Becoming an Expert on Dry-pipe, Preaction, and Deluge Sprinkler Systems

STEVEN WOLIN, VICE PRESIDENT, PRODUCT TECHNOLOGY & COMPLIANCE
ANTONIO LUIS, TECHNICAL SERVICES MANAGER
RELIABLE AUTOMATIC SPRINKLER CO., INC.

Outline

1. Sprinkler System Types
2. Dry-pipe Valve Types
3. Deluge/Preaction Valve Types
4. Actuators
5. Corrosion
6. Air supplies
7. Accelerators

Sprinkler System Types

- Wet-pipe
- Dry-pipe
- Preaction
  - Non-interlock
  - Single-interlock
  - Double-interlock
- Deluge

Sprinkler System Types

Wet-pipe

Dry-pipe

Preaction

- Non-interlock
- Single-interlock
- Double-interlock

Deluge

NFPA 13:

A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

Sprinkler System Types

Wet-pipe

Dry-pipe

Preaction

- Non-interlock
- Single-interlock
- Double-interlock

Deluge

NFPA 13:

A sprinkler system employing automatic sprinklers that are attached to a piping system containing air or nitrogen under pressure, the release of which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry pipe valve, and the water then flows into the piping system and out the opened sprinklers.

Dry-pipe Sprinkler System Water Delivery Time Options

1. 60 second water delivery time to test connection
2. 500 gallon system exemption
3. 750 gallon system with quick-opening device exemption
4. Listed water delivery calculation
5. Water delivery test manifold
6. Other water delivery time listed by a nationally recognized testing laboratory

Dry-pipe systems serving dwelling units must meet 15 second requirement.

Factors Influencing Water Delivery Time

System volume

System configuration

Supervisory pressure

Trip pressure

Quick-opening device (accelerator)

Water supply

Sprinkler/test valve size

Dry-pipe Sprinkler System Allowable Sprinkler Types

Upright sprinklers

Horizontal sidewall sprinklers installed so water is not trapped

Listed dry sprinklers

In areas above 40°F only:

- Pendent or sidewall sprinklers on return bends
- On systems using potable water only, pendent or sidewall sprinklers on copper or CPVC specifically listed for dry pipe applications

Dry-pipe Sprinkler System Hydraulic Design

30% increase in area of sprinkler operation without changing density

Gridded systems not permitted

Reduced Hazen-Williams C Value for black steel pipe*

- 100 dry-pipe/preaction
- 120 for wet-pipe and deluge

*Reduced Hazen-Williams C Value for dry-pipe and preaction systems also applies to galvanized pipe starting in 2013 edition of NFPA 13.

Sprinkler System Types

Wet-pipe

Dry-pipe

Preaction

- Non-interlock
- Single-interlock
- Double-interlock

Deluge

NFPA 13:

A sprinkler system employing automatic sprinklers that are attached to a piping system that contains air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the sprinklers.

Preaction Sprinkler System Allowable Sprinkler Types

Upright sprinklers

Horizontal sidewall sprinklers installed so water is not trapped

In areas above 4°C only:

- Pendent or sidewall sprinklers on return bends
- On systems using potable water only, pendent or sidewall sprinklers on copper or CPVC specifically listed for dry pipe applications

Sprinkler System Types

Wet-pipe

Dry-pipe

Preaction

- **Non-interlock**
- Single-interlock
- Double-interlock

Deluge

NFPA 13:

A non-interlock system, which admits water to sprinkler piping upon operation of detection devices or automatic sprinklers

Sprinkler System Types

Wet-pipe

Dry-pipe

Preaction

- Non-interlock
- **Single-interlock**
- Double-interlock

NFPA 13:

A single interlock system, which admits water to sprinkler piping upon operation of detection devices

Often used in data centers.

Non-interlock and Single-interlock Preaction Sprinkler Systems

Maximum 1,000 sprinklers per preaction valve

Supervisory gas required for single-interlock systems with more than 20 sprinklers

By definition all non-interlock sprinkler systems have supervisory gas

- Minimum supervisory gas pressure of 7 psi required

Non-interlock and Single-interlock Preaction Sprinkler System

Gridded systems not permitted for storage

- Miscellaneous storage may be protected with gridded systems

Reduced Hazen-Williams C Value for black steel pipe*

- 100 dry-pipe/preaction
- 120 for wet-pipe and deluge

*Reduced Hazen-Williams C Value for dry-pipe and preaction systems also applies to galvanized pipe starting in 2013 edition of NFPA 13.

Sprinkler System Types

Wet-pipe

Dry-pipe

Preaction

- Non-interlock
- Single-interlock
- **Double-interlock**

Deluge

NFPA 13:

A double interlock system, which admits water to sprinkler piping upon operation of both detection devices and automatic sprinklers

Double-interlock Preaction Sprinkler System – Water Delivery Time

60 second water delivery time to test connection

or

Listed water delivery calculation

or

Water delivery test manifold

A listed quick-opening device (accelerator) may be used to help meet the water delivery time requirements.

Double-interlock Preaction Sprinkler System - Hydraulic Design

30% increase in area of sprinkler operation without changing density

Gridded systems not permitted

Reduced Hazen-Williams C Value for black steel pipe*

- 100 dry-pipe/preaction
- 120 for wet-pipe and deluge

*Reduced Hazen-Williams C Value for dry-pipe and preaction systems also applies to galvanized pipe starting in 2013 edition of NFPA 13.

Sprinkler System Types

Wet-pipe

Dry-pipe

Preaction

- Non-interlock
- Single-interlock
- Double-interlock

Deluge

NFPA 13:

A sprinkler system employing open sprinklers or nozzles that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers or the nozzles. When this valve opens, water flows into the piping system and discharges from all sprinklers or nozzles attached thereto.

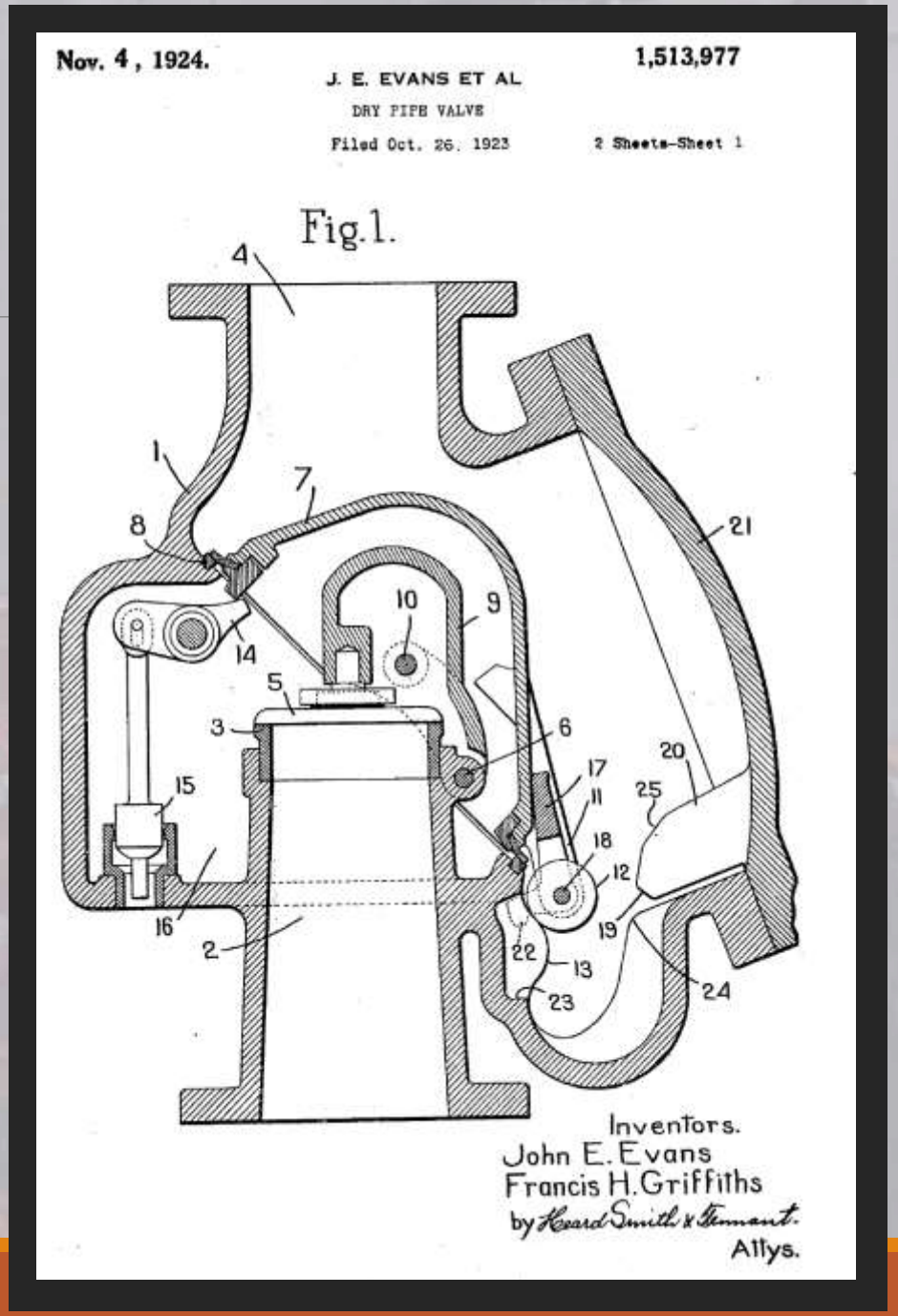
Dry-pipe Valve Types

DIFFERENTIAL

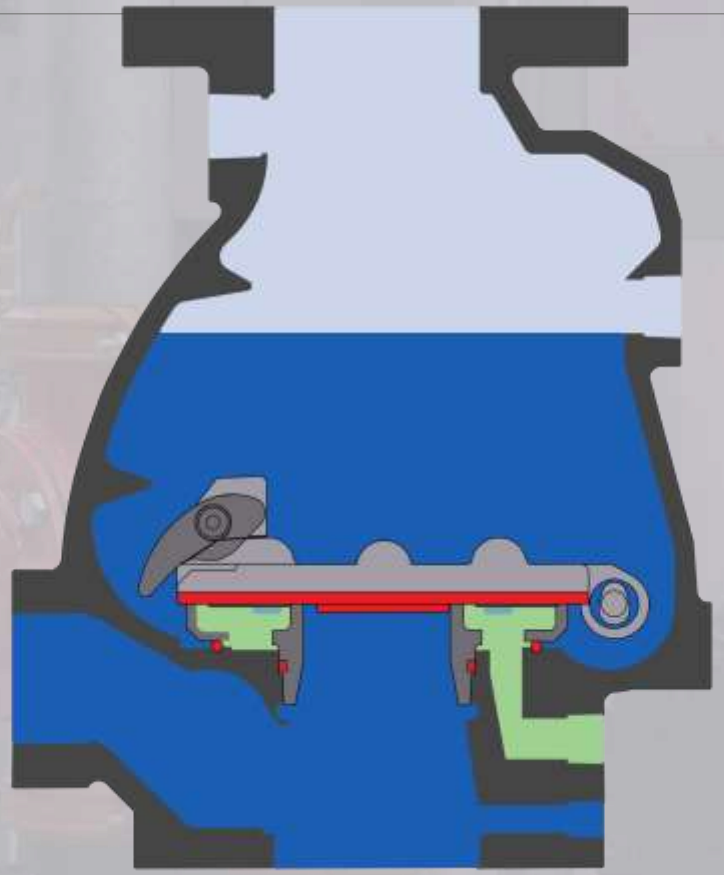
MECHANICAL

Differential Dry-pipe Valves

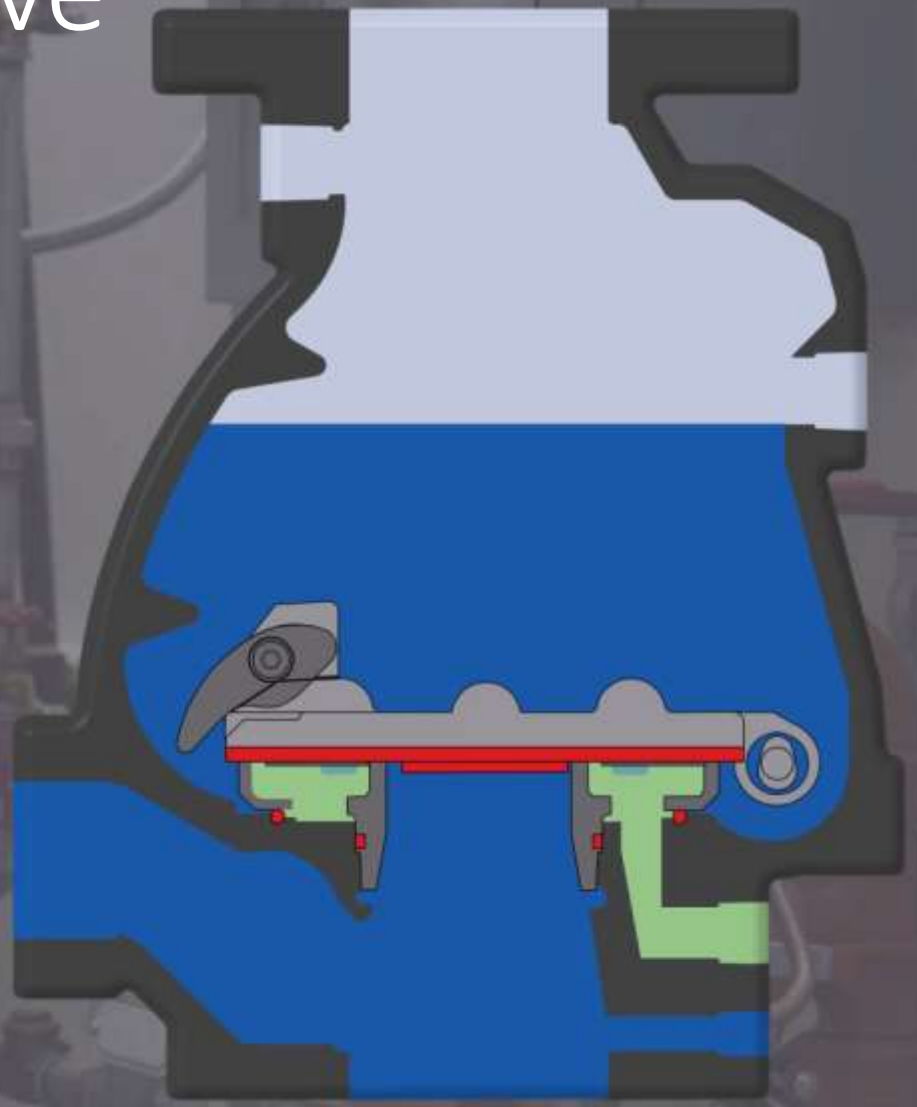
100 year old technology



Differential Dry-pipe Valves



Differential Dry-pipe Valve Operation



Differential Dry-pipe Valves

ADVANTAGES

Simplicity

DISADVANTAGES

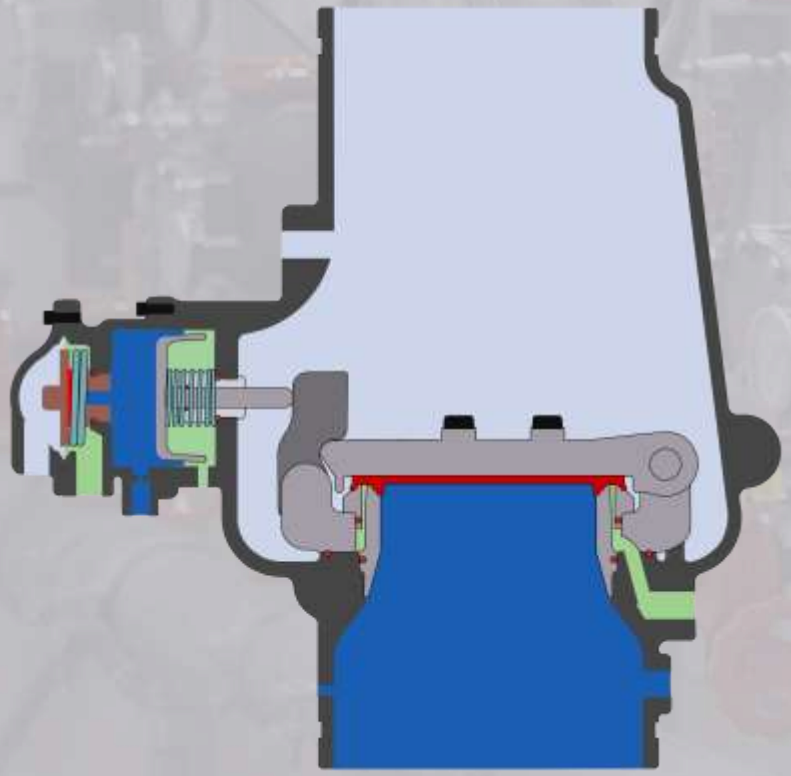
Size and weight

Supervisory pressure

Water delivery time

Mechanical Dry-pipe Valves

Modern dry-pipe valves



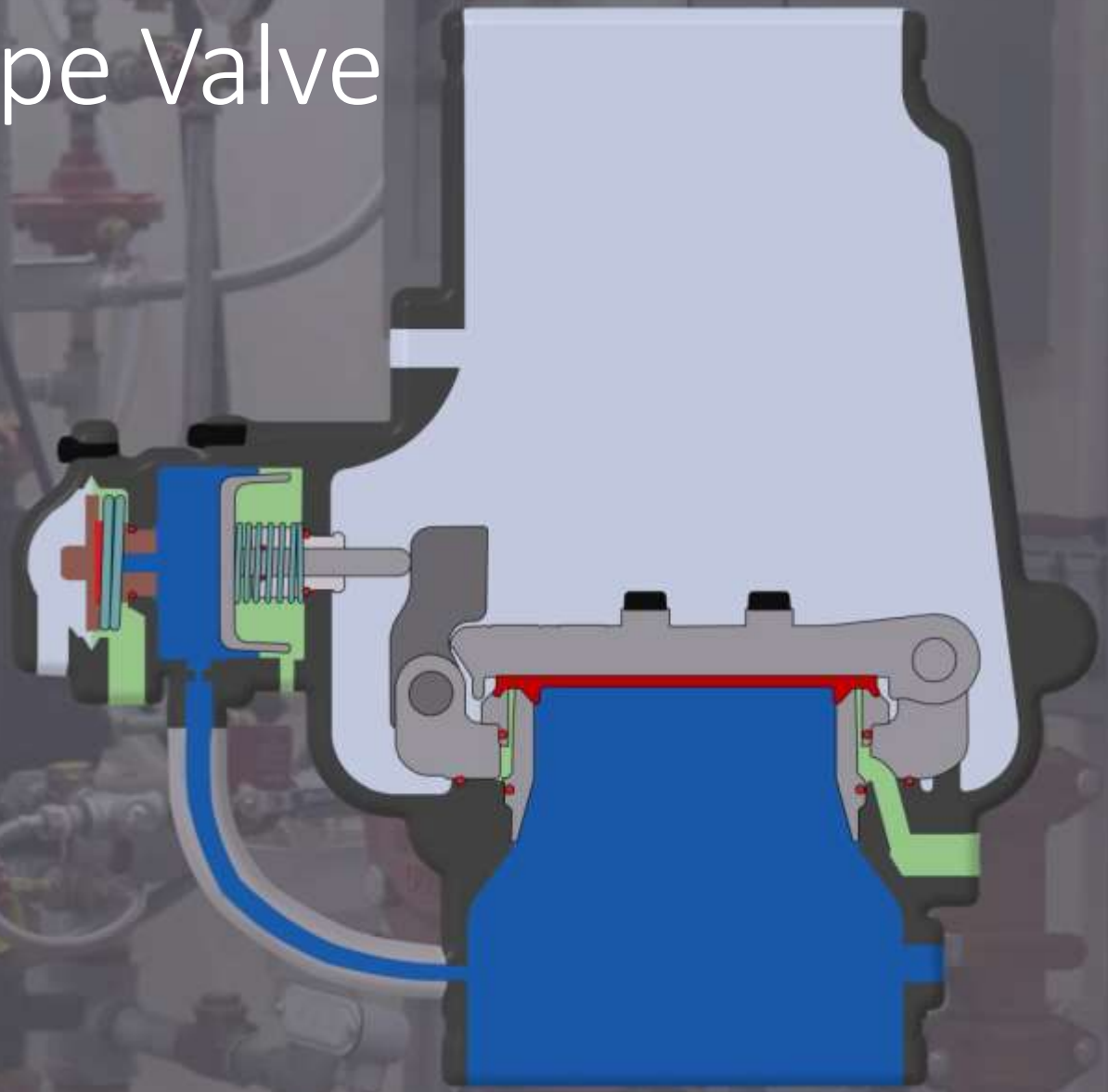
Mechanical Dry-pipe Valve Operating Mechanism

Ratio controlled by actuator instead of clapper

Clapper latched in closed position by a combination of levers or pushrods

Clapper size similar to inlet size

Mechanical Dry-pipe Valve Operation



Mechanical Dry-pipe Valve Operation in Real Time

Mechanical Dry-pipe Valves

ADVANTAGES

Size and weight

Low supervisory gas pressure

Water delivery time

DISADVANTAGES

Complexity

Supervisory Gas Pressure

Water Supply Pressure (bar)	Example Differential DPV Supervisory Pressure (bar)	Example Mechanical DPV Supervisory Pressure (bar)	Reduction in Supervisory Pressure with Mechanical vs Differential
7	1.7	1.0	40%
12	2.8	1.2	55%
17	3.8	1.5	60%
21	est. 4.5	1.7	est. 62%

Lower Supervisory Gas Pressure Means:

Less leakage

Smaller compressor

Smaller nitrogen generator

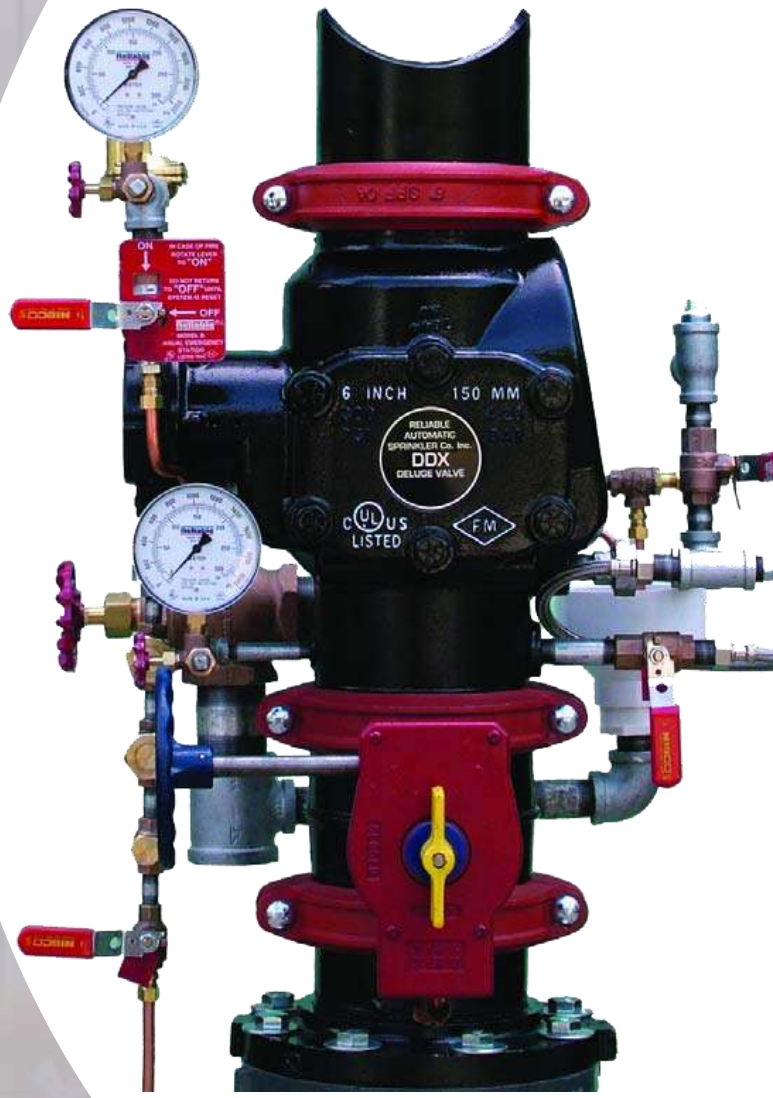
Faster water delivery

Deluge/Preaction Valve Types

MECHANICAL

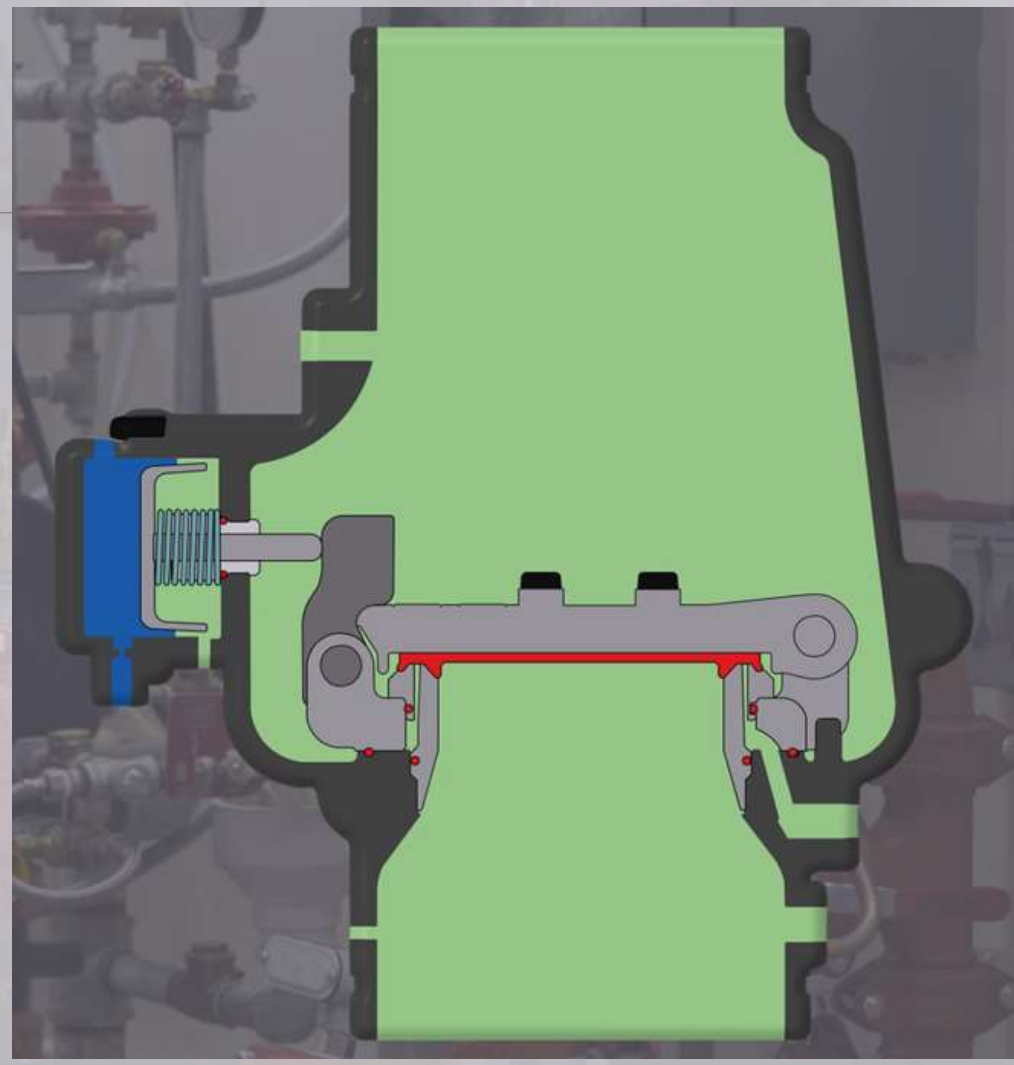
DIAPHRAGM

SOLENOID

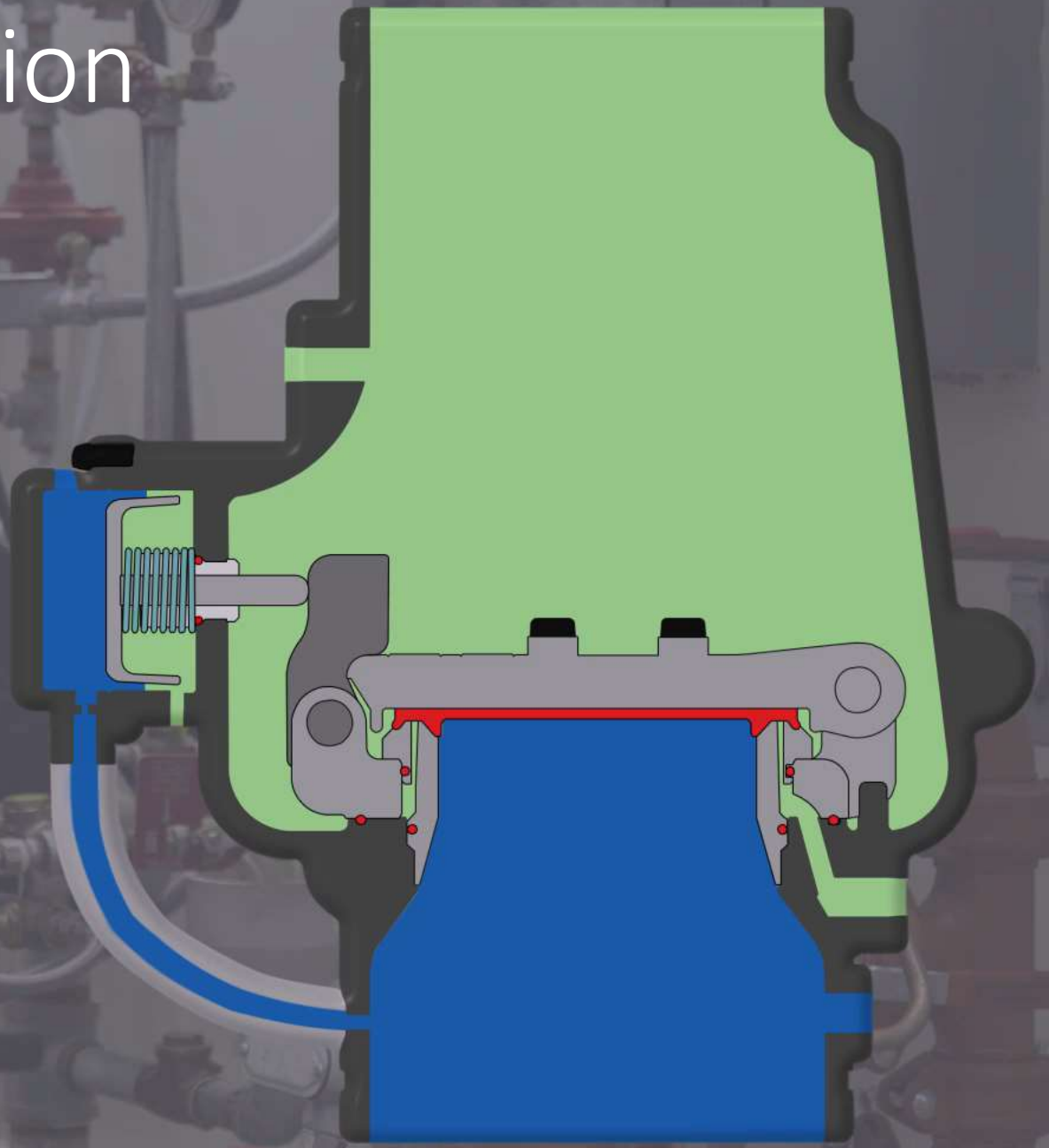


Mechanical Deluge/Preaction Valves

Clapper latched in closed position by a combination of levers or pushrods



Mechanical Operation



Mechanical Deluge/Preaction Valves

- Low friction loss (depending on design)
- Held closed by high-strength metal components
- Mechanically latches open
  - Cannot reset itself
- Fast operation
- Available in a wide variety of sizes

Diaphragm Operation

Diaphragm Valve Operation

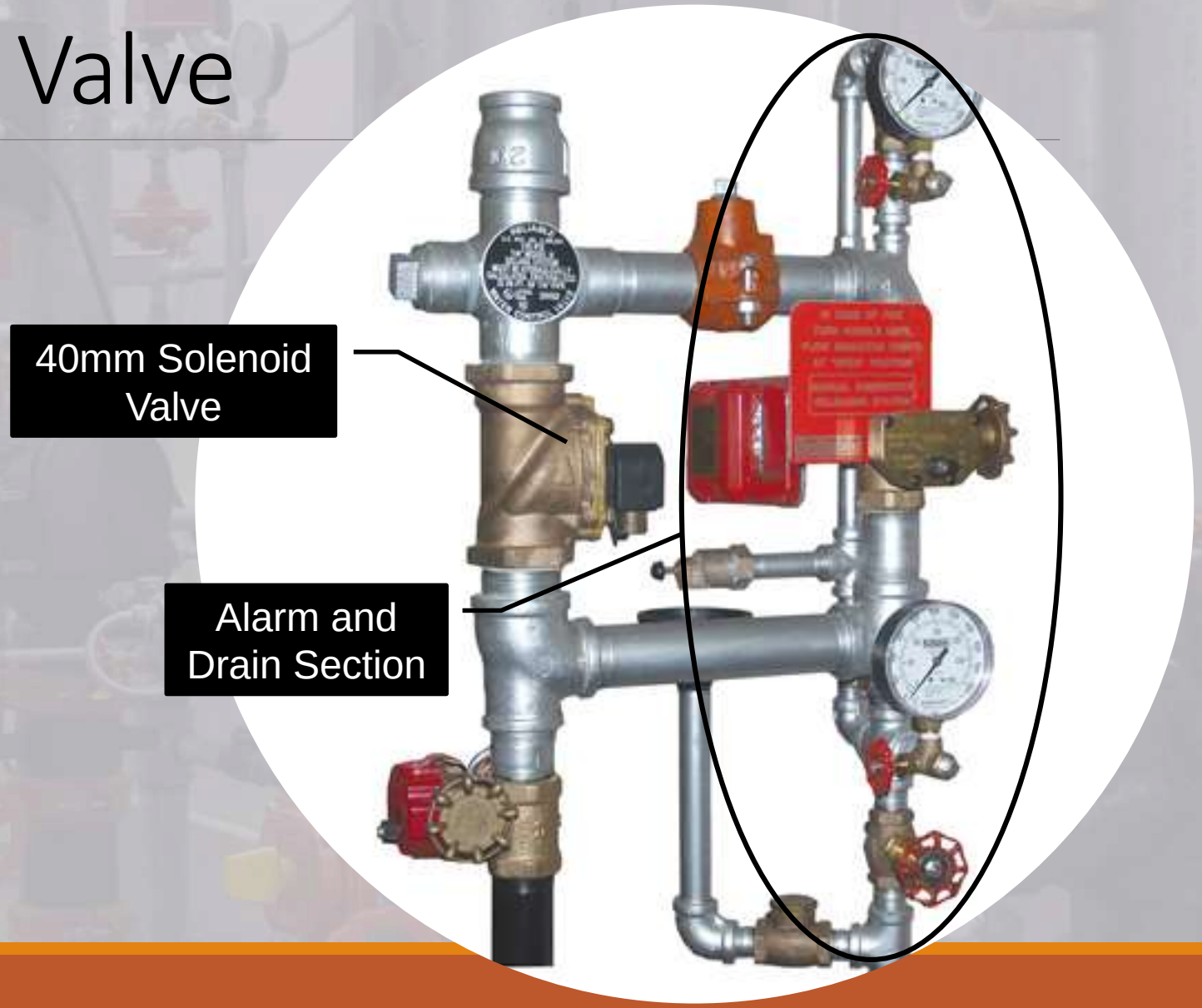
Diaphragm Deluge/Preaction Valves

Capable of remote resetting

Capable of pressure regulation

Available in a wide variety of sizes

Solenoid Deluge Valve



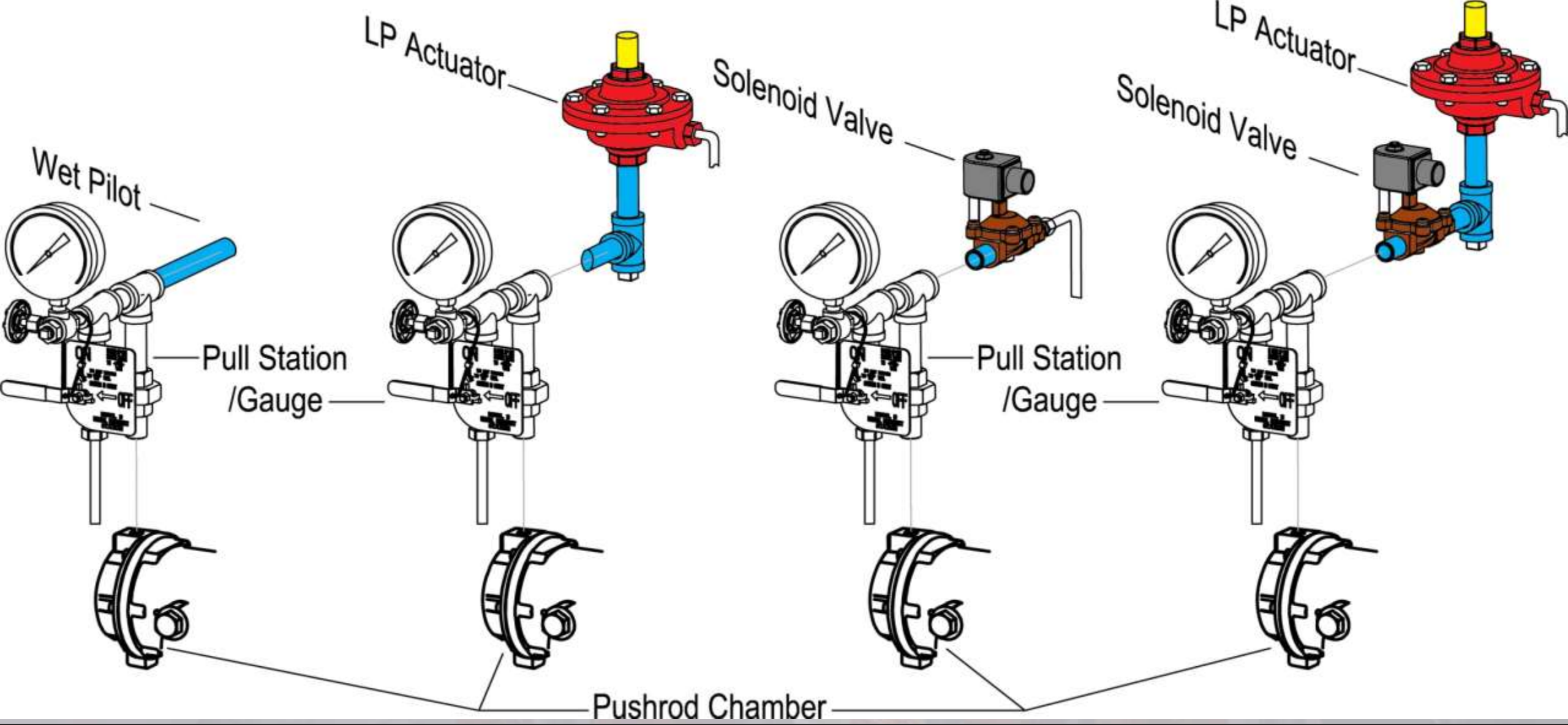
Solenoid Deluge Valves

Minimal required installation depth

Only available in small sizes (40mm)

Relatively high friction loss

Actuators



Actuators connect to deluge/preaction valves to maintain pressure in the control chamber until valve operation

Solenoid Valve Normally Closed

Power open

Used with valves that mechanically latch open

Often used in data centers.

Solenoid Valve Latching Impulse

Pulse power open

Pulse power closed

Solenoid valve “latches” in position until next power impulse changes state

Used with on/off type valves

Wet Pilot Line

Hydraulically connected (piped) to deluge/preaction valve

Dry Pilot Actuator

Supervisory pressure holds actuator closed until pilot line detector/sprinkler opens

Double-interlock Electric/Electric

Releasing Control Panel (RCP) monitors detection system and supervisory pressure switch

Valve opens upon:

- RCP energizing solenoid to release system

Double-interlock Electric/Pneumatic

RCP monitors detection system

Dry pilot actuator monitors system pressure

Valve opens upon both:

- RCP opening solenoid based on detection system operation; and
- Dry pilot actuator opening from loss of supervisory pressure

Often used in refrigerated storage buildings.

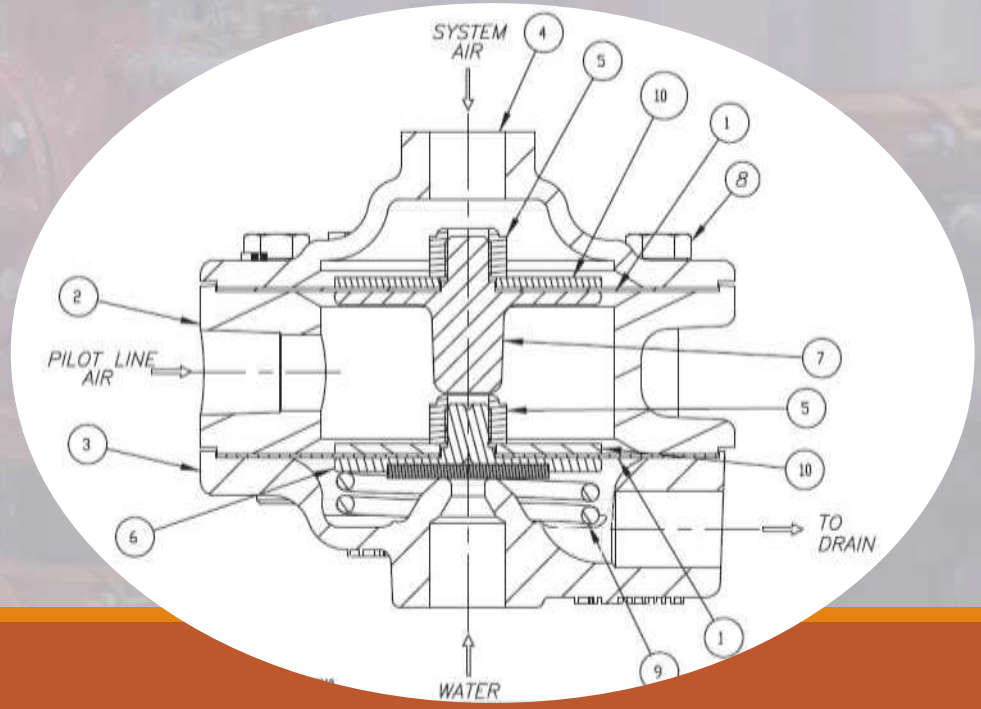
Double-interlock Pneumatic/Pneumatic

Actuator connected to:

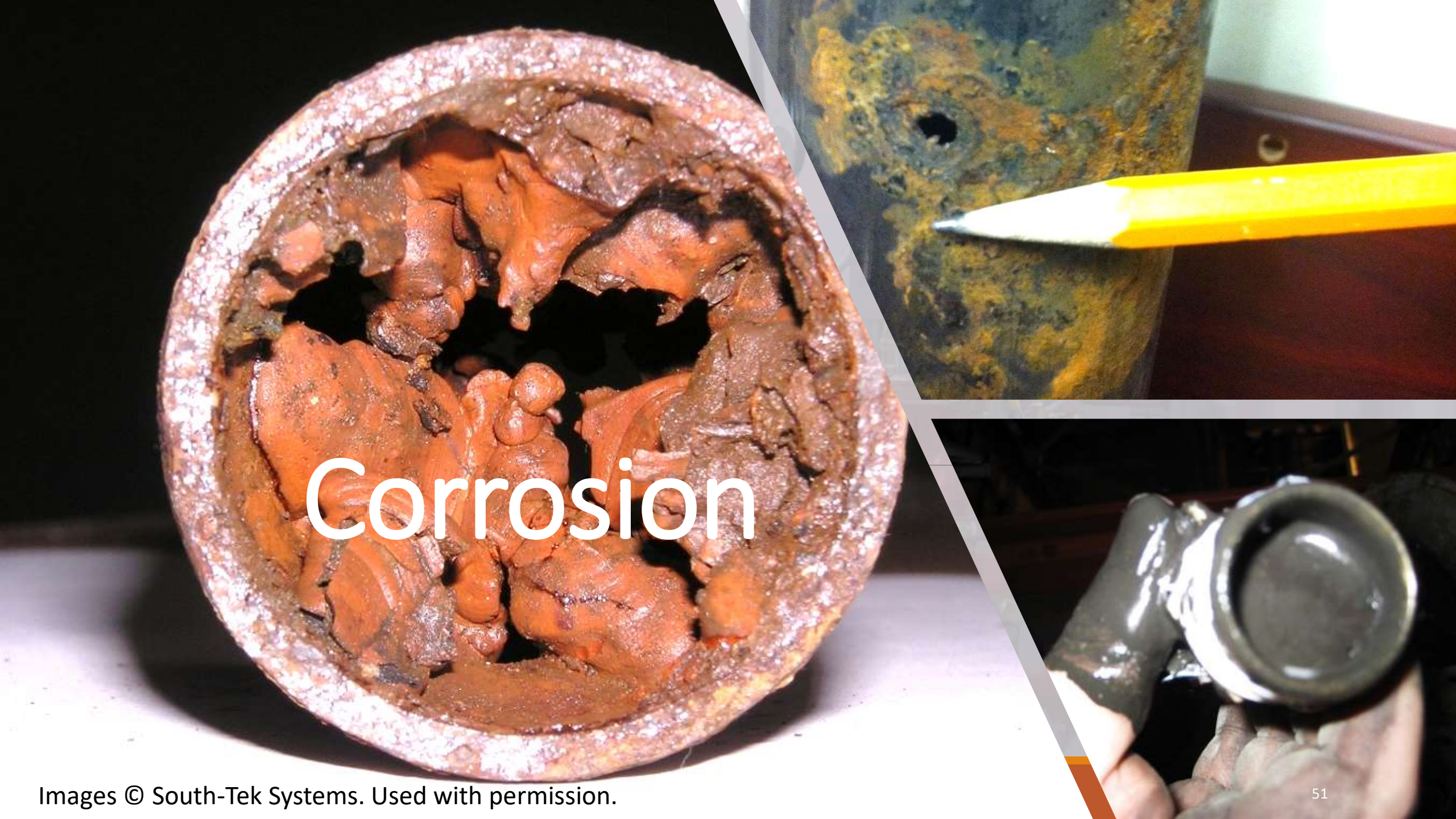
- System to monitor supervisory pressure in system
- Dry pilot line to monitor supervisory pressure in dry pilot line

Valve and actuator open upon both:

- Loss of supervisory pressure in system
- Loss of supervisory pressure in dry pilot line

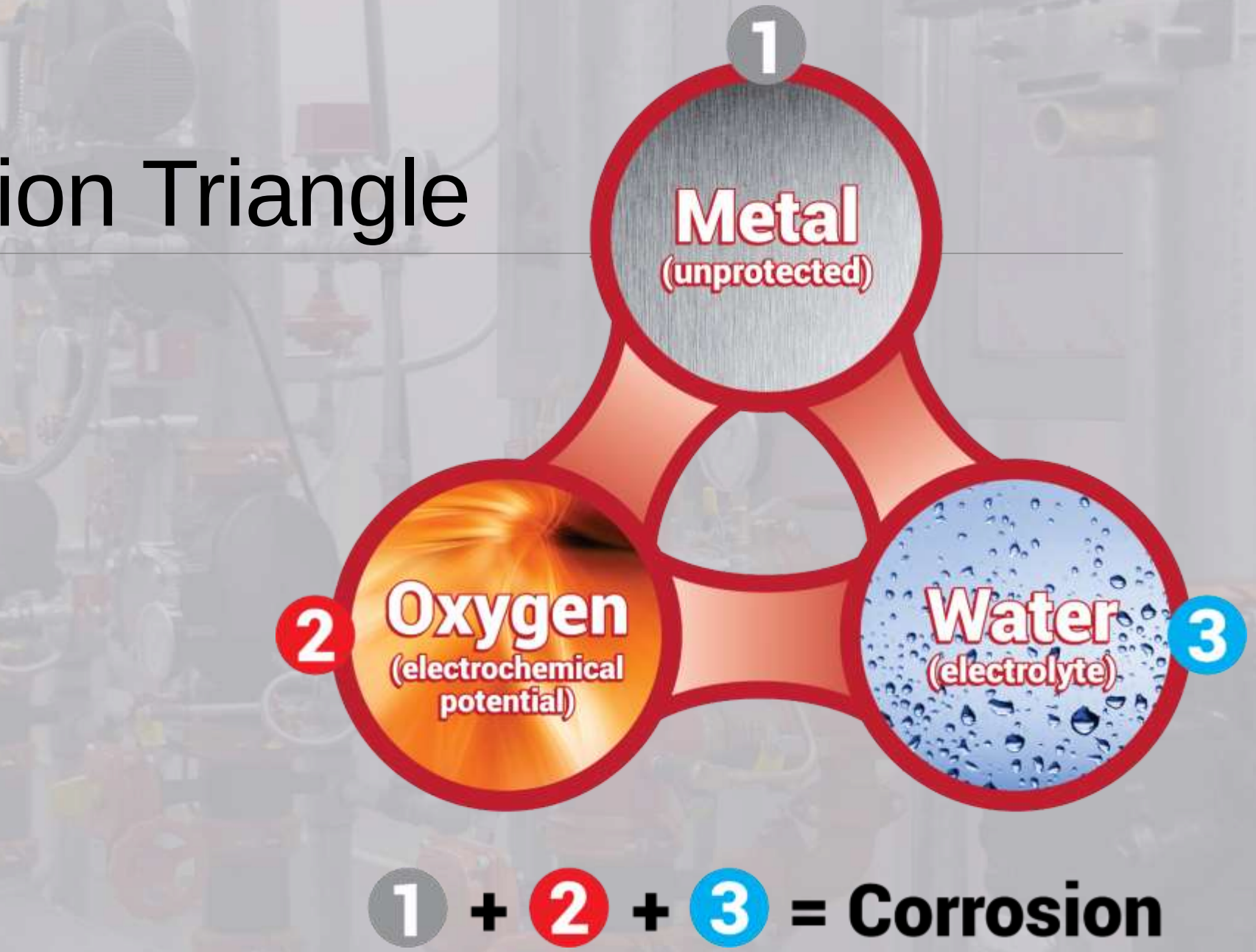


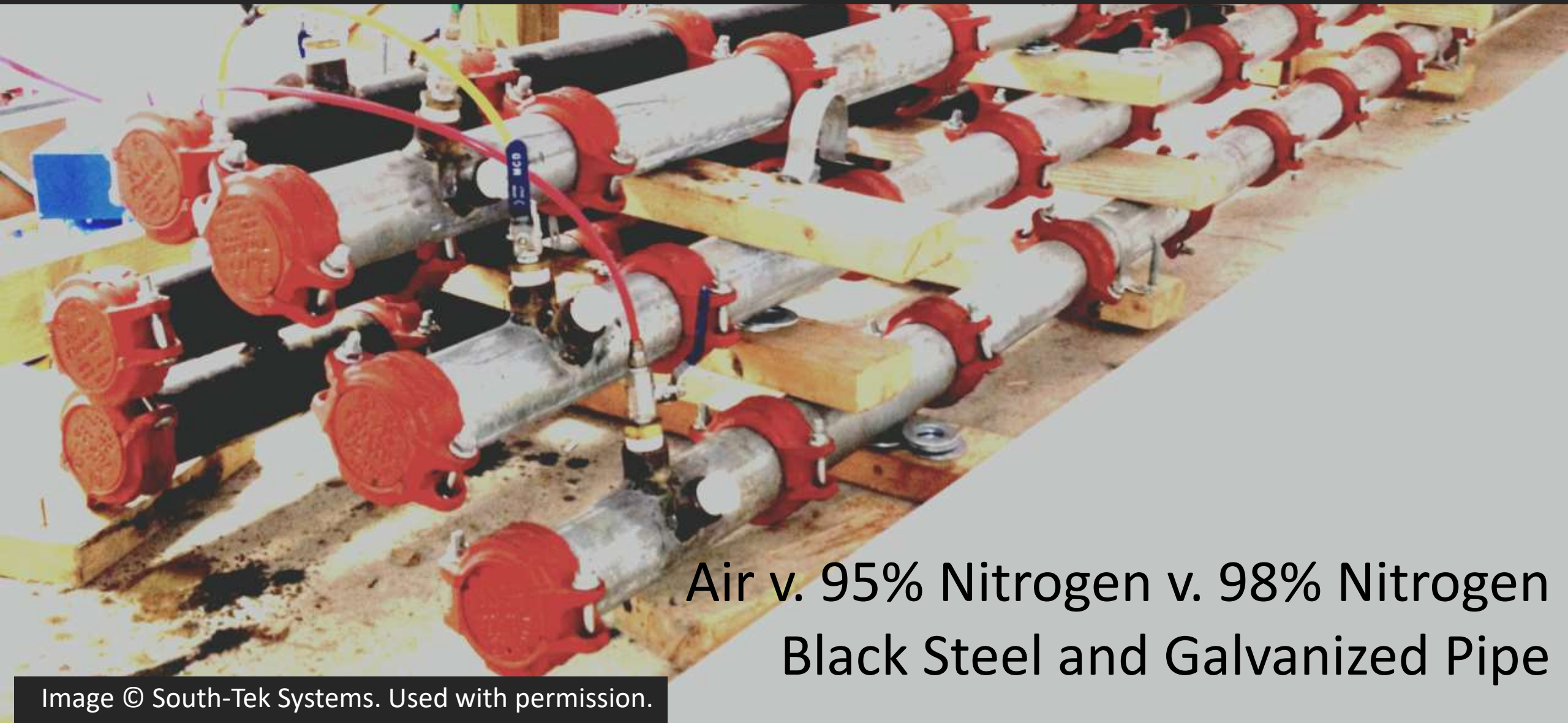
Corrosion



- Dry and pre-action systems are involved in 59% of fire losses caused by corrosion-related obstructions to sprinkler flow (FM Global)
- 73% of dry and pre-action systems inspected had significant corrosion issues after 12.5 years (VdS Study)
- Corrosion leads to property damage, ongoing pipe repair and replacement, decreased c-factor and sprinkler head blockage – potentially rendering the system inoperable in the event of a fire

Corrosion Triangle





Air v. 95% Nitrogen v. 98% Nitrogen
Black Steel and Galvanized Pipe

Schedule 10 Black Steel (Results after 7.9 years of testing)

As Received	Cleaned	
		**Compressed Air Supervision** 20.7 Years Service Life
		**95% Nitrogen Supervision** 25.2 Years Service Life
		**98% Nitrogen Supervision** 63.2 Years Service Life

Schedule 10 Galvanized Steel (Results after 7.9 years of testing)

As Received | Cleaned

Compressed Air Supervision

9.9 Years Service Life

95% Nitrogen Supervision

12.6 Years Service Life

98% Nitrogen Supervision

176 Years Service Life

Corrosion Testing Conclusions

As a result of 98% nitrogen in lieu of compressed air supervision:

- Extension of black steel pipe service life from 20 to 63 years
- Extension of galvanized steel service life from 10 to 176 years

Air (or Nitrogen) Supply

Air Supply Sources

Compressor

Plant air

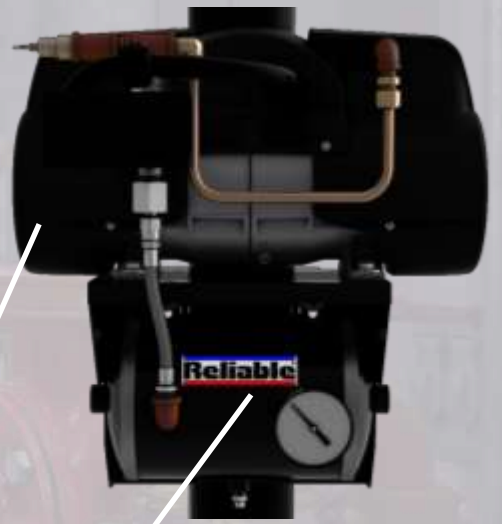
Nitrogen generator

Bottles/cylinders

Air Supplies
Pressure Maintenance Device

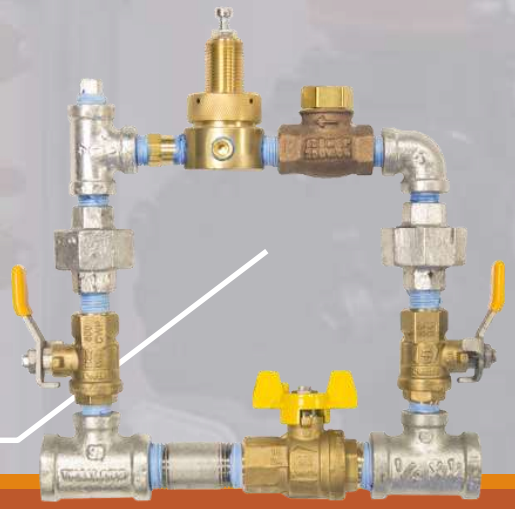
A pressure maintenance device and air receiver (tank) are required by NFPA 13

- Exception: Compressors supplying less than 160 lpm at 0.7 bar without an air receiver (tank)



Compressor

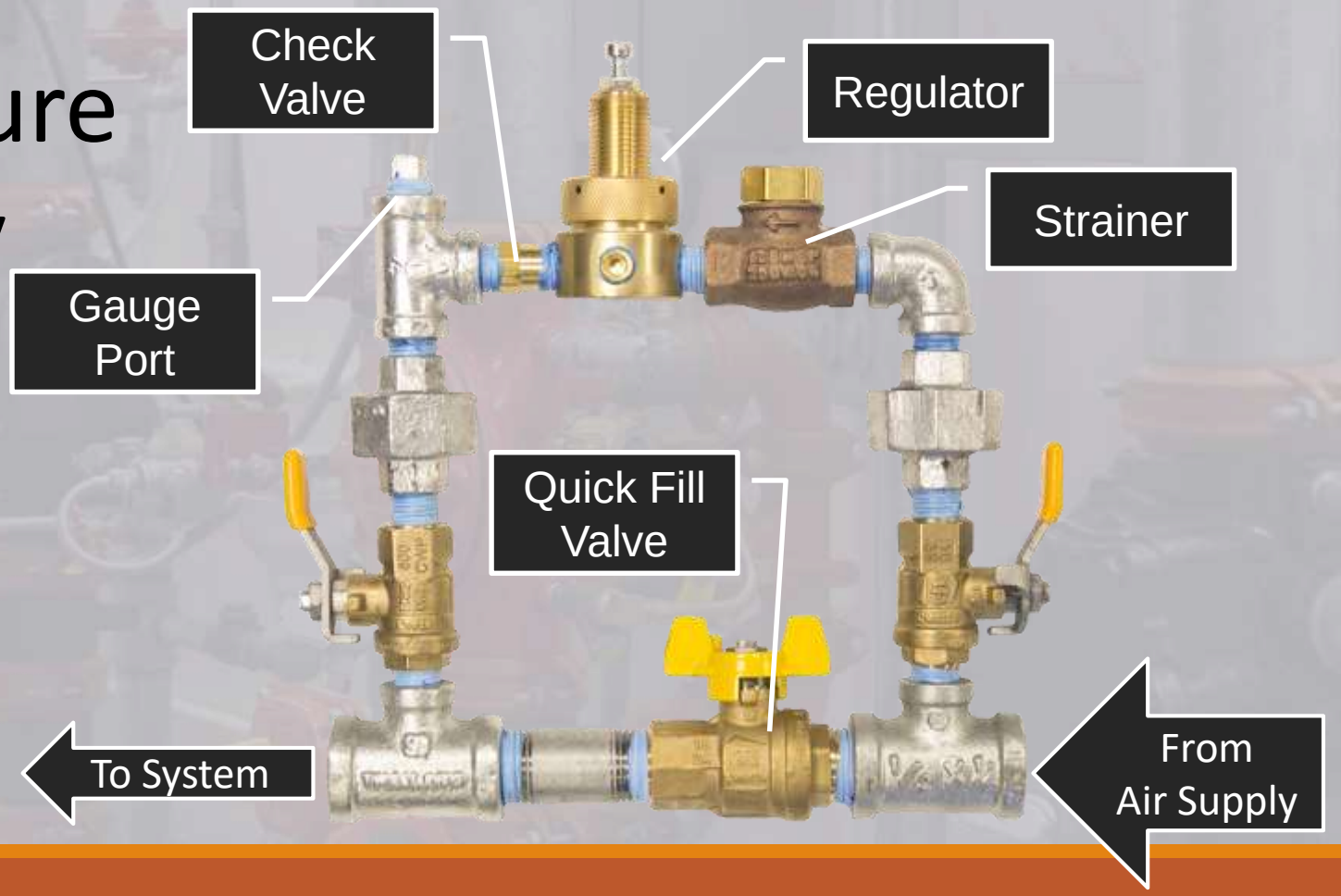
Air Receiver (tank)



Pressure Maintenance Device

Air Supplies
Pressure Maintenance Device

- Regulates supervisory pressure
- Limits supervisory gas flow into sprinkler system
- Allows for quick filling



Air Supply Tips

1. A tank mounted air compressor with a pressure maintenance device is the default in NFPA 13 . . . for good reason
2. Gauges are required by NFPA 13 in each independent segment of air supply pipe
3. “Quiet” air compressors are becoming more common
4. Follow the additional air supply requirements in NFPA 13 Section 7.9 for refrigerated spaces (limit ice plugs)
5. Engineers and building owners should consider using >98% nitrogen (with a pressure maintenance device) for supervisory gas in dry-pipe and preaction sprinkler systems

If a dry-pipe or preaction sprinkler system in this building fills with water how is it drained?

Air supplies are important to help prevent unintended valve operation.

Also, system side control valves help maintenance personnel test the system without introducing water to the refrigerated space.

Quick Opening Devices Accelerators

Accelerators are intended to improve the trip time of dry-pipe and preaction valves

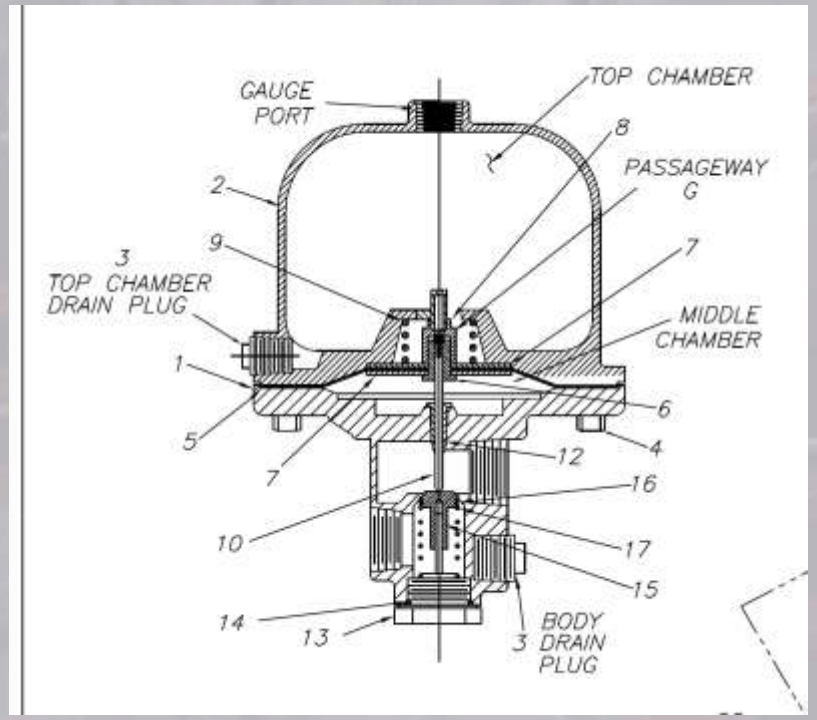
Open on supervisory pressure decay
- Rate of pressure change (not differential)

Divert supervisory gas into intermediate chamber (differential DPV)

Vent actuator (mechanical DPV)

Quick Opening Devices Accelerators

MECHANICAL



ELECTRONIC

Sensor and controller monitor supervisory pressure, open solenoid upon pressure decay

Requires power supply and back-up power

Summary

There are three types of preaction sprinkler systems

1. Single-interlock
2. Double-interlock
3. Non-interlock

Significant components of a dry-pipe or preaction sprinkler system

Dry-pipe valve or preaction valve with actuator

Air/nitrogen supply

Sprinklers

Operating mechanisms used for dry-pipe or preaction valves

Differential clapper

Mechanical clapper

Diaphragm

Solenoid

Components of the standard air supply required by NFPA 13

1. Compressor
2. Air receiver (tank)
3. Pressure maintenance device

Reliable®

ANRACI
COLOMBIA

Thanks for your attention!!!!