

AIR VALVES:

Critical Components in Modern Water Infrastructure

By Mark Gimson

WATER DISTRIBUTION SYSTEMS RELY ON MANY COMPONENTS WORKING TOGETHER SEAMLESSLY, BUT FEW ARE AS ESSENTIAL YET OVERLOOKED AS AIR VALVES. These

precision-engineered devices play a vital role in maintaining pipeline efficiency, safety, and longevity. Despite their importance, air valve failures remain a common issue that can lead to water contamination, reduced flow capacity, and in extreme cases, catastrophic pipeline failures. This article delves into the reasons behind air valve failures, the consequences of these failures, and the solutions available to mitigate these risks.

Understanding the Air Challenge in Water Systems

Air in pipelines presents significant challenges for water infrastructure. As an invisible and compressible fluid, air can disrupt water distribution in multiple ways. It forms pockets that impede flow, reduces pipeline capacity, and may create complete blockages known as airlocks. Additionally, trapped air accelerates corrosion, creates environments conducive to microbial growth, and intensifies water hammer effects.

“You can only move water as fast as you can get air out of the pipeline,” explains Dave Dolman, an expert in valve design. “Consider that a 40-in. diameter pipe that is 1 mile long and filled with water weighs 1,392 tons. Add gravity to that and you are dealing with 13,657 tons of force moving through that pipeline.”

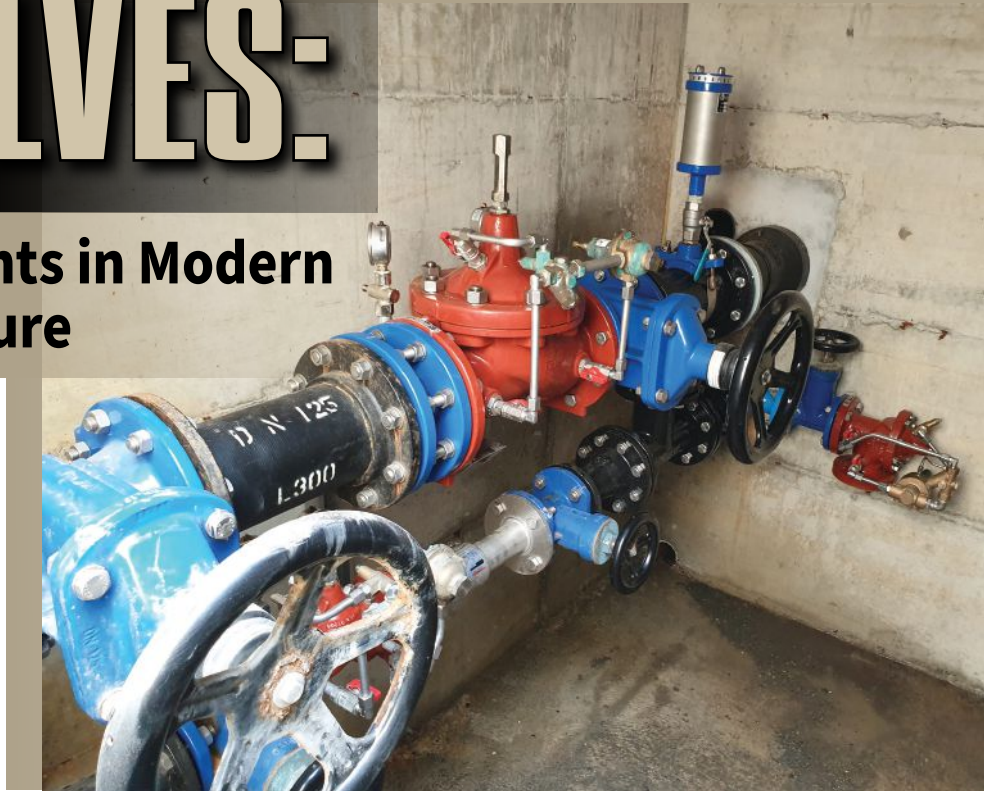
Air pockets function as pressurized springs that react to sudden pressure changes. Since air moves through pipelines up to seven times faster than water, these pockets expand and contract more rapidly

than water can adjust, causing dangerous velocity changes that may result in system failures.

When pipelines drain or experience negative pressure, they can collapse under atmospheric pressure if air isn't allowed to enter properly. This phenomenon has resulted in dramatic incidents, as Dolman has experienced worldwide.

“In California, we saw a 42-in. steel pipeline that carried water from a lake to the city's water treatment plant flattened like a pancake after contractors created a vacuum while draining the pipe. In terms of air valve failure, a town in Utah had a 110-foot section of a large steel pipe cave in when a frozen air vent caused a vacuum pressure while crews were draining the pipe for maintenance. These situations put workers at risk, and sometimes with devastating consequences as we saw with a project in the Middle East where water hammer was so bad that it shattered a Class 250 cast iron valve, killing an operator,” recollected Dolman.

Multiple factors contribute to air valve failures, including design limitations, insufficient maintenance, and installation errors. Many air valves cannot handle low-pressure conditions effectively, leading to leakage and failure. Accumulation of grease, fats, and various solids can also clog valves and render them ineffective.



Advanced Air Valve Technology: A Comprehensive Solution

To prevent air valve failures, it is essential to select high-quality air valves that are designed to handle the specific conditions of the water or wastewater system. These valves perform three critical functions: air release, air/vacuum intake, and surge protection in one valve. By allowing air to escape during pipeline filling, permitting air entry during draining, and controlling air release rates to mitigate pressure surges, these valves maintain the integrity and efficiency of water distribution systems.

“The Cla-Val 39A, for example, showcases some of these cutting-edge features. With a sealing pressure as low as 4.3 psi static and 7.25 psi dynamic, it ensures optimal performance even in low-pressure applications. Its versatility is evident in its pressure rating of up to 1450 psi and size range from 1 in. to 20 in., making it suitable for a wide array of installations,” said Dolman.

Advanced-engineered air valves incorporate features that address common pain points in air valve design and maintenance:

- 1. Gasket-free design:** Utilizes standard O-rings instead of custom gaskets, simplifying maintenance and reducing the need for specialized spare parts.
- 2. Durable construction:** Recognizing that air valves often serve as access points to chambers, opt for metal top caps instead of plastic, eliminating the risk of broken plastic components and ensuring longevity even under harsh conditions.
- 3. Foolproof assembly:** Ask for a universal anti-slam float to eliminate the risk of incorrect installation. Anti-slam mechanisms prevent rapid closure during high-pressure events, reducing the risk of water hammer.
- 4. Material versatility:** Tailor materials to specific environmental needs such as stainless steel, duplex, and super duplex alloys. This ensures long-term reliability even in corrosive or high-pressure applications.
- 5. Adaptable configurations:** Versatility allows utilities to standardize their air valve solutions across different parts of their network. Choose a line of air valves that has various outlet options and specialized models for different applications from potable water to sewage and even high-rise building systems. There is no one model-fits-all solution when it comes to air valves.

Spending a little bit more on advanced engineering and taking the time to ensure you have the right options for your specific application will go a long way in protecting your assets and personnel for years to come.

Benefits Beyond Failure Prevention

While preventing catastrophic failures is critical, properly functioning air valves deliver additional system-wide benefits:

- 1. Enhanced Efficiency:** By preventing air accumulation, valves ensure pipelines operate at full capacity, reducing pumping costs and energy consumption. Studies demonstrate that entrapped air can decrease system efficiency by up to 30%.
- 2. Improved Water Quality:** Minimizing areas where air can accumulate reduces potential for bacterial growth and water contamination.
- 3. Extended Asset Lifespan:** Effective pressure management and surge reduction help prolong the service life of expensive pipeline infrastructure.
- 4. Operational Control:** Features like controlled air release enable precise system management, particularly valuable in pump stations and areas with existing surge conditions.

Looking Forward

As water utilities continue upgrading aging infrastructure, recognizing the critical role of air valves becomes increasingly important. These components represent significant advances in water infrastructure technology and demonstrate how seemingly minor system elements can have outsized impacts on overall performance.

Proper selection, installation, and maintenance of air valves should be prioritized in all water management projects. By investing in these often-overlooked components, utilities not only protect their infrastructure investments but also ensure reliable delivery of water to communities worldwide.

As the water industry focuses on building more resilient and sustainable systems, advanced air valves will continue to play a vital role in meeting these objectives. 🌟

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Vacuum pressure created inside pipelines while draining, in addition to air valves failures, can cause even steel pipelines to flatten like a pancake.



Dave Dolman installing an advanced air valve.