

Improve Valve Reliability and Performance in PSA Applications

Challenge

Pressure swing adsorption (PSA) applications require control valves that maintain tight shutoff amidst high cycles and bi-directional flows. These harsh environments degrade control valves quickly, increasing maintenance and downtime and threatening PSA efficiency and throughput.

Solution

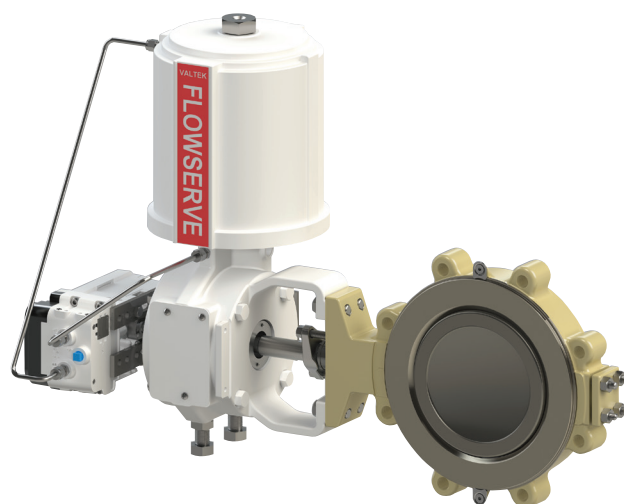
Flowserve proactively developed a unique valve soft seat to overcome the challenges inherent in PSA applications. We designed the valve to use the pressure drops across it (resulting from bi-directional flow) to help energize the soft seat to bubble-tight shutoff in either flow direction. The new soft seat increases control reliability, reduces maintenance costs and downtime, and improves PSA process efficiencies.

Industry shift in valves threatens PSA reliability

Chemical plants, oil refineries and other facilities often use PSA to separate and purify a wide range of industrial gases. PSA is commonly used in refinery units, ethylene plants, propane dehydrogenation plants, hydrogen manufacturing units (steam methane reforming) and air separation units. The PSA process uses “beds” of solid adsorbents to filter impurities from a feed gas. Control valves play a crucial role in the PSA process, as they regulate the bi-directional flow of feed gas across these beds.

For years, globe valves were the go-to valves for PSA applications. They provided reliable, tight shutoff and excellent wear resistance, even amidst high cycles (up to 200,000 per year) and bi-directional flow. Over time, the PSA industry shifted to more economical and advanced butterfly control valves. Butterfly valves, though widely used, struggled to meet the demanding PSA sealing requirements. Many of these valves, which were expected to last years, required maintenance after only 6 months.

Reliability issues stemmed from accelerated wear due to high cycling and bi-directional flow. Compromised valves impacted process efficiencies, increased maintenance time and costs, and resulted in PSA operations being offline for several hours to days as crews repaired valves.



Valtek® Valdisk™ high-performance butterfly control valve



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Flowserve designs a more reliable valve seat

Recognizing the shift to butterfly valves compromised efficiency and costs in PSA and other alternating flow applications, Flowserve took a proactive approach and designed an innovative valve seat to improve butterfly valve performance.

The Flowserve design philosophy includes using voice-of-the-customer insights combined with our in-depth industry expertise to create solutions that meet customers' needs. We set out to develop a high-cycle soft seat that could retrofit into an existing butterfly valve design. The valve seat's main requirements included:

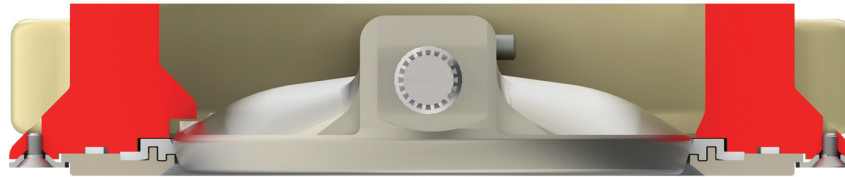
- Class VI shutoff
- 1,000,000-cycle life

Flowserve used these insights to develop a variety of design prototypes, including 4- and 12-in versions. After designing the valve seat, Flowserve engineers conducted cycle testing, made improvements, modified clearances, and conducted additional cycle tests before finalizing the new design.

The new soft seat incorporates several innovative proprietary key features, including:

- The valve seat's S-shape allows the seat to flex to better conform to the disc, creating a tighter seal and eliminating wear and misalignment issues.
- An anti-extrusion tab keeps the seat contained within the retainer and limits seat movement, keeping it from slipping and leaking when the valve disc rotates.
- Upstream and downstream pressure changes (from constant bi-directional flows) create a pressure-energized seal, forcing the seat tighter against the disc. This improves the seal and enables tight shutoff.
- The seat's angle below its sealing point is nearly parallel to the disc, reducing wear and leaks.

To ensure the valve seat works as intended, Flowserve tested it under real-world conditions to verify it can meet the cycle demands of PSA applications.



High-cycle soft seat arrangement on Valtek Valdisk valve





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Flowserve engineers conducted numerous hours of cycle testing on the new high-cycle soft seat arrangement before finalizing the design.

Reduce costs, downtime and process inefficiencies

By retrofitting existing butterfly valves with the redesigned valve seats, PSA operations can experience various benefits, including:

Improved valve reliability

Before Flowserve designed the new valve seat, customers reported having to respond to valve leaks every six months. Using the new design, PSA operations can extend valve mean time between repair (MTBR) to 2.5 to 3 years.

Reduced maintenance costs

By increasing valve MTBR to 3 years, PSA operations can significantly reduce costs in labor, parts and associated downtime over the valve's life.

Increased PSA efficiencies and profits

By increasing butterfly valve shutoff reliability, PSA operations can increase the pressure in the PSA vessel and extract purer hydrogen, oxygen and nitrogen (or other gases). Increased gas purity and capacities lead to greater production and higher profits.

To learn more about how you can increase valve reliability and performance in PSA and other alternating flow applications, contact your local Flowserve representative.

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