Fighting fugitive emissions

How products and practice are crucial in controlling leakage from volatile organic compounds

Within the past 20 years, fugitive emissions regulations have become increasingly strict. As governing bodies intensify their focus on safety and environmental concerns, the laws governing fugitive emissions compliance have evolved in kind. International agencies have established stringent guidelines for leak detection, monitoring frequency and repair parameters, leaving the global chemical industry seeking high-technology fugitive emissions solutions that meet the requirements of regulators worldwide.

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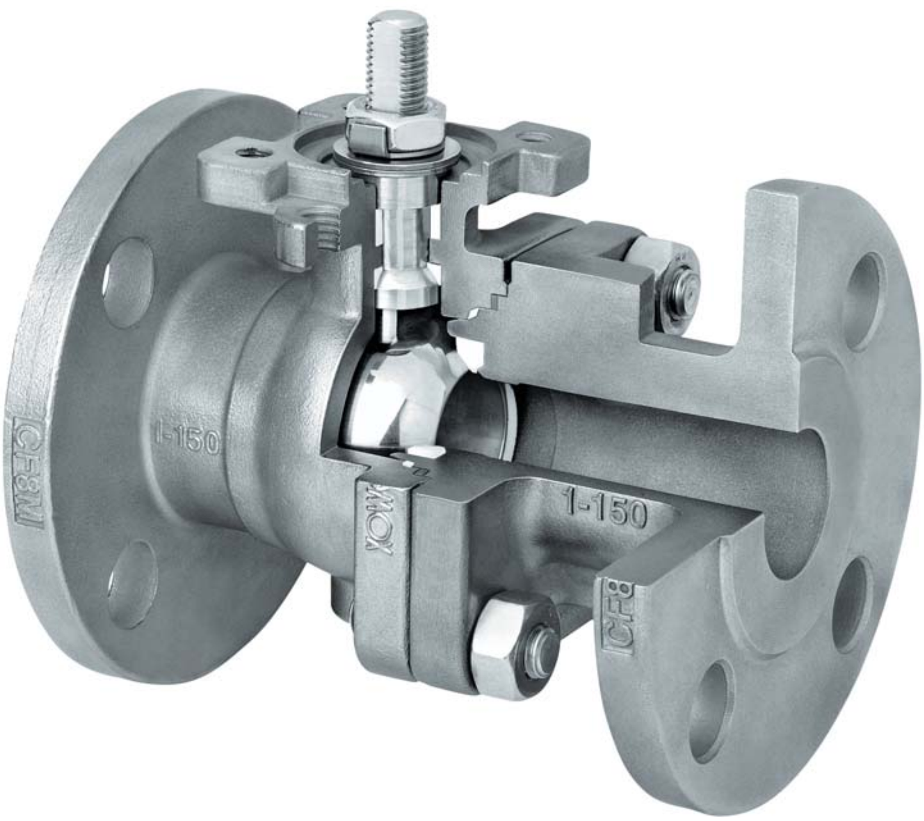
The 2012 United Nations Global Chemical Outlook values the total environmental external cost from "global human activity" producing volatile organic compounds at more than US $230 billion dollars.[1] By the year 2020, the acceptable level of emissions from VOCs will have been reduced by 95% since 1990. With more than 60% of fugitive emissions worldwide emanating from valves, valve users must utilize effective solutions that comply with the changing regulatory landscape. Ensuring that fluid handling equipment adheres to the global standards governing fugitive emissions can be challenging, as end users are subject to differing global industrial regulations and must find equipment that helps them achieve conformance in various applications. This article will explore the ways in which valve users in the chemical process industry can evaluate valve solutions and implement effective work practices to ensure superior fugitive emissions control.

Controlling emissions through valve design

To reduce fugitive emissions, valve users should focus on two primary areas of vulnerability: valve stem packing and design and the body to bonnet joint. While various methods can help achieve exceptional sealing, this article will illustrate how a soft-seated ball valve mitigates the risks associated with VOCs from hazardous chemicals and protects as well as it performs. The valve technology described herein utilizes multiple stem seals, a dual-material body gasket and a range of unique design features to address the dynamic nature of fugitive emissions control in the chemical process industry.

Valve stem seals

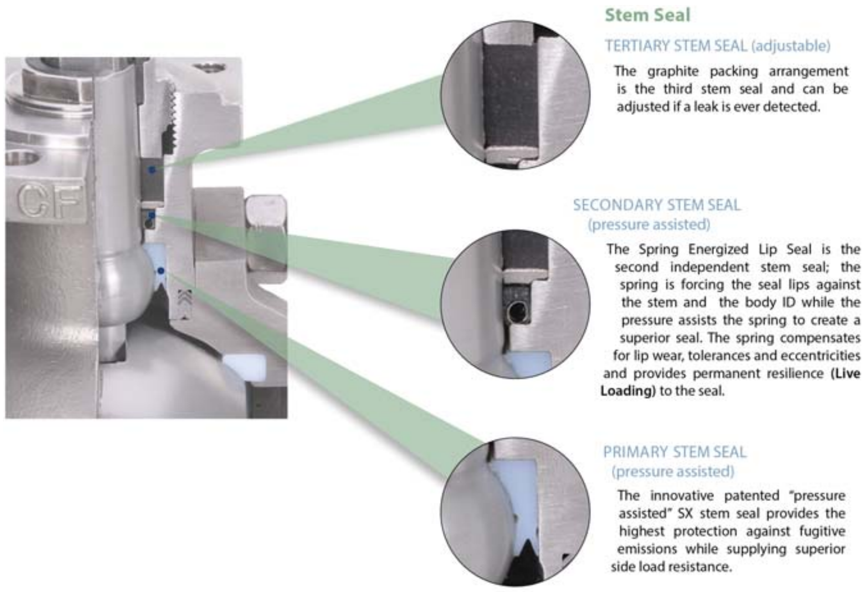
Essential to fugitive emissions control, stem seal design is especially challenging due to the movement of the valve stem through the packing in rising-stem valves. Utilizing a quarter-turn valve, like the ball valve described below, is an effective preliminary method of defense against fugitive emissions susceptibility. While traditional packing options such as flat rings or square cross sections can be successful against most fluid leakage, they can be sufficient in guarding against fugitive emissions of highly hazardous chemicals. Therefore, when selecting a valve, users should carefully assess stem seal design and materials. To exceed the industry standards of maximum allowable leakage, a new ball valve design, which is certified to EPA Method-21, ISO-15848, and TA-Luft according to VDI 2440, incorporates three independent stem seals.



A common fugitive emissions concern with traditional ball valve designs is stem seal leakage caused by side loads on the stem, which can be caused by improper manual operation, abusive contact and misalignment. Due to the volatile nature of chemical process applications, this failure is a serious concern. To address this danger, the primary seal of the new soft-seated ball valve features a unique design that offers side load protection. The primary, patented pressure-assisted SX stem seal provides the highest protection against fugitive emissions while supplying superior side load resistance.

The secondary spring energized lip seal is the second independent stem seal, in which the spring forces the seal lips against the stem and the body ID while pressure assists the spring to create a superior seal. The spring compensates for lip wear, tolerances and eccentricities and provides permanent resilience (live loading) to the seal.

Finally, an adjustable tertiary stem seal with graphite packing provides an additional degree of protection against fugitive emissions and can be adjusted in the event that a leak is ever detected. In selecting a valve design to maximize fugitive emissions protections, end users should carefully assess the number and efficacy of stem seals in valves.



Valve body design

The second major point of susceptibility to fugitive emissions occurs at a valve's body to bonnet joint, and valve users should thus ensure that equipment is specially designed to function in dynamic temperature conditions. Thermal cycling in chemical processes can create a leak path between the PTFE body seal and the metal body joint in severe service conditions plagued by extreme pressure and temperature fluctuations, a temperature differential across the body joint, and bolt stress relaxation and creep.

To mitigate the leak risks associated with thermal cycling, valve users should consider a valve with a dual-material body gasket that provides a chemical seal to both protect against fugitive emissions and ensure fire-safe operation. The unique spiral-wound body gasket of the new soft-seated ball valve, for example, combines a PTFE chemically-inert inner seal and a secondary graphite fire-tested outer seal to conform to API 607-6th edition & ISO 10497:2010.

The spiral wound gasket is an industry-proven design that provides structural support and live loading via the metal spiral "v" shaped rings. Located in the fully-contained body groove, these "v" rings protect the PTFE and graphite seals from extrusion and cold flow during thermal cycles. Thus, while standard gasket seal designs can leak as a result of thermal expansion between the PTFE body seal and the metal body joint, a dual-material gasket in the spiral-wound configuration is able to recover during thermal cycling and operate uncompromised in all temperatures while meeting fire safe performance.

Controlling emissions through work practices

Although the selection of highly-engineered valve equipment is the first line of defense against VOC leakage, valve users need to ensure that their work practices align with the objective of achieving best-in-class fugitive emissions protection.

Leak detection and repair

As defined by the United States Environmental Protection Agency, "work practices refer to the plans and procedures undertaken to reduce or estimate emissions…and are the most commonly used control techniques for equipment leaks."[2] These plans and procedures, when properly implemented, will reduce the threat of fugitive emissions resulting from operating conditions, equipment ageing and the deterioration of sealing devices of valves and other process components. Commonly applied to valves, pumps and other sources, these practices are known as the "leak detection and repair" (LDAR) of sources. While a robust LDAR program is critical to safe and efficient plant operation, the emissions reduction potential for LDAR is highly variable and depends upon several factors. The frequency of monitoring, leak sources and the threshold definition of a leak should all be considered when determining the effectiveness of a leak detection and repair program. Furthermore, characteristics of individual sources can affect the emissions reduction achieved by LDAR. Important characteristics include leak occurrence rate, leak recurrence rate, accessibility of leaking equipment, and repair effectiveness.[2]

According to the EPA, a monthly monitoring plan is generally more effective than a quarterly monitoring plan in reducing emissions, as leaks can be identified and corrected more quickly. Similarly, a maintenance system that corrects smaller leaks usually is more effective than a system that responds only to larger leaks.

The standardized current practice of sniffing, established by EPA Method 21, aims to detect all leaks regardless of size for any product, and is highly effective in quantifying leaking sources on your equipment. Adhering to EPA Method 21 for fugitive emissions detection helps to identify emergencies and establish an adapted maintenance program.

The use of an infrared camera is an alternative practice to sniffing and allows plant operators to detect leaking sources in a qualitative way. Although this approach is quicker and less expensive, it fails to deliver quantitative leak information and identifies only large sources of emissions from certain products.[3]

Valve Supplier selection

Even the industry's most well-designed products can be destined to fail if not manufactured by trusted valve suppliers who utilize strict processes and high-quality materials. It is therefore crucial to implement a robust supplier selection process to ensure that valve manufacturers adhere to the highest safety and quality standards, and that they share a commitment to reducing fugitive emissions. A good supplier selection process will include preliminary assessments, continuous evaluation and clear communication of performance.

During the initial sourcing tollgate process, valve users should complete a product assessment that addresses the specifications and technical requirements of a product. Next, a supplier assessment and audit, including an in-depth analysis of quality, delivery and cost performance should be conducted. Finally, end users should verify the manufacturer's process control plan and implement an onboarding program, manufacturing readiness review and product inspection.

Evaluating supplier capabilities and ongoing performance is paramount to ensuring the reliability of their products. Expectations and feedback should be clearly communicated so that manufacturers can identify performance gaps and initiate corrective actions. As a result, a valve supplier's long-term effectiveness can be monitored to provide insight into future sourcing strategies and illustrate ways that both manufacturers and end users can ensure the safety and quality of their operations.

Conclusion

As new applications arise and emerging markets become major production centers, the valve industry's commitment to reducing fugitive emissions will likewise intensify. While valve manufacturers and users alike assume increasing responsibility for fugitive emissions control, utilizing highly-engineered products and establishing a framework of workplace best practices are essential in achieving their goals.

During product selection, valve users should focus on valve stem design, and the body to bonnet joint for superior fugitive emissions protection. Likewise, work practices such as implementing an LDAR program and a thorough valve supplier selection process can further ensure that daily operations support the objective of emissions reduction.

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About the author

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