Fire Sprinkler Systems Corrosion Risk Assessment

Consultant-Driven Solutions for Fire Sprinkler Corrosion Detection and Prevention

CORROSOLVE
CORROSION & IMPAIRMENT REMEDIATION

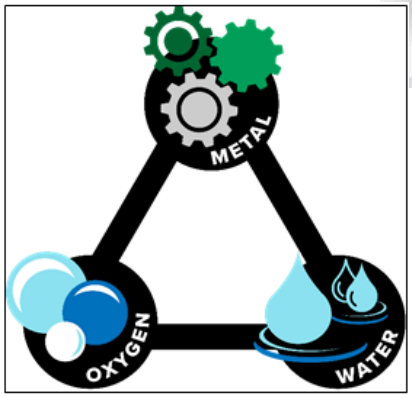
Corrosion in Fire Protection Piping Systems

Corrosion is a general term that can include oxidation, cathodic etching and biologically influenced water chemistry changes. The most common form of corrosion in the built environment is oxygen cell corrosion, which can occur when steel piping comes into contact with oxygen and water, triggering a reaction that produces iron oxide - commonly known as rust - and is a positive-charge reaction. Cathodic corrosion occurs when ferrous piping becomes negatively charged, and can be triggered by inadquate grounding of water-based system piping or the contacting of dissimlar metals. The third type of corrosion is due to biological influence, such as bacteria colonizing in water-based piping or storage vessels. Fire sprinkler systems are expecially at risk to this third type of corrosion, known more commonly as Microbiologically Influenced Corrosion, or MIC. All of these reactions are destructive and progressive, meaning that once it starts, the rate of deterioration accelerates over time. Of these, MIC is the most intrusive and challenging to resolve because it almost never exhibits signs of infection and internal corrosion until the piping starts to leak.

MIC is typically localized, meaning that while specific sections may experience severe degradation, widespread failure across the entire system is extremely rare. Targeted repairs or partial piping replacement are most often sufficient when identified early.

- Detection tools such as video scoping (borescopes) help visualize internal pipe conditions, making it possible to pinpoint corrosion before it causes operational issues or leaks.
- Service contractors often enable infected systems to continue leaking over time, driving up the value of their maintenance contracts and often culminating in costly proposals to remove and replace the entire system.
- Understanding and addressing the science of corrosion is essential for maintaining system integrity and ensuring long-term reliability of fire protection systems.

Both wet and dry fire sprinkler systems are susceptible to corrosion, but MIC targets wet systems, as the water-filled piping provides a controlled and hospitable environment for bacteria. What makes bacterial infections more persistent than other sources of corrosion is that the bacteria known to cause MIC can metabolize with (aerobic) and without (anaerobic) oxygen, whereas the other types of corrosion only occur in the presence of oxygen.



Risk Identification – Assessing Potential Hazards

The most common bacteria that cause MIC are known as sulfate-reducing and iron-oxidizing and they attack the integrity of the piping in different ways:

- **Sulfate-reducing bacteria (SRB)** accelerate steel corrosion by producing hydrogen sulfide (H2S) as a byproduct of their metabolism, which reacts with iron to form iron sulfides, weakening the steel. They also create acidic microenvironments and biofilms that further promote corrosion. SRB can thrive in both aerobic and anaerobic environments, enabling dense and aggressive colonization in fire sprinkler systems regardless of how much trapped and dissolved oxygen there is in the system.
- **Iron-oxidizing bacteria (IOB)** accelerate steel corrosion by using iron as an energy source, leading to the formation of iron oxides and other compounds that can damage the steel. These bacteria oxidize ferrous iron (Fe2+) to ferric iron (Fe3+), releasing energy in the process, and this oxidation can create localized areas of differing oxygen concentrations on the steel surface, causing corrosion. Like SRB, IOB can create biofilms that trap corrosive byproducts, and are most robust in aerobic environments.

Corrosion Hard Facts

- Corrosion is cumulative; it worsens over time and becomes increasingly aggressive, especially in piping with poor drainage or by frequent oxygen introduction, such as draining and refilling the system with fresh water. Once thought to be a means of resolving MIC by discharging the bacteria, we now know that introducing fresh water replenishes the oxygen and revitalizes the bacteria.
- The most corrosive byproducts of bacterial activity are Hydrochloric Acid (HCl) and Hydrogen Sulfide (H2S). Once bacterial colonies begin to form on the sides of the pipe walls they will grow in density and number of layers as biofilms create scale and pockets of trapped HCl and H2S, which often manifest as tubercules, which are barnicle-like bumps on the piping. These are the "hot-spots" where pinhole leaks usually start, which is the first visual cue that there's something wrong in the piping.

Common Risk Factors

- Use of thin-wall piping (Schedule 7), which can be 30% thinner walled than Schedule 10 and 45% less than Schedule 40.
- Frequent draining and refilling of the system (introduces fresh oxygen in both trapped air pockets and dissolve in water).
- System elevation differences that cause trapped water.
- No means to exhaust or release trapped air.

Corrosion in fire sprinkler piping is a silent threat that can compromise system performance long before visible signs appear. Identifying and understanding the associated risks is critical to ensuring life safety, property protection, and business continuity.

Avoid Costly Interruptions and Repair

Risk of Piping Failure
MIC weakens the internal walls of sprinkler piping, usually evidenced at first by pinhole leaks. If not addressed, the chances of a more profound pipe failure increase as the infection intensifies.

- Water damage to building contents and finishes.
- Unexpected system activations due to water movement.
- Costly emergency repairs and service interruptions.

Impacts to Business Operations
An impaired fire sprinkler system disrupts operations, sometimes triggering facilities shutdowns and temporary interruption of occupancy. Corrosion-related failures are considered "unplanned" impairments and absent a contingency plan, may lead to costly interruptions of operations.

- Costly fire watch or fire department standby fees.
- Insurance implications and increased liability.

Compromised System Performance
MIC not only fosters corrosion, it causes buildup of sludge, scale and slime that reduces internal diameter, clogs sprinkler outlets and impairs system performance.

- Reduced flow due to internal obstruction or blockage.
- Delayed or inadequate sprinkler response.
- Increased risk to adjacent tenants and structures.

Liability and Exposure to Damages
Insurance companies put up obstacles to MIC-related claims .

- MIC is classified as an environmental hazard like black mold and mildew. Without specific coverage, claims are most often denied.
- Even with coverage in place, general liability claims can allege negligence if rigorous maintenance and inspection protocols are not undertaken, especially if a known impairment is the cause.

Anticipate | Identify | Prevent
Property owners, asset managers and facility service directors must collaborate, plan and practice proactive measures to diagnose, remediate and control biologically-influenced corrosion.

- Conduct regular internal inspections using tools like video scoping or ultrasonic testing
- Monitor for early warning signs (discoloration, pinhole leaks, system pressure drops)
- Evaluate system materials, design, and age
- Partner with fire protection professionals for risk assessments. corrosion management plans

Understanding and identifying these risks early enables timely maintenance, extends system life, and ensures that fire sprinkler systems perform as designed when they are needed most.

Our Method

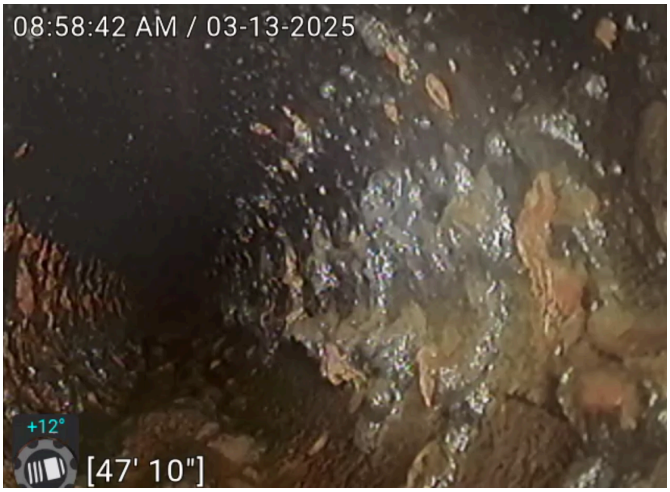
Due Diligence Inspection
A technician from our consulting team reviews the property's risk factors and leak history to develop the most effective and appropriate assessment strategy. If the intent is to identify whether a building is at risk, water samples are taken from the systems and public water supply for comparison and detailed analysis.

On-Site Assessment
Leveraging data from comprehensive internal video investigation, pipe sample analysis, system design evaluation, leak history, and our engineering expertise, Corrosolve will identify and document:

- Overall condition of piping using Red-Yellow-Green color-coding to clearly illustrate severity of damage.
- Locations of all known leaks and where piping has been previously replaced
- Roof and system high points, and areas where air is trapped in the system
- Risk levels associated with potential leaks or obstructions

Industry-Best Practices and Methods

- Collaborate closely with building management and tenant representatives to identify the least disruptive camera insertion points within occupied spaces. The ultimate objective is to minimize tenant disruption while undertaking a thorough investigative process.
- Develop a detailed work plan is developed and shared in advance, clearly outlining the specific areas and suites where our team will be present each day.
- Work closely with the owner's designated fire protection contractor to safely open designated sections of the sprinkler system, close joints at camera access points and restore service upon completion.
- Our team will access elevated piping and disassemble pipe joints as needed to undertake internal video inspections. We use advanced, self-leveling borescope cameras equipped with time and date stamping, as well as distance-tracking capabilities. These state-of-the-art cameras can travel up to 200 feet within a single branchline, enabling extensive inspection coverage while minimizing disruption to tenant spaces.



Deliverable Work Product

Assessment Report

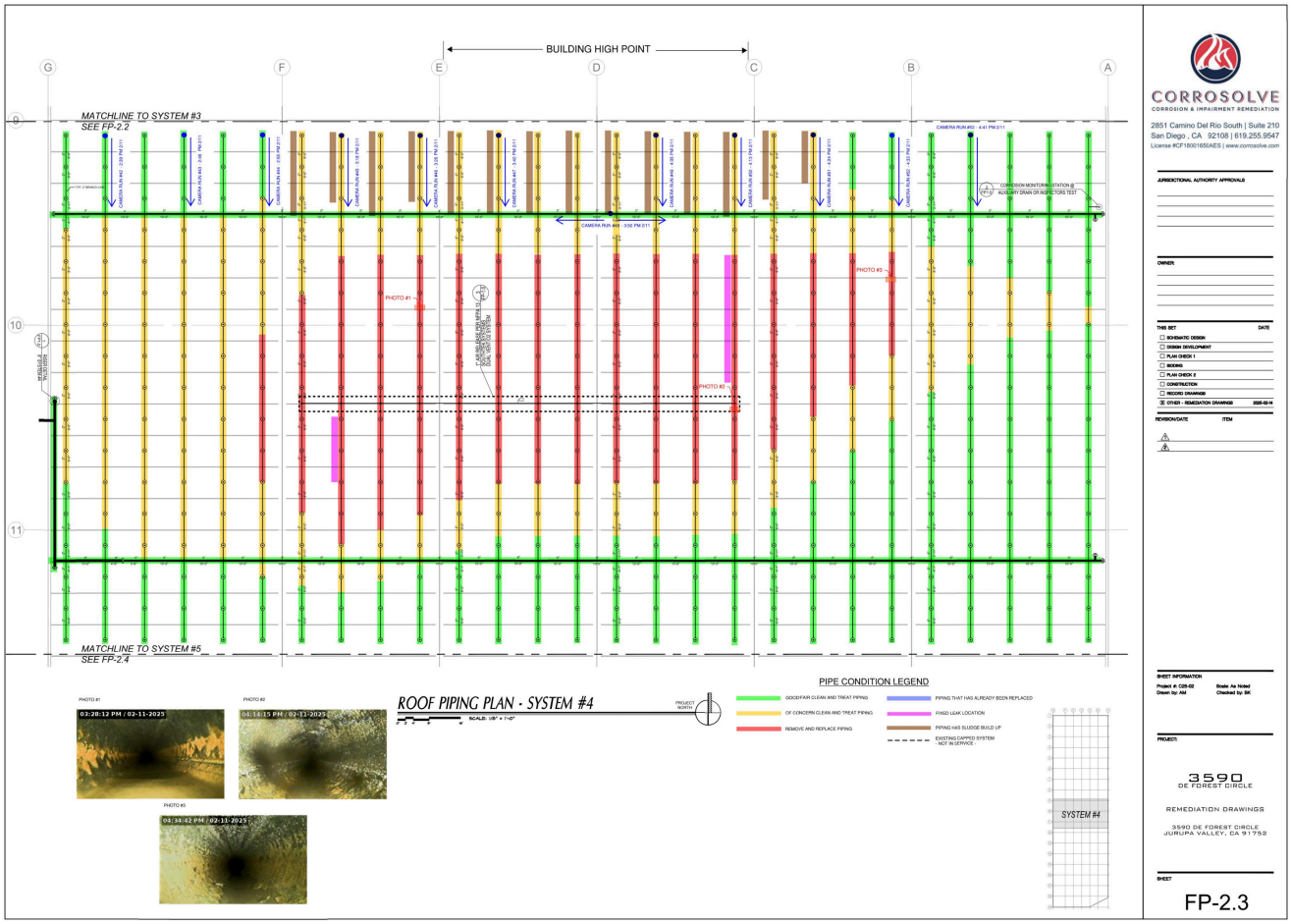
- Comprehensive technical summary outlining corrosion issues and associated risk factors
- High-resolution images from the interior of the sprinkler piping system with narrative commentary
- Documentation of standout physical evidence
- Identification of the root cause of corrosion and contributing factors affecting the current system condition
- Strategic remediation recommendations aligned with your long-term facility objectives, including:
  - Targeted pipe replacement
  - Corrosion mitigation and control measures
  - Design enhancements or modifications

Supporting Documentation

- Annotated sprinkler system drawings with clearly marked recommendations, and color coated legends for streamlining communication with contractors and minimizing administrative burden while bidding out repairs to contractors.

Post-Assessment Support

- Continued access to Corrosolve for technical guidance
  - Coordination meetings with contractors to define and clarify the scope of work
  - Consultations with facility ownership or management as needed
  - Post-construction verification to ensure completed work aligns with defined scope and standards



CORROSOLVE

CORROSION & IMPAIRMENT REMEDIATION

Steve Leyton - President

Brent Kearney - Vice President

CORROSOLVE
CORROSION & IMPAIRMENT REMEDIATION
2851 Camino Del Rio South, Suite 210
San Diego, CA 92108 | 619.255.9547