



# *Corrosion in Fire Sprinkler Systems*

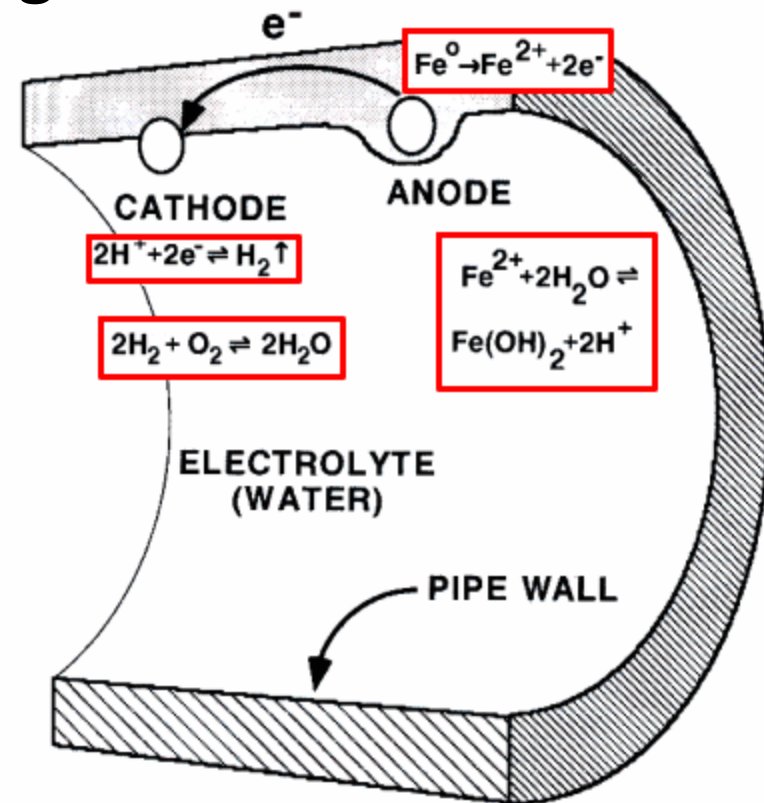




## Generalized Corrosion

Generalized Corrosion, also known as rust, requires 3 things:

- 1) Water
- 2) Iron
- 3) Oxygen



Generalized Corrosion Cell  
(Rust reaction)



## ***MIC in FSS***

FM Global study found **10-30%** of corrosion was influenced by MIC and **70-90%** of corrosion was generalized (oxygen) corrosion.





## *Slowing Corrosion*

The largest concern for corrosion is related to oxygen.

How do we eliminate oxygen in the fire protection system?



## ***Dry and Pre-action***

*Corrosion flourishes in Dry and Pre-action systems because air compressors supply an **unlimited** supply of oxygen and water.*

Trapped water from hydrostatic testing, combined with humid air supplied constantly by the air compressor creates a perfect storm.



Typical “Dry” System



# *Nitrogen*

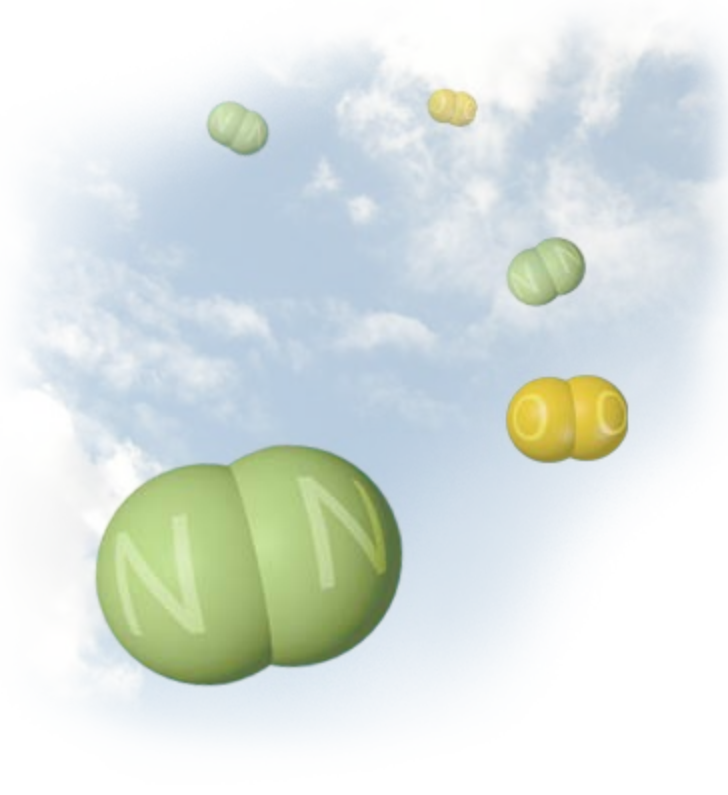
## Replace the Oxygen with Nitrogen.

**Nitrogen is an INERT gas.**

It does not react with metals.  
Thus, no oxidation or rust occurs!

The earth's atmosphere is 78%  
nitrogen and 21% oxygen.

Strip the oxygen from air and  
leave pure nitrogen!





# *Nitrogen Tests*



**Corrosion Comparison Tests**



# *Nitrogen Tests*



**Compressed Air**



**98% Nitrogen**

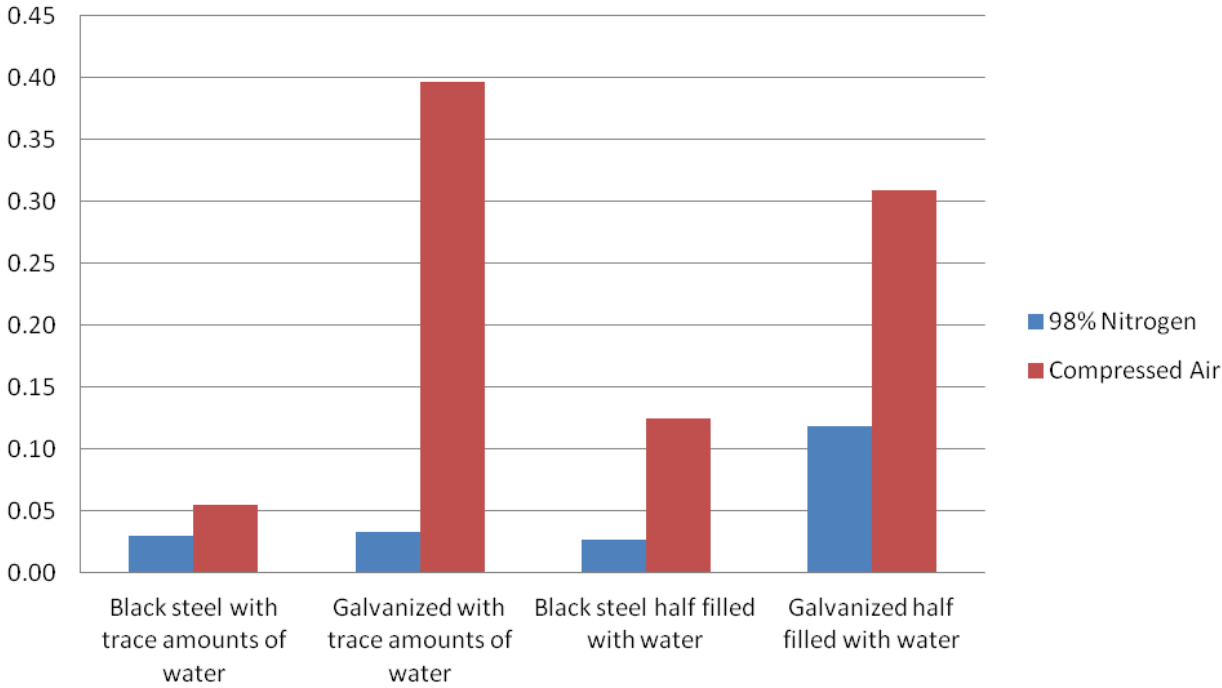
**After 20 months**





# Nitrogen Tests

### Metal Loss of Corrosion Coupons under 98% Nitrogen and Compressed Air



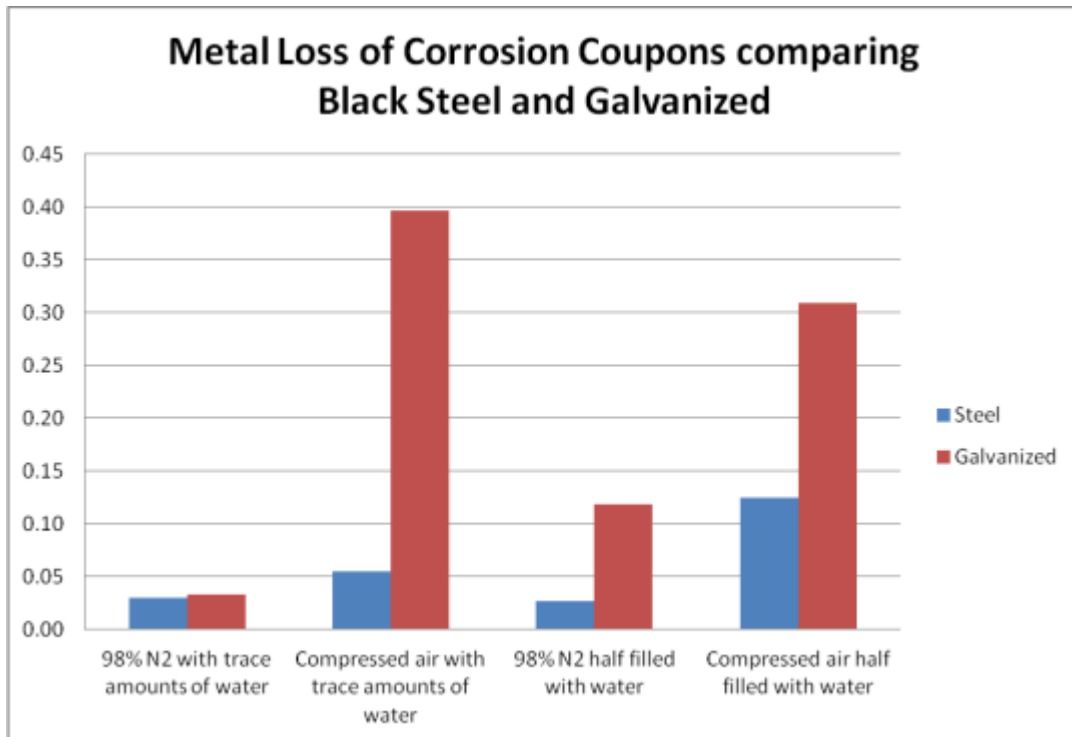
On average, using 98% Nitrogen gas over compressed air increases the life expectancy of a dry fire sprinkler system up to

**5.3X**



# Galvanized Pipe

**Galvanized is not effective.**



Galvanized Schedule 10 after only 18 months



Galvanized Schedule 40 after only 3.5 years



# Galvanized Pipe

Table 23.4.4.7.1 Hazen-Williams C Values

| Pipe or Tube                                       | C Value* |                          |
|--|----------|--------------------------|
| Unlined cast or ductile iron                       | 100      |                          |
| Black steel (dry systems including preaction)      | 100      | } No Hydraulic Advantage |
| Black steel (wet systems including deluge)         | 120      |                          |
| Galvanized steel (dry systems including preaction) | 100      |                          |
| Galvanized steel (wet systems including deluge)    | 120      |                          |
| Plastic (listed) all                               | 150      |                          |
| Cement-lined cast- or ductile iron                 | 140      |                          |
| Copper tube or stainless steel                     | 150      |                          |
| Asbestos cement                                    | 140      |                          |
| Concrete   | 140      |                          |

\*The authority having jurisdiction is permitted to allow other C values.



## FM Global Data Sheets 2-0

**2.5.2.5** Use internally galvanized, stainless steel, or similar corrosion-resistant pipe in all new dry-pipe, pre-action, refrigerated-area, deluge, and exposure-protection sprinkler systems.

**Exception:** Black steel pipe can be used in dry-pipe sprinkler systems equipped with closed-type sprinklers if the piping system is filled with an inert gas.

## Corrosion Technical Report

**8 - B.2** Fill dry pipe or preaction systems with **nitrogen** as supervisory gas (e.g., use on-site nitrogen generator) to mitigate galvanized steel pipe corrosion.



# How do you supply nitrogen to a fire sprinkler system?

## **7.2.6.8 Nitrogen or Other Approved Gas.**

**7.2.6.8.1\*** Where nitrogen or other approved gas is used, the supply shall be from a reliable source.

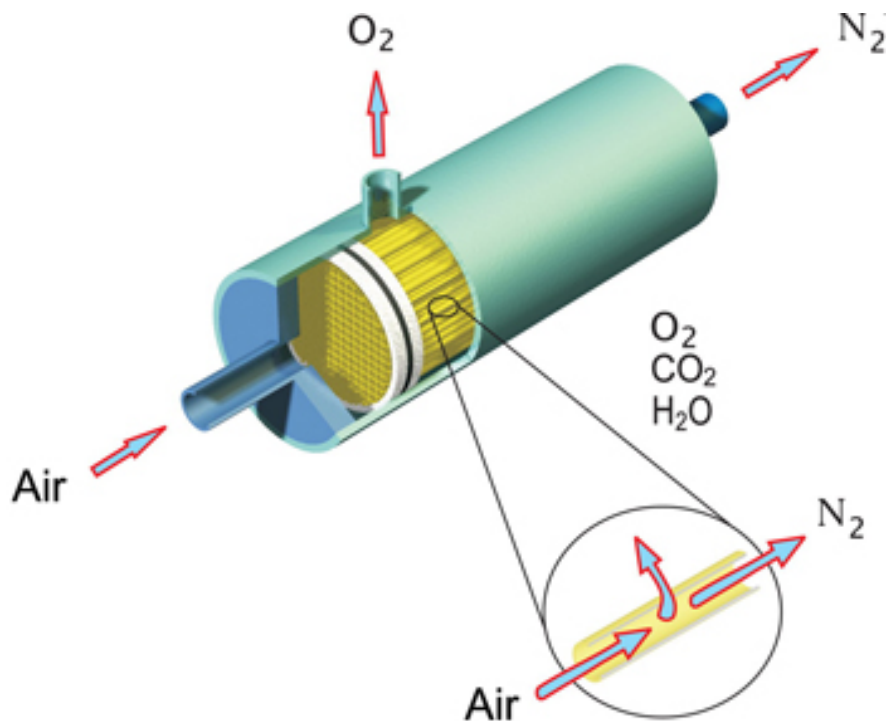
**7.2.6.8.2** Where stored nitrogen or other approved gas is used, the gas shall be introduced through a pressure regulator and shall be in accordance with 7.2.6.6.

**7.2.6.8.3** A low pressure alarm shall be provided on gas storage containers to notify the need for refilling.



# *Nitrogen*

Strip the oxygen from air and leave nitrogen!



The nitrogen membrane is the “heart” of the nitrogen generator.



## ***Nitrogen Generator***

Potter offers a complete line of nitrogen generators that provide on-site reliable nitrogen production.



- Meet NFPA 13, 30 minute fill time requirements
- Easy installation
- Sized to meet the needs of systems
- Cost effective
- Low maintenance
- Dependable
- Four model families
  - NGP-250D, NGP-500D
  - NGP-1000D, NGP-2200D



# Nitrogen Generators

## Purging Process – Getting Air Out

- Initial system fill with air
- Nitrogen level monitoring
- Stops purging when nitrogen levels reach target.
- BMS connectivity and notification
- Advance Purging – Designed for drying and freezer applications, reducing moisture and ice build-up.
- Manual options also available



INS-PV



NGP-SPV



INS-RA





# ***Nitrogen Generators***

## Economic Impact

- Use black steel instead of galvanized piping
  - Saves roughly **30%** on sprinkler piping
- Save existing systems from additional corrosion
- Use a lower supervisory pressure
  - Smaller compressor
  - Smaller membrane
  - Less expensive system
- Feed more than one system
  - “Plant Nitrogen”
  - Economies of scale



*Parking garage installation*



# Nitrogen Generators

## Case Study – New Assisted Living Facility

### Design 1 - Traditional:

- 2 X 425 Gallon Dry Sprinkler Systems
- 40 PSI
- Air Compressor
- Galvanized Steel Pipe (Sch. 10)
- Galvanized Fittings
- No Labor

|                          |                     |
|--------------------------|---------------------|
| Galvanized Material Cost | \$ 76,553.82        |
| Air Compressor Equipment | \$ 1,150.00         |
| <b>Total Cost</b>        | <b>\$ 77,703.82</b> |

### Design 2 - Nitrogen:

- 2 X 425 Gallon Dry Sprinkler Systems
- 40 PSI
- Nitrogen Generator and Purge Valves
- Black Steel Pipe (Sch. 10)
- Steel Fittings
- No Labor

|                              |                     |
|------------------------------|---------------------|
| Black Steel Material Cost    | \$ 61,112.98        |
| Nitrogen Generator Equipment | \$ 12,000.00        |
| <b>Total Cost</b>            | <b>\$ 73,112.98</b> |

|   |                 |
|---|-----------------|
| Estimated Galvanized System Life under Compressed Air | 10 years        |
| Estimated Black Steel System Life under Nitrogen      | <b>53 years</b> |



# Dry Systems

- Use nitrogen over compressed air
- Use black steel over galvanized
- Limit addition of new water



## *Corrosion Monitoring*

Every corrosion mitigation plan should include a monitoring program.



Corrosion Monitoring Station



# Questions?