FACILITIES & MAINTENANCE

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Hidden Failure Points in Fire Sprinkler Systems: Where Water, Air, and Neglect Collide

BY AGF

Fire sprinkler systems are widely recognized as among the most dependable life safety measures in the built environment—but reliability is shaped by the details. Learn the secrets to avoiding hidden failure points that can compromise performance when systems are needed most.

Yet investigations following system impairments, unwanted water discharge, or failure to operate as intended continue to reveal a common pattern: many problems originate not from major component failure, but from small, overlooked conditions that develop gradually over time.

These hidden failure points are rarely dramatic at installation. Instead, they stem from how air and water behave within piping networks, how systems are drained and tested, and how maintenance activities interact with original design assumptions. Left unaddressed, these factors can compromise system performance and increase the risk of impairment when the system is most needed. Understanding and mitigating these vulnerabilities is essential for designers, installers, inspectors, and building owners seeking reliable fire protection throughout the life of a building.

Reliability Is Not the Same as Compliance

Modern fire sprinkler codes and standards establish essential baseline requirements for life safety. Meeting those requirements is essential, but compliance alone does not guarantee long-term reliability. In practice, many systems that technically meet code still experience operational issues that increase the risk of impairment during testing, maintenance, or emergency activation. These issues often arise from design decisions made early in a project, particularly when consideration is given primarily to installation efficiency rather than to how the system will perform over decades of service.

Reliability is shaped by the details. It depends on how air is managed within the piping network, how water is drained after testing or system activation, and how easily the system can be inspected and maintained without introducing new risks. These considerations are often secondary during design and installation, yet they play an outsized role in how systems age and perform.

Trapped Air: A Global Challenge with Local Consequences

Air is inevitably introduced into wet fire sprinkler systems during initial filling, maintenance activities, and normal operation. Temperature fluctuations cause dissolved gases to come out of solution, forming air pockets even in sealed systems. Once inside the system, air migrates to high points in the piping network. If it is not actively removed, it becomes trapped. In wet systems, trapped air accelerates internal corrosion by introducing

oxygen into the piping network, increasing the likelihood of pinhole leaks, premature pipe failure and obstructions.

Across global markets, removing trapped air has become an increasingly recognized best practice. Air vents are now required by NFPA 13, allowing accumulated air to be released. Automatic options continuously remove trapped air without manual intervention. When installed at appropriate high points in a system, they help reduce long-term corrosion risk and extend the longevity of system piping.

Cold Climate Lessons That Apply Everywhere

Freeze-related failures are among the most visible and costly sprinkler system issues, but the lessons they reveal extend well beyond cold climates. Investigations frequently show that freezing occurs not because systems lack heat tracing or insulation, but because water remained trapped where it should not have been.

These failures highlight the cumulative effect of small design and maintenance decisions. A slight sag in piping, a missing auxiliary drain, or an undocumented low point can allow water to collect unnoticed. When temperatures drop, the consequences are immediate and severe. Even in regions where freezing is rare, the same trapped water conditions contribute to corrosion and long-term degradation, reinforcing the importance of effective drainage worldwide.

The Role of IoT in Preventive Fire Protection

Internet of Things (IoT) technologies are increasingly being applied to life safety systems to provide continuous insight into system status. Sensors can monitor pressure, temperature, valve position, and water presence, transmitting data that allows stakeholders to identify abnormal conditions early.

When integrated thoughtfully, connected monitoring does not replace inspections or maintenance. Instead, it enhances them by highlighting where attention is needed most. Early alerts allow corrective action before conditions escalate into impairments, water damage, or system downtime.

Solutions such as AGF Connect, which provide remote monitoring of key sprinkler system parameters, illustrate how digital tools can support preventive maintenance strategies. By offering real-time visibility into system conditions, these platforms help bridge the gap between scheduled inspections and everyday operation.

Data as a Tool for Risk Reduction

Beyond individual alerts, connected systems generate valuable data over time. Trends in

continued...

pressure fluctuation, temperature exposure, or repeated minor events can reveal systemic issues within a building or across a portfolio of properties.

For building owners and facility managers responsible for multiple sites, this data supports more informed decision-making. Maintenance resources can be allocated proactively, reducing emergency responses and unplanned downtime.

From a broader industry perspective, aggregated data offers insights into how sprinkler systems behave in real-world conditions, informing future design practices and standards development.

Small Interventions, Meaningful Impact

Post-incident analyses consistently show that system impairments often begin with small, manageable issues: trapped air in a wet system, condensation in auxiliary drains, or gradual pressure loss over time. Individually, these issues may seem minor. Collectively, they represent a significant reliability risk.

Addressing these vulnerabilities does not require radical system redesign. Instead, it involves thoughtful integration of air management, effective drainage, and improved system visibility. Automatic air vents, heated auxiliary drains, and remote monitoring technologies all play a role in reducing uncertainty and improving system resilience.

Designing for the Life of the Building

Fire sprinkler systems should be evaluated not only on their performance at installation, but on how reliably they operate throughout decades of service. Systems designed with air, water, and visibility in mind experience fewer impairments, lower maintenance costs, and improved confidence among stakeholders.

Designers, installers, and owners who adopt a life-cycle perspective recognize that reliability is an ongoing process, not a one-time achievement. Integrating practical, preventive measures at the design stage supports safer, more dependable fire protection over time.

Toward a More Predictable Future

Fire protection has always been rooted in anticipation and prevention. As buildings become more complex and expectations for reliability increase, the industry is evolving to address not only catastrophic events, but the everyday conditions that lead to them. By combining sound system design and proactive maintenance, the industry can reduce hidden failure points and enhance confidence in fire sprinkler system performance.

ABOUT THE AUTHOR: AGF Manufacturing is a family-owned, American manufacturer delivering innovative fire sprinkler solutions for over 30 years. Known for industry-leading TESTanDRAIN and specialty products, AGF combines reliability, versatility, and hands-on expertise to simplify maintenance and improve fire protection system performance.

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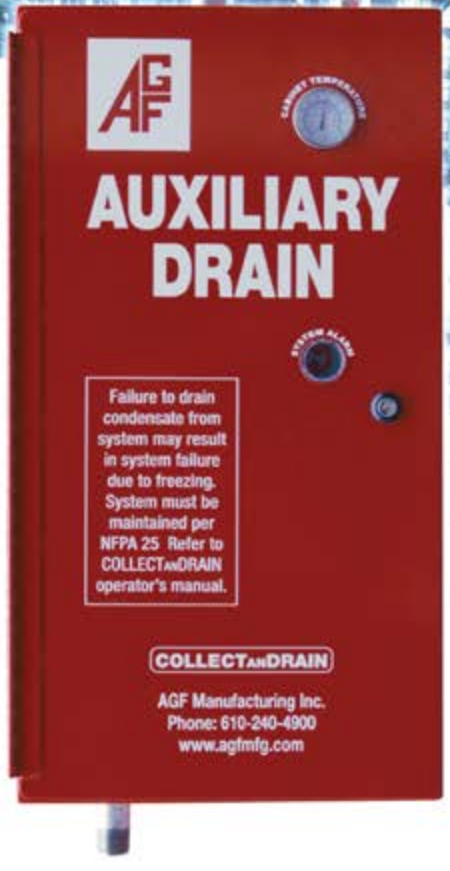
PRODUCT VIDEO



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At a major university residential expansion project in the Southeast, collaboration and cooperation among the construction management firm, window and door manufacturer, and installation contractor resulted in a several stunning projects recreating the look of the surrounding century-old buildings. All totaled, Hope's Windows, Inc., supplied over 1,200 unique windows made from custom hot-rolled steel profiles and nearly 100 high traffic and fire-rated door assemblies made from 10 and 12 gauge cold-rolled steel.

According to Sean Farrell, senior project manager at Layton Construction, establishing collaborative relationships is key to successful construction projects. One of the best examples of this maxim is a multi-phase university project for which Layton Construction is serving as construction manager. Layton, part of the STO Building Group, is a nationally-ranked commercial contractor with ten offices around the United States. The firm specializes in healthcare, industrial, warehousing, and higher education projects. As construction manager, Layton hires the sub-contractors and manages and oversees the project as part of a team.

> "Since we were building windows and doors to make a brand new college, we needed a company with the methodology to produce the product like it was done 100 years ago."
>
> *— Sean Farrell, Sr Project Manager*
> *Layton Construction*

Hope's Brian Whalen, Vice President of Sales, acknowledges that the project was a real test of Hope's capabilities. He is especially proud that they Hope's was able to expedite the schedule even in the face of design changes and in the midst of the Covid-19 pandemic. The shop drawing approval process – including preparation of blueprints of windows and doors with all setting conditions, sizes, customized designs, and required testing – took longer than normal. Changes were made along the way that might have pushed back the delivery schedules for some, but Hope's made adjustments during the production process to deliver all materials on time. Whalen gave a nod to Joey Riggan and the team at Alexander Metals, the frame and glass installer team, saying the overall project went extremely smoothly once the frames were on site.

Says Whalen, "It was a fantastic collaboration among all the parties. Hope's worked closely as the manufacturer to fulfill the architect's design vision, and then the installer worked closely with us to make sure everything was installed executed properly."

PHOTOS: Steve Hall, © Hall + Merrick Photographers

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Hope's® Windows, Inc., is a business based on 100 percent customized work design and manufacturing, Hope's provides a specialized skillset to assist clients in design and production of unique window and door assemblies. Meeting the expectations of Layton Construction in combination with the aesthetic vision of the client and architect was definitely a challenge. The overall experience was a testament to the quality standards of the university and an honor to be a part of. In business since 1912, Hope's had the global experience to make it happen.

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