portfolio of valve products, particularly knife-gate valves, for use in the transportation of slurry.

Shale-Inland Holdings Acquires Major Sourcing LLC

Shale-Inland Holdings, parent company of Sunbelt Supply, announced it acquired Major Sourcing LLC (Major Inc.) in a transaction completed on July 27, 2015. Major Inc. is a valve automation, integrator and distributor, primarily focused on the power industry.

The acquired company, which is headquartered in New Jersey, will continue to operate under its trade name, Major Inc., and will be a part of Shale-Inland's Valves & Automation platform. Major president Dave Kuhn will continue to lead the business.

Siemens Gets Approval to Obtain Dresser-Rand

The European Commission has unconditionally approved Siemens' acquisition of Dresser-Rand. This means all regulatory approvals required to complete the transaction have been obtained. The overall purchase price for all outstanding Dresser-Rand shares, including the assumption of outstanding financial debt of $1.2 billion, is about $7.8 billion.

Emerson Process Management Gains Spectrex, Inc.

Emerson Process Management has acquired Spectrex, Inc., a manufacturer of flame and open path gas detectors. Spectrex will join the Rosemount portfolio of measurement and analytical technologies. Terms of the acquisition were not disclosed.

Spectrex and its staff are located in Cedar Grove, NJ, with sales and technical support offices in Houston, UK and Taiwan.

A. W. Chesterton Obtains Ceramic Polymer GmbH

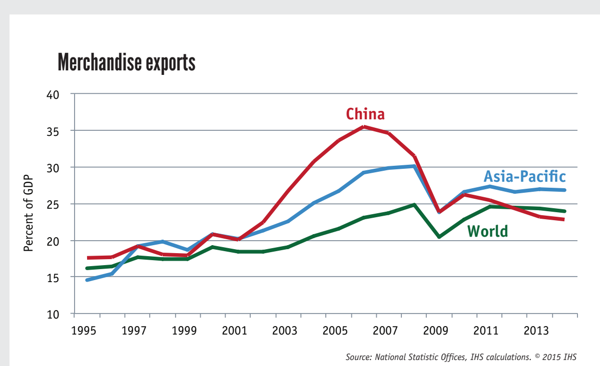
A.W. Chesterton Company announced the purchase of Ceramic Polymer GmbH. The company manufactures

MARKET FOCUS: AN UPDATE ON CHINA

At the time VMA members met in August for the 2016 Market Outlook Workshop, there was much uncertainty in China. The country's economy was about 10% gross domestic product (GDP) year-over-year growth. (See story page 15.) Zhou Hao, senior economist at Commerzbank AG in Singapore, said after the conference that he expected China's growth to dip below 7% for the third quarter of 2015. His predictions were supported by figures showing that China's imports declined more than expected at the same time exports shrank.

Manufacturers slashed prices at the fastest rate in six years in August as commodity prices fell, demand cooled, and China devalued the yuan. The Chinese stock market crashed spectacularly during the month the workshop was held, though many Western analysts pointed out the crash was not as important to the global economy as a worldwide weakening of demand for consumer goods.

This downbeat data affected global markets, including the commodities market and in particular, the oil and gas markets. Oil prices tumbled more than 5% following China's stock market crash, to a new six-year low below $39 a barrel. As this issue of VALVE Magazine went to press, oil sat just under $45.



Weak Chinese manufacturing data also triggered a drop in U.S. markets, prompting the Federal Reserve to delay an expected interest rate hike during its September meeting. Meanwhile, as part of a campaign to gain support for interest rate hikes later in 2015, Atlanta Federal Reserve bank president Dennis Lockhart urged investors to focus on the strength of the U.S. economy rather than what he says is the more remote risk of a global slowdown.

industrial coatings, specializing in those for protecting metal and concrete of large industrial structures.

The acquisition further expands Chesterton's ARC brand of products as well as its line of specialty lubricants and maintenance, repair and operations products. Ceramic Polymer GmbH will continue to operate under that name.

Pentair Buys ERICO Global Company

Pentair PLC has entered into an agreement to acquire ERICO Global Company for $1.8 billion in cash, including the repayment of ERICO debt.

Based in Solon, OH, ERICO manufactures and markets engineered electrical and fastening products for electrical, mechanical and civil applications. ERICO has 1,200 employees in 30 countries.

Rotork Purchases Spirax Sarco Subsidiary M&M

Rotork acquired M&M International, a subsidiary of Spirax Sarco Engineering, for €9.7 million ($10.9 million), adding its range of solenoid valve products to the Rotork Instruments division.

Established over 30 years ago, M&M of Bergamo, Italy manufactures general purpose solenoid valves, air-actuated piston valves, automatic drain valves, connectors, coils and customized instrumentation used in commercial and industrial flow control industries.

Wolseley Industrial Sells EPG Business to Emco

On July 13, Wolseley Industrial Canada Inc. announced the sale of its Engineered Pipe Group to Emco Corporation. With the purchase, Emco acquires Wolseley Industrial's high-density polyethylene pipe, fittings and flanges, and fabricated vessels business. Wolseley retains the remainder of its industrial business, which includes industrial valves, specific application valves, valve actuation, and pipe, flange and fitting products.

NEW CONTRACTS

Curtiss-Wright to Support U.S. Army Program

Curtiss-Wright Corporation received an initial contract to supply elevation and hatch control electromechanical actuators for use on the U.S. Army Multi-Mission Launcher in support of the Indirect Fire Protection Capability program. Under the agreement, Curtiss-Wright will provide modified solutions based on its Exlar electromechanical actuation technologies, as well as hatch actuation controls and engineering services. The estimated potential contract value over the life of the program is about $75 million.

Flowserve and United Valve Announce Agreement

Flowserve Corporation has formed a strategic agreement with United Valve to have United Valve perform factory-authorized repair and service on Edward valves.

The scope of the agreement between Flowserve and United Valve includes authorized valve repair, valve modification and other opportunities as directed by Flowserve. The agreement with United Valve will provide Edward valve customers an outlet for approved valve service work outside of the Flowserve Raleigh, NC, location, specifically in the refining and petrochemical-rich Gulf Coast area of the U.S.

Bernard Controls Supplies Depot in Cameroon

Bernard Controls delivered and set up more than 120

Curtiss-Wright will support the U.S. Army MML program.

2015

OCTOBER

21-23
VMA Valve Basics Seminar & Exhibits
San Antonio
www.vma.org

DECEMBER

8-10
Power-Gen International
Las Vegas
www.power-gen.com

2016

MARCH

9-11
VMA Technical Seminar & Exhibits
New Orleans
www.vma.org

APRIL

19-21
VMA Valve Basics Seminar & Exhibits
Rosemont (Chicago), IL
www.vma.org

MAY

2-5
Offshore Technology Conference
Houston
2016.otcnet.org

JUNE

2-3
VRC Valve Repair Conference & Exhibits
Houston
www.vma.org

19-22
ACE 16 Annual Conference & Exhibition
Chicago
www.awwa.org

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

VALVE MAGAZINE

STAFF

PUBLISHER
William S. Sandler

ASSOCIATE PUBLISHER/
EDITOR-IN-CHIEF
Judy Tibbs

MANAGING EDITOR
Genilee Parente

SENIOR EDITOR
Kate Kunkel

ASSISTANT EDITOR
Chris Guy

CONTRIBUTING EDITOR
Greg Johnson

ART DIRECTOR/
PRODUCTION MANAGER
Michelle Wandres

ADVERTISING DIRECTOR
Sue Partyke

How to Contact
VALVE Magazine

EDITORIAL OFFICES
13613 Baycraft Terrace
Midlothian, VA 23112
phone: 804.639.1365
email: jtibbs@vma.org
website:
www.ValveMagazine.com

ADVERTISING SALES
Sue Partyke
145 Harrell Road
Suite 119
Fredericksburg, VA 22405
phone: 540.374.9100
fax: 540.374.9265
email: spartyke@vma.org

CIRCULATION/SUBSCRIPTIONS
phone: 570.567.1193
fax: 570.320.2079
email:
valve@PublishersServiceAssociates.com

NEW PRODUCTS, MEDIA AND
INDUSTRY NEWS
Chris Guy
phone: 571.274.5224
email: cguy@vma.org

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.

explosion-proof quarter-turn actuators (SQX models) with INTELLI+ intelligent integrated control, to automate oil fire protection for a depot for Société Camerounaise des Dépôts Pétroliers (SCDP) located in Douala, Cameroon).

SCDP Douala oil storage depot is one of the 13 such depots owned by the company.

Powell Valves Adds Exclusive Distributor for China

The Wm. Powell Company (Powell Valves) and KS Distribution Ltd. (KSD) have entered into an exclusive agreement whereby KSD will represent and distribute Powell Valves in China and Hong Kong.

KSD is a supplier of equipment and consumables for the oil and gas, offshore and marine, petrochemical, mining and other related industries. KSD represents more than 300 established and accredited brands and distributes over 70,000 line items.

GE Oil & Gas Awarded Subsea Service Agreement

GE Oil & Gas has signed a framework agreement with Statoil Petroleum AS to provide subsea operations services for the company's operated fields—Tordis, Vigdis, Snorre and Troll, located off the coast of Stavanger, Norway.

GE Oil & Gas will run the services from its Dusavik site, providing subsea operations services, including offshore installation and intervention, equipment repair and maintenance, studies, upgrades and modifications.

MRC Global Signs Contract Expansion with Phillips 66

MRC Global Inc. announced that its subsidiary, McJunkin Red Man Corporation, has signed a 5-year contract to supply pipe, valve and fitting products and services for Phillips 66. This global agreement is an expansion of the existing North American supply contract between the two companies, expanded to include refining in Europe.

In addition to providing products for maintenance, repair, operations and capital projects, MRC Global will continue to provide integrated supply services.

NEW FACILITIES

Setpoint Opens New Green Tag Center

Setpoint Integrated Solutions announced the opening of its new Consolidated Green Tag Center (GTC) for safety relief valve assembly and repair at its corporate headquarters in Baton Rouge, LA.

The GTC designation came after the Baton Rouge facility's newly acquired Valve Repair accreditation from The National Board of Boiler and Pressure Vessel Inspectors and American Society of Mechanical Engineers Section I and VIII assembler certifications.

Wey Valve Expanding to Mississippi Facility

Wey Valve, Inc. is expanding and relocating operations to the Tupelo Lee Industrial Park South in Shannon, MS. Wey says the move includes building a 40,000-square-foot manufacturing facility and new office space. Its existing 23,000-square-foot facility in Nettleton, MS was built in 1998 and expanded in 2012.

PEOPLE IN THE NEWS

COLFAX CORPORATION… announced that **Matthew L. Trerotola**, formerly an executive vice president at DuPont, was named CEO and a director of Colfax, effective July 24, 2015. He succeeds **Steven E. Simms**, who will assist in the transition and will continue to serve on the Colfax Board. Simms notified the board early this year that he planned to retire.

Trerotola has spent most of his career at DuPont, Danaher Corporation and McKinsey & Company. He was most recently an executive vice president and a member of DuPont's office of the chief executive.


John Quinlivan

METSO… has made two new appointments to its executive team. **John Quinlivan** has been appointed president, flow control, and **Perttu Louhiluoto** has been appointed president, services. Both appointments took effect immediately.

Quinlivan has held several management positions within Metso's Automation and Flow Control since 1989. Louhiluoto has been president of Metso's Flow Control business area and its preceding automation segment since 2012. He has been with Metso since 2008.

ASCO EXPRESS™

Because time matters, ASCO Express delivers the great products you need, when you need them. Just place your order by 3:00 P.M. EST and ASCO ships same day.

2, 3, & 4-Way Solenoid Valves | Air Operated Valves | Combustion Products | Miniature Valves

SAMEDAY | Guaranteed same day shipment or ASCO pays the freight. Over 2000 of ASCO's most popular products qualify for the ASCO Express guarantee. ASCO Express includes our most popular valves, valve rebuild kits, and accessories.

5DAY | As part of our continued drive for customer service, we expanded the ASCO Express program with over 50,000 products that can be shipped within five business days.

ASCO®
Right. Now.™

EMERSON.
Industrial Automation

800-972-ASCO (2726) | e-mail: info-valve@asco.com | www.ascovalve.com/express

Crane ChemPharma & Energy Expands Service Center

Crane ChemPharma & Energy recently expanded its Baton Rouge Service Center to better support customers in the Gulf Coast region. The enhanced facility, with new equipment and twice the amount of square footage of the previous building, is designed to accommodate larger products, higher capacity and increased inventory of Xomox, Krombach and WTA products.

Saint-Gobain Seals Opens New Office

Saint-Gobain Seals announced the opening of its new technical and sales office in Houston, with a district sales manager and application engineer on staff to reinforce and support local oil and gas customers.

Opening a dedicated office in Houston is part of Saint-Gobain Seals' business strategy to expand its sealing solutions presence in North America.

AWARDS & MILESTONES

VMA Members Win Innovation Awards

Flow Control magazine announced the winners of the 2015 Flow Control Innovation Awards, which included three VMA members. The magazine honors technologies for "novel features and contributions to the processes of fluid movement, measurement and containment." Emerson Process Management, ASCO Numatics and Siemens Industry were among the nine winners.

Award nominees were featured in the June 2015 edition of the magazine.

Crane Celebrates 160-Year Anniversary

Crane ChemPharma & Energy proudly celebrated 160 years of existence for Crane Co. during the Valve World Americas Expo on July 15-16.

Crane ChemPharma & Energy, which is the consolidation of former businesses Crane ChemPharma Flow Solutions and Crane Energy Flow Solutions, is part of the company's history, which dates back to 1855. Crane has provided solutions to markets as distant as the moon, with pumps used in the Gemini and Apollo Space programs.

Lined Valve Company's 20:20 Celebration

Lined Valve Company (LVC) employees celebrated the company's 20th anniversary by donating 20 boxes of items to a local cause to represent each year of the company's growth. LVC, which was born in 1995 in Beaverton, OR, has outgrown two buildings and finally settled into its current location in Woodland, WA. It then opened a second manufacturing facility in Ocala, FL to serve customers on the East Coast.

LVC employees packed boxes with food, clothing, and personal items to be given to Woodland Action Center, whose mission is to provide essential services to those in need in the Woodland, WA community.

PPE Celebrates 40 Years

Founded in 1975, Precision Polymer Engineering (PPE) celebrated its 40-year anniversary in 2015. PPE recently marked that milestone with a company birthday party attended by employees and families. Globally, PPE employs more than 300 people.

In 2010, PPE was acquired by IDEX Corporation and changed from a privately owned company to part of a large, multi-billion-dollar global organization. Since then, two additional sealing companies, FTL Technology Ltd. and Novotema Spa., have joined PPE to form IDEX Sealing Solutions.

PPE employees gather to commemorate 40 years

Lined Valve employees donate boxes.

Victaulic Honored with Vendor Support Award

Victaulic recently was awarded the William C. Tamburro, Sr. Vendor Support Award from the Philadelphia Chapter of the Society of Fire Protection Engineers (SFPE).

The SFPE chapter's purpose is to advance the art and science of fire protection engineering and its allied fields, to reduce life and property losses from fire, to maintain high ethical standards on engineering among its members and to foster fire protection education. Recognition of fire protection engineering as a discrete engineering discipline is a prime goal.

Universe Machine Celebrates 50 Years in Edmonton

Universe Machine Corporation celebrated 50 years of business in Edmonton, Alberta, Canada this year. Universe Machine is a locally owned family business started in 1965 by Kurt Feigel Sr., winner of the 1993 Pinnacle Award for one of the best-run family businesses in Alberta.

Over its 50-year history, Universe has grown from a 2000-square-foot shop to a modern 110,000-square-foot facility. VM

Biggest Power Show Ever this December

A record-breaking 22,000 people are expected at Power-Gen International, which is Dec. 8-10 in the Las Vegas Convention Center, Las Vegas, NV.

Power-Gen is the world's largest power generation event, focusing on industry innovations, technical trends and business strategies. The conference features more than 200 of the industry's top speakers, 50 educational conference sessions and more than 1,400 exhibitors. Attendees include a wide variety of power professionals from engineers and architects to CEOs and administrators of the world's top power companies. They also come from 90 different countries.

Thirteen tracks guide attendees to topics of interest in their particular areas such as general industry trends, financing, competitive power generation, areas of specialty such as gas turbine technologies, emissions control and onsite and plant operations. The conference also is held concurrently with several other power conferences including Nuclear Power International, Renewable Energy World Conference & Expo, Coal-Gen and GenForum, and attendees cross between the shows during the week of events.

The exhibit hall is the world's largest showcase of products and services in the field such as boilers, turbines, engineers, boiler water and feedwater treatment services, computer hardware and software, consulting services and equipment, including piping, pumps, valves and actuators.

Power-Gen is produced by PennWell, presented by Power Engineering and supported by power organizations such as the American Public Power Association and Cooling Technology Institute as well as specialty trade associations such as VMA. VALVE Magazine and VMA will be represented in the exhibit hall.

More information on the event is available at www.power-gen.com.

Chem Show Turns 100 This Year

The 100th anniversary of the Chem Show occurs this year Nov. 17 to Nov. 19 in the Javits Center, New York City.

The biennial event, which has been running since 1915, showcases the newest innovations in processing equipment, technology and operations. Thousands of engineers, plant managers and other chemical processing professionals looking to optimize their process operations in the chemical, pharmaceutical, food and other industries, come to the show.

The 2015 show has an all-new seminar series for attendees, free "best practices" seminars and an exhibit hall that features hundreds of manufacturers for products handling process equipment, safety tools, plant maintenance, and instrumentation and controls.

Over 6,000 people attend the show from 45 states and 67 countries and 300 companies will show their wares in the 30,000-square-foot exhibit hall.

For information, go to www.chemshow.com.

VMA Welcomes New Leaders, Honors Members and Looks Forward

The Valve Manufacturers Association elected new board members, presented awards to people who have served the organization and listened to speakers share their ideas on how the economy and the industry are faring at the 77th Annual VMA/VRC (Valve Repair Council) Meeting Sept. 30 to Oct. 2 in Naples, FL.

The top leader's position in the organization—chairman—went to **Bob Kemple**, ASCO Numatics, who succeeds **Greg Rogowski**, Mueller Co. At the association business meeting, Rogowski was thanked by VMA President **Bill Sandler** for his service during the past year. The outgoing chairman will now serve on the board as immediate past chairman.

Bob Kemple

Greg Rogowski (left) and Bill Sandler

Other board members elected for 2015-16 are: Vice Chairman **Jim White**, Curtiss-Wright; and Program Chairman **Mark Nahorski**, PBM.

New board members are: **Bruce Johnson**, Emerson Process Management Fisher Controls; **Ron Warren**, Bray International; and **Brian Wright**, A-T Controls. Returning for a second term is **Louis Pinkham**, Crane Fluid Handling.

Sandler also recognized three retiring board members: **Sam Bennardo**, AUMA; **Randy Cowart**, Powell Valves; and **Ivan Velan**, Velan Valve.

Jim White (left) and Bill Sandler

HONORED FOR SERVICE

VMA's top honor—VMA Person of the Year—went to long-time member **Jim White** of Curtiss-Wright, who has been in the valve industry more than 20 years. White's list of VMA accomplishments and activities includes serving on the board as well as having volunteered to serve on numerous nominating and program committees for many annual meetings. Sandler called him his "go-to guy whenever I needed a volunteer." Nine former recipients of the award, which has been around since 1974, joined Sandler on the stage to congratulate White.

Also recognized for service to the association was **Tracy Fairchild** of Velan, who has been an integral part of the Communications Committee, and now serves as its chair. Fairchild has helped to implement and market VMA's new Career Initiative. She received the VMA Service Award for her efforts in bringing that initiative to the forefront.

Tracy Fairchild

OUTSTANDING SPEAKERS

Brian Beaulieu, CEO of ITR, challenged members to ignore those who say U.S. manufacturing is on the decline. He said industry in this nation is on the incline instead and is poised to surpass its 2008 pinnacle. For the immediate future, Beaulieu predicted that oil prices will rise to the upper \$50s to low \$60s per barrel next year and said the recent stock market woes were corrections.

Brian Beaulieu

He warned, however, the significant recession ITR had previously predicted will hit here in 2019 followed by a major depression in the 2030s. Business objectives for the immediate future should include careful budget analysis, investment in market research that will reduce price sensitivity, investing in top-notch training and retention, effective marketing spending, looking at ways technology can drive efficiencies, locking in costs toward the end of this year and planning for that first big recession in 2019.

On the minds of many members is the talent gap that any industry relying on manufacturing faces today. **Maureen Crawford-Hentz**, director of talent acquisition for A.W. Chesterton Company, outlined her thoughts on what businesses can do to recognize and appeal to the millennial generation, who are

Maureen Crawford-Hentz informed attendees about the value of mentoring.

technology dependent and more cause-oriented than money driven. Hentz outlined how valuable mentoring programs are in appealing to a generation used to being self-driven, but needing and wanting direction and growth.

VMA's careers initiative, which was introduced at last year's annual meeting, was defined and outlined by Fairchild as well as **Greg Johnson**, United Valve, vice chair of the communications committee. The program has gone very far in one year's time and now includes valvecareers.com; a careers brochure and marketing materials; a social media campaign; and budding partnerships with schools such as Texas State Technical College. In the works are a human resources workshop (Nov. 9-10 in Arlington, VA); a video; participation in careers fairs and more.

The 78th VMA/VRC Annual Meeting takes place Sept. 21-23 in Rancho Mirage, CA. VM

NEW MEMBERS

During the past quarter, VMA recently welcomed four companies as new members:

Joining the ranks as a manufacturing member is **CIRCOR International, Inc.**, Burlington, MA. CIRCOR designs, manufactures and markets valves and other highly engineered products and subsystems for the energy, aerospace and industrial markets.

Howard Tool Company, Bangor, ME joined as an associate supplier member. Howard Tool was founded in 1985. Its staff of programmers, machinists and inspection personnel produces high quality parts for industry.

Andrews Industrial Controls, Carnegie, PA, became one of two new VMA distributor members. Andrews has been in business since 1977 and serves Ohio, Pennsylvania, Maryland, West Virginia and Kentucky, representing companies that make products for industrial automation.

Also joining as a distributor is **TRI-FLOW Corporation**, West Berlin, NJ. It has been in business 25 years as a manufacturers' stocking representative for high quality industrial valves, control valves, controls and instruments, and specialty piping products.

2016 MARKET FORECAST:

Dodging Market Strikes

BY KATE KUNKEL

Discussion of crude oil and natural gas have dominated much of the last few VMA Market Outlook Workshops and this year's event, which was Aug. 6-7 in Chicago, was no different: Declining oil prices made it into most discussions at the workshop, and shale gas came up many times. However, a few other issues also seemed to bounce off the walls and return repeatedly to the list of concerns among the assemblage. Among them: China's current economic doldrums and the high U.S. dollar.

For the most part, the mood of speakers was that while the U.S. economy is in fairly good shape, pressures from declining oil prices and cheap gas, uncertainties over economies of other countries and lessening demand possibilities from China are creating the possibilities of stormy weather ahead. Those who know what's coming may be able to dodge the lightning strikes.

» GENERAL TRENDS TO WATCH:

- China is faltering, which is affecting many global economies.
- Emerging economies are driving increased demands for energy.
- Capital spending is tight everywhere.
- Oil and shale producers are learning ways to cut costs and focusing on more profitable drilling locations and methods.
- The U.S. is on track to become a gas exporter (some say by 2017).
- LNG could become a balancing mechanism in the gas market.

Kate Kunkel is senior editor of VALVE Magazine. Reach her at kkunkel@vma.org.

UPSTREAM OIL

A Time of Price Pressures

John Spears, president, Spears and Associates, had the unhappy task of sharing some negative news on the upstream oil front this year.

"As we were meeting last year, prices were dropping, but nobody expected them to drop as much as they have," Spears reported.

U.S. oil supplies grew faster than world oil demand in 2013 and 2014 and by the third quarter of 2014, slowed demand in this country combined with these growing supplies was putting a strain on prices.

Meanwhile, "The Saudis were not willing to cut production and lose share. Prices plummeted," he explained.

In looking ahead at pricing, Spears could be somewhat more positive. He pointed out that: "World oil demand growth has accelerated in response to lower oil prices. At the same time, U.S. oil production growth is slowing."

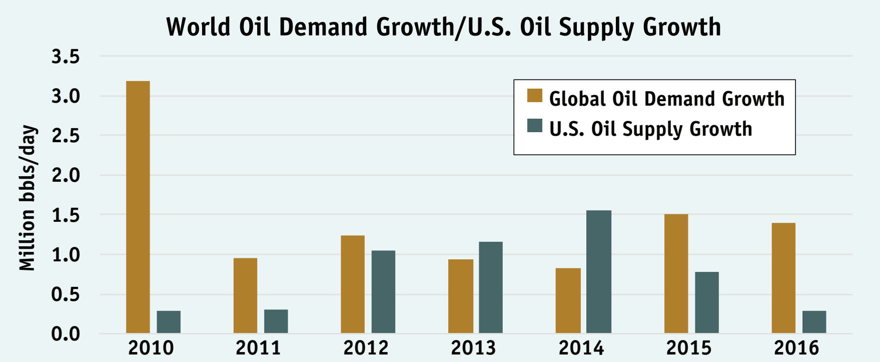
Still, OPEC has increased output in the last four months, which means "global oil production will grow in the next year, resulting in continuing low prices," he said.

Spears expects U.S. oil production to continue to slide for the rest of 2015. Also, despite the Energy Information Association's forecast of slight U.S. oil production growth for 2016, Spears anticipates negative overall growth. If that occurs: "It will help tighten the market as time goes by."

He also pointed to another current concern, which is: "How fast and to what extent will Iran's re-entry affect the market?"

THE GLOBAL PICTURE

Spears pointed out that emerging markets account for more than half of global oil use, and they will continue to drive global demand growth. This is because energy efficiencies and sluggish economic growth mean developed economies are using less oil. He also pointed out that fears over demand, which are driven by uncertainty in China, are currently more important than supply side worries about OPEC output or more Iranian production.



China accounts for 37% of the growth in demand, he said, while the Middle East is at 22% and India is at 12%. These three combined account for over 70% of net increase in global oil demand since 2010. This means that even though economic improvements in North America translate into a fairly significant increase in oil demand for 2015 to 2016, the stagnation in China could negate those gains.

Lessening demand in China also is responsible for the other worry for the rest of 2015, which is a cutback in capital markets. Earlier in 2015, producers found an open market, but bankers re-evaluate risks twice a year. Because of lessened demand, "banks will close their lending windows to many of these producers," said Spears. "That means oil patch operators will have to self-finance every new thing they plan to do."

The good news is that producers have been proactive in reducing costs. Last year, the break-even price averaged about $60/barrel dependent on location. Above that amount, operators would drill anything. However, price declines mean operators are trying to drill only the best wells and are changing how wells have been drilled to some degree. The result of those efficiencies is that the break-even price has gone down to about $40/barrel, which makes the industry healthier over the long term.

Another factor that could lead to a tightening of the oil market is that surplus production capacity is near an all-time low. "The rate we're running now is something less than 2% below demand," said Spears, which means there is about 18 months of spare capacity. He said he believes that the OPEC nations figure it will be U.S. producers that can pick up the slack when needed because those producers have the capability of adding 1 to 2 million barrels per day. Spears warned, however, that increasing or decreasing production according to market is not as smooth as opening a valve. Still, overall, that means the demand picture looks better than a year ago and should continue upward motion; market tightening will take place in the second half of 2016, which might mean a $65/barrel price by then.

FORECAST

- *The oil and gas price environment will be challenging through year end 2015, but gradual improvement is expected over the course of the next year as supply growth slows and markets tighten.*
- *U.S. rig counts are expected to fall 45% in 2015 and another 10% in 2016.*
- *U.S. oil production will not exceed the second quarter 2015 production peak until after 2016. Oil-related midstream construction will slow sharply this year and next; it will probably be 2018 before this area will get back to peak levels.*
- *Uncertainty about future prices will diminish upstream investment, which means improvement in North American drilling activity is more likely to occur in the second half of 2016.*
- *This situation will create headwinds for the valve industry in this area through 2016.*

Energy Demand Sets the Stage

Ken Medlock, senior director, the Center for Energy Studies at Rice University, says much has changed on the Liquefied Natural Gas (LNG) front from last year to this year.

"The price in Asia was $15 [price per thousand cubic feet or mcf] then, now it is in the $7 to $8 range," he said. In the U.S., prices are about $2.50 mcf.

"So while the spread is not as large [from world to U.S.], there is still enough difference to support trade. The question is: How much demand will there be, and who will fulfill it? The U.S. is not the only country interested in exporting natural gas," he said.

Medlock pointed out that one of the biggest drivers of volatility in natural gas is who will need the energy, and who will provide it. On the supply side, oil, natural gas and coal are growing in the developing world, but moderating in North America.

Also, despite a slowing, "shale is not dead," Medlock said. "But operators have to be smarter about where and how they produce."

Cost reductions between 25-35% have been implemented partly because of better prices from suppliers. These lowered costs as well as improvements in productivity have moderated the impact of lower prices, Medlock said.

On the demand side, the slope is driven by what's happening in Asia since energy growth is not about to occur much in developed countries, he noted. "Energy used per unit GDP [gross domestic product] is relatively low in developed countries because most growth comes from the service sector," he said. That sector doesn't require as much energy as industries such as manufacturing "so even if there is economic growth, there is not huge growth in power needs," he added.

Sources of energy also come in and out of favor as the population gains wealth, Medlock pointed out.

For example, "The Chinese use of coal is tapering and flattening out because, as people get wealthier [and their energy demands have been met], air quality gets more important," he said.

At the other end of the spectrum are developing countries such as Malaysia, Thailand, Myanmar, Laos, Cambodia and Vietnam.

"These are poor countries with tremendous potential due to low labor costs and slack regulations," said Medlock. "A dramatic growth in manufacturing makes these countries huge consumers of energy."

Also, while per capita income is still low compared to other areas of the world, it's growing.

"Even at modest rates of economic growth (4-6% per year), by the 2030s, you will have millions more people moving into the middle class," he said.

As they do that, they buy stuff and will need more power for gadgets and cars, he said. "This change in needs sets the stage for energy demand to grow."

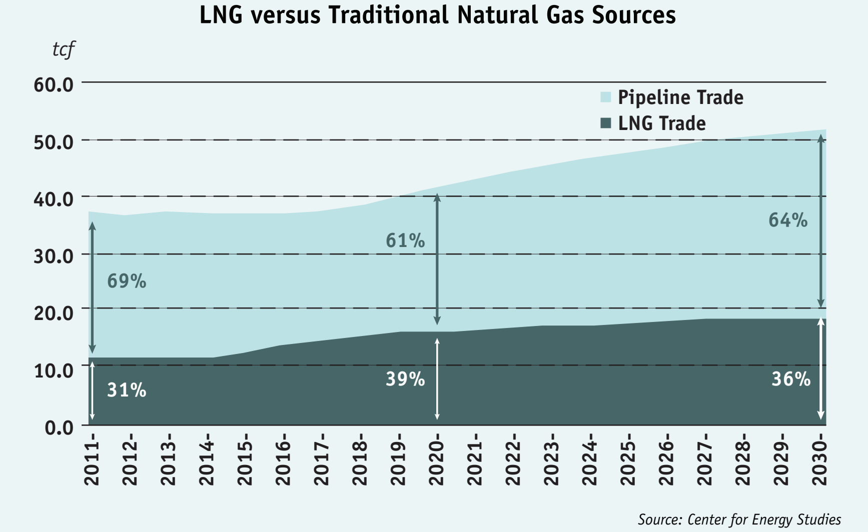
As an example, he said India is currently about where China was in the mid-1990s in terms of per capita income. Economic growth rates in that country are accelerating at about 6.5-7% growth per year, which creates an increasing appetite for energy. However, the country has a trading partnership with Iran, a relationship that will deepen around energy. This means that Iran, which has the second largest conventional natural gas supply in the world, will be the major competitor with the U.S. for exports of LNG to India.

While many in North America are looking to China as a customer for natural gas, that country built 60% of its infrastructure in the last decade. Those power plants are coal-fired, and coal plants are not retired quickly. "Once you build [coal plants], you're in it for the next 30 to 40 years, so they are not going to stop using coal anytime soon," noted Medlock. As a result, China won't be buying huge quantities of natural gas in the immediate future.

» FORECAST

- *The growth in global LNG trade will occur in multiple locations. The U.S. is viewed as the third largest exporter in the world at just under 7 billion cubic feet per day.*
- *New consumers will enter the market as global demands increase, with Asia leading the way.*
- *LNG will become an important "balancing" mechanism in the global gas market moderating global spot prices (and based on transportation costs).*
- *The next decade will be a buyer's market. Contracts to buy products at a particular price will remain important to underpin financing, but will be less important for dictating the terms of trade.*

LNG versus Traditional Natural Gas Sources



Source: Center for Energy Studies

A Shakeup for Suppliers

Analysts from Deloitte Consulting presented outlook workshop attendees a blunt assessment of the situation in Alberta, Canada. They also told the audience that end users are looking very closely at pricing structures.

In Alberta, "There is a lot of fear. Colleagues and friends in oil sands are more frightened than they were during the recession," said Martin Brotschul, principal with the company.

The relative strength of the U.S. dollar is adding more stress to the situation, because producers buy supplies in American dollars, he said. "At 29 cents premium on the dollar, [that] has a huge impact."

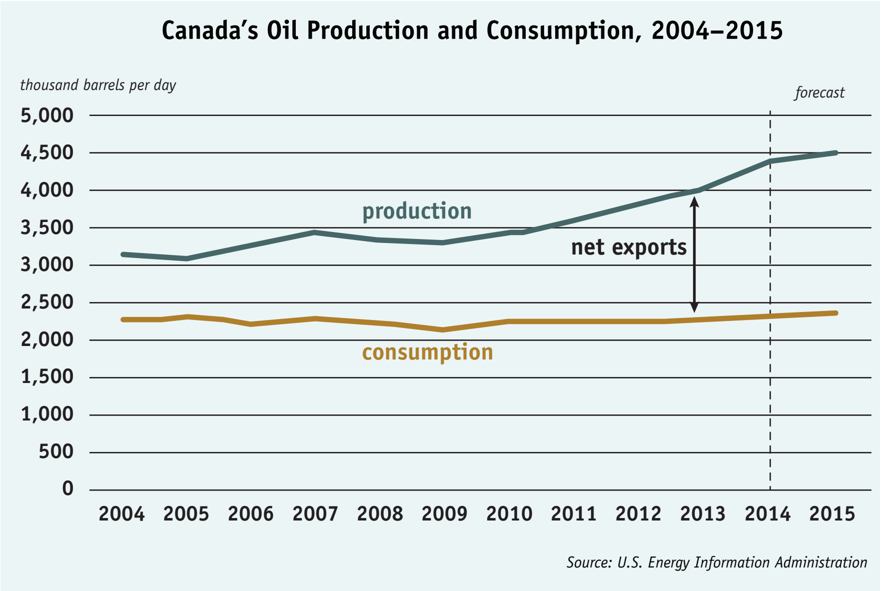
Canada has been the hardest hit as far as the oil sands situation with a double whammy of lower oil prices and a weak Canadian dollar; 75% of all major project cancellations announced are within Canada, and people are focused on producing the choicest assets with the best technologies.

When oil prices were high, there was a proliferation of small exploration and production (E&P) companies, which required much capital. As prices remain low, he expects those smaller companies to be consolidated into the larger companies, which could mean a smaller customer base for valve manufacturers.

He also anticipates that prices will be tested further with the possibility of Iran production coming back into the world market.

Producers who survive this situation will do so by taking action now, he said. His assessment of the situation was:

- A shakeout of smaller, less-well-capitalized companies will occur. Companies with strong balance sheets are seeing this as an opportunity to gain market share and scale, ultimately meaning fewer, larger customers in the market.
- Marginal programs and projects will be mothballed or abandoned. He pointed out there are already more than 17 oil sands projects that have been cancelled. If oil stays below $50/barrel, that number could easily double.
- Producers are cutting back production to only the most profitable wells to manage cash flow. Most companies engaged in cost reduction programs in 2015. Continued softening would mean further contractions and negotiations.



Grant Poeter, specialist leader with Deloitte, says E&P companies also are currently figuring out how they can make their processes and internal cost structures as low and efficient as possible. To accomplish this, they break down what the input costs are from each of their suppliers, including those that supply valves, he said. Because they can't ask all companies that produce the products they need for an across-the-board percentage cut, they look at the cost structures of each of their suppliers. They then break down, by component, the actual cost for suppliers and ultimately for end users. By driving to this level of information, they have educated conversations on pricing, including indexing to key cost drivers such as materials.

"Users understand that there has to be profit for their suppliers," Poeter said. But "60-70% of our operators are getting into in-depth analysis of costs of their suppliers and ultimately for their own operations."

An issue going forward for manufacturers will be how they can respond to "the squeeze," as Ted Brennan, senior manager at Deloitte, called the situation.

This squeeze has been helped along by a number of market trends in the manufacturing industries. For example, "Commodities are volatile," Brennan said. Prices increased right up until the economy collapsed in 2008. "Now we have price decreases again as the economy stalls. The second downturn in 15 years means that it is imperative that manufacturers become increasingly sophisticated in managing commodities. It will give them a competitive advantage," he said.

He suggested manufacturers look at strategies they can put in place now to work with their supply base in the future.

FORECAST

- *Low oil prices are likely here to stay: A consensus of analysts and data point to no real improvement for 12 months or more with an upside that would be $70-$80/barrel. No one is predicting a return to $100 anytime soon.*
- *All operators have conducted cost-cutting programs with mixed results. More will likely follow.*

Growth will Come; but not from China

IHS world economist Simona Mocuta admitted that this year, for the first time in her experience, her attitude on China is not positive. "Normally I say that China is doing well. But there's nothing I can give you in terms of a positive story there this time," she reported. Globally, however, Mocuta was more optimistic, stating that recoveries in the United States, the Eurozone and Japan will support global growth in 2016-17.

Three major factors affecting today's economies are:

- ***Divergence:*** "The developed markets are trending up but the emerging markets are trending down," Mocuta said. "This could actually intensify over the next year. The only big country [among the BRICs—Brazil, Russia, India, China] that looks better today than a year ago is India. Its economy is not worsening, but it is also not really getting better." There also is a huge discrepancy between emerging markets.
- ***Disinflation:*** The downtrend in commodity prices and easing consumer price inflation make Mocuta wonder if consumers are simply getting close to "too much of a good thing," she said. "They just can't or don't buy as much," she noted. "This is concerning because consumers generally, and the Asian consumer in particular, were supposed to be a big driver to the world economy."
- ***Depreciation:*** Every major economy other than the U.S. has depreciated over the last year and many emerging-market currencies have depreciated sharply. "To a large extent, the dollar is close to its peak and will start weakening over the medium term," she said. Meanwhile, China has done nothing to its currency over the last year, and the fundamentals in that country are worsening.

FORECAST

- *Low oil prices, monetary stimulus in Europe and Asia, and better U.S. growth will provide the foundations for a pickup in the global economy.*
- *The U.S. expansion is led by domestic demand, with consumer spending and residential construction accelerating.*
- *The Eurozone is gaining momentum, helped by a weak euro. Contagion from the ongoing Greek situation will be limited.*
- *The Asia-Pacific region will make the strongest contribution to global economic growth.*
- *The biggest risk to the global economy is a hard landing by China. If consumerism starts to decrease in that country, big trouble could be around the corner.*

"That will have a further effect on demand from Chinese consumers," she said.

POST-CRISIS ECONOMICS

Mocuta reports that fiscal deficits are decreasing in most countries and household debt is on a better trajectory than recent years. Inflation remains mild, and global current-account imbalances are manageable.

Canada is technically in a recession at this time, thanks in large part to the slump in oil prices, she said. One of the biggest concerns in this country is that foreign investors are buying properties in Canada, which drives up prices for real property.

The fact Asia isn't doing as well as it did previously creates a risk that this particular source of demand and support will weaken.

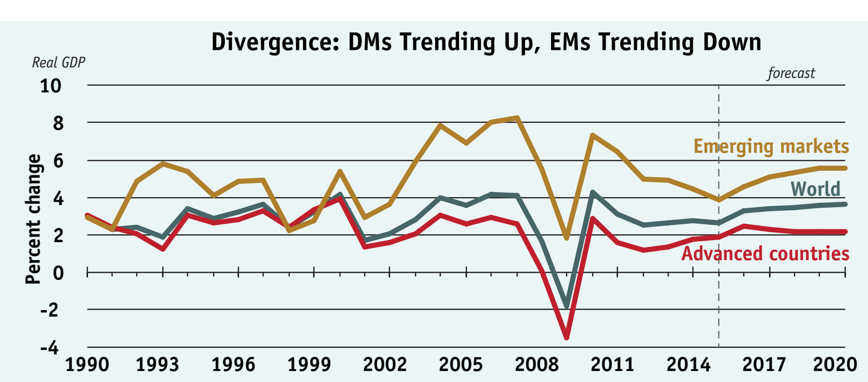
Mexico's economic outlook is optimistic. Constitutional changes are opening Mexico's oil and gas industries to foreign investment, and global automakers are committing to new capacity in Mexico.

The Eurozone economy is slowly gaining momentum, led by an acceleration in consumer spending. Investment will strengthen as 2015 progresses, helped by rising business confidence, export growth and easing credit conditions. Mocuta sees a 45% probability that Greece will exit from the Eurozone.

"The key to everything is China," Mocuta said. The country's real GDP growth held steady at 7% in the second quarter of 2014, and economic growth is expected to settle near 6.5% over the next few years, she said.

Also, while the rise and fall of stock prices had a limited impact on consumer spending, "the government's reaction to the stock market correction in China earlier this year was more frightening than the correction," she said. "There was such a barrage of 'throw everything at this problem' that all the steady progress in terms of liberalizing the financial markets was erased within a week," she said. Mocuta cautioned companies whose business growth depends on Chinese growth to rethink strategy.

Latin America's economic growth has stalled, especially Brazil where the government is facing a crisis of confidence. Low oil prices and corruption investigations at Petrobras are taking a toll on the energy and construction sectors, while a currency depreciation and a drought pushed the consumer price inflation up to 8.5% year over year in May, its highest rate since 2003.

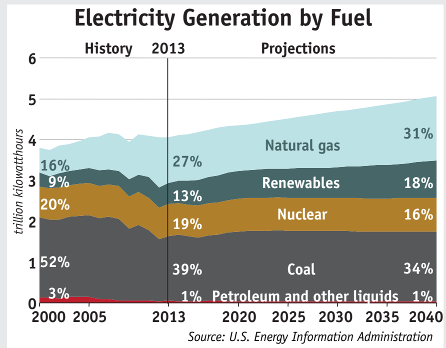


UTILITIES

New Challenges Mean New Valves

Electricity will stay relatively flat in North America because of slow load growth and increased energy efficiency, according to Tim Riordan, vice president of engineering services for American Electric Power. However, there is concern about the ongoing ability of producers to meet the demand because of environmental regulations.

"Suppliers to the power generation industry are going to be called upon to provide equipment and components that can support the new reality of more demanding duty cycles," he said. "A greater emphasis will be placed on reliability, flexibility and the maintainability of the existing fleet. There also will be a huge need for equipment and components to support the new technology."



Manufacturers will need to spend money on research and development for equipment to meet the challenges of building new facilities and for keeping the existing fleets operating. Those challenges include:

- Higher temperatures (up to 1300°F or 704°C) and pressures (over 4,000 psi) to achieve higher steam-cycle efficiencies
- Gas turbine and heat recovery steam generator improvements to increase efficiency
- Chemical-looping processes: instead of taking oxygen out of the air, metals such as ferric oxide are mixed with fuel and air to produce heat and power and to inherently separate CO_2
- Oxy-combustion, where coal or gas is burned in the presence of pure oxygen to improve emissions and generate a pure CO_2 stream
- Supercritical CO_2 power cycles that operate at very extreme temperatures and pressures, but instead of steam, they use high pressure CO_2 and push it through a turbine
- Coal gasification and post-combustion carbon capture and storage/utilization technologies.

REGULATORY CONCERNS

Riordan said the mercury air toxic standard is pummeling the power industry right now. "It is creating upheaval for cost, and producers don't know whether or not to build. Public utilities want more power, but the EPA [Environmental Protection Agency] is making it difficult."

He said one reason the lights haven't gone off is the weather has been generally mild. "Additionally, the economy has been flat in some territories where the power has been cut back."

A problem for many suppliers and utilities is that states are implementing renewable standards. When they need an extra 100 megawatts, for example, a certain percentage of that portfolio must be renewable, according to many state's current requirements. However, the technology to do that is more expensive. Also, because there is no way that an economically viable coal plant can be built today, new baseload power plants will be fired with natural gas. Riordan says that may be a problem because, by 2040, a quarter of the grid may be supplied by renewables, and the other three-quarters by natural gas. "It's like having all your eggs in one basket," he said. "That is very risky."

The net effect for the power generation industry is that a brutal winter or particularly hot summer could mean times when there is not enough power for the public or for industry.

Products to maintain and repair are going to be needed, which is good for the valve industry. The need to transport natural gas means more pipelines, valves and attendant controls.

In the long term, more advanced technologies will create the need for new valves with higher temperature and pressure requirements.

DOMESTIC U.S. ECONOMY

An Area of Brightness

While the news on some fronts was not so great this year, many factors currently point in a positive direction for the domestic U.S. economy, according to Jeff Werling, executive director of Inforum, the University of Maryland. Among them are expanding employment, which will have beneficial spillovers for wages, housing and government spending. That spending is stabilizing, relieving some fiscal pressure for many states and localities currently recouping income after the Great Recession.

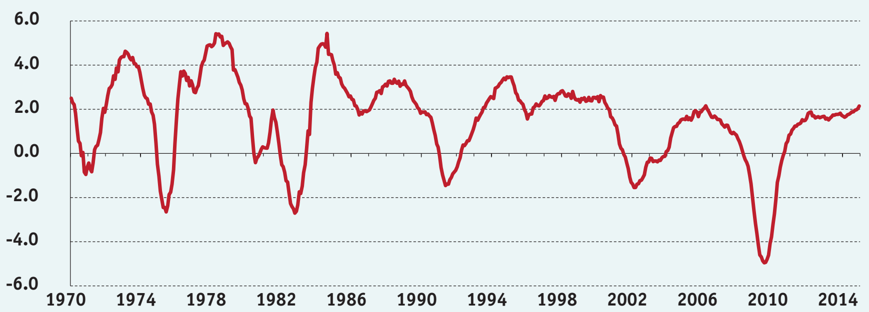
Werling used August 2015 job figures as an example: From July to August, 215,000 net new jobs were created, the unemployment rate was steady at 5.3% and average wages grew by 2.1% year over year.

Oil prices are low, and consumers are confident, he added. The relief of pressure on states and localities means growth in infrastructure spending, while health care "is growing at a fast rate," he said.

On the downside is the reality that while employment has been expanding modestly for about 60 to 70 months, "wage growth is still very sluggish. That is symptomatic of a lot of the angst about the economy," he said.

Also, while the GDP is showing steady, moderate growth, it's not where it should be—at about 3%, he said. Instead it was about 2.3% from 2014 to 2015. The growth that is occurring "is driven in large part by energy production and personal consumption. Private business is not investing in equipment and non-residential construction, despite having plenty of cash and inexpensive credit," he said.

Werling also finds it troubling that the percentage of



U.S. Nonfarm Wage and Salary Employment

Source: Bureau of Labor Statistics

growth after each recession has fallen. "In the past, non-farm employment would snap back pretty quickly. But the recent recession was huge, and we are not snapping back like we used to. In each recovery over time, you see the percentage growth has fallen," he said.

Another issue to watch is the labor force participation rate, which fell from 65.5% to 63%. "That's nearly 3% of the labor force," Werling said. While some of that can be blamed on retirements, "another factor is that, when people get laid off, they might not go back because jobs are just not that great," he said. A more troubling statistic is residual defection. "People are just not participating in the labor force for whatever reason, and it is taking out quite a bit of potential economic growth," he said.

Like Mocuta, Werling sees foreign financial problems and security issues as the biggest threat to domestic economic growth and stability. But other issues are contributing.

"We are in a unique time in macroeconomics because monetary policy, meaning the interest rate cuts, didn't stimulate the economy," he pointed out. This is because companies, banks and homeowners were all overleveraged.

"If you can't borrow, zero interest rate doesn't help," he pointed out.

The lack of inflation is also a problem. Disinflation and deflation make debt loads for governments and individuals more difficult to deal with, he said, because there is no growth to cover the debt load.

Another problem Werling sees is that governments have not been spending on infrastructure. "We were spending 10% less on infrastructure in 2012 than 2003," he said. The very short stimulus period was not enough to counteract the recession, he added.

FORECAST

- *Werling looked to 2030 and said potential GDP growth will be about 2.3%. The manufacturing outlook is challenging due to the real exchange rate.*
- *Government services will expand. Healthcare spending (with or without reform) will dominant government spending and domestic production growth, he said.*

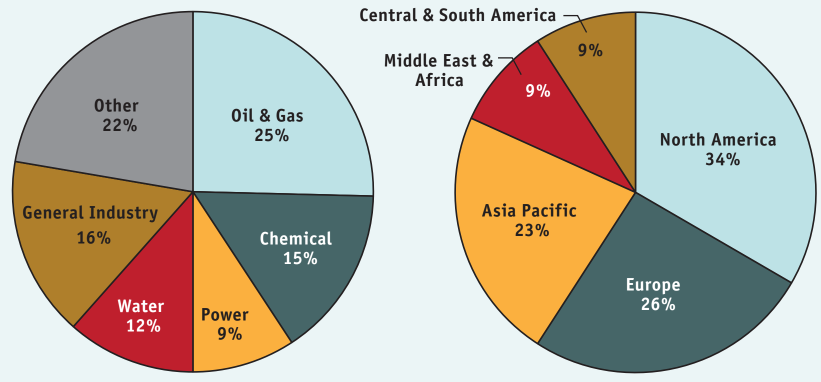
U.S. Production Growth Looks Positive

Like Medlock, Michael Halloran, senior research analyst at Baird, emphasized that he does not think shale is a dead market. However, he said that in the short- to medium-term, the market will be challenging for commodity-based businesses, including valve manufacturing.

Halloran had positive comments on the macro-economic front. He pointed out that U.S. industrial production growth has been steady since exiting the recession, even though that growth is a modest 2.5% year-over-year from the second half of 2012. Global industrial production growth, meanwhile, has moderated into a range of about 1-2% growth through early 2015.

"While most companies still anticipate positive demand trends in the U.S. for 2015, the growing global headwinds have tempered both domestic and global growth trajectory and outlook," Halloran said. He believes 2016 and 2017 will not be as strong as 2015.

Average Sales Mix for Flow Companies



Sources: Company reports, Flowserve estimates, European Industrial Forecasting, and Robert W. Baird & Co. estimates

"Capex [capital expenditures] investment started showing signs of inflection in the second half of 2013 and early 2014 as end users and equipment manufacturers gained confidence in the anticipated ramp-up of late-cycle infrastructure work," he said. However, expectations failed to materialize and conversion of projects from bidding and quoting to final orders took longer to complete than anticipated.

"This long cycle is exacerbated by recent declines in commodity prices, particularly oil," he said.

Halloran said the lower oil price environment and increased fears about the global backdrop have meant large energy infrastructure projects were put on the backburner, with end users maintaining a "wait and see" attitude.

Demand in the U.S. remains positive for the most part, Halloran said, though concerns about the trajectory of growth are building, particularly in light of an expected Federal Reserve rate hike later this year. Europe is still generally sluggish; and growth in emerging markets such as China, Brazil and Russia continues to deteriorate. Overcapacity is a key concern, he said.

Many global industrial companies are looking at flattish organic revenue in 2015 as a "good case" scenario, however. Halloran said the automotive, U.S. commercial and residential construction, and aerospace and defense industries will exhibit growth for 2015 while power and municipal water and wastewater will have a year similar to 2014. Meanwhile, general industrial, oil and gas, chemical, mining and agriculture are trending downward. His assessments:

- ***Oil and Gas:*** In the upstream oil and gas markets, rig counts have declined and an inventory of wells has been drilled but not completed. Capital spending is down as much as 30-40% in North America and 10-15% internationally. Markets for midstream and downstream are seeing spending cuts, resulting in a slowdown in orders and a number of project suspensions or postponements until 2016.

- ***Chemical Processing:*** New capacity investments are on hold because of hesitant end-user spending, although end-user demand for chemical output is stable and improving. North America is expected to be the primary driver of chemical demand.
- ***Power Generation:*** In addition to overcapacity in the industry, near-term power demand remains constrained by global economic uncertainty, delays in finalizing environmental regulations and broader market overcapacity. A material global infrastructure investment acceleration appears unlikely near term, but signs of improvement are increasing, particularly in Asia, tied to emissions control regulations. Energy-efficient solutions are at the forefront of new project work and product innovation as customers and end users look to reduce cost of ownership and save on energy usage costs.
- ***Municipal Water/Wastewater:*** Large municipal infrastructure project work has been weak for several years, but there is an encouraging pickup in capital investment spending. Break-and-fix activity levels remain solid because end users can only put off these investments for so long.
- ***Mining:*** Demand remains challenging and global mining equipment shipments continue to fall. Aftermarket activity appears steadier but is still constrained by lack of growth in the installed base.
- ***General Industrial:*** Global business investment is muted and commodity price declines have led to a capex pullback and general uncertainty in this sector. Automation is the one area in which people are spending money because it provides a return on investment.
- ***Construction:*** U.S. commercial construction is one of the primary bright spots for industrial companies, and new project work is building through 2015. Outside the U.S., emerging markets continue to be strong, but Europe remains soft, with growth still very modest. Despite more moderate than expected growth, residential construction in the U.S. continues to be positive.

FORECAST

Baird expects that in the upstream oil and gas market, softness will persist for the foreseeable future. In the chemical market, maintenance activity should improve in the second half of 2015 as turnaround activity normalizes. Capex spending growth is expected to increase slightly, to more than 4% year over year in 2015 and 2016. In construction, low- to mid-single-digit improvement in commercial construction markets is expected in 2015 with potential for acceleration in 2016.

Shrinking Differential

The large gap between oil and gas in 2013 to 2014 created a price differential that was advantageous to chemical production in North America, where natural gas is plentiful, according to Mike Eramo, vice president–Global Chemical Insights, IHS Chemical. Crude oil prices plunging has changed that.

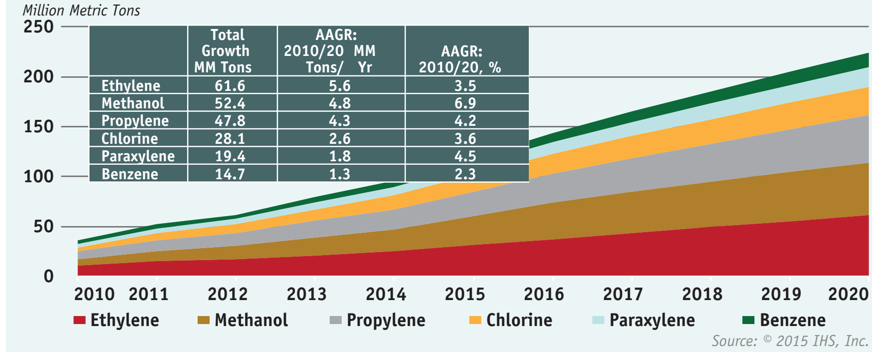
"If you're a chemical executive deciding on where to make plans for growth, this shifts the profitability," Eramo said, and it changes the price dynamics. "Approved projects are moving forward, but unapproved projects are being put on hold."

New technologies also influence decisions for plant locations and what kinds of products will be made. For example, a new process makes it possible to convert gas or coal to methanol, and another involves catalytic/oxidative coupling of methane to ethylene. These technologies affect the potential for chemical processing growth in North America, he added.

Recently, a large shift in the geographical location of petrochemical investment in China has occurred. In the past, many of the plants were in coastal provinces, and they used oil for feedstock. As oil prices rose, more development went into coal-based olefin and mono-ethylene glycol facilities, so more of the plants were moved west and inland because they were closer to coal mines. "This strong domestic investment is focused on reducing import dependencies," Eramo said. "However, these processes are huge consumers of water and require high capital investments. With the environmental and cost issues, we expect a slowdown after this current wave gets built."

In the Middle East, the investment pace has been moderate lately, but these countries are also diversifying the feed slate to support downstream market development and industrial expansion beyond ethylene chemistry.

Global Base Chemicals Cumulative Demand Growth



	Total Growth MM Tons	AAGR: 2010/20 MM Tons/ Yr	AAGR: 2010/20, %
Ethylene	61.6	5.6	3.5
Methanol	52.4	4.8	6.9
Propylene	47.8	4.3	4.2
Chlorine	28.1	2.6	3.6
Paraxylene	19.4	1.8	4.5
Benzene	14.7	1.3	2.3

Source: © 2015 IHS, Inc.

GROWTH

With a global economic growth forecast for the chemical industry of about 3.5%, that puts demand growth in this area in line with global GDP. This equates to nearly 20 million metric tons (MMT) of new demand growth each year.

The more than 60 MMT of ethylene and over 50 MMT of methanol growth that are expected during the next decade mean 40 new world-scale ethylene units and 33 new world-scale methanol units (if world-scale is 1.5 MMT).

"If North America keeps this up," Eramo said, "it might recoup some of the production manufacturing lost in years past."

FORECAST

- *Total market size by 2020 is forecast at 565 MMT of basic chemicals.*
- *Integrated margins for low-cost producers are declining while some high-cost producer margins will improve.*
- *Approved "advantaged" projects will advance in the near term, but new projects may be put on pause.*
- *Developments in on-purpose technology will impact the decision on where to build and how much is spent, which will impact valve and attendant product sales.*
- *The epicenter for change is China.*

WATER AND WASTEWATER

Upward Movement now Clearly Visible

Growth in the water and wastewater market has not been huge for some time, but Tom Decker, vice president, Brown and Caldwell, had positive news to share this year.

"Last year at this time, construction was below the line," he said. "This year it's at 10% overall growth through May," he said.

In the U.S., the water business is about $100 billion per year with wastewater taking about 65% and drinking water 35%. Globally the business is about $500 billion with wastewater taking 40-45% of that amount and fresh water 55-60%, he said.

"Even though the signs are all very positive, we are having difficulty forecasting the timing of projects," Decker told attendees. "We know there is work, but delays keep pushing things out," so figuring out when work will start is a major challenge.

AGING INFRASTRUCTURE

The American Society of Civil Engineers has given plants in the U.S. a grade of D. Loss of treated water due to leaks, cracks or breaks can be as high as 31% in places such as Atlanta, and the American Water Works Association estimates that a trillion dollars must be spent over the next 25 years simply to keep the situation no worse than it is now.

Long-term supply of water is a concern not just in areas of drought, but in many places. At the same time, conservation is taking hold, "which is good for supply, but also means revenue is down for the utilities," Decker said.

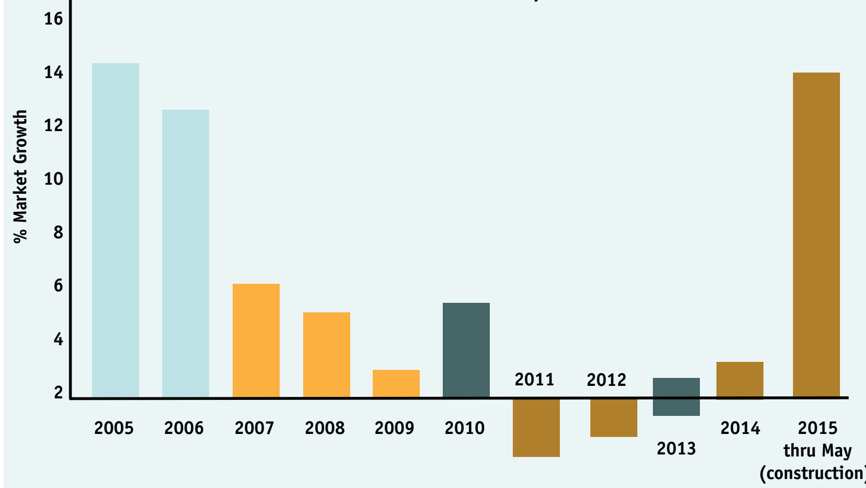
Today's world population is 7 billion people with 60% living in cities; by 2050 the population will be 9.5 billion with more than 70% living in cities.

"This is putting stress, strain and capacity problems on water delivery and wastewater systems," he said.

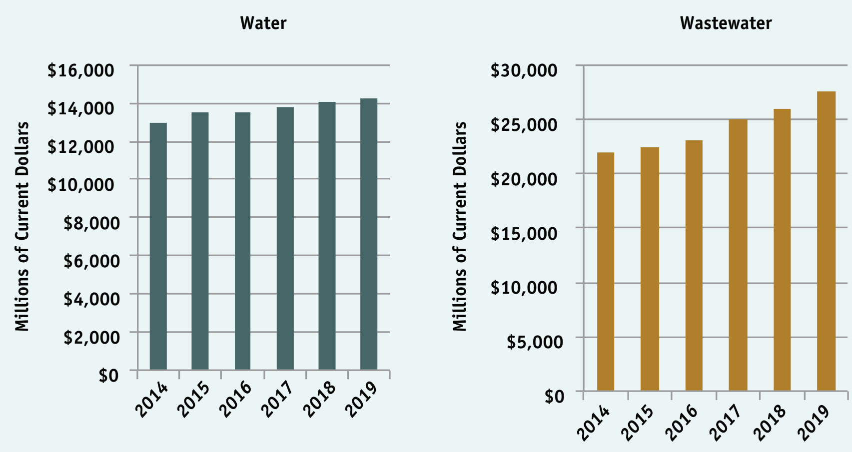
In the U.S., the fact the EPA is enforcing existing regulations is "a major driver on the wastewater side and probably the biggest single reason for the fact that 65% of money spent on water projects in the U.S. is on wastewater," said Decker.

One issue that the water industry faces is getting funding when revenue is down. But while public apathy (out of sight, out of mind) exists, "when you have an initiative or bond issue, the public generally supports infrastructure-related bonds," Decker said.

Desalination and reuse is increasing around the country. In Texas, for example, even though a recent drought is now officially over, the state is moving forward with a massive water plan with funding that could go as high as $27 billion. Both Texas and California have plans for desalination and reuse plants.



Source: Brown and Caldwell



Source: FMI Corp.

FORECAST

- *The water and wastewater market will be up 3-4% in 2015 with a similar bump in 2016.*
- *There likely will be some water regulations coming up in 2016 on disinfection and lead and copper, but they will not be as comprehensive as the Safe Drinking or Clean Water acts.*
- *Housing starts, which have a positive effect on water/wastewater, are expected to be up 19% in 2015 over 2014.*
- *Over the next 10 years, there will be a 60-70% increase in reuse programs.*

Hazards in Chlorine Piping and the History of a Solution

BY MARK FUCICH

North America relies on chlorine for many industrial processes and for making the ingredients that go into many of the nation's chemicals. But using it carries a certain amount of risk. Among the solutions for handling those risks is the bellows seal metal-seated globe valve. This article outlines the hazards and how this solution was born.

Executive Summary

SUBJECT: Bellows seal metal-seated globe valves provide advantages for applications that must address the dangers in moving chlorine through a process.

KEY ISSUES:

- Where chlorine is used
- Risks in chlorine processes
- How a solution developed

TAKE-AWAY: Although these valves got their start in Europe, they are growing rapidly in use in North America.

CHLORINE USES

About 13.6 million metric tons of chlorine is produced every year in North America with the greatest volume (40%) going into the production of polyvinyl chloride (PVC). PVC is a low-cost, versatile plastic used to construct everything from water pipes and home siding to appliance parts and food storage containers. Another 37% of chlorine produced in North America is used in other organic compounds, including basic chemicals needed for manufacturing, and solvents for metalworking, dry cleaning and electronics. About 4% is used for water treatment, and other, inorganic uses include producing hydrochloric acid for chemical processes and for making titanium dioxide, a popular white pigment.

SPECIFIC HAZARDS

Among the risks of using chlorine are:

Hydrogen: Hydrogen (H_2) is a co-product of all chlorine manufactured by the electrolysis of aqueous brine solutions. Mixtures of chlorine and hydrogen are flammable and potentially explosive within a certain concentration range. The negative reaction of this mixing can be initiated by direct sunlight, other sources of ultraviolet light, static electricity or sharp impact.

Nitrogen Trichloride: Small quantities of nitrogen trichloride, an unstable and highly explosive compound, can be produced in making chlorine. When liquid chlorine containing nitrogen trichloride is evaporated, the nitrogen trichloride may come to hazardous concentrations in the residue.

Oil and Grease: Chlorine can react, sometimes explosively, with a number of organic materials, including oil and grease, which may come from sources such as air compressors, valves, pumps, oil-diaphragm instrumentation or pipe thread lubricants. Equipment and piping using chlorine must be cleaned to remove this oil and grease. Non-reactive lubricants can help.

Fire: Chlorine itself is neither explosive nor flammable, but it will support combustion under certain conditions. Many materials that burn in oxygen (air) atmospheres will also burn in chlorine atmospheres.

Chemical Action/Reactions: Chlorine has a strong affinity for reacting to many substances. It will react with both inorganic and organic compounds, usually triggered by the evolution of heat. Chlorine reacts with some metals, for example, under a variety of conditions. Chlorine will react with steel and other metals at temperatures above 300°F (149°C). For these reasons, welding piping and other equipment without properly evacuating and purging chlorine from the equipment is avoided at all cost. It is also vital to avoid using any titanium in dry chlorine service.

Corrosive Action on Steel: At ambient temperatures, dry chlorine, either liquid or gas, does not corrode steel. Wet chlorine is highly corrosive, however, because it forms hydrochloric and hypochlorous acids. To avoid this, precautions should be taken to keep chlorine and chlorine equipment dry. Piping, valves and containers should be closed or capped when not in use to keep out atmospheric moisture such as precipitation or humidity. Also, materials of construction must be chosen carefully, depending on the expected conditions. If water is used on a chlorine leak situation, for example, the resulting corrosive conditions will make the leak worse.

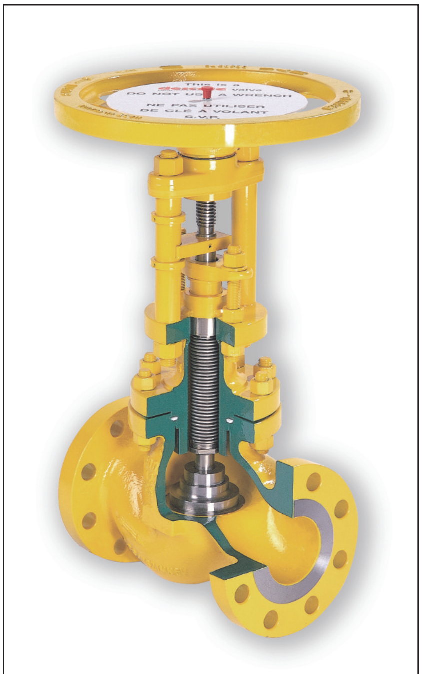


Figure 1. Bellows seal globe valve

Volumetric Expansion: The volume of liquid chlorine increases with temperature. Precautions should be taken to avoid hydrostatic rupture of piping, vessels, containers or other equipment that is filled with liquid chlorine. Any time liquid chlorine can be trapped between two valves, an expansion device should be in place.

Auto-Refrigeration: When a chlorine container is punctured and chlorine is released, it initially will escape rapidly. However, as the chlorine is released, the container that was under pressure will attempt to equalize in pressure with the atmosphere. Once the liquid level drains below the puncture point, auto-refrigeration takes place and the rate of release will significantly decrease, although there still is a considerable amount of liquid chlorine remaining in the container.

LIQUID FORM

Liquid chlorine is a challenging application for valves because of these factors:

Hydroscopic: This condition is the ability of a substance to attract and hold water molecules from the surrounding environment. When the water content in liquid dry chlorine is greater than 50 parts per million (ppm), hydrochloric acid (HCL) and ferric chlorides (CL_3Fe) are formed. HCL is highly corrosive and damaging to piping systems made of carbon steel. In addition, CL_3F_3 scale can be problematic for seating surfaces made of Teflon.

Toxic by Inhalation (TIH): Liquid chlorine is classified as a TIH. To put this in perspective:

- One pound of liquid chlorine will create a lethal chlorine gas cloud equal to 6,440 cubic feet.
- 1000 ppm can be fatal (that equates to two deep breaths).

This illustrates the criticality of this chemical and the need to keep it inside a valve with no leaks from packing, body bonnet joint and castings.

Fire: Liquid and gas chlorine reacts with hydrocarbon-based lubricants, sometimes explosively. Valves must be cleaned and prepared for chlorine service. In addition, proper packaging for transport and storage is imperative. The norm for bellows seal globe valve makers and authorized repair shops is to ship valves with the gasket plus metal blind flanges that have studs and nuts.

Dual Phase Flow: Dual phase flow causes flashing and cavitation so it is problematic for valves because of the energy generated inside the valve that damages trim and stems. When applications involve any throttle, it is critical that end users communicate with valve manufacturers on potential issues. Opportunities exist here for bellows seal globe valve manufacturers to provide contoured discs or an open bonnet design.

BELLOWS SEAL GLOBE VALVES

In 1974 Dr. Roger Papp, engineering manager for UGINE KUHLMAN (now Arkema) asked a valve maker to design and build a bellows seal globe

THE ADVANTAGES

The reasons bellows seal metal-seated globe valves are becoming commonplace in chlorine applications are:

- The bellows seal design eliminates packing leaks by offering a metal barrier between the process and the packing (Figure 2). The HC 276 bellows allows the stem to move up and down acting as an expansion joint. Typically, the bellows are multi-ply with a guarantee of 10,000 cycles at maximum pressure and temperature for the ANSI class.
- Metal seats made of Stellite or HC 276 provide tighter shut-off over time because the sharp edges and hard surfaces cut through without damaging the ferric chloride scale, which does typically cut the soft seats in plug and ball valves (Figure 3).
- Level II castings, which are standard because of the Euro Chlor specifications, deliver confidence to chlorine producers and consumers in North America that the process can be contained.
- Quality trained valve repair companies have driven the total cost of ownership to less than a ball or plug because of the long-lasting castings. It is not uncommon to see valves 30 years old that continue to be rebuilt.
- These valves have several safety benefits including bi-direction vs. quarter turn with vented plug or ball, which makes them single-directional. Also, some manufacturers provide needle roller bearings in the yoke assembly as a standard. This allows for much lower torque output than traditional quarter-turn valves, resulting in fewer injuries for operations personnel.

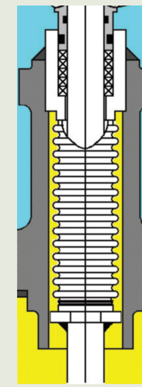


Figure 2. Cross section of bellows-seal design

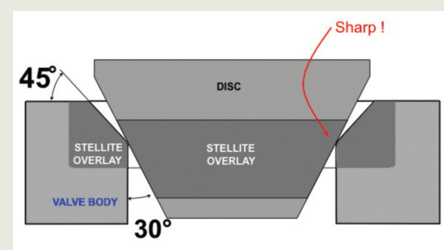


Figure 3. Seat/disc geometry

valve for two halogen services, which included chlorine and fluorine, from the ground up. Before this, valve manufacturers just changed the metallurgy on commodity valves for those services. Papp selected a small valve manufacturing plant in central France to execute his vision.

Today, what was created is reflected in what is globally recognized as the Euro Chlor Standards. Although Euro Chlor standards are also recognized in the United States, especially by multinational firms, the Chlorine Institute and its guidelines are widely used here as well.

The standards include:

- GEST 06/318 – (Flanged Bellows Seal Globe Valves) – Requirements and Design for Use on Liquid Chlorine (42 pages)
- GEST 86/128 – Procedure for Approval of Process Valves for Use on Liquid Chlorine (14 pages)
- GEST 86/129 – Procedure for an Independent Assessment of Process Valves for Use on Liquid Chlorine, Prior to Consideration for Euro Chlor Approval (19 pages)
- GEST 96/220 – Specification for Weld Repairs during Manufacturing of Cast Valves for Liquid and Dry Gaseous Chlorine (10 pages)

To this date, the Euro Chlor membership does not recognize quarter-turn soft-seated plug and ball valves for liquid dry chlorine.

The Chlorine Institute sets safety guidelines for chlorine producers and consumers in the U.S. and Canada. Pamphlet 6 provides the guidelines for piping systems for liquid and gas chlorine.

In the mid-1960s, conventional gland-packed commodity globe valves were used in North America as primary isolation valves at chlorine-producing and consuming sites. To ensure durability, ANSI Class 600-pound valves were installed even when the application only required ANSI Class 300-pound. The trim was historically all Monel. At this point in time, Stellite was not widely accepted for industrial uses.

Starting in the mid-to-late 1960s, all new construction for chlorine production made a switch to quarter-turn ball and plug valves with Teflon seats. The switch was made because:

- The valves require less low torque to operate than rising stem valves.
- The initial purchase price is lower than rising stem valves.

Monel was the material choice for ball valves and stems. Because liquid chlorine could be trapped inside the

The Chlorine Institute sets safety guidelines for chlorine producers and consumers in the U.S. and Canada.

ball or plug when in the closed position, the downstream-side of the ball or plug had to be drilled for venting.

An interesting note is that one ball valve maker made an ANSI 300-pound valve in a short pattern. It was a great marketing idea because no other company made one. When the valves failed, the user was forced to replace them with the same brand.

In the mid-1980s, the Euro-Zone makers of bellows seal globe valves that were Euro Chlor-approved came to the U.S. looking for market growth. They quickly found out that here, only chlorine producers and consumer sites built before the mid-1960s had ANSI 300-pound and ANSI 600-pound globe valves. The new valves were welcomed and very quickly replaced the commodity globe valves as they were needed for maintenance, repair and operations.

More than 70% of potential users had quarter-turn balls and plugs in place. The problem for the bellows seal globe valve makers then was the 300-pound ball and plug face-to-face was shorter than the 300-pound globe. Meanwhile, the producers and consumers of chlorine were not willing to cut pipe so they could install globe valves. For example, a 2-inch, 300-pound ANSI globe valve face to face is 10-and-a-half inches and a 2-inch, 300-pound ANSI ball and plug valve is eight-and-a-half inches.

Because of this, Euro-Zone makers of bellows seal globe valves in the late 1980s made new patterns for a 300-pound globe valve with a ball and plug valve face to face.

Because of superior performance and lower cost of ownership (see sidebar), bellows seal metal-seated globe valves are growing rapidly in use. From the early 1990s to present, bellows seal globe valves have come to represent 55-70% of the market share for the current installed base. VM

Mark Fucich is president of FCTech, a distributor for descote s.a.s (www.descote.com). Reach him at mfucich@fctechusa.com.

WHERE VALVES ARE USED

American Electric Power's 600-megawatt John W. Turk, Jr. Power Plant in Arkansas, which went into operation in 2012, was the first plant in the United States to use ultra-supercritical coal combustion technology. The plant generates electricity more efficiently at higher temperatures, requires less coal and produces fewer emissions to generate the same amount of power as existing coal units.

Power Plant Isolation Valves Beat the Heat

BY GREG JOHNSON

About a century ago, pressures of 300 psi and temperatures of 400°F (204°C) were normal for steam power plants. The next 50 years would see constantly rising pressures and temperatures as the quest for higher efficiency proceeded. By the end of the 1950s, temperatures approached 1200°F (648°C) and pressures above 4,000 psi were benchmarks for generating steam power in the supercritical (SC) range. As these new benchmarks have been achieved, the design of isolation valves used in these plants has changed, from cast iron T-pattern globe valves to 9 chrome pressure seal gate valves.

The SC range is defined today as pressures between 3,553 psi and 4,133 psi and corresponding temperatures between 1004°F (540°C) and 1076°F (580°C). The reason these pressures and temperatures are so important is that supercritical water has a lower density and a higher motility (the molecules move more freely), which enable more efficient transfer.

These SC ranges are common in today's power generation, and plants are now climbing to higher levels of pressure and temperature in a quest for even higher efficiency. A new pinnacle called ultra-supercritical (USC) is becoming more common. The difference in performance (heat output) between a SC and a USC plant is about 5-8%, which seems like a low number. But in the power industry, those percentages are significant.

Executive Summary

SUBJECT: Supercritical and ultra-supercritical are the most efficient new technologies for meeting increased power needs in the world. They present special materials and design issues for valves and other equipment.

KEY ISSUES:

- Pressure and temperature challenges
- What valves are used
- Materials and design considerations
- Where the U.S. is headed

TAKE-AWAY: The U.S. needs to catch up with the rest of the world in embracing the new technologies.

Currently, there is only one commercially operating USC plant in the United States—The John W. Turk, Jr. Power Plant in Fulton, AK. Turk came online in 2012 and so far, it has been a great success.

What all this means to valve manufacturers and plant owners is they are now dealing with old designs and materials that will not perform as required in these new power plant environments. The biggest challenge will be the need for acceptable high temperature materials of construction.

PEAK PLANT PROBLEMS

Beyond the challenges of temperatures and pressures lies an additional obstacle in the way of increased operating efficiencies—peaking power plant operation. In years past, almost all power plants were always in operation (we refer to them today as "base load" plants). In other worlds, base load plants were like the main electrical service to homes—always "on." In contrast, a peaking plant only runs when needed (like a switched-on light in a room), usually at peak times of the day or peak months of the year. As long as a plant is operating at constant temperatures and pressures, the potentially damaging effects of radical temperature and pressure changes on components are not an issue. In a peaking plant, however, temperatures may oscillate by 500°F (260°C) every day. This periodic temperature variance, on top of up and down pressure levels, is very hard on the equipment, including the valves, which are expected to last 30 years or more.

To meet the isolation valve requirements in these plants, legacy valve types as well as newer designs are employed. Gate valves are still popular, but Y-pattern globes have taken a share of the business. The metal-seated ball valve has also taken some of the market. Even high-performance, metal-seated butterfly valves are being tried for certain applications.

For gate, globe and check valves to meet SC and USC requirements, pressure-seal bonnets should be demanded. Bolted bonnet in Class 2500 above designs are cost-prohibitive, and creep of the bonnet bolting can pose problems.

GATE VALVES

Gate valves in high-pressure steam service are still popular. Their biggest advantage here is the very low pressure drop through the open valve, a pressure drop almost equal to straight pipe. Gate valves do present a few drawbacks in that they generally have more operability problems, a higher leakage rate than globe valves, a tendency to trap fluid in the bonnet, and they are more difficult to repair in-sutu.

Various gate valve wedge designs are used in high-pressure steam service, and each has pros and cons. The solid wedge is the only viable type for small diameter (less than an inch-and-a-half) valves. Larger, solid disc valves can jam in the body as a result of temperature changes during heat-up and cool-down.

Split Wedge

Split wedge designs (where the wedge is comprised of two separate pieces) tolerate line loads and temperature transients more easily by allowing each wedge piece to align with its matching seat. This feature is used in larger gate valves to overcome thermal binding problems. Because of the increased seating integrity of this design, both wedge pieces can simultaneously seat, which can result in locking potentially damaging fluid pressure into the body cavity. The split wedge design is also easier to repair than solid-wedge or many flex-wedge designs.

Flexible Wedge

Flexible wedge designs offer many of the same features as split wedge designs. Their flexibility allows expansion and contraction of the wedge and prevention of temperature locking into the valve body. The flexible wedge designs are easier to repair than solid wedge designs. A disadvantage of the flexible seating, however, is that inadvertent upstream and downstream seating can result in fluid pressure locked in the body cavity.

Parallel-Expanding Wedge

Parallel-expanding wedge designs are more complex in design, but offer several advantages over wedge-type designs. For one thing, when opening and closing the wedge, faces do not contact the seating surfaces. Only when the valve is closed do the wedge assemblies slide away from each other and form a seal on both the upstream and downstream body seats. This means prevention of unwanted contact between sealing surfaces as the valve opens and closes. Because of the seat design's potential to cause bi-directional sealing, internal body cavity fluid pressure can be locked in the valve.

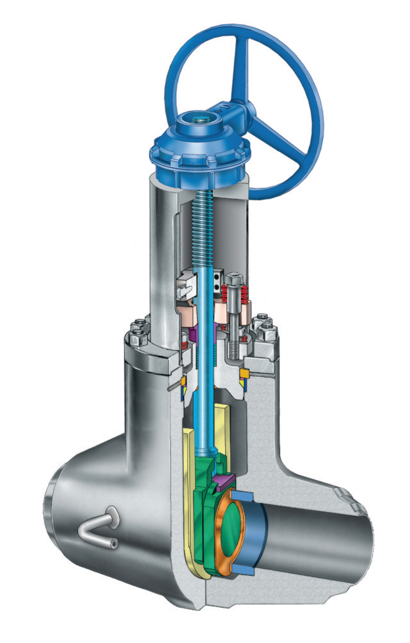


Figure 1. A pressure seal parallel slide gate valve

Parallel Slide Double-Disc

The parallel slide double-disc gate, also called a parallel expanding double-disc gate, is constructed in two pieces with each piece floating independently and mating to its requisite body seat (Figure 1). The wedge sections are preloaded using springs. This design provides much better immunity from thermal locking. Parallel slide double-disc designs can only provide unidirectional sealing, however. They are also most effective in larger sizes and in applications where there is adequate differential pressure across the sealing surfaces.

GATE VALVE PORT SIZING

In subcritical power plant applications, as well as in most petrochemical and refining installations, valves are sized at B16.34. These designated dimensions are generalizations and do not take velocity of flow, pressure drop or noise into consideration. In the case of SC and USC applications, valve port (seat sizing) is critical. With pressures of over 3,500 psi, fluid velocity and related pressure drop through the valve can be damaging and dangerous.

A side effect of high velocity is noise, which requires abatement when the plant is located near the general public. In the United States, no federal noise abatement requirements have been made for power plants. However, the European Union (EU) has stringent requirements, which are listed in the EU Environmental Health and Safety Guidelines. Those guidelines allow no more than 60 weighted decibels (dba) during the day and 45 dba at night, which are measured half a kilometer (a third of a mile) from the sound source.

Part of the issue in port size is glossed over by using the term "full port," a term that in piping parlance can be ambiguous at best and useless at worst. Considering the fact some newer piping materials are much stronger (which means higher allowable stresses), but also have thinner walls and larger inner diameters (IDs), the relationship between full-port B16.34 dimensions and the actual matching pipe ID may be very different.

From a valve performance standpoint, this can mean larger port (seat opening) sizes so they can handle higher velocities, lower pressure drops and lower decibel levels. However, overkill is not good. Larger-than-required valve ports mean larger actuators with a resulting higher cost. Oversized ports also can lead to flow issues that adversely affect nearby check valves.

India's National Thermal Power Corporation does not recommend valve port sizes to valve vendors, but it does specify maximum allowable velocities and maximum pressure drops. This is an idea that U.S. power plant design engineers may need to consider.

BODY CAVITY PRESSURE RELIEF

All of the gate valve designs that suffer from unwanted body cavity pressure buildup can be modified to alleviate the potential problem of body cavity pressure. Modifications include:

1) Adding external bypasses to vent the pressure either upstream or downstream, 2) Drilling a hole in the upstream side of the disc, 3) Adding a pressure relief valve to the body, and 4) Incorporating an internal bypass design.

GLOBE & BALL VALVES

Although the globe valve is known primarily as a throttling or control valve, they also are used extensively in block valve applications for power plants. The primary globe design used in isolation service is the Y-pattern (Figure 2). The Y-pattern body is designed to reduce the flow resistance of the globe valve, which on a standard T-pattern design is extreme. Globe valves have fewer operability problems compared to gate valves. Globe valves also normally provide excellent leak tightness. They are usually installed so that flow is from under the disc. Because of the design of the globe, which pushes directly on to the flow, larger actuators are required.

Even though the Y-pattern globe valve has a better flow rate than the standard T-pattern globe, it is no match for the gate valve in terms of pressure drop, cavitation prevention and velocity through the valve.

The use of ball valves in power plant isolation service is limited to metal-seated designs. Because these are non-trunion types, the full force of the flow is directed onto the ball when in the closed position. This means these valves are limited to smaller sizes and often have reduced ports to lower the required closure torque. The reduced port design creates a change in the Cv of the valve because of pressure loss and a higher exit velocity. For

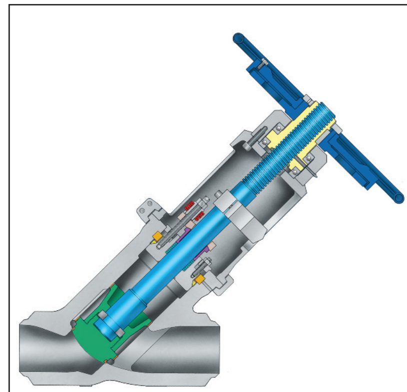


Figure 2. Y-pattern pressure seal globe valve

vents and drains seldom operated, this is not a problem; but for continuous process applications, service issues arise.

Table 1. Materials used in SC and USC plants

Material	Chemistry	Temperature range
F91	Super 9 Cr Mo	1100°F (593°C) maximum
F92	9 Cr Mo V Nb	1147°F (619°C) maximum
C12A	9 Cr Mo casting	1200°F (649°C) maximum
Inconel 617B	High nickel alloy	1291°F (699°C) and higher
Inconel 740H	High nickel alloy	1291° and higher

MATERIAL SELECTION AND CREEP

For elevated-temperature, high-performance valves, the selection of materials is critical. Materials of construction must meet the demands of constant high temperature use, while under tremendous stress from the high internal pressures. Several mechanical properties come into play when selecting a metal. They include tensile strength, yield strength and ductility. While these are all very important, an additional property becomes critical under these conditions: creep resistance.

To understand what creep is, we need to look at the property of yield strength in steels. If a load that is slightly less than the elastic limit is applied at room temperature, the steel elongates, and when the load is removed, it will return to its original length or shape. This elastic behavior will continue regardless of the number of loadings made on the component. If, however, an identical piece of steel is heated to slightly elevated temperatures and a load is applied, after a length of time, the specimen may assume a permanent deformation even though the applied load is below the elastic limit at room temperature. This phenomena is called creep, and it can result in catastrophic failures of metallic components.

Consider body-bonnet bolting as an example. Creep can mean the bolts relax and lose their load, which means the body/bonnet could leak. To test the tendency of a metal to creep under given conditions, a specimen is held under constant temperature and subjected to a constant tensile load for a suitable length of time. The load causes the specimen to elongate gradually. This elongation is then measured over a period of hours, days, weeks, months or years. From these tests, the creep behavior of a particular metal can be determined.

Some of the newer materials used in SC and USC power plant valves are shown in Table 1 above.

DESIGN STANDARDS ARE KEY

The working pressures at various temperatures of most metals used in valve pressure boundary construction are listed in the American Society of Mechanical Engineers (ASME) document B16.34, Valves Flanged, Threaded and Welding End. The tables in B16.34 also take into account the creep resistance of particular steels. To meet the requirements for USC power plants, new materials have been added to the B16.34 document, while other B16.34 code-case listed metals are also being considered. Austenitic stainless steels such as 304ss and 347ss can meet very high temperature requirements (especially in the high carbon "H" grades), and the section thickness would be much greater because of the lower strength of these materials.

The problem with relying solely on B16.34, the traditional standard for power plant valve design, is the basis of the calculations as well as some of the listed specifications, such as wall thickness. Looking at the history of the document provides insight into why that is. Shortly after World War II, data was gathered on valve design, and wall thickness calculations were developed. Much of this research was done in the Crane R&D facilities in Chicago.

The initial result of that research led to the creation of the Manufacturers Standardization Society (MSS) SP-66, Pressure-Temperature Ratings for Butt-Welding End Valves, in 1964. The aim of the B16.34 document, which was first published in 1974, was standardization of sizes and basic dimensions to increase manufacturing production while maintaining a conservative safety margin. This was a boon to manufacturers because it allowed common dies and patterns to be used for valves of different materials. The area of wall thickness, with its one-size fits every-material approach, is an example. However, that example unfortunately does not fit well into today's power plant design process.

As a result of the poor fit of the B16.34 document for SC and USC power plant valves, designers have looked to different valve design standards. The most important of these is the European standard EN 12516-2, Shell Design Strength. This document has become the first reference for SC and USC valve designs using the newer, high-strength/high-temperature materials because of its calculation methods and formulas (which are different from B16.34).

AN EXPERT OPINION

One of most prominent leaders in SC and USC valve design, Rana Bose, president of Rana Bose & Associates, feels strongly that this newer type of design requires an integrated approach.

Since 2012 John W. Turk Power Plant has been providing clean, economical power to the region as well as being a valuable test bed for USC power production.

"Valve specifications must take into account the heart of valve design concepts such as seat bore and its interactivity with high velocity, pressure drop and noise control requirements," Bose reports. "Newer valve materials necessitate a fresh look at design concepts that are more responsive to thermal cycling operations, peaking plants and thermal distribution in sealing areas," he adds.

PROPER WELDING

No matter which alloys are chosen for valve components, coincident welding and post-weld heat treatment (PWHT) issues must be overcome because all of the valves will be welding-end or socket-weld designs. Welding engineers disagree on the correct procedure for PWHT on C12A material, as well as how best to handle some of the more complicated, newer materials. In some cases, pipe also may be a different material than the buttweld end valve. This requires the use of suitable dissimilar welding filler materials and welding procedures and may mean possible complications with in situ, PWHT procedures.

Another problem that can arise in SC and USC valve applications is the oxidation of graphite-based packings at very high plant operating temperatures. Graphite packings are said to oxidize at 1200°F (649°C). This may require newer packing designs or fins around the packing area to dissipate the heat.

GETTING THERE FROM HERE

In the U.S., nuclear has become a no-no and traditional coal-fired plants are viewed as evil. At the same time, the nation's power consumption will only rise. To achieve higher power generation efficiencies and reduce emissions of environmentally damaging gases, new technologies must be embraced.

In many other areas of the world, including India and China, SC and USC plants are already very popular. Since our country resides on the same planet as all the rest of the world, it's to our advantage to retire even more of our inefficient coal-powered plants and replace them with much more efficient USC facilities. The Department of Energy has invested in pilot plants in the United States, but we are still behind other countries in employing this technology. Part of the reason is slowness in solving some of the challenging materials issues. Another issue is the anchor that the government attaches to any new power plant project. For example, it currently takes six to seven years to license a new natural gas power plant.

One factor is certain, however: North American valve manufacturing companies will be at the forefront of matching safe, functional valve designs with the needs of emerging power plant technologies. VM

A special thank you goes to Rana Bose, who provided not only comments, but valuable research information for this article.

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

A Beginner's Guide to the Right Actuator (Consider the Valve!)

BY CHRIS WARNETT

A valve, in its most basic form, consists of a body and an internal moving component (closure element), which shuts off or restricts flow through the valve. To automate that valve, an actuator is added. The best way to understand valve actuation, however, is to begin by exploring the valves they will drive.

There are many types of valves in the industrial world, which are categorized by type, industry, size, pressure class or one of many other considerations. Which actuator is needed for automation, however, really depends on four basic parameters: motion, force, speed and frequency of operation.

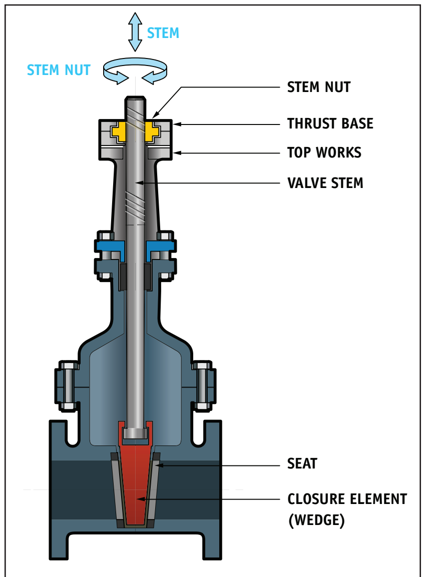


Figure 1. Rising non-rotating stem valve, gate valve

MOTION

Classifying valves by the first parameter, motion, means looking at some distinct differences in valve design:

Linear valves

Valves with a closure element that requires linear movement can use a fluid power linear cylinder or a diaphragm coupled to a smooth stem. Alternatively, a multi-turn actuator with an electric or fluid power motor could be used to drive a threaded stem.

Valves with a linear motion on the closure element need a rotary-to-linear conversion mechanism to allow them to be automated by multi-turn actuators. This conversion mechanism is described using one of these three categories of valve stem designation: 1) rising non-rotating stem, 2) rotating non-rising stem, or 3) rising rotating stem.

The rising non-rotating stem valve (Figure 1) is typically a gate valve that has a fixed threaded stem. A matching threaded nut in the actuator (the stem nut), when rotated, will move the stem up or down. The stem is connected to the disc or plug (closure element) in the valve and the actuator can open or close the valve by rotating the stem nut in a clockwise or counterclockwise direction. Because the stem nut is located in the actuator assembly, the thrust of the valve is also contained in the actuator, usually in the base of the unit.

The rotating non-rising stem valve (Figure 2) works on a similar principle to the rising non-rotating stem valve, but has the stem nut located in the closure element of the valve. This is more complex because the valve design has to allow for the length of the threaded stem to fit inside the closure element as it travels to the open position. The valve thrust is contained in a thrust bearing in the valve top works.

The rising rotating stem (Figure 3) is a hybrid of the previous designs. The stem nut is located in the top of the valve, so as the stem is rotated, it raises or lowers the closure element. The actuator is coupled to the valve stem with a sliding spline or "butterfly" nut arrangement. Typically the thrust of the valve is contained by the top works of the valve.

Although the closure element moves in a linear fashion, the actuator output is rotary. The movement is converted from a rotary motion to a linear motion by the stem nut.

For valves with no linear-to-rotary conversion mechanism, a linear output actuator is needed to achieve the required motion. The most common of this type are pneumatic linear actuators used to operate process control valves (Figure 4).

Part-turn valves

Most part-turn valves require a quarter turn of the valve stem to move from closed to open and vice-versa. This

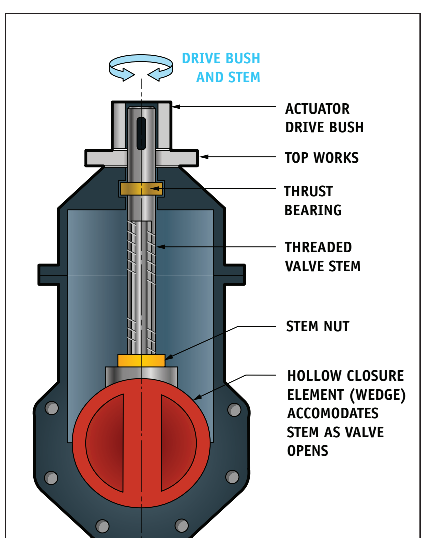


Figure 2. Rotating non-rising stem, gate valve

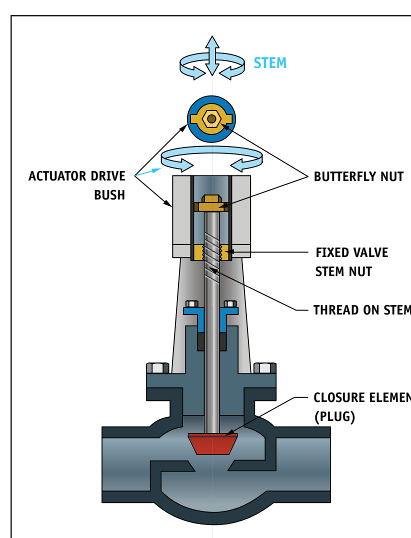


Figure 3. Rising rotating stem, globe valve

IMAGE COURTESY OF RICHARDS INDUSTRIES

Figure 4. Linear output, spring diaphragm pneumatic actuator on a sliding stem valve.

IMAGE COURTESY OF CIRCOR ENERGY

Figure 5. Resilient seated butterfly valve.

IMAGE COURTESY OF CIRCOR ENERGY

Figure 6. Ball valve

type of valve, having a standard movement of 90 degrees, allows use of an actuator with a known travel distance. The closure element on the quarter-turn valve could be a disc (butterfly valve), a sphere (ball valve), the frustum of a cone (tapered plug), or a variation or combination of these types (Figures 5 and 6).

FORCE

The force required to move the valve through its range of motion is critical in selecting an actuator. In the case of sliding stem valves (Figure 7), this force would be a linear push or pull. For multi-turn or part-turn valves, a rotary force or torque is required.

The torque (Figure 8) required to operate a valve usually varies with the size of the valve, the valve design and the differential pressure across the valve. Typically, it is this differential pressure in the closed position that creates the greatest force requirement of the valve, which is the force required to open the valve.

The larger the valve closure element, the larger the force on the seats. For some valves, such as gate and globe valves, this force can be calculated and a reasonable estimate of the valve force demand can be made for sizing the actuator.

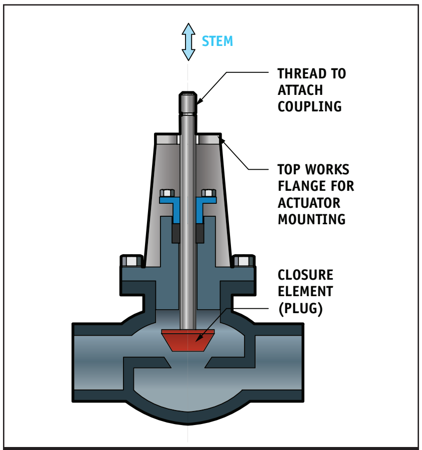


Figure 7. Sliding stem valve

Other considerations are stem packing friction, the media temperature and the mechanical characteristics of the valve and valve stem.

For quarter-turn valves, however, it is not possible to independently calculate the torque demand of the valve with accuracy. This has to be done by physical measurement of each valve size under the various differential pressure conditions.

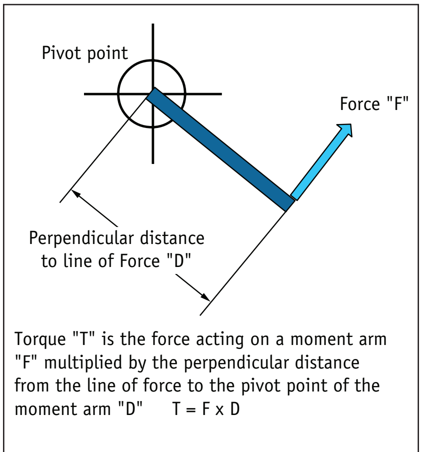


Figure 8. Rotary force measurement, torque

Several types and designs of actuator are needed to cover the full range of output force required for covering the spectrum of valve sizes and pressure classes. The greater the valve torque demand, the larger the actuator and the more costly.

SPEED

The speed of operation required by a valve application defines what power is needed from the actuator.

Power is defined as work done during a specific time frame. The work done by an actuator is the force demanded by the valve multiplied by the distance over which that force has to be applied (the valve travel). If this work has to be done over one minute, for example, then the power needed would be twice as much as that needed to operate the same valve over two minutes.

For electric actuators, this is a critical parameter because it dictates the motor power. For fluid power actuators, this parameter impacts the size of the supply and exhaust lines as well as the direction control valve sizing. In both cases, cost is significantly impacted, as is the physical size of the actuator.

FREQUENCY OF MOVEMENT

The preceding valve demand criteria dictates the needed output motion, force output and power of the actuator. The required frequency of operation has a direct impact on the durability of the mechanical drive and robustness of the controller (Figure 9).

Isolating or regulating duty valves and actuators usually only need to operate infrequently. As a result, little wear on mechanical components and controls occurs.

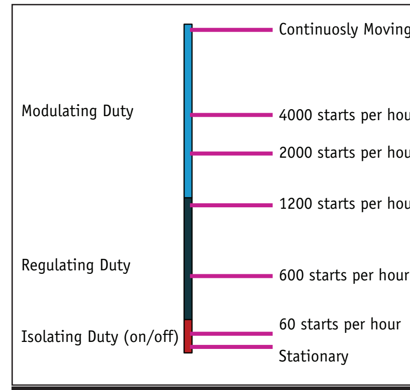


Figure 9. Frequency of operation chart

Modulating process valves, however, may operate constantly. This requires a degree of resistance to wear on the valve and actuator assembly. For this reason, it's important that modulating requirements are factored into the actuator selection. Not only is greater mechanical wear on the drive train possible, but also the controls must be capable of constant change without overheating or failing.

Many subjective opinions have been made on the definition of modulating and regulating duty. However, the industry has adopted milestones of 60 and 1200 starts per hour for actuator capability. Figure 9 attaches some general nomenclature to those start frequencies.

This column is only a brief description of the key parameters of a valve that must be considered when choosing an actuator. In reality, there are many other options that need to be defined when selecting the appropriate actuator for a valve and its application. These topics are covered in more detail in the book "Valve Actuators" (see below). VM

Chris Warnett is currently the principal of CPLloyd Consulting Inc. (www.cplloydconsulting.com.), which provides marketing and applications expertise for the valve automation industry and its customers. He has over 37 years of engineering, sales and marketing experience in valve automation.

This column is excerpted from Warnett's soon-to-be released book, "Valve Actuators: A Comprehensive Introduction to the Design, Selection, Sizing and Application of Valve and Damper Actuators." For information on where to obtain the book, visit the home page of CPLloyd Consulting or contact him at chris@cplloydconsulting.com; Tel 01 585 298 6239.

Q: Is it possible to produce remanufactured cast valve bodies that comply with NACE MR0175/ISO 15156 and NACE MR0103?

BY DON BUSH

A: For most common cast materials, the simple answer to this question is "No," but that answer deserves explanation. Let's start by comparing the legacy NACE standard MR0175 version 2002 (and previous versions) with the current version (NACE MR0175/ISO 15156) and NACE MR0103.

NACE MR0175-2002 contained little control for welding. The general requirements were specified as follows:

> *"5.3.1 Welding procedures shall be used to produce weldments that comply with the hardness requirements specified for the base metal in Sections 3 and 4. Welding procedures shall be qualified according to AWS, API, ASME, or other appropriate industry codes. Welders using this procedure shall be familiar with the procedure and shall be capable of making welds that comply with the procedure."* [1]

The paragraph specifically covering welding of carbon steels indicated:

> *"5.3.1.2 Welding procedure qualifications on carbon steels that use controls other than thermal stress relieving to control the hardness of the weldment shall also include a hardness traverse across the weld, HAZ, and base metal to ensure that the procedure is capable of producing a hardness of 22 HRC maximum in the condition in which it is used."* [1]

Note that this paragraph provided no details with regard to the "controls other than thermal stress relieving," and also didn't define the "hardness traverse." Although not stated directly, it also implied that such testing was not required when stress relieving was performed. For the most part, equipment producers used stress relieving to bring weld repairs in castings into compliance. Note that no specific stress-relieving requirements such as temperature, soak time or heating/cooling rates were specified, and no qualification testing (such as a hardness traverse) was required.

The paragraph for low-alloy steels and martensitic stainless steels indicated:

> *"5.3.1.3 Low-alloy steel and martensitic stainless steel weldments shall be stress relieved at a minimum temperature of 620 C (1150 F) to produce a hardness of 22 HRC maximum."* [1]

Again, no stipulation was made that qualification testing was required.

There was also a requirement that filler materials for carbon steel and low-alloy steels could not contain more than 1% nickel.

For other materials, no specific requirements were stated.

Based upon these requirements, the prevailing practices for complying with NACE MR0175-2002 were to:

- Stress relieve carbon steel, alloy steel and martensitic stainless-steel castings, all of which are quench-hardenable.
- Use austenitic and duplex stainless-steel castings and nickel alloy castings in the as-welded condition, because these materials are not quench-hardenable.

NACE MR0175/ISO 15156 and NACE MR0103 both include requirements for welding procedure qualification that are much more specific and much more rigorous than those in NACE MR0175-2002.

NACE MR0175/ISO 15156 requires performing a weld procedure qualification (WPQ) hardness survey with either Vickers using a 10 kilogram load or with the Rockwell 15N scale for any material that has a maximum specified hardness limit. This encompasses the carbon steels, low-alloy steels, martensitic stainless steels, austenitic stainless steels and all the precipitation-hardenable alloys. For duplex stainless steels, a hardness survey is not required, but metallographic ferrite measurements are required in the weld deposit, and a microstructural examination at 400X is required to verify second-phase precipitates do not exist above certain levels.

NACE MR0103 requires that a WPQ hardness survey be performed with Vickers using a 10 kilogram load for carbon steels, alloy steels, martensitic stainless steels, duplex stainless steels and all of the precipitation-hardenable alloys. In addition, for duplex stainless steels, metallographic ferrite measurements are required in the weld deposit and heat-affected zone. Note that NACE MR0103 does not require a hardness survey for austenitic stainless steels.

Neither NACE MR0175/ISO 15156 nor NACE MR0103 require any special welding controls for the annealed solid solution nickel alloys.

That brings us back to the original question. Is there a way to ensure compliance with NACE MR0175/ISO 15156 and NACE MR0103 when remanufacturing a valve body casting?

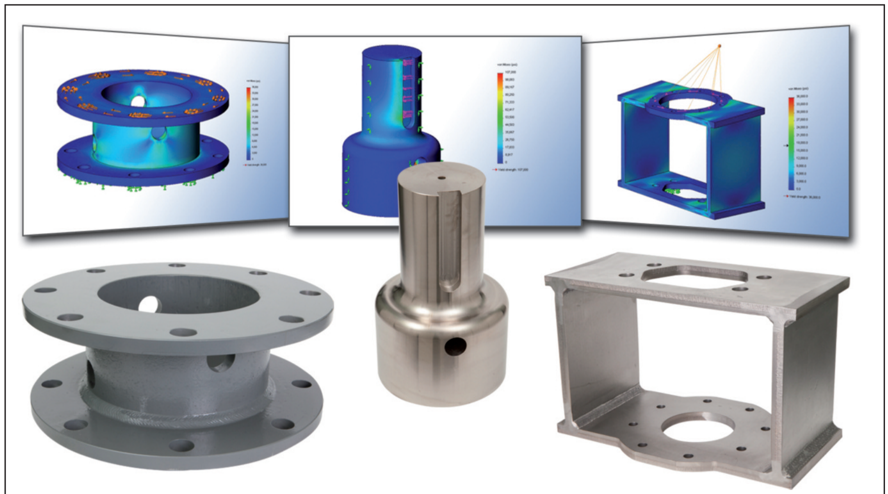
The reason the answer to that is generally "no" is that welding can be performed on a cast valve body at many stages in its lifetime, by:

- the original foundry
- a third-party machine shop machining the casting
- the original valve manufacturer

CONTINUED ON PAGE 41

The Underappreciated Mounting Kit

BY TONY LAMBERT



Mounting hardware must stand up to a number of forces to meet standards.

All too often, the mounting kit is considered trivial, an afterthought deemed a commodity within all the other specified control components that comprise a complete automated valve package. However, inadequate mounting kit designs are a primary reason valves fail prematurely or automation packages fail to function properly.

As a result, industry is taking formal steps to ensure safety, quality, consistency and increased uptime by considering the complete valve automation assembly, including its mounting. In 2011, the International Organization for Standardization (ISO) released the 12490 standard, Petroleum and Natural Gas Industries Mechanical Integrity and Sizing of Actuators and Mounting Kits for Pipeline Valves. The American Petroleum Institute (API) then released API-6DX: Standard for Actuator Sizing and Mounting Kits for Pipeline Valves in 2012. API 6DX and ISO 12490 are identical and together are referred to as American National Standards Institute (ANSI)/API 6DX-201/ISO 12490-2011.

These two standards contain dedicated sections geared specifically to the mechanical integrity of a mounting kit. Although they are technically written for pipeline valves, many other markets are adopting their requirements, and many valve and actuator manufacturers are using them as guidelines.

This article creates awareness of these standards and encourages readers to think twice about the mounting kit they are using in the field: Can they guarantee the end user that the mounting kit is engineered to withstand all the forces that can be applied without triggering premature valve failure?

FACTORS TO CONSIDER

The forces applied by the actuator drive the factors behind ensuring the mechanical integrity of the mounting kit. Section 7.6.1 of these standards states that the mounting kit should be designed to transfer all of the loads from the actuator to the valve, and to react to them—including loads of 1.1 or more times the maximum torque or thrust output, taking into account the following:

- ***For pneumatic/hydraulic actuators:*** The torque/thrust generated at maximum operating pressure or as limited by the relief valve or other pressure-limiting device
- ***For spring return actuators:*** The torque/thrust generated by maximum compressed spring force
- ***For electric actuators:*** The torque/thrust at stall condition or 100% torque/thrust switch setting

These standards also require that, when calculating the integrity of the mounting kit, sufficient factors of safety exist at 1.1 times the maximum torque/thrust. Section 7.6.1 specifically talks about tensile, shear, torsion and bearing stresses and, where applicable, welding strength.

It requires that tensile stresses in mounting kit components do not exceed 67% of specified minimum yield strength (SMYS) when delivering 1.1 or more times the maximum torque/thrust output. Shear, torsion and bearing stresses should not exceed the limits specified in American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code (BPVC) Section VIII:2004, Division 2, Part AD-132, except when design stress intensity values (Sm) is 67% of SMYS. Also, for all mounting kits, attention must be paid to deflection and strain. The standards say adherence to these allowable stress limits alone might not result in a functionally acceptable design for the actuated valve assembly. (7.6.2)

The standards also require that fillet welds are designed with a strength efficiency factor of 0.75 or better.

THE VALVE

Although the actuator is a key factor in a mounting kit design, valve details cannot be ignored. Section 8.1.1 states that the purchaser of an actuator should ensure that the maximum allowable stem torque and maximum torque/thrust of actuator and valve are compared to ensure compatibility of the design. It is imperative this information is exchanged by the necessary entities during the quoting and specification stages. Other valve criteria includes:

valve torque and/or thrust data, safety factor, and operating time and valve dimensions

ANSI/API 6DX-201/ISO 12490-2011 addresses other mounting kit details such as welding and fasteners by noting:

- For welding, repair welding, and structural welds (including mounting kit): They should be performed in accordance with procedures qualified to ANSI/American Welding Society (AWS) D1.1/D1.1M or an equivalent standard. Welders and welding operators are to be qualified in accordance with ANSI/AWS D1.1/D1.1M or an equivalent standard. (11.2)
- Also acceptable for structural welding are welding procedure specification and procedure qualification records, in accordance with procedures qualified to ISO 15607, ISO 15609 (all parts), ISO 15614-1 or ASME BPVC Section IX, as well as welders and welding operators qualified in accordance with ISO 9606-1, ASME BPVC Section IX or EN 287-1. (11.2)
- Visual inspection of welds should be in accordance with ANSI/AWS D1.1/D.1.1M or an equivalent standard. Parts should be subjected to a visual inspection in accordance with the manufacturer's quality procedures. (12.1.3)
- For the fasteners, bolting in mounting kits should not be subjected to shear forces, unless specific exception is agreed upon. (7.6.2)

Bolted joint slip calculations are the best way to ensure the clamping force generates enough friction force to withstand the shear force generated by the maximum torque of the actuator. Adequate friction force will prevent the bolts from going into a shear loading condition.

OTHER REQUIREMENTS

ISO and API also provide general requirements and guidelines for mounting kits, such as:

The mounting kit design and manufacturing tolerance should ensure:

- Parallelism of the intermediate support mounting faces
- Concentricity of the pitch circle diameter (PCD) for bolting for intermediate support
- Alignment of the PCD, valve stem, coupling and the actuator drive. (7.6.2)

The mounting kit design should also consider:

- Installed orientation of the valve and actuator (Note here that valves installed with horizontal stems can require additional support, e.g., spigots, to ensure accurate alignment of valve and actuator during removal and refitting in field service.)
- External loading from environmental effects (e.g., wind, snow, seismic activity)
- Blast loading, if specified
- Frequency of cycling and speed of operation. (7.6.3)

In conclusion, every component in the valve assembly must be able to withstand the demands of the application. Users of these kits need to ensure they are using hardware engineered for valve automation so they don't put themselves in a position of trying to explain to customers that valve problems, plant downtime or other consequences resulted from an inadequate mounting kit design.

This article highlights only a portion of the requirements found in ANSI/API 6DX-201/ISO 12490-2011. To obtain the full version of these standards, please purchase or download them online. VM

Tony Lambert is vice president of Engineered Valve Automation Hardware, VanAire Inc. (www.vanaireinc.com). Reach him at tlambert@vanaireinc.com.

CITED REFERENCES AND KEY SECTIONS:

ANSI/API 6DX-201/ISO 12490-2011: Mechanical integrity and sizing of actuators and mounting kits for pipeline valves

Section 7: Design
Section 8: Sizing
Section 9: Instrumentation/Regulation
Section 10: Materials
Section 11: Welding
Section 12: Quality Control
Section 13: Testing
Section 14: Surface Protection

MATERIALS Q&A *(continued from p. 39)*

- the customer
- the original valve manufacturer's service organization or
- the customer's third-party maintenance contractor.

Since the remanufacturer doesn't know the entire history of the casting, it is impossible to certify that welding occurring on the casting has been performed using a welding procedure qualified in accordance with either of these NACE standards. It may have been welded with an improper filler, or using a process that requires special evaluation, such as production weld deposit hardness testing. (This is required when certain welding processes or filler materials are used to weld carbon steel in accordance with NACE MR0103.) Unlike NACE MR0175-2002 and previous versions, stress relieving is not viewed as an after-the-fact fix-all and is not adequate to upgrade the casting to be compliant with either NACE MR0175/ISO 15156 nor NACE MR0103.

The exception is the annealed solid solution nickel alloy castings acceptable per these NACE standards. Since these materials are acceptable with no welding controls, they can be certified compliant with NACE MR0175/ISO 15156 and NACE MR0103. VM

Reference

1. NACE Standard MR0175-2002, "Sulfide Stress Cracking Resistance Metallic Materials for Oilfield Equipment" (Houston, TX: NACE)

Don Bush is a principal materials engineer at Emerson Process Management–Fisher Valve Division (www.emersonprocess.com). Reach him at don.bush@emerson.com.

Changing the Way Americans Think About Manufacturing Careers

BY JESSICA BELLO

The Valve Manufacturers Association is focusing a major effort on developing a solution to a problem that plagues this industry as well as most of the industrial world: how to find and attract talented new workers. While VMA can help in forming a solution, the association can't do it alone—industrial companies themselves need to rethink recruiting methods and ways to improve the image of manufacturing and heavy industry.

There is no debate about the need for this: Over the next decade, the skills gap is expected to widen to such an extent that 2 million of the almost 3.5 million manufacturing jobs that could be available may go unfilled. Part of the reason is that 2.7 million baby boomers will be retiring just as 700,000 jobs are expected to come from economic expansion.

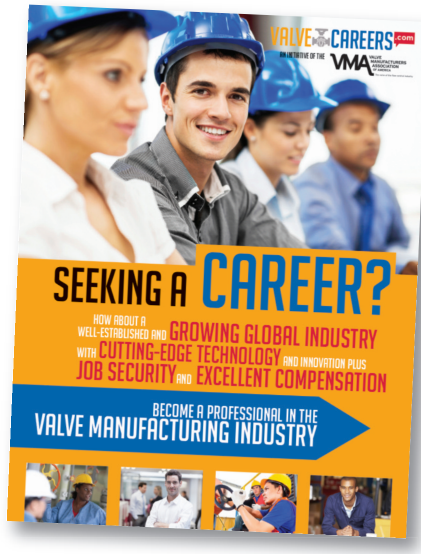
However, another part of the problem is simply that manufacturing is not considered a glamorous industry. This image problem translates into a lack of interest from young candidates. Nicholas Wyman, Forbes contributor and CEO of the Institute for Workplace Skills and Innovation has said that only one in three families will encourage their children to pursue manufacturing careers.

A PROFESSIONAL AND REWARDING CAREER

"Many Americans cling to the outdated notion of manufacturing as low-skilled, menial work," Wyman notes. He points to a poll by the Fabricators and Manufacturers Association that found 61% of teenagers have no interest in manufacturing because they prefer to pursue what they consider a "professional" career.

"They don't think manufacturing jobs are intellectually rewarding, and they don't see opportunities for career development or advancement in the factory," Wyman says.

What needs to be pointed out to many parents and students is that



skilled workers on average earn upwards of $80,000 a year working in manufacturing because their skills are in such high demand.

To recruit new talent into the industry, employers will need to conduct a grassroots campaign of reaching out to young people both physically and digitally. Companies must ultimately convince them that a career in manufacturing is not only well-paying, but exciting, cutting-edge and full of opportunities.

Educating the public and today's youth is no quick or simple task, but it is one that can make a huge difference to the industry and can be a collaborative effort among all VMA members. The association is encouraging employers to partner with local high schools, technical schools, community colleges and universities. They also should invite young people into factories and offices, and they should learn how to show that the typical four-year degree is not the only option for a viable long-term career. They should push special math, science and engineering programs in schools as well as skilled trades programs at higher levels. They also need to show students why manufacturing is so important to modern society.

MAKING A DIFFERENCE, ONE BY ONE

A number of VMA members already are working toward this end. For example, Balluff, which is headquartered in Florence, KY, recently hosted its first-ever Manufacturing Day event. Activities included hands-on sensor learning labs, tours of the facility, and product and technology demonstrations. Students also experienced automation in action first hand in the new Balluff Demo Van. Balluff's strategic marketing manager, Will Healy III noted that, "We need skilled and excited people for automation. This demands that we encourage and invest in manufacturing events in our community and STEM [science, technology, engineering and mathematics] programs at schools to help develop the next generation."

The manufacturing skills gap doesn't end at recruiting and hiring either—companies will need to keep training and professional development at the forefront of efforts. They will need to find ways to keep workers up to date on the latest technology, and they will need to learn best practices for building strong workforces.

VMA is very much a part of that big picture thinking. In early 2015, the Valve Careers initiative was launched—a program that aims to inform and educate the next generation about the lucrative and challenging field that is industrial valve manufacturing. The program strives to enlighten young people and show them how valve manufacturing is exciting, rewarding and offers many different career paths and opportunities for growth. To keep up with Valve Careers, visit the program's website at www.valvecareers.com, and connect with the Valve Careers social media on LinkedIn, Twitter and Facebook. VM

Jessica Bello is VMA's careers program coordinator. She encourages anyone interested in learning more about the association's Valve Careers Initiative to contact her at jbello@vma.org.


Rotary motion converted
linear
Size on maximum force
Very high force outputs

Allagash International Group, LLC
Portland, ME
www.allagashinternational.com

- **Nor'East Controls**
  www.noreastcontrols.com

American Valve, Inc.
Greensboro, NC
www.americanvalve.com

ARI Armaturen USA L.P.
Houston
www.ari-armaturenusa.com

ASCO Valve, Inc. - Emerson Industrial Automation
Florham Park, NJ
www.ascovalve.com

A-T Controls
Cincinnati, OH
www.a-tcontrols.com

AUMA Actuators, Inc.
Canonsburg, PA
www.auma-usa.com

Automation Technology, Inc.
Houston
www.atiactuators.com

Babbitt Chainwheel
New Bedford, MA
www.babbittsteam.com

Harold Beck & Sons, Inc.
Newtown, PA
www.haroldbeck.com

Bernard Controls, Inc.
Houston
www.bernardcontrols.com

Bray International Inc.
Houston
www.bray.com

Cameron
Houston
www.c-a-m.com

- **Flow Control**
  Houston
- **Valves & Measurement**
  Houston

Champion Valves, Inc.
Wilmington, NC
www.wafercheck.com

Check-All Valve Mfg. Co.
Des Moines, IA
www.checkall.com

ChemValve, Inc.
Tomball, TX
www.chemvalve.com

CIRCOR International, Inc.,
Burlington, MA
www.circor.com

Colfax Fluid Handling
Warren, MA
www.colfaxcorp.com

Continental Disc Corporation
Liberty, MO
www.contdisc.com

- **Groth Corporation**
  Stafford, TX
  www.grothcorp.com
- **LaMOT Brand Products**
  Liberty, MO
  www.lamot.com

Conval, Inc.
Somers, CT
www.conval.com

Cowan Dynamics, Inc.
Montreal, Quebec, Canada
www.cowandynamics.com

Crane Co.
Stamford, CT
www.craneco.com/business/crane_valves.cfm

- **Crane Energy Flow Solutions**
  The Woodlands, TX
  www.craneenergy.com
- **Crane ChemPharma Flow Solutions**
  Cincinnati
  www.xomox.com
  www.resistoflex.com
  www.saundersvalve.com

Curtiss-Wright Valve Group - Industrial Division
www.cw-industrial.com

- **Enertech**
  Brea, CA
- **Exlar**
  Chanhassen, MN
- **Farris Engineering**
  Brecksville, OH
- **Target Rock**
  East Farmingdale, NY

DeZURIK
Sartell, MN
www.dezurik.com

- **APCO Willamette**
  Schaumburg, IL
  www.apcovalves.com
- **Hilton Valve**
  Redmond, MN
  www.hiltonvalve.com

DFT Inc.
Exton, PA
www.dft-valves.com

Elliott Manufacturing
Binghamton, NY
www.elliottsafeoperator.com

Emerson Process Management
Marshalltown, IA

- **EIM Company, Inc.**
  Missouri City, TX
  www.eim-co.com
- **Fisher Controls**
  Marshalltown, IA
  www.fisher.com
- **TopWorx**
  Louisville, KY
  www.topworx.com
- **Valve Automation Division**
  St. Louis
  www.emersonprocess.com/valveautomation

Everlasting Valve Company, Inc.
South Plainfield, NJ
www.everlastingvalveusa.com

Flowserve Corporation HQ.
Irving, TX
www.flowserve.com

- **Flowserve Durco, Automax, Worcester**
  Cookeville, TN
  www.flowserve.com
- **Flowserve Valtek Control Valves**
  Springville, UT
  www.flowserve.com
- **Flowserve Edward and Anchor/Darling**
  Raleigh, NC
  www.flowserve.com
- **Flowserve Limitorque**
  Lynchburg, VA
  www.limitorque.com
- **Flowserve Gestra Steam Traps & Systems**
  Louisville, KY
  www.gestra.com
- **Flowserve Nordstrom and Vogt**
  Sulphur Springs, TX
  www.flowserve.com
- **Flowserve Valbart**
  Houston
  www.flowserve.com

Forum Energy Technologies - Valve Solutions
Stafford, TX
www.f-e-t.com

Franklin Valve LP
Houston
www.franklinvalve.com

GE Oil & Gas
Houston
www.ge.com

- **Consolidated Safety and Safety Relief Valves**
  Alexandria, LA
- **Masoneilan Control Valves**
  Avon, MA
- **Regulation and Control**
  Houston

Indelac Controls, Inc.
Florence, KY
www.indelac.com

ITT Engineered Valves
Lancaster, PA
www.engvalves.com

Kinetrol USA, Inc.
Plano, TX
www.kinetrolusa.com

Kingston Valves
Torrance, CA
www.kingstonvalves.com

Kitz Corporation of America
Stafford, TX
www.kitz.com

Mastergear, Division of Regal-Beloit Corporation
Clinton, WI
www.mastergearworldwide.com

Metso Automation USA Inc.
Shrewsbury, MA
www.metso.com

Moog Flo-Tork, Inc.
Orrville, OH
www.moog.com

Mueller Water Products
Atlanta
www.muellerwaterproducts.com

- **Anvil International**
  Portsmouth, NH
  www.anvilintl.com
- **Henry Pratt Company**
  Aurora, IL
  www.henrypratt.com
- **Henry Pratt, Hydro Gate**
  Denver
  www.hydrogate.com
- **Henry Pratt, Lined Valve**
  Woodland, WA
  www.knifegatevalves.com
- **Milliken Valve Company**
  Bethlehem, PA
  www.millikenvalve.com
- **Mueller Co.**
  Chattanooga, TN
  www.muellercompany.com

PBM, Inc.
Irwin, PA
www.pbmvalve.com

Pentair Valves & Controls
Houston
us.valves.pentair.com/valves

The Wm. Powell Company
Cincinnati
www.powellvalves.com

Process Development & Control, Inc.
Coraopolis, PA
www.pdcvalve.com

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

REXA
West Bridgewater, MA
www.rexa.com

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

Roto Hammer Industries, Inc.
Tulsa, OK
www.rotohammerinc.com

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

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

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

Rupture Pin Technology
Oklahoma City
www.rupturepin.com

Samson Controls, Inc.
Baytown, TX
www.samsoncontrols.com

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

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

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

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

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

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

ValvTechnologies, Inc.
Houston
www.valv.com

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

Victaulic
Easton, PA
www.victaulic.com

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

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

WEY Valve
Nettleton, MS
www.weyvalve.com

ASSOCIATE MEMBERS

DISTRIBUTOR/CHANNEL PARTNERS

AIV, LP
Houston
www.aivinc.com

Andrews Industrial Controls
Carnegie, PA
www.andrewsic.com

Ci Valves & Actuators
Houston
www.ciactuation.com

Classic Controls, Inc.
Lakeland, FL
www.classiccontrols.com

DistributionNOW
Houston
www.distributionnow.com

Edgen Murray Corporation
Houston
www.edgenmurray.com

FCX Performance, Inc.
Columbus, OH
www.fcxperformance.com

MRC Global, Inc.
Houston
www.mrcglobal.com

RES Energy Solutions
Houston
www.res-co.com

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

Sunbelt Supply Co.
Houston
www.sunbeltsupply.com

TRIFLOW Corp.
West Berlin, NJ
www.triflowcorp.com

Wolseley Industrial Group
Newport News, VA
www.wolseleyindustrialgroup.com

SUPPLIERS

A.W. Chesterton
Groveland, MA
www.chesterton.com

All-Pro Fasteners, Inc.
Arlington, TX
www.all-profasteners.com

American Foundry Group
Bixby, OK
www.americanfoundry.com

Auge Industrial Fasteners
Houston
www.augeusa.com

AVK Carbo-Bond/Bi-Torq Inc.
LaFox, IL
www.bitorq.com

Balluff, Inc.
Florence, KY
www.balluff.us

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

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

Climax Calder Testing Systems
Newberg, OR
www.climaxportable.com

Delta Centrifugal Corp.
Temple, TX
www.deltacentrifugal.com

EGC Critical Components
Humble, TX
www.egccomponents.com

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

Engis Corporation
Wheeling, IL
www.engis.com

The Flexitallic Group, Inc.
Houston
www.flexitallic.com

Garlock Sealing Technologies
Palmyra, NY
www.garlock.com

Highland Foundry Limited
Surrey, British Columbia, Canada
www.highlandfoundry.com

Houston Plating & Coatings, LLC
South Houston, TX
www.houstonplating.com

Howard Tool Company
Bangor, ME
www.howardtool.com

Jet-Lube Inc.
Houston
www.jetlube.com

Kennametal Inc.
Belleville, Ontario, Canada
www.kennametal.com/stellite

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

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

Matrix Metals LLC
Richmond, TX
www.matrixmetalsllc.com

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

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

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

Scientific Linings & Coatings
San Antonio
www.weathercap.com

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

Sigma Corporation
Cream Ridge, NJ
www.sigmaco.com

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

Stainless Foundry & Engineering Inc.
Milwaukee, WI
www.stainlessfoundry.com

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

Technetics Group
Columbia, SC
www.technetics.com

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

Watson Grinding & Mfg.
Houston
www.watsongrinding.com

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

MEMBERS OF THE VALVE REPAIR COUNCIL

An affiliate of the Valve Manufacturers Association of America

Allagash International Group, LLC
Portland, ME
www.allagashinternational.com

Allied Valve
Chicago
www.alliedvalveinc.com

AVP Valve, Inc.
Lakeland, FL
www.avpvalve.com

Bay Valve Service, Inc.
Seattle
www.bay-valve.com

Cameron
Houston
www.c-a-m.com

CFM/VR-TESCO LLC
Elgin, IL
www.globalfield.net

Chalmers & Kubeck North
Westfield, MA
www.candknorth.com

Classic Controls, Inc.
Lakeland, FL
www.classiccontrols.com

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

CWFC Farris Engineering
Brecksville, OH
www.cwfc.com

Dayton Precision Services
Dayton, OH
www.daytonprecisionservices.com

Dowco Valve Company
Hastings, MN
www.dowcovalve.com

Eastern Controls, Inc.
Philadelphia
www.easterncontrols.com

ECI/ICE Valve and Instrument Services
Monessen, PA
www.service-solution.com

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

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

Flowserve Corporation
Baton Rouge, LA
www.flowserve.com

Formosa Plastics USA
Point Comfort, TX
www.fpcusa.com

Furmanite
Houston
www.furmanite.com

GE Oil & Gas
Houston
www.ge.com

- **Consolidated and Masoneilan Aftermarket and Field Service**
  Deer Park, TX
- **Consolidated Safety and Safety Relief Valves**
  Alexandria, LA
- **Masoneilan Control Valves**
  Avon, MA

Gulf Coast Modification, LP
Houston
www.gulfcoastmod.com

Gulf Coast Valve, Inc.
Corpus Christi, TX
www.gulfcoastvalve.net

J&S Machine and Valve, Inc.
Nowata, OK
www.jsmachineandvalve.com

Kirksey Machine
Houston
www.kirkseymachine.com

Metso Automation
Shrewsbury, MA
www.metso.com

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

NWS Technologies
Spartanburg, SC
www.nwstechnologies.com

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

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

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

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

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

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

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

Thorco
Tulsa, OK
www.thorcousa.com

United Valve
South Houston, TX
www.unitedvalve.com

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

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

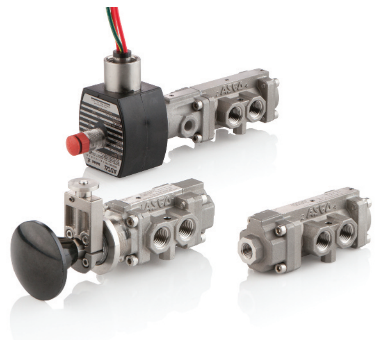
Wal-Tech Inc.
Mobile, AL
www.wal-tech.com

Watson Valve Services
Houston
www.watsonvalve.com

VRC ASSOCIATE MEMBER

Quality Valve
Mobile, AL
www.qualityvalves.com

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



ASCO Numatics has introduced the 362 and 562 Series of stainless-steel spool valves for control valve automation in the upstream, midstream, and downstream oil and gas markets.

The series offers low-power solenoid versions that consume only 1.4 watts, making them the most energy-efficient valves in their class. A 0.55-watt solenoid option is coming soon that will be ideal for remote applications requiring alternate energy sources.

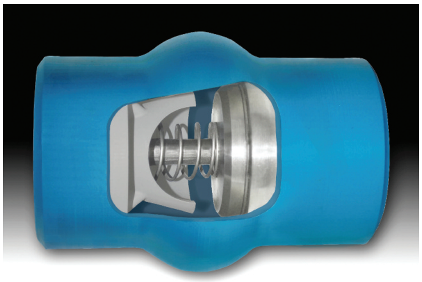
The 562 series is a four-way spool valve designed for double-acting process valves. The 362 series is a three-way valve made for single-acting process valve applications.

AUMA FQM fail-safe units automatically open and close valves in the event of an emergency, even when power supply is disrupted. Incorporating a patent-pending constant force spring motor, the new fail-safe unit mechanically provides the required torque needed for an emergency. While conventional springs lose 80% of their torque across valve travel, the AUMA solution provides virtually constant torque.

Additionally, an overriding gear arrangement ensures that the spring does not move during standard operation. Both these factors contribute to enabling selection of significantly smaller actuator solutions.

Conval recently updated its 900-page engineering binder containing technical information on its full line of high-pressure, high-temperature forged valves and accessories for some of the world's most demanding applications.

This comprehensive resource is available to qualified specifiers in hard copy or online. Contents include specifications, drawings, typical applications, case studies, accessory and actuation options for ball valves, bellows seal valves, blowdown valves, cryogenic valves, fire-safe valves, gate valves, globe valves, special valves and throttling valves.



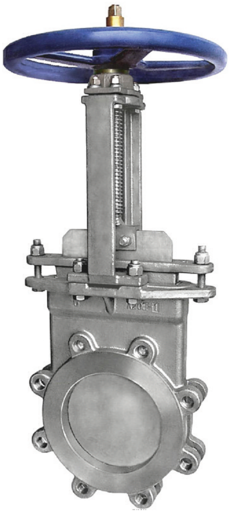
DFT Inc. offers its new BNC Check Valve, a nozzle-style, axial-flow check valve specifically designed to excel in high-pressure applications. The product is significant because many natural gas companies and other power industries are placing their pipelines below ground so they are looking for a one-piece valve they can weld in and bury. This check valve has a precision nozzle-style valve that uses axial-flow technology to eliminate turbulence and prevent erosion and vibration.

The valve also provides a critical service to the power industry because the valve's enhanced leak proofing under high pressure virtually eliminates acid and chemical leakage.

Emerson Process Management introduces the Fisher Z500 line of metal-seated ball valves. The metal-seated valves are engineered to withstand

higher temperatures, pressures and more erosive conditions than a standard on/off ball valve, providing increased reliability and protection of critical assets in demanding applications. A bi-directional sealing design offers a solution to process back pressure and shutoff requirements in both flow directions, safeguarding control valves and other equipment in the line.

Fisher Z500 valves are designed with an integral metal seat and self-energized metal body gasket to help eliminate leak paths and withstand extreme temperature changes.



Lined Valve Company's bonnetless resilient seat knife gate valve is manufactured with heavy-duty cast stainless-steel body, packing gland and yoke, and stainless-steel gate and stem. This valve is designed to resist deflection under extreme loads. With the rubber seat sitting flush with the bottom of the port, potential pockets collecting media are eliminated. The Figure 77 has a bi-directional drip tight seal to 150 psi and is certified to MSS SP-81, AWWA C520 and compact wafer configuration to TAPPI.

The Figure 77 is suitable for many applications such as pulp stock to 7% and light slurries, wastewater and cooling water, pulp and paper, power generation, beverages and food processing, chemicals and fertilizers.

CONTINUED ON PAGE 48

CONTINUED FROM PAGE 46

Pentair Valves & Controls is expanding its Anderson Greenwood pressure relief product range with the launch of an improved design of its pilot-operated pressure relief valve model for LNG storage in on- and offshore applications. The Anderson Greenwood 9300H offers LNG operators a key advantage by increasing flow capacity by 30%, enabling the design and construction of larger storage tanks without the need to increase valve sizes. In addition, the compact new model minimizes equipment footprint, which is especially critical for LNG vessels where space is limited.

A shorter body design is fully versatile and can accommodate both on- and offshore storage requirements. In addition to increased flow capability, the new valve handles a large temperature range and features a self-draining body and low sensitivity to back pressure within the exhaust piping.

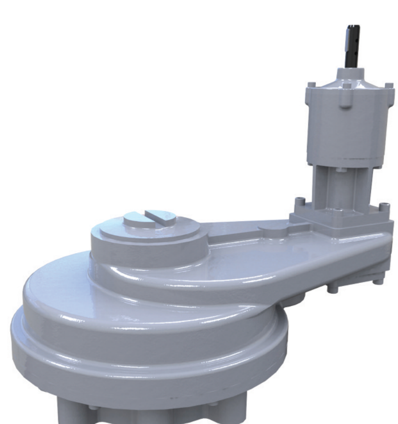
Victaulic has introduced a line of stainless-steel Advanced Groove System (AGS) fittings, allowing customers to create complete large-diameter grooved mechanical piping systems in stainless-steel.

Featuring Victaulic AGS grooved ends, AGS stainless-steel fittings are available in 90- and 45-degree elbows, tees, reducers, adapters and caps. The fittings are joined to AGS-grooved pipe, valves and accessories with the Victaulic Style W89 AGS coupling. The wedge-shaped AGS groove facilitates proper coupling positioning and provides increased coupling-to-pipe engagement. The two-piece design of the coupling housing enables quick joint completion. AGS-joined pipe handles higher end loads and a higher pressure rating—up to 350 psi (2,410 kPa)—with a nominal three-to-one safety factor.

Rotork introduces the new HOS/MPR multi-turn spur gearboxes, designed for the manual operation of gate, globe, sluice and penstock valves.

These gearboxes can be installed above or underground with upward or downward input orientation. The totally enclosed, maintenance-free spur gearing is grease lubricated for life and designed with carefully chosen ratios to meet manual rim effort requirements. A range of handwheels is available with rim diameters between 200mm and 1000mm.

Standard materials of construction, including a cast iron gearcase, ductile iron baseplate, protected steel input shaft and protected steel fasteners, provide excellent resistance to aggressive operating environments. The standard IP67 dust and watertight enclosure can be increased to IP68 (continuous submerged duty at depth of 15 meters) and an ISO 10497 fire-safe option is also available. VM



ADVERTISER Index

When your company advertises in VALVE Magazine, you'll reach close to 70,000 industry professionals, from end users and AEC/EPC firms to distributors and valve manufacturers. Contact Sue Partyke, advertising director, at 540.374.9100 or email spartyke@vma.org to learn more.


Fire
&
Ice