Engineered Corrosion Solutions

Science of Corrosion and Corrosion Management for Fire Sprinkler Systems

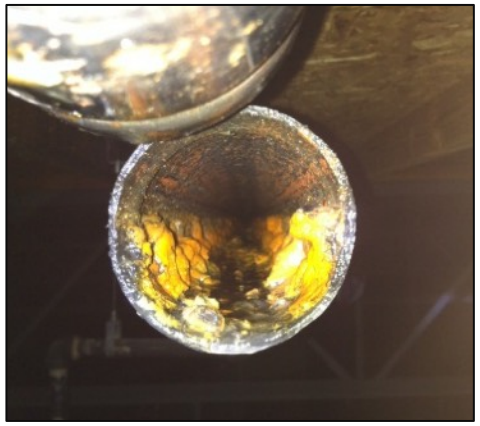
by Engineered Corrosion Solutions, LLC

Setting the standard in corrosion control

Question: Why is corrosion such an important issue?

Answer: Corrosion doesn't just cause leaks in fire sprinkler systems;

It impedes water delivery to the fire!

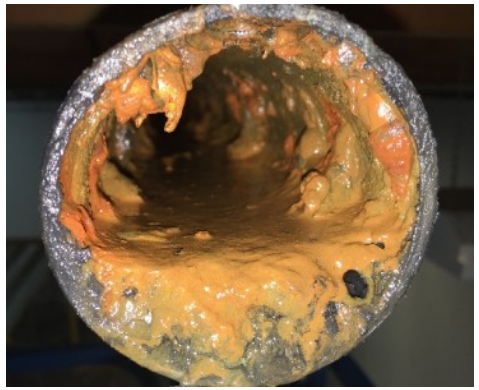


NFPA July 2017 Research Report "U.S. Experience With Sprinklers"

- **Sprinklers 96% effective when they operate**
- **No. 1 cause for failure to control - System Shut Off**

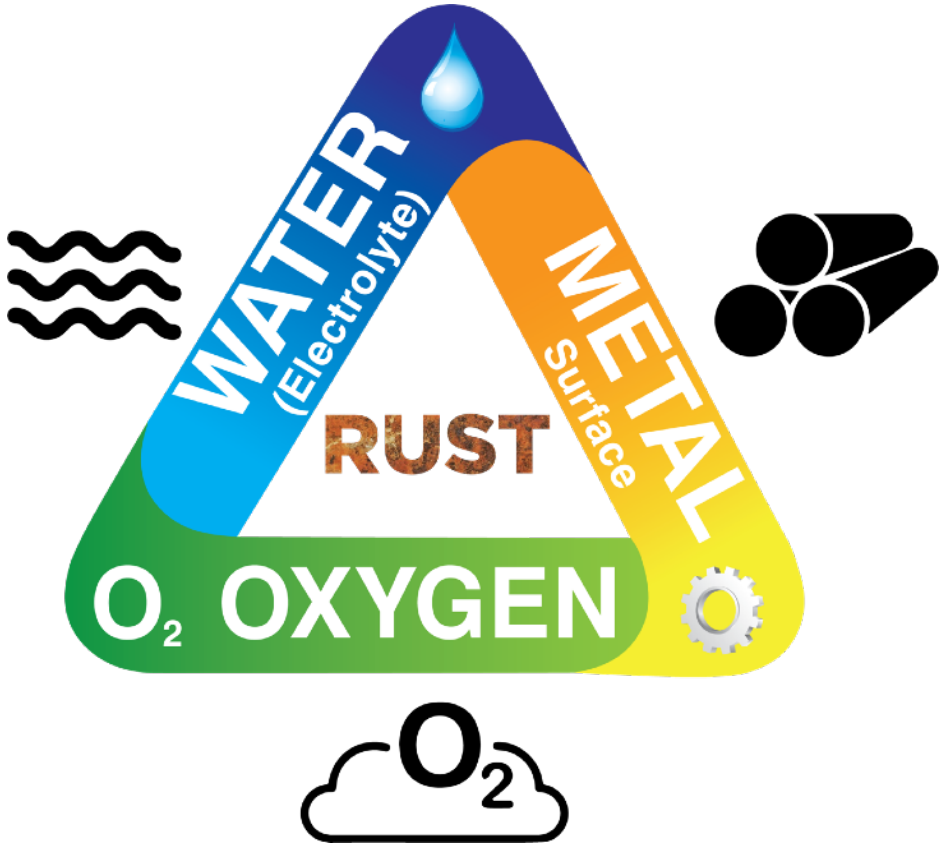
<u>When Sprinklers Operate But Are Ineffective at Control</u>

- **No. 1 cause (51%) - Water did not reach fire**
- **No. 2 cause (30%) - Not enough water discharged**



The Science of Corrosion

Oxygen is the Primary Cause of Corrosion in Sprinkler Systems



The Science of Corrosion

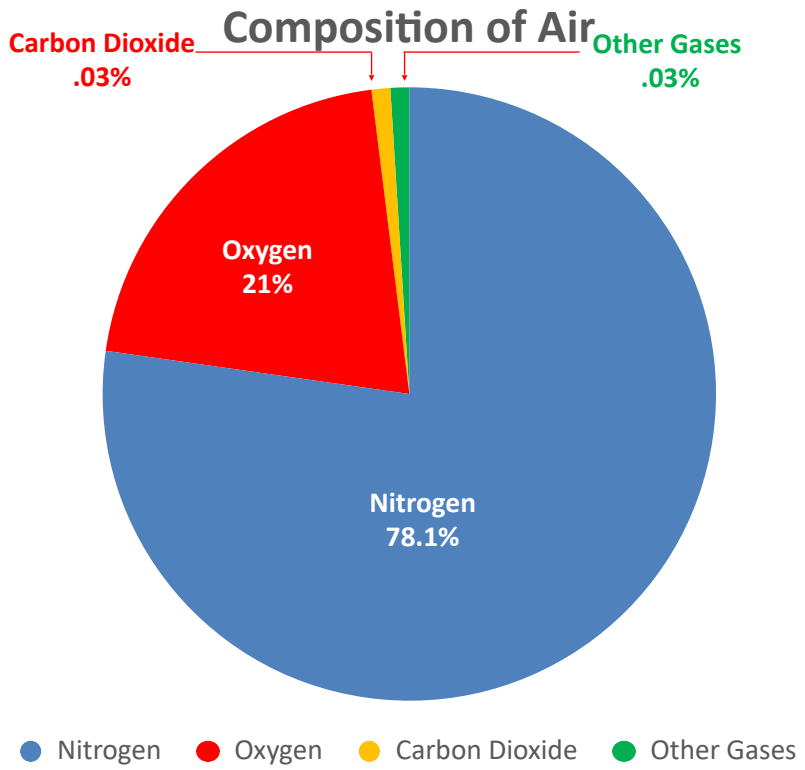
Raw Iron Ore

Energy In

Formed Steel
Fire Sprinkler Tubing

Steel tubing wants to return to a lower energy state
Iron Oxide or CORROSION

The Science of Corrosion



The Corrosive Gases in air are Oxygen (21%) and Carbon Dioxide (0.03%)

Factors that Accelerate Corrosion in Sprinkler Systems

- More oxygen = more corrosion
  - More activity (drain/fill, repairs, remodels)
- Dry pipe fails faster than wet pipe
- Galvanized fails faster than black steel
- Higher temperature increases the rate of corrosion
  - Every 18°F (10°C) increase = Corrosion rate doubled

Corrosion is Cumulative

Systemic Corrosion Practices

Fire sprinkler industry in general has several **“systemic”** practices that make corrosion problems **unavoidable**

- Wide spread use of ***thin walled*** branch lines
- Using ***galvanized pipe*** on dry/preaction systems
- Gridded design with ***elevated branch lines***
- Inspector’s test on riser ***no longer vents air***
- Lack of ***heat annealing*** of welded joints and seams
- ***Trapped water*** in all dry pipe systems
- Code mandated ***system testing***

The Most Common Myths Regarding Corrosion

MIC (Microbiologically Influenced Corrosion) is the primary cause of leaks in fire sprinkler systems.

- *Bacteria are always present, but oxygen is the primary cause of corrosion in fire sprinkler systems[1].*
- *No direct correlation between bacteria present in a fire sprinkler system and leaks in the sprinkler system.*

Bad Water causes fire sprinkler system leaks.

- *Almost all fire supply water comes from fresh, clean municipal water supplies that are not chemically corrosive.*

Materially Defective Sprinkler Pipe causes leaks, particularly at the weld seam.

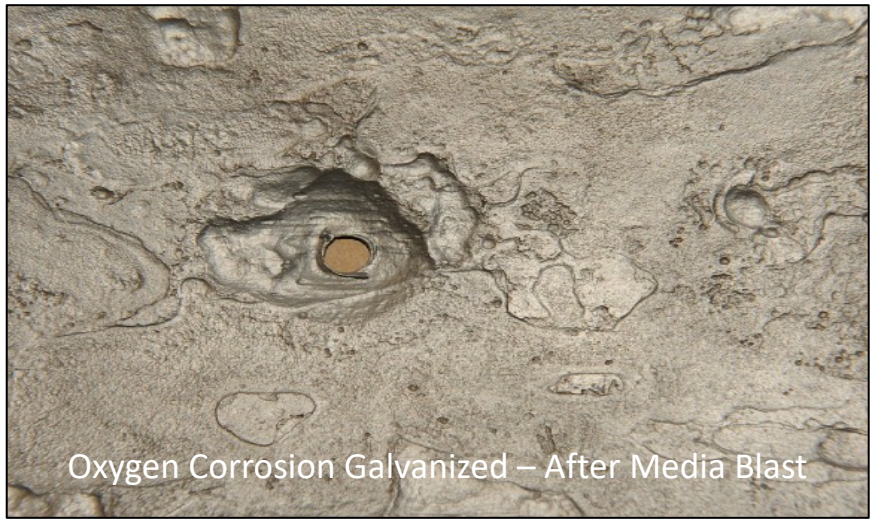
- *Pipe materials used today meet or exceed ASTM requirements incorporated in NFPA 13. Root cause analysis very rarely identifies material defect as the cause of failure.*

Pervasive myths regarding corrosion have hindered the implementation of effective corrosion control strategies in fire sprinkler systems.

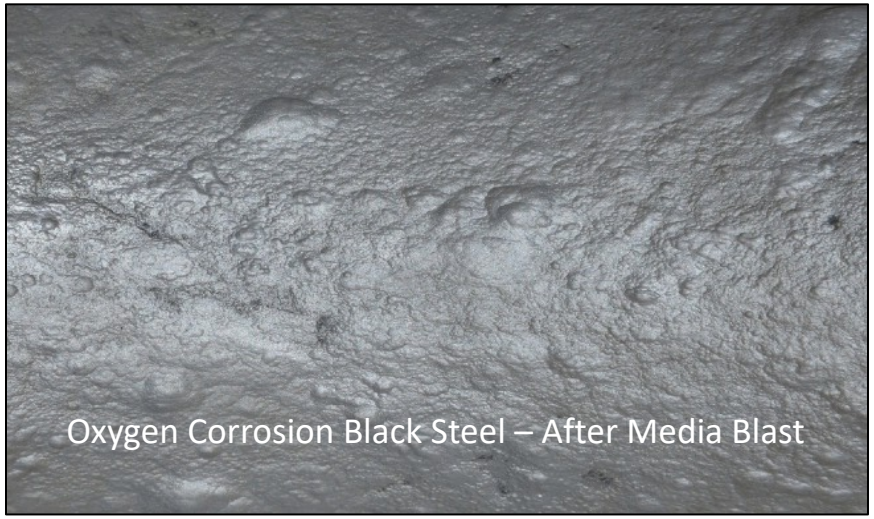
[1] "Corrosion and Corrosion Mitigation in Fire Protection Systems" by Paul Su and David Fuller., FM Global Technical Report- July 2014

Sprinkler System Corrosion

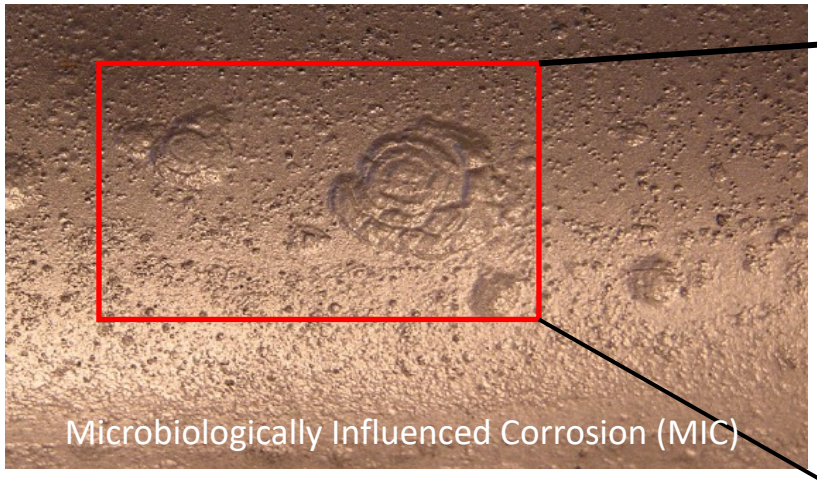

Oxygen Corrosion Galvanized – Before Media Blast


Oxygen Corrosion Galvanized – After Media Blast


Oxygen Corrosion Black Steel – Before Media Blast


Oxygen Corrosion Black Steel – After Media Blast

Sprinkler System Corrosion



Options for Controlling Corrosion

1. **Metallurgy** – too expensive (copper, stainless)
2. **Plastics** – restricted by code (light hazard, residential)
3. **Coatings** – delamination complications (sprinkler plugging)
4. **Chemical Inhibitors** – ineffective, incompatible (designed for flowing systems, degrades plastics and elastomers)
5. **Remove the Corrosive Gas** – purge the oxygen

Fill and Purge Breathing vs. Constant Pressure Venting

	ECS Only **"Fill and Purge" Venting**	Other Providers Constant Pressure Venting
Supervisory Gas Pressure	Digitally Controlled Fluctuation	Static
Vent Location	Riser Room	Remote (Over Protected Area)
Gas Mixing	Throughout	Poor
Oxygen Removal	Complete	Partial

Case Study – Compressed Air Dryer vs. Nitrogen Generator

Background:

- Cold storage facility
- 1MM+ square foot facility
- Supervisory gas provided by eight (8) Dry Air Pac™ units
- Annual inspections

Problem:

- Frost and **ice plugs were consistently being found** during annual inspections
- Dry Air Pac™ maintenance was cumbersome and costly

Solution:

- Four (4) of the Dry Air Pac™ units were replaced with a single ECS Nitrogen Generator

Results:

- **Zero ice and frost accumulation** in subsequent annual inspections
- Project completed in May 2016

Nitrogen Generator Basics and Features

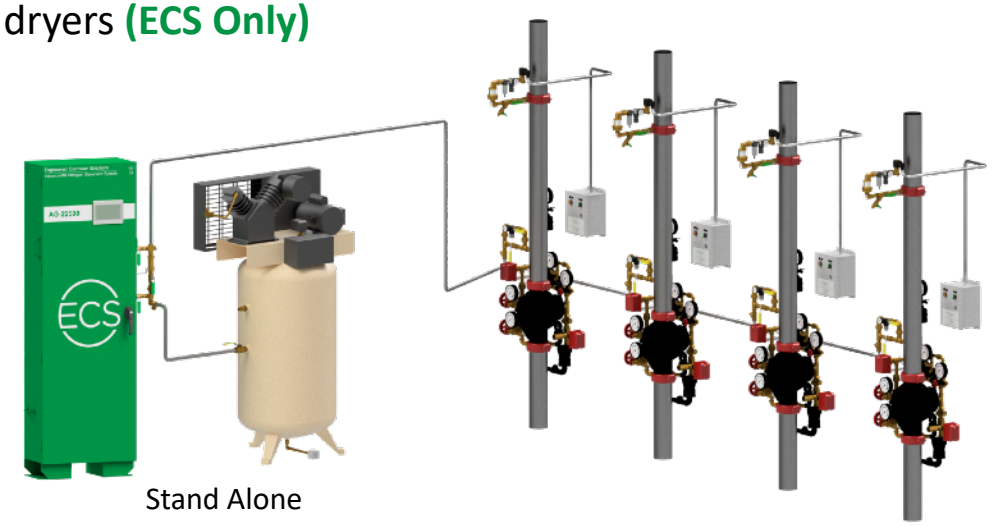
Basics

- Nitrogen generators can serve one or more systems from a single location.
- Available in wall-mount or stand-alone configurations.

Wall-Mount

Important Features

- FM Approved (Standard 1035), UL Listed (UL 508A), CE Certification
- HMI Interface with Internet Connectability and Remote Monitoring
  - Bypass Alarm Signal (visual)
  - Leak Monitor Alarm (audible)
- Vent installed at the riser **(ECS "Fill and Purge" Breathing Only)**
- No nitrogen storage tanks or refrigerated air dryers **(ECS Only)**
- Standard monitoring points
  - Nitrogen generator loss of power
  - Air bypass mode
  - Nitrogen generator running
  - Nitrogen supply line pressure
  - Excessive runtime/leak monitoring



Stand Alone

FM APPROVED

UL 508A Listed Industrial Control Cabinet

UL 508A Listed to Canadian Standards

CE

Sprinkler System Comparison

Untreated System **WPNI Treated System**

Corrosion Monitoring

What is Corrosion Monitoring?

- Implementation of devices used to give real-time corrosion data within Fire Sprinkler Systems

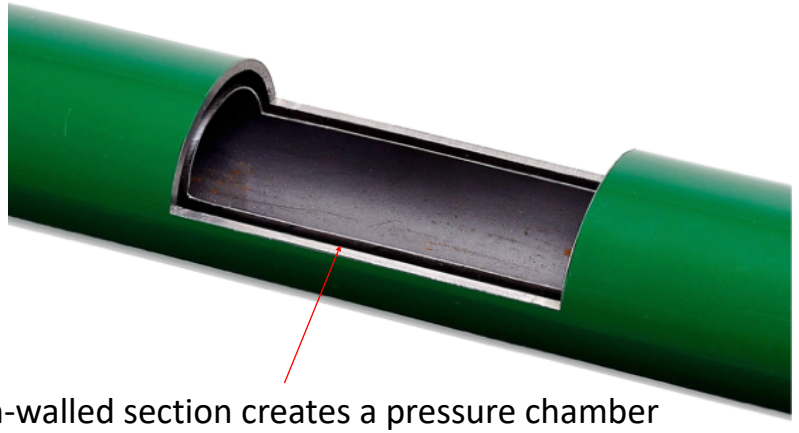
Why is Corrosion Monitoring necessary?

- Early warning to prevent risk
- Validates effectiveness of corrosion management system

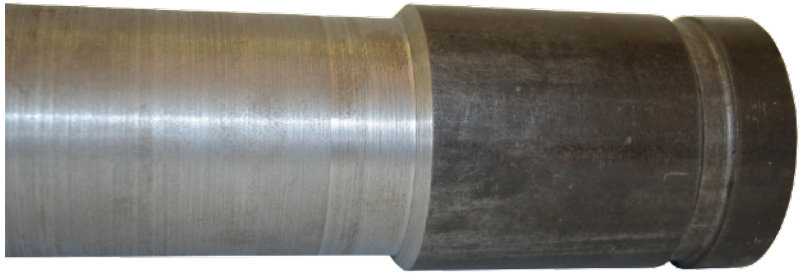
In-Line Corrosion Detector (ILD) - U.S. Pat. No. 9,095,736

Important Features:

- Only **UL Listed (UL 2987) method** for monitoring corrosion in fire sprinkler systems.
- **U.S. Pat. No. 9,095,736**
- **For Dry Pipe, Pre-action and Wet Pipe Systems.**
- **Complete 360º Coverage of Corrosion Detection.**
- Continuous monitoring of corrosion activity inside fire sprinkler system.
- Installed where corrosion is most likely to occur.
  - Low point mains in dry systems.
  - High point branch lines in wet systems.
- Local and remote monitoring.



Thin-walled section creates a pressure chamber



Milled section of pipe, results in thin-walled section of 35 mil wall thickness

Remote Test Station included

QUESTIONS?

- Additional Information: www.ecscorrosion.com
- Email Questions: info@ecscorrosion.com
- Contact Direct: (314) 432-1377

- Additional webinars or in-person presentations available upon request