



Sprinkler Pipe Corrosion

in Wet, Dry and Preaction Fire Protection Systems

Presented by:

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WET, DRY AND PREACTION SPRINKLER PIPE CORROSION

Corrosion Leads to Catastrophic/Pinhole Leaks

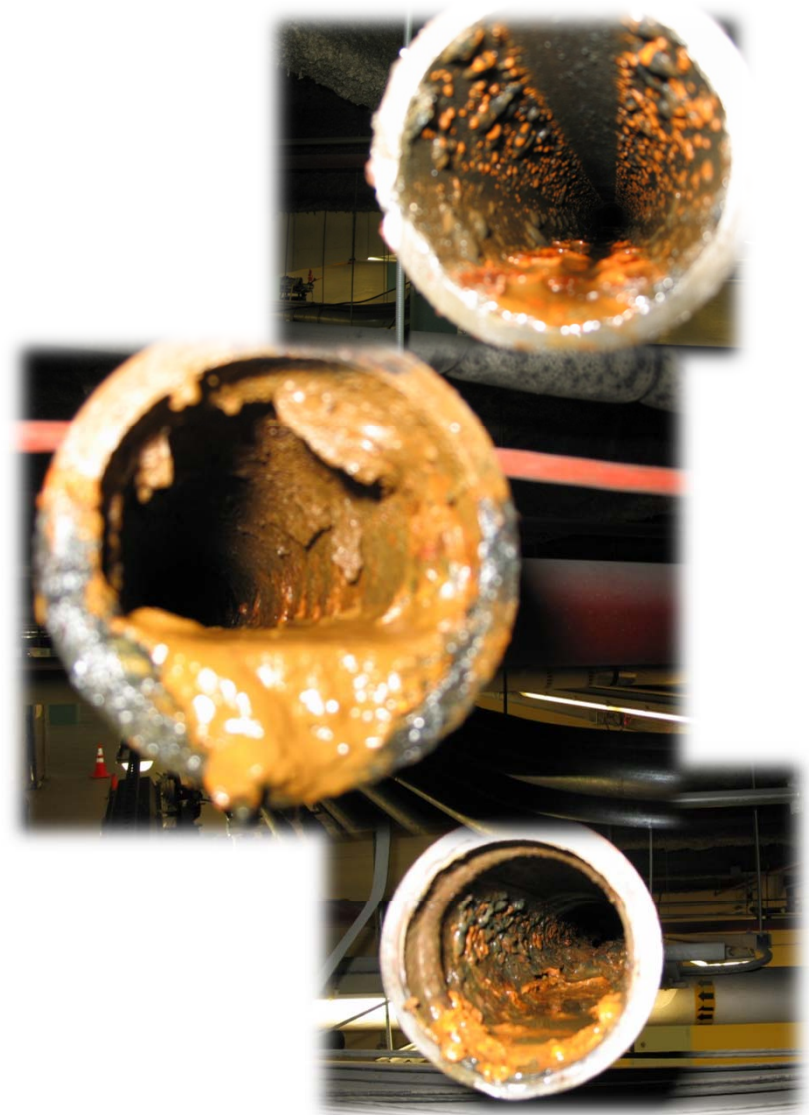
Property/Equipment damage

Costly ongoing repairs; pipe and/or system replacement

Renders Fire Protection System (FPS) inoperable in event of fire

Sprinkler head blockage

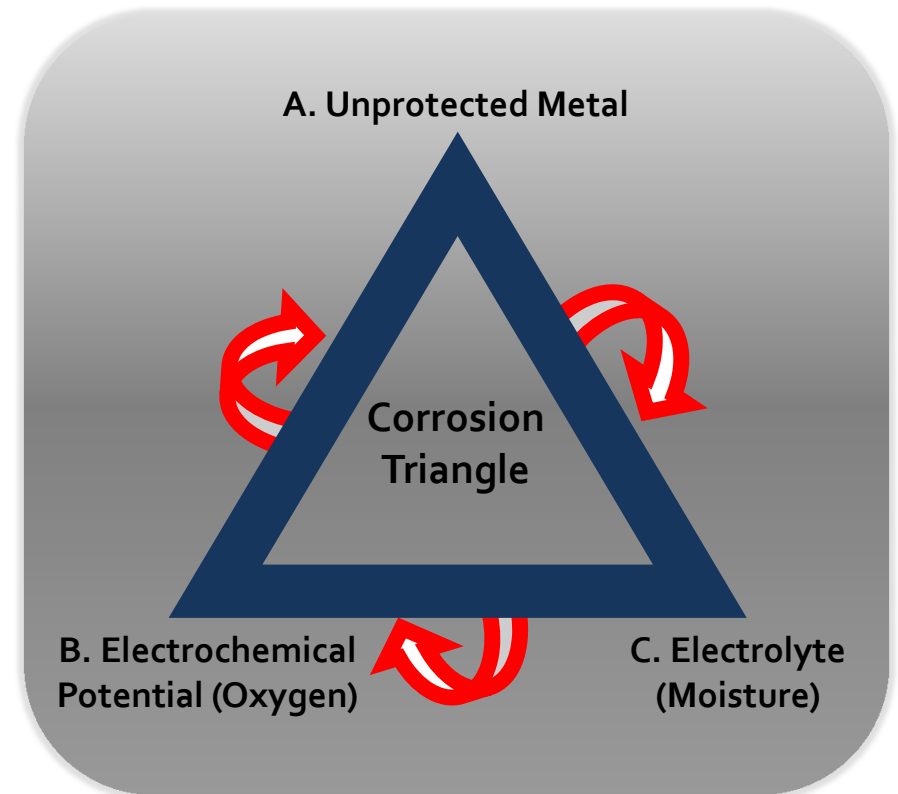
Deteriorates system components such as gaskets and seals



Corrosion Occurs in Galvanized & Black Steel

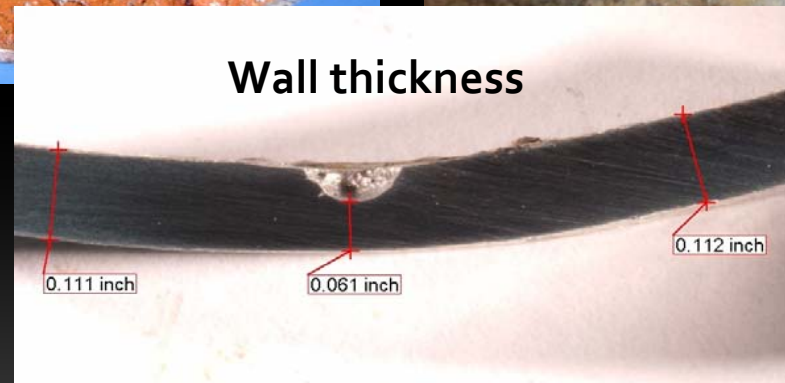
A + B + C = Corrosion

- **Unprotected Metal (A)**
 - Uniform wall thinning corrosion mechanism in Black Steel
 - Localized pitting corrosion mechanism in Galvanized
- **Electrochemical Potential (B)**
 - Inexhaustible source of Oxygen in compressed supervisory air
- **Electrolyte (C)**
 - Residual water and moisture left behind after hydrotest



Nitrogen eliminates the Electrochemical potential (B), therefore the equation is not complete and Corrosion is Inhibited.

Example: Galvanic Corrosion



Courtesy of:
CorrConsult

SPRINKLER PIPE TESTING

|| Nitrogen vs. Air

Ongoing, long term exposure tests conducted to compare the performance of Nitrogen vs. air

Sections of **Schedule 10** Black Steel and Galvanized Pipe

Individually subjected to **compressed air and supervisory Nitrogen**

Measure the corrosion rates and extrapolate

Sufficient data collected to project significant pipe service life extension as a result of Nitrogen supervision



BLACK STEEL

36-Month Test Results

As Received



Cleaned



Compressed Air

16.4 Years Pipe Service Life



95% Nitrogen

20.3 Years Pipe Service Life



98% Nitrogen

48 Years Pipe Service Life

GALVANIZED STEEL

36-Month Test Results

As Received



Cleaned



Compressed Air

7.1 Years Pipe Service Life



95% Nitrogen

10.4 Years Pipe Service Life



98% Nitrogen

9.2 Years Pipe Service Life

RESULTS

36-Month Test

Pipe Material	Supervisory Gas	Exposure time (Days)	Uniform wall loss or Pit depth (inches)	Penetration Rate (mils/yr)	Average Penetration Rate (mils/yr)
Black steel	Compressed Air	497	0.009	6.6	7.3
		759	0.022	10.6	
		780	0.017	8.0	
		1116	0.015	3.9	
Black steel	95% Nitrogen	497	0.008	5.9	5.9
		759	0.012	5.8	
		780	0.016	7.5	
		1116	0.013	4.3	
Black steel	98% Nitrogen	497	0.004	2.9	2.5
		759	0.003	1.4	
		780	0.007	3.3	
		1116	0.007	2.3	
Galvanized steel	Compressed Air	497	0.028	20.6	17.5
		759	0.034	16.4	
		780	0.036	16.9	
		1116	0.050	16.4	
Galvanized steel	95% Nitrogen	497	0.003	2.2	11.5
		759	0.040	19.2	
		780	0.020	9.1	
		1116	0.047	15.4	
Galvanized steel	98% Nitrogen	497	0.001	0.001	1.3
		759	0.003	1.4	
		780	0.007	3.3	
		1116	0.002	0.7	

Sprinkler Pipe Testing Conclusions

As a result
of 98%
Nitrogen
supervision
instead of
compressed
air
supervision

- Potential extension of black steel pipe service life from 16 to 48 years
- Potential extension of galvanized steel service life from 7 to 92 years
- Significant cost savings can be realized by using black steel pipe in combination with Nitrogen supervision instead of galvanized steel pipe.

SPRINKLER PIPE ICE PLUGS

Ice Plugs

Accumulation of condensation leads to ice plugs

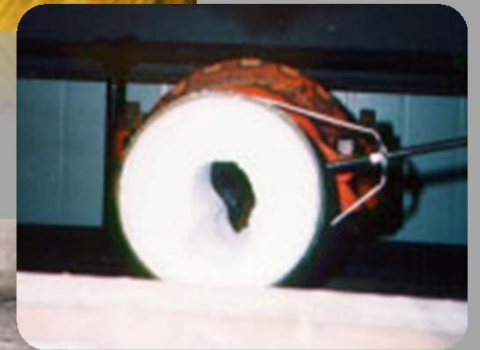
Compressed air exits the air compressor between 180° and 250°F

Warm air cools too quickly and moisture develops on the low temperature piping

Even with regenerative dryer, moisture collects whenever dew point is greater than pipe temperature

Nitrogen is an inert gas with a true -40° to -70°F dew point

Per FM Global, "It is recommended that a dew point 20°F lower than the freezer temperature be chosen."



Photos courtesy of FM Global

**DRY & PREACTION:
NITROGEN GENERATION TECHNOLOGY**

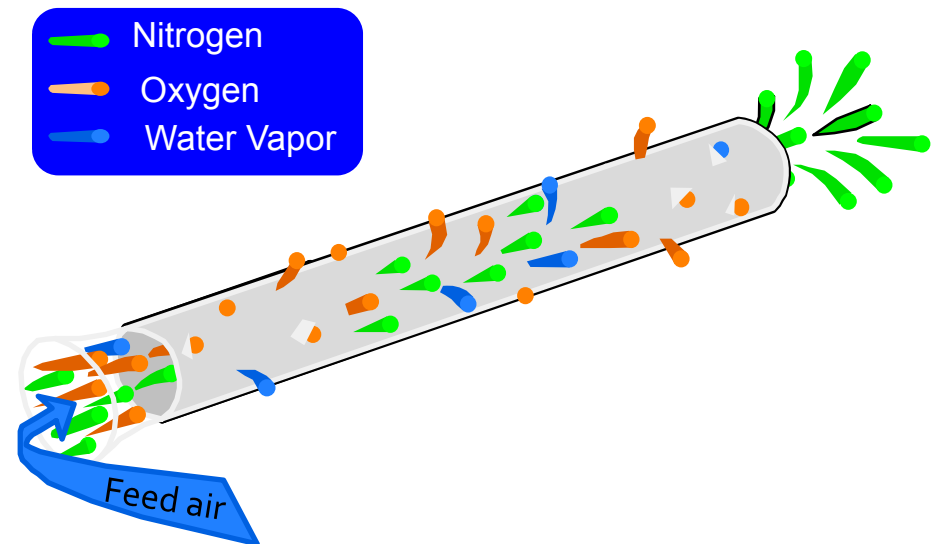
Membrane Technology

Used to generate Non-cryogenic (gaseous) Nitrogen on-site

A polymeric hollow fiber permeates oxygen, water vapor, and impurities out of side walls, allowing Nitrogen to flow through its center

10 – 15+ year lifespan (when properly designed and maintained)

Requires a minimum of 125 PSI of clean, dry compressed air



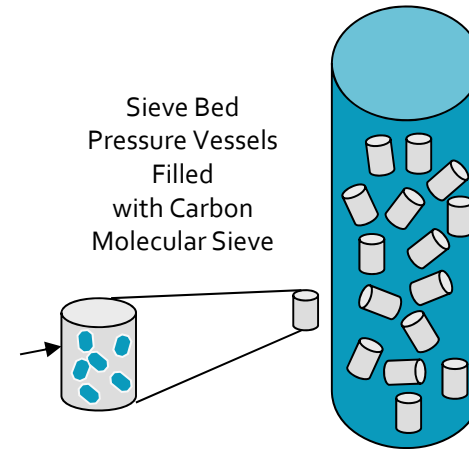
PSA Technology

Cost effective for larger applications

For applications requiring up to 99.995% Nitrogen purity

Carbon Molecular Sieve (CMS) adsorbs Oxygen and all other molecules under high pressure, allowing Nitrogen to pass through

20 – 25 year lifespan (when properly designed and maintained)



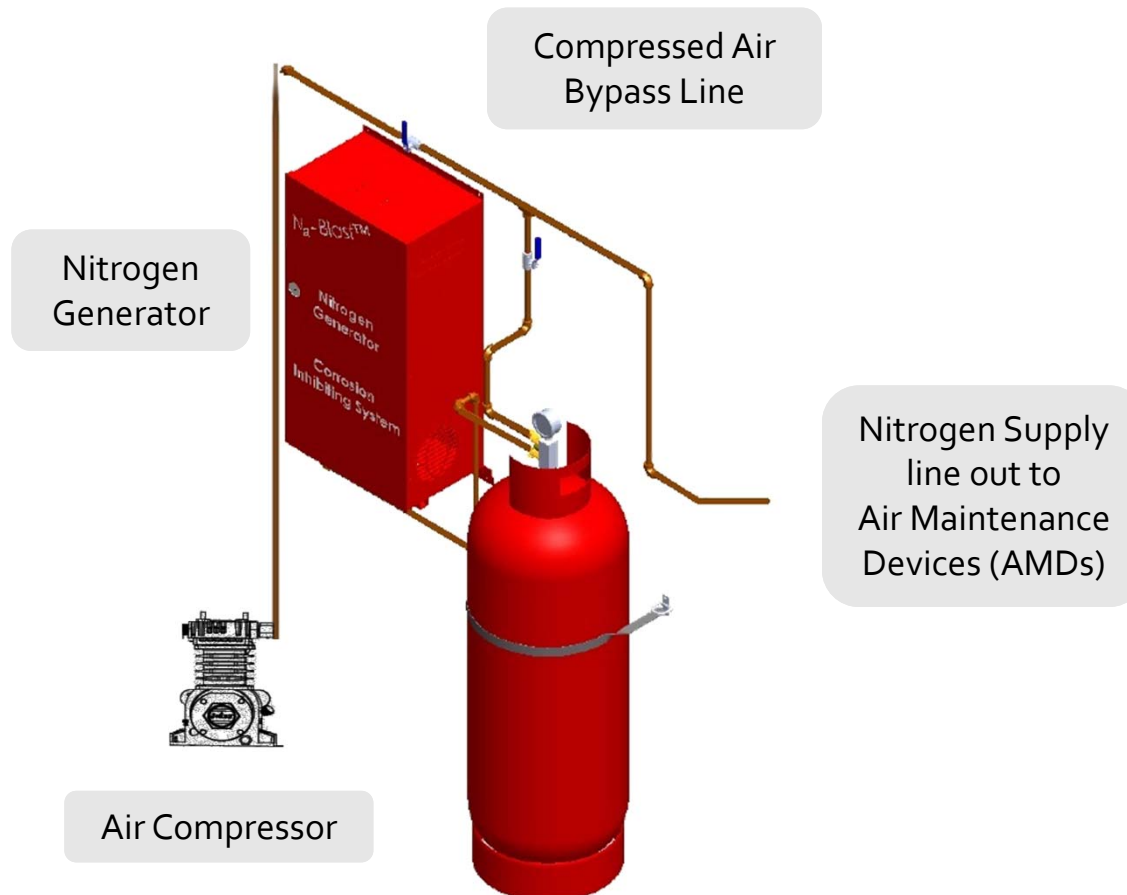
Vessels are filled with Carbon Molecular Sieve (CMS)

Under high pressure, CMS adsorbs impurities, allowing Nitrogen to pass through and into the Storage Tank

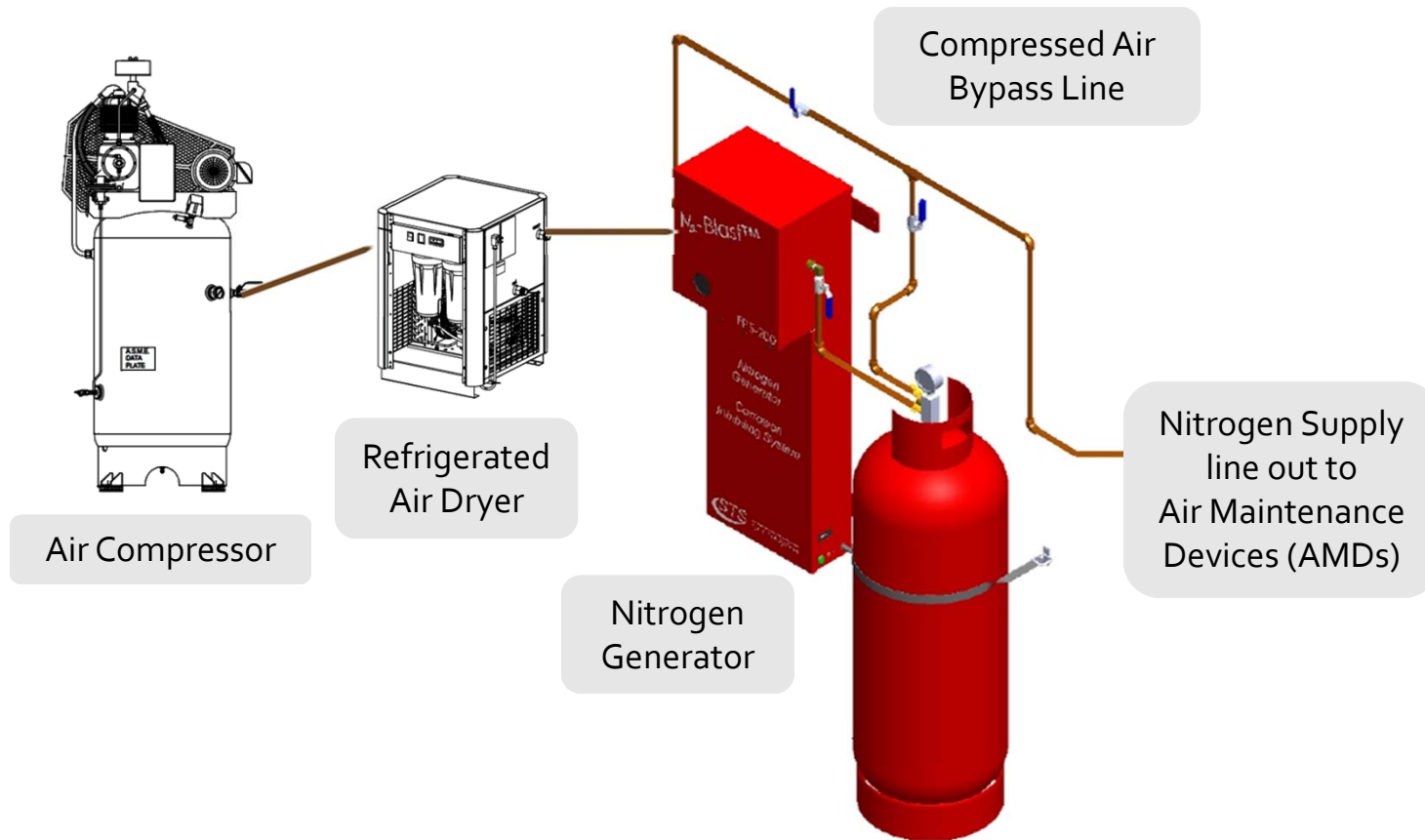
Once the CMS is saturated, the vessel is vented to atmosphere and impurities are released from the CMS

The CMS is now ready for the next N₂ generating cycle

Type 1 Nitrogen Generator Installation Layout

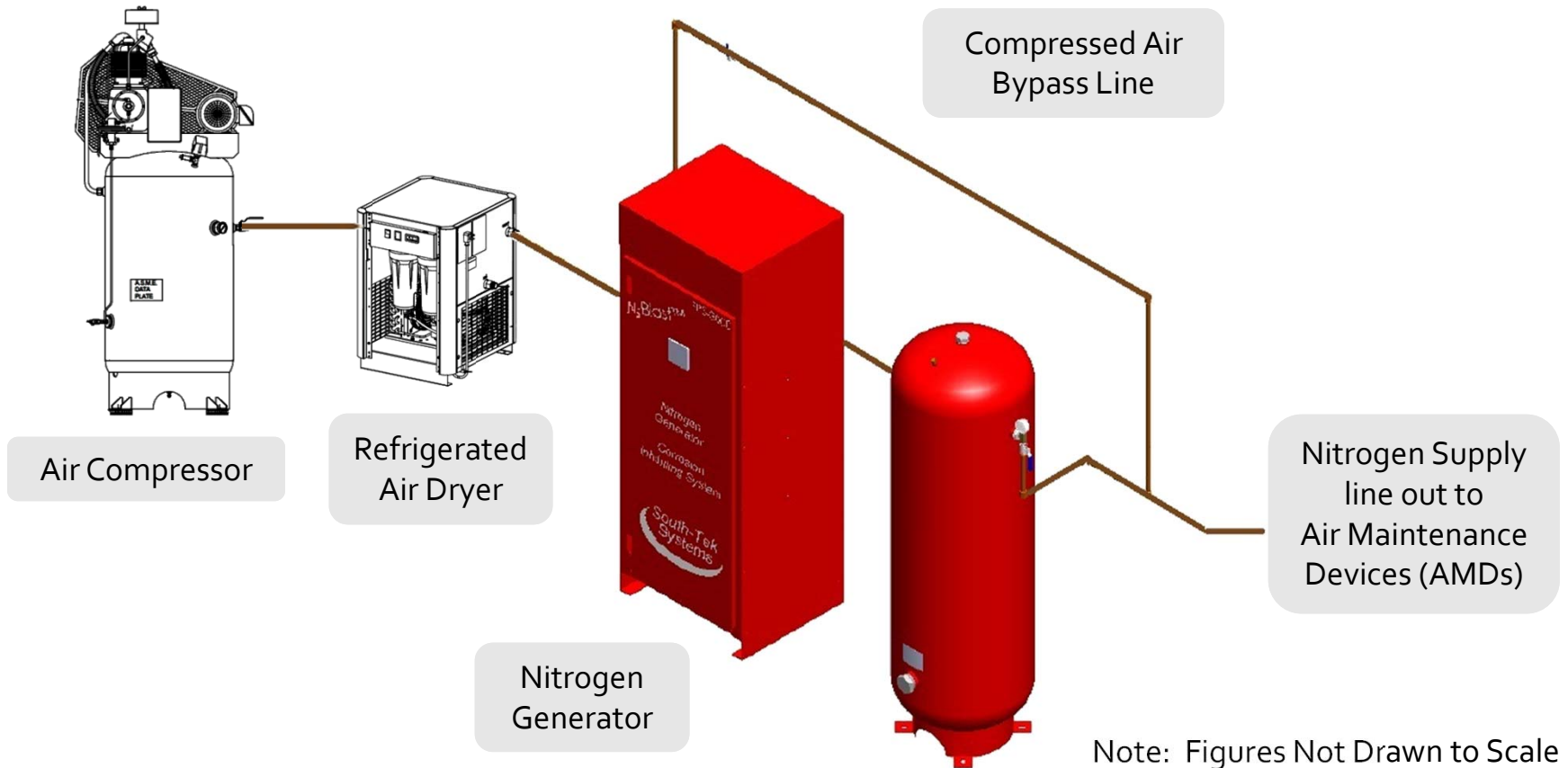


|| Type 2 Nitrogen Generator Install Layout



Note: Figures Not Drawn to Scale

Type 3 Nitrogen Generator Installation Layout



TOTALPAC[®] 3

NEW N₂-Blast[®] INTEGRATED CORROSION INHIBITING SYSTEM for FIRE PROTECTION SYSTEMS



FIREFLEX
Systems Inc.

South-Tek
Systems

South-Tek
Systems

TOTALPAC[®]3

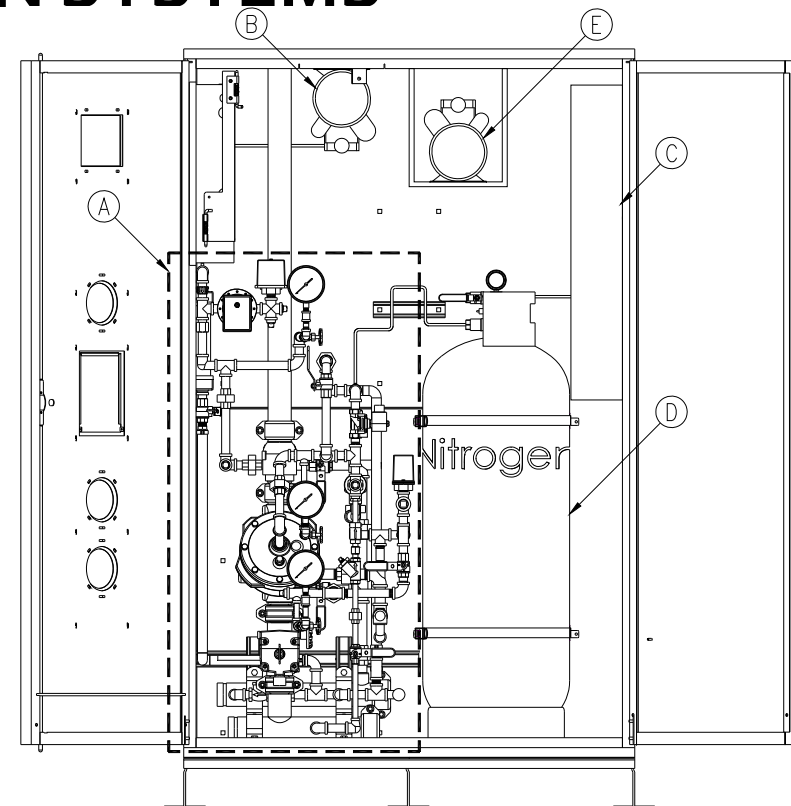
NEW N₂-Blast[®] INTEGRATED CORROSION INHIBITING SYSTEM for FIRE PROTECTION SYSTEMS

N₂-Blast[®] Option Components

- A: Dry or preaction automatic sprinkler system
- B: Air Style "A" Direct air compressor (shown) or Style "B" APMD available
- C: Nitrogen generator
- D: Nitrogen storage tank (28 gallons)
- E: Maintenance Air Compressor - Maintains storage tank pressure

N2-Blast[®] Option Specifications

	FPS-250	FPS-750
Maximum System Capacity (Gal)	250	750
Electrical	120V/60Hz/1 Phase	120V/60Hz/1 Phase
Amperage	20	20
N2 Receiver Tank Size	28 Gallons	28 Gallons



Building Monitoring System Integration

Leak Detection System

- Should be provided with every Nitrogen generator
- Alarms when the Nitrogen Generator senses a significant leak in FPS piping, which causes the equipment to run excessively
- Alarms if the equipment is not working properly
- Built within the Nitrogen Generator cabinet and includes dry contact for signal out to Building Monitoring System

Air Bypass Alarm



Alarms if Nitrogen Generator is bypassed by air compressor or inadvertently powered "off"

Ensures that Nitrogen, not air, is continually flowing to the Air Maintenance Device/s

Built internal to the Nitrogen Generator and provides both a visual and audible alarm

Includes a dry contact to wire into the Building Monitoring System

AutoPurge System

In order to effectively inhibit corrosion, high purity Nitrogen must be equally distributed throughout the entire FPS

- Provides a constant purge of Nitrogen within each FPS Zone
- Assists in drying out residual water and moisture left behind after hydrotest
- Proven through Computational Fluid Dynamics Modeling to be the most effective way to ensure high purity Nitrogen reaches all branches within the FPS



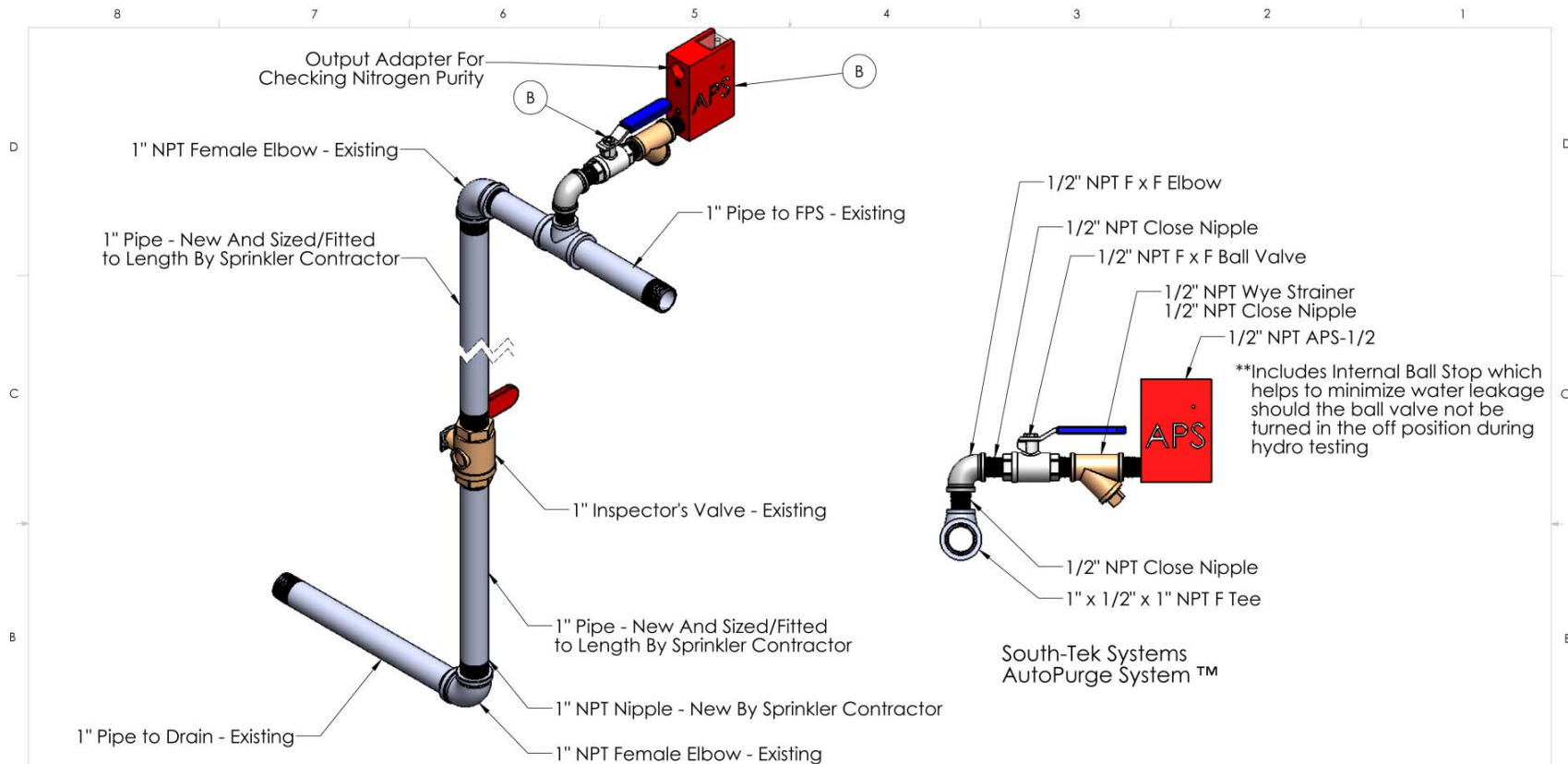
(1) to be installed on each Zone / System

Install on remote section of FPS

Easily tuned on site by the Sprinkler Contractor

Pneumatic, no power required

AutoPurge System Install



Installation Notes:

- Install 1" NPT Tee on a horizontal section of the Fire Protection Piping.
- Mount APS at a high point within the Fire Protection System as far from the pump room as possible.
- Ensure that the Tee's 90 degree outlet from the main is facing upward so that the main of the APS runs horizontally with the Fire Protection Piping.
- Close Ball Valve on AutoPurge System before hydrostatic testing

Note A: Plumb APS to drain in water sensitive areas
 Note B: Close valve during hydrostatic testing

UNLESS OTHERWISE SPECIFIED:		NAME	DATE	SOUTH-TEK SYSTEMS	
DIMENSIONS ARE IN INCHES		DRAWN	JN	02-17-11	2940 ORVILLE WRIGHT WAY
TOLERANCES:		CHECKED			WILMINGTON, NC 28405
FRACTIONAL ±		ENG APPR.			WWW.SOUTHTEKSYSTEMS.COM
ANGULAR: MATCH ±		MFG APPR.			(910) 332-4173
TWO PLACE DECIMAL ±		Q.A.			TITLE:
THREE PLACE DECIMAL ±		COMMENTS:			APS-1/2 FCT™
INTERPRET GEOMETRIC TOLERANCING PER:					AutoPurge System™
MATERIAL					SIZE
FINISH					DWG. NO.
DO NOT SCALE DRAWING					B
					A03-APS-00-03
					REV
					SCALE: 1:8
					WEIGHT:
					SHEET 1 OF 1

PROPRIETARY AND CONFIDENTIAL
 THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SOUTH-TEK SYSTEMS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF SOUTH-TEK SYSTEMS IS PROHIBITED.

|| Tuning the AutoPurge System

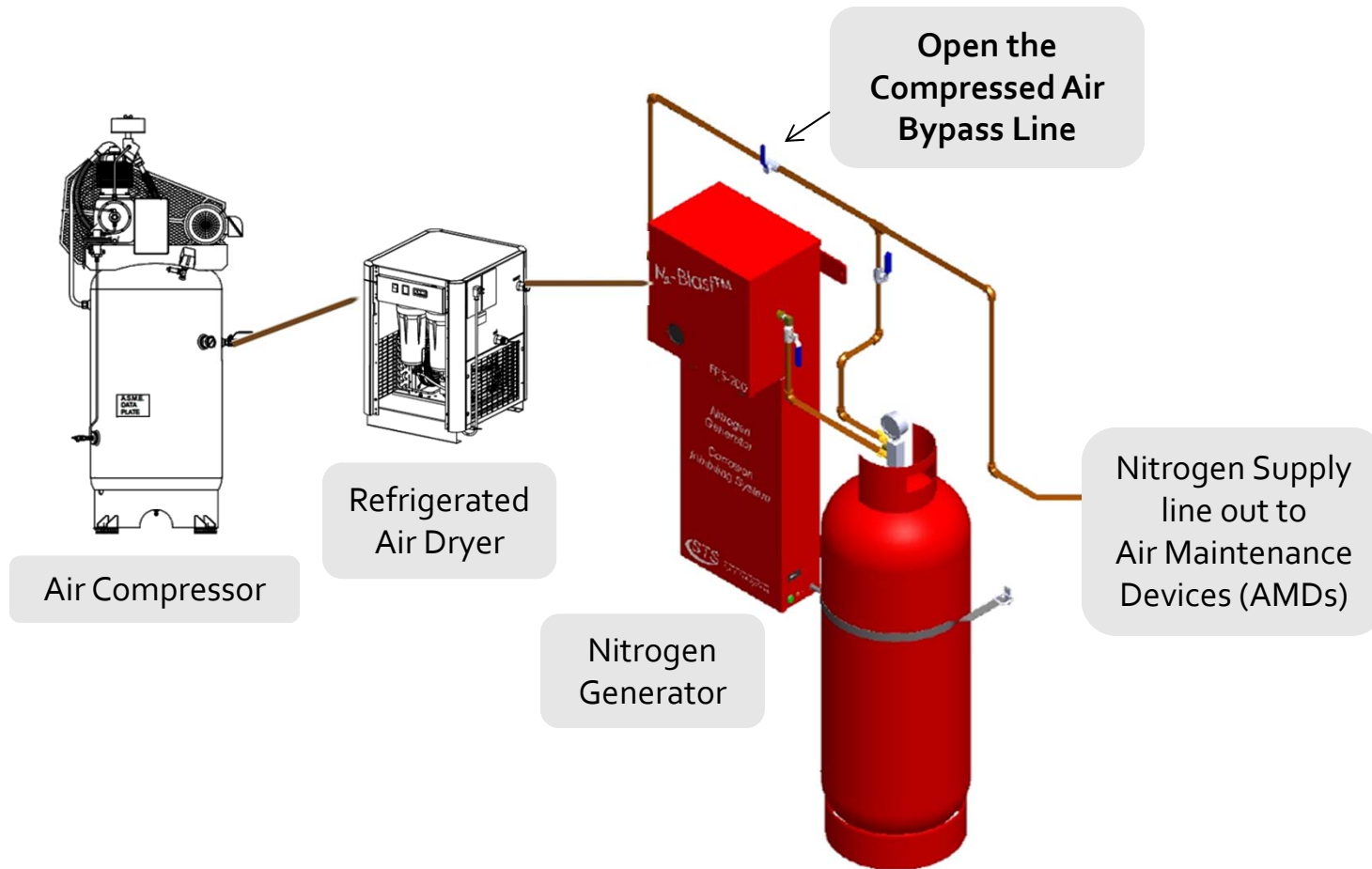
Gallons in Zone - APS 2 Flow Setting

Set the APS Flow Setting once the FPS system is at supervisory pressure. Use the bleed screw below to relieve the water check feature if no flow occurs, see manual for instructions.

50	1/4	600	C
100	1/2	650	C+1/4
150	3/4	750	C+1/2
200	A	800	C+3/4
250	A+1/2	850	D
300	A+3/4	900	D+1/4
350	B	950	D+1/2
400	B+1/4	1000	D+3/4
500	B+1/2	1050	E
550	B+3/4		

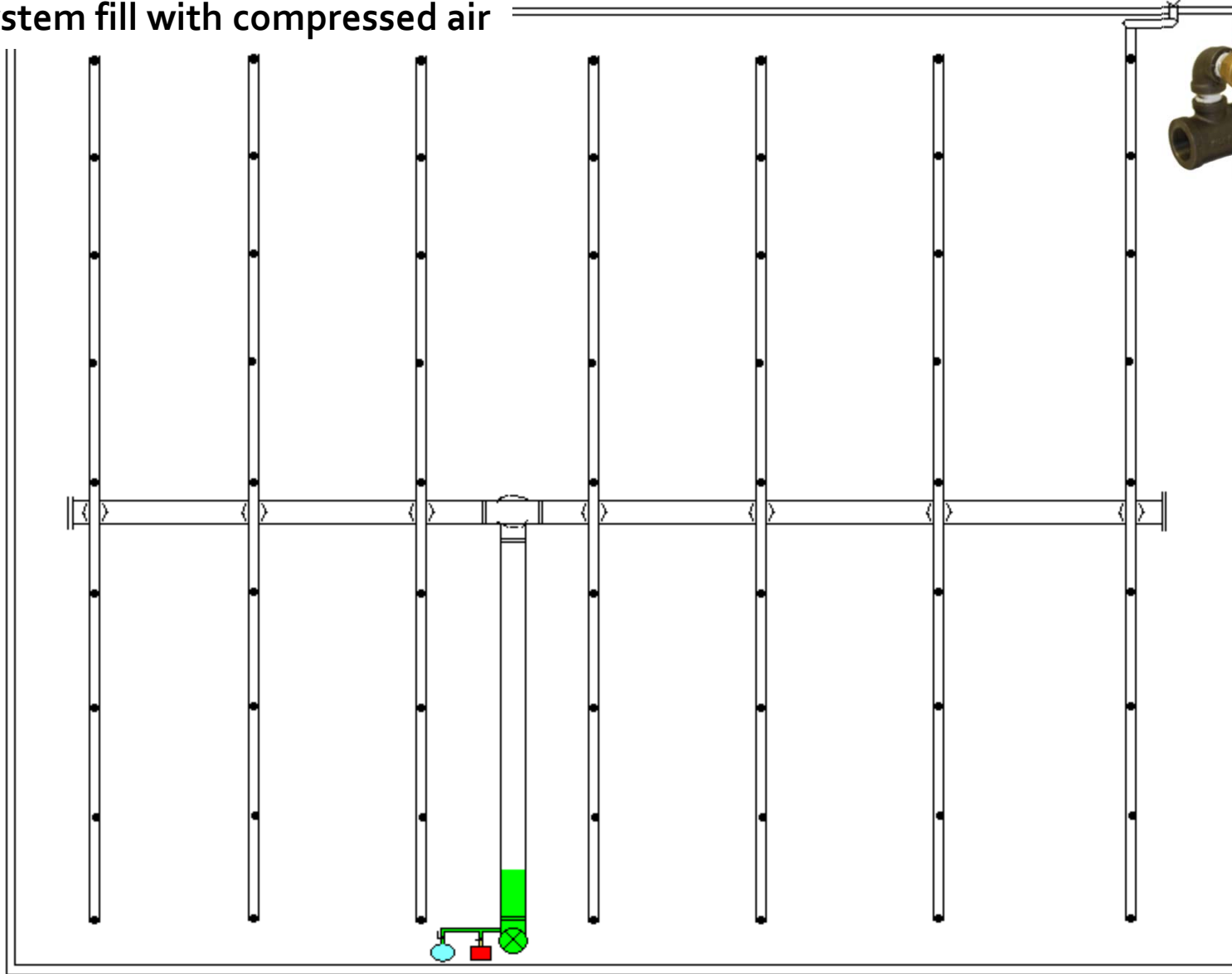
Warning: AutoPurge Systems should be valved off during all FPS pressure tests. This system allows a controlled purge of the FPS system and should be set to the proper APS Flow Setting only. Other settings may cause the FPS to alarm or malfunction.

Initial fill with Compressed Air



Note: Figures Not Drawn to Scale

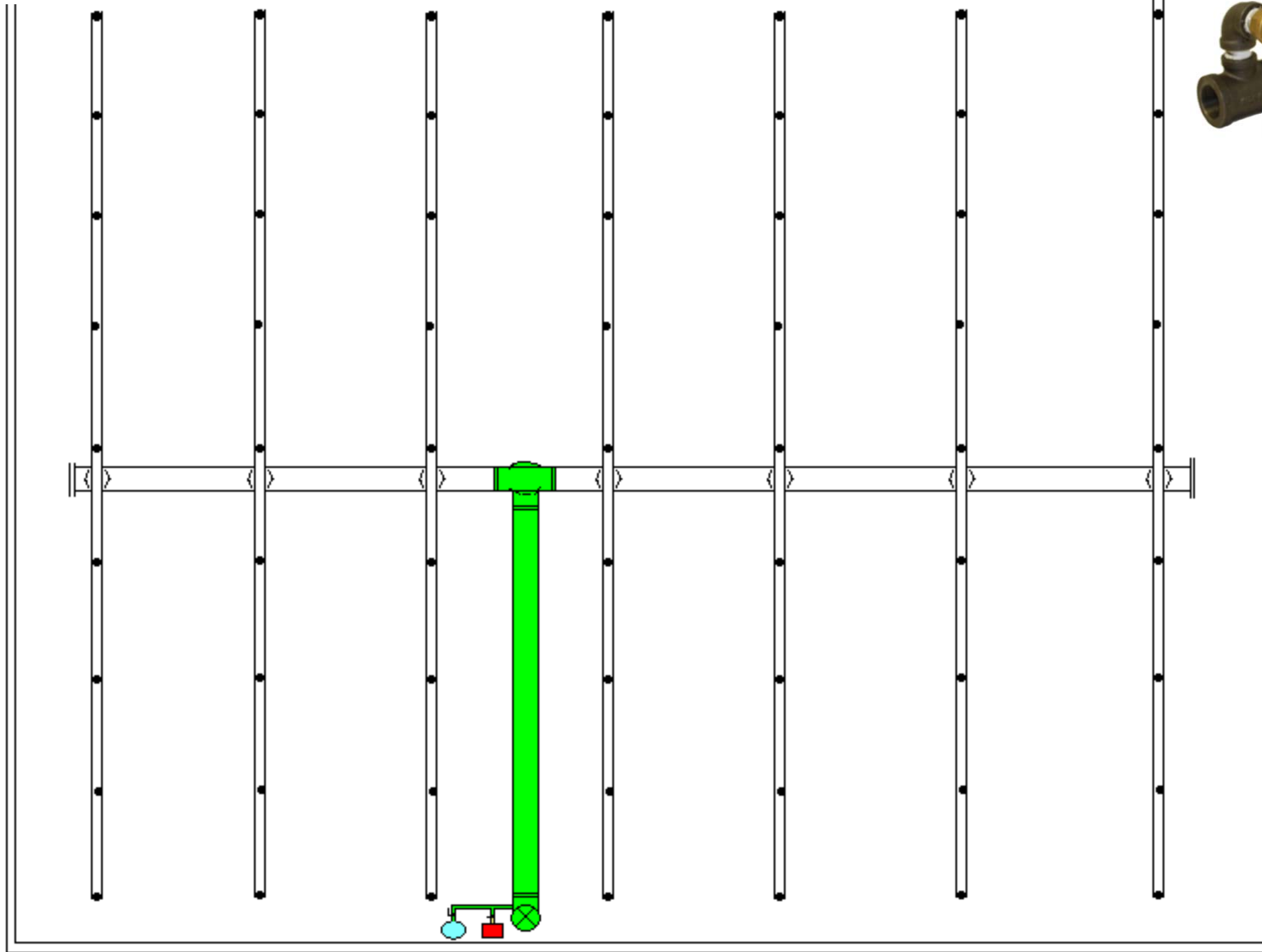
System fill with compressed air



**AutoPurge
System™**

Dry or Preaction Riser

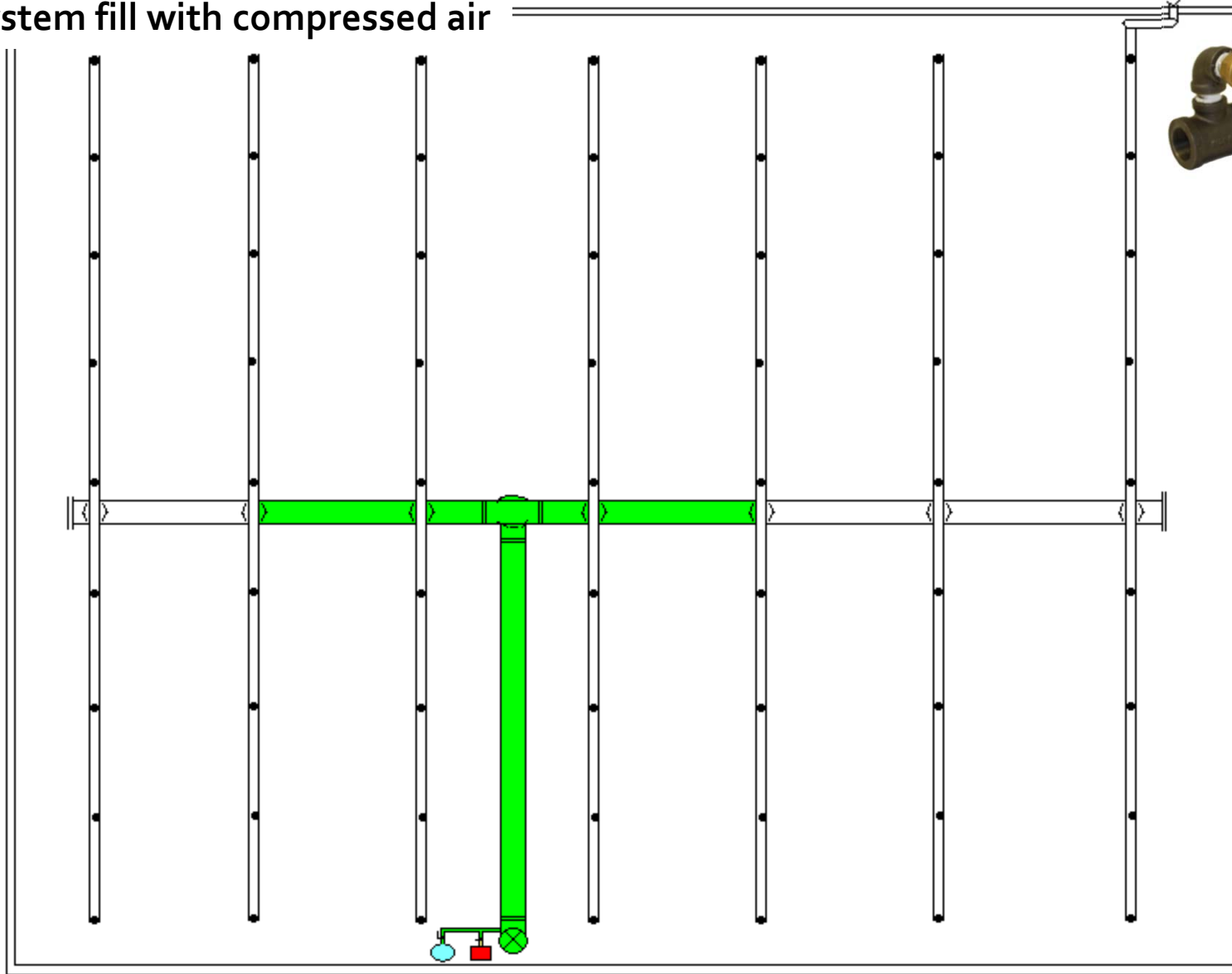
System fill with compressed air



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Dry or Preaction Riser

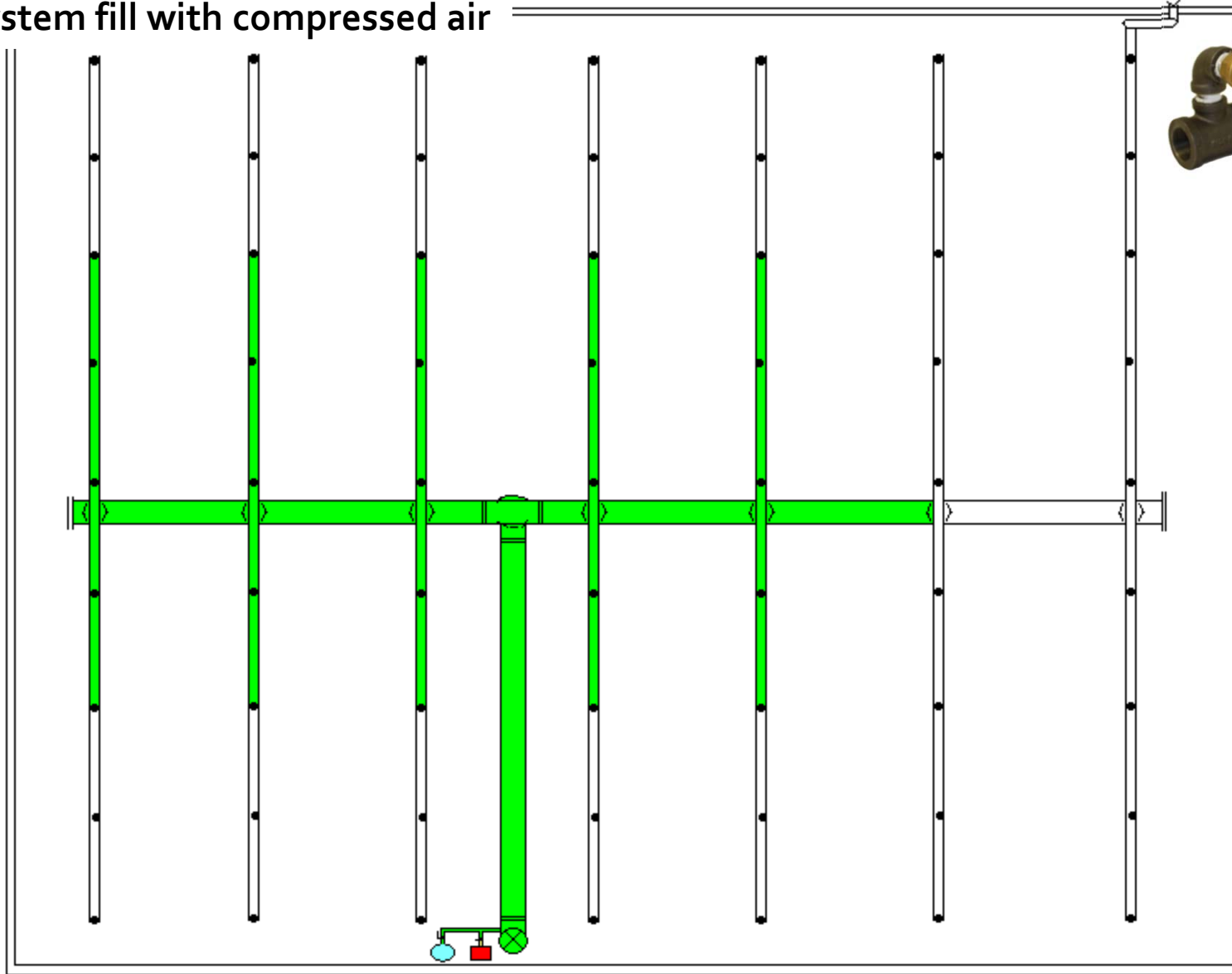
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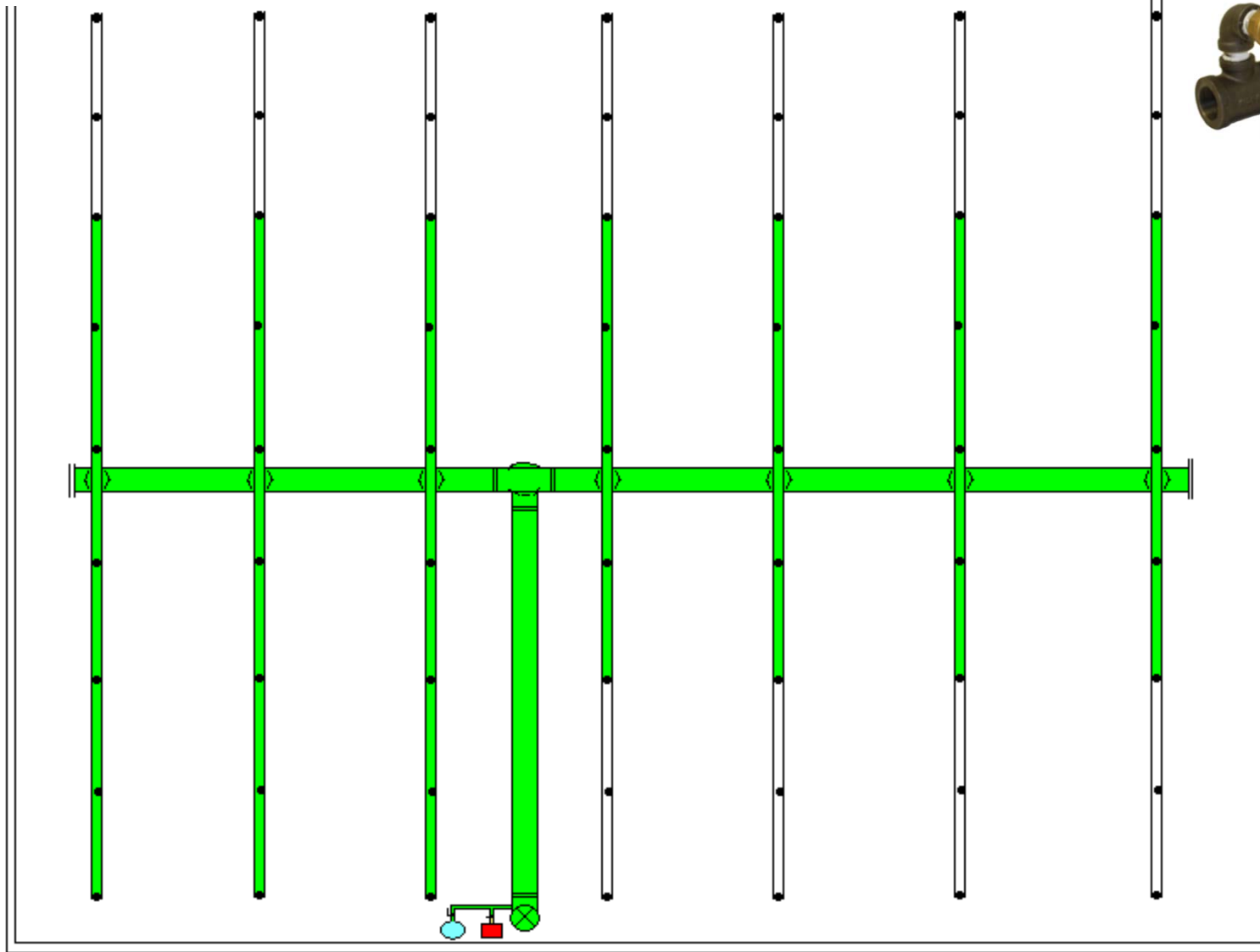
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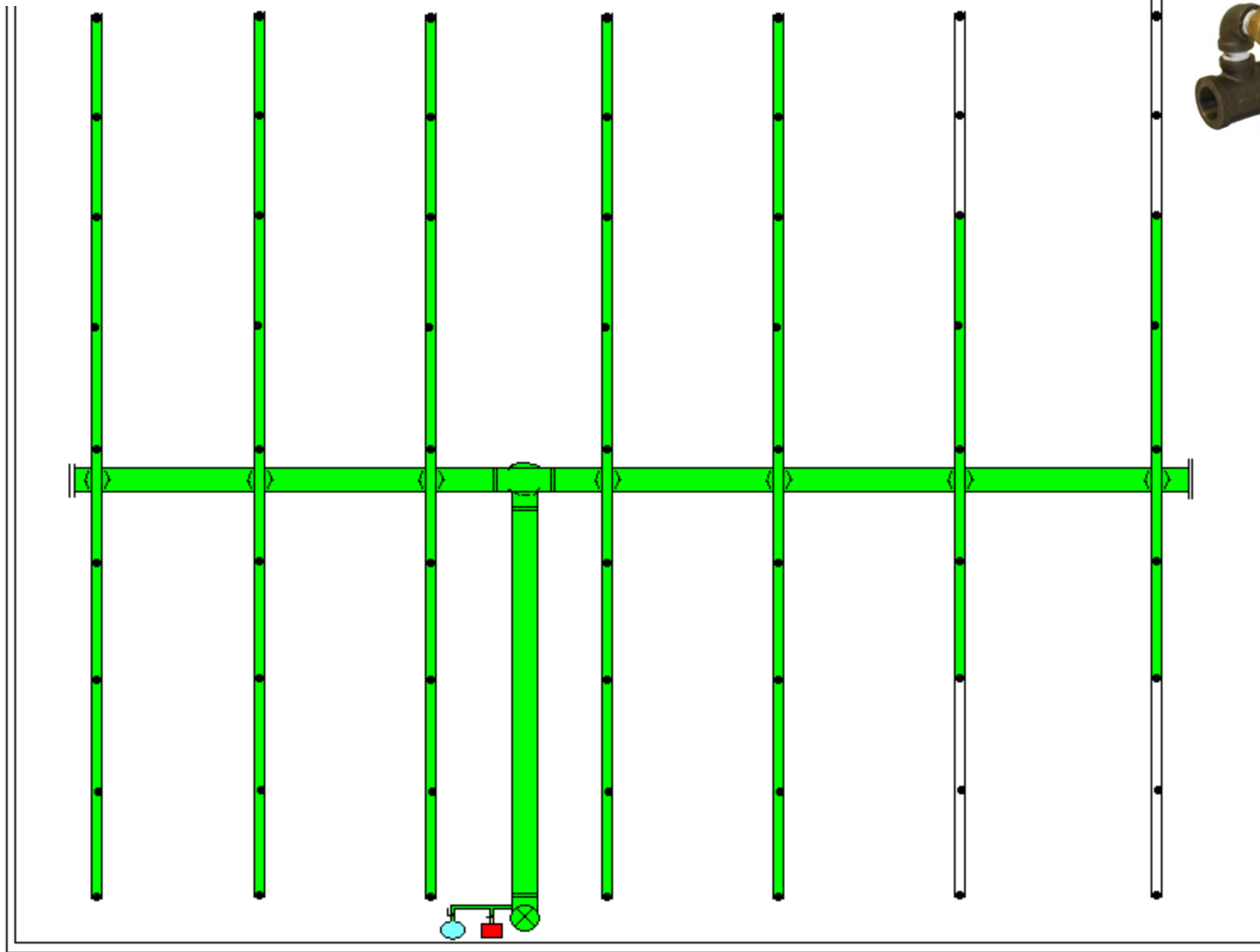
System fill with compressed air



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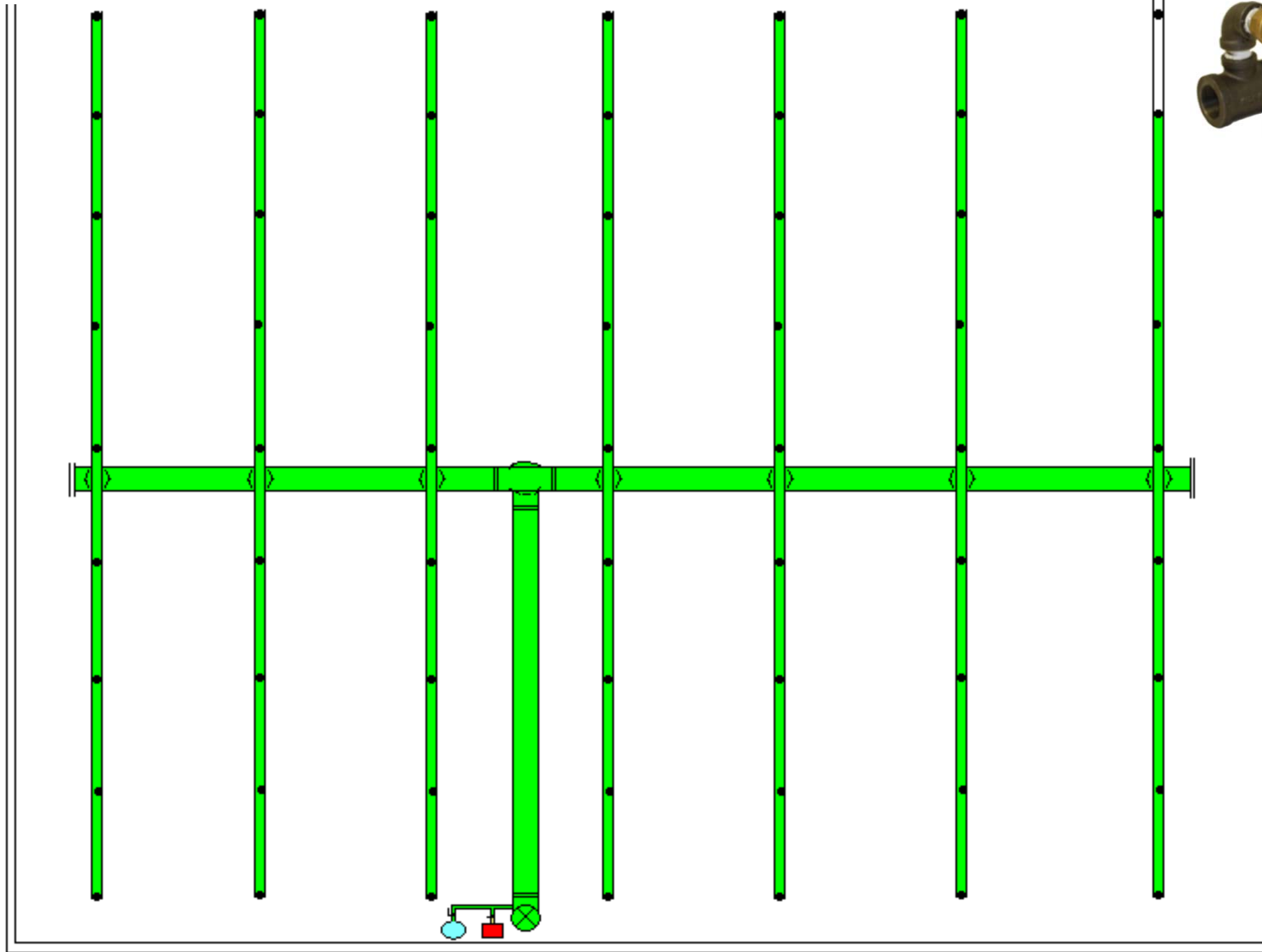
System fill with compressed air



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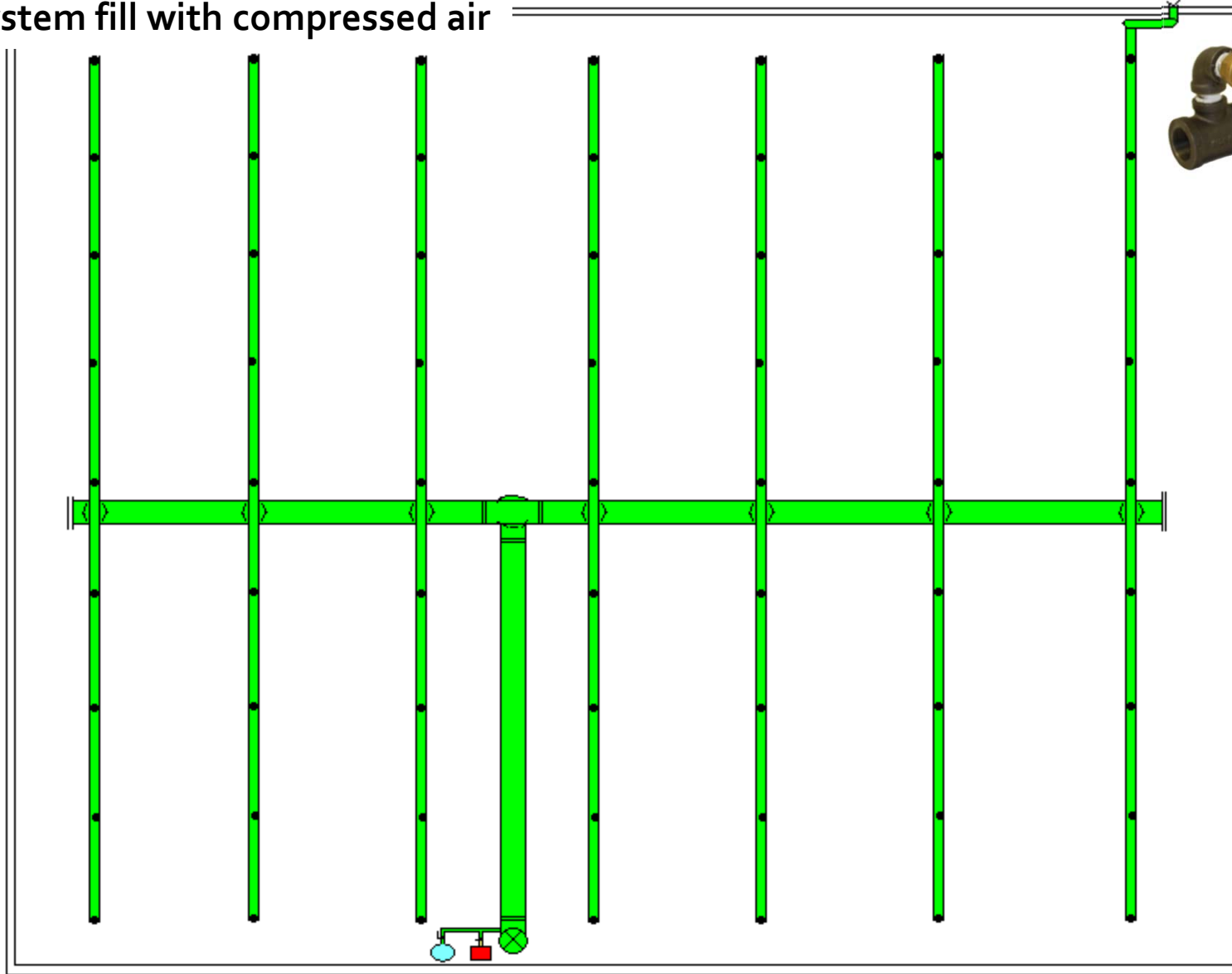
System fill with compressed air



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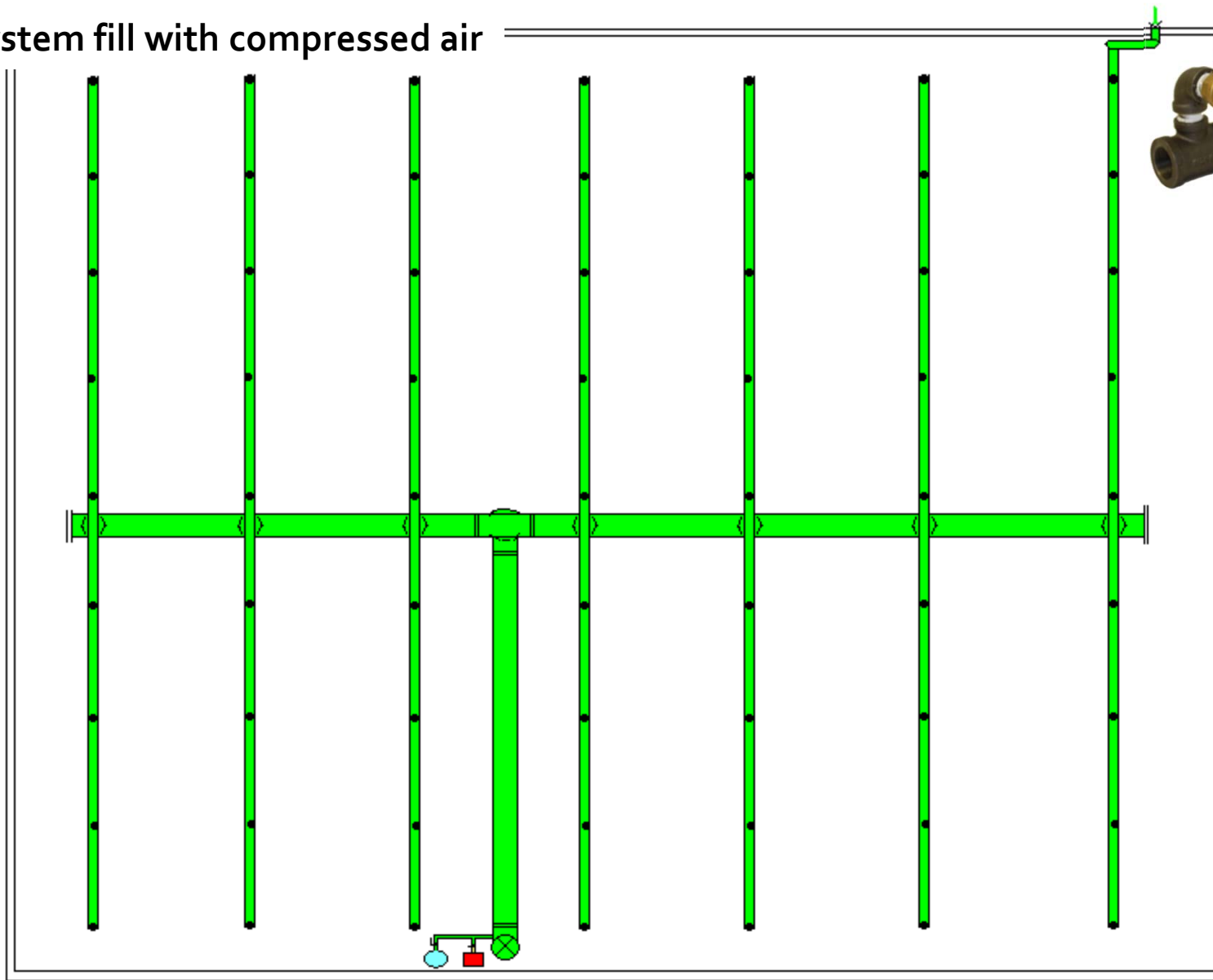
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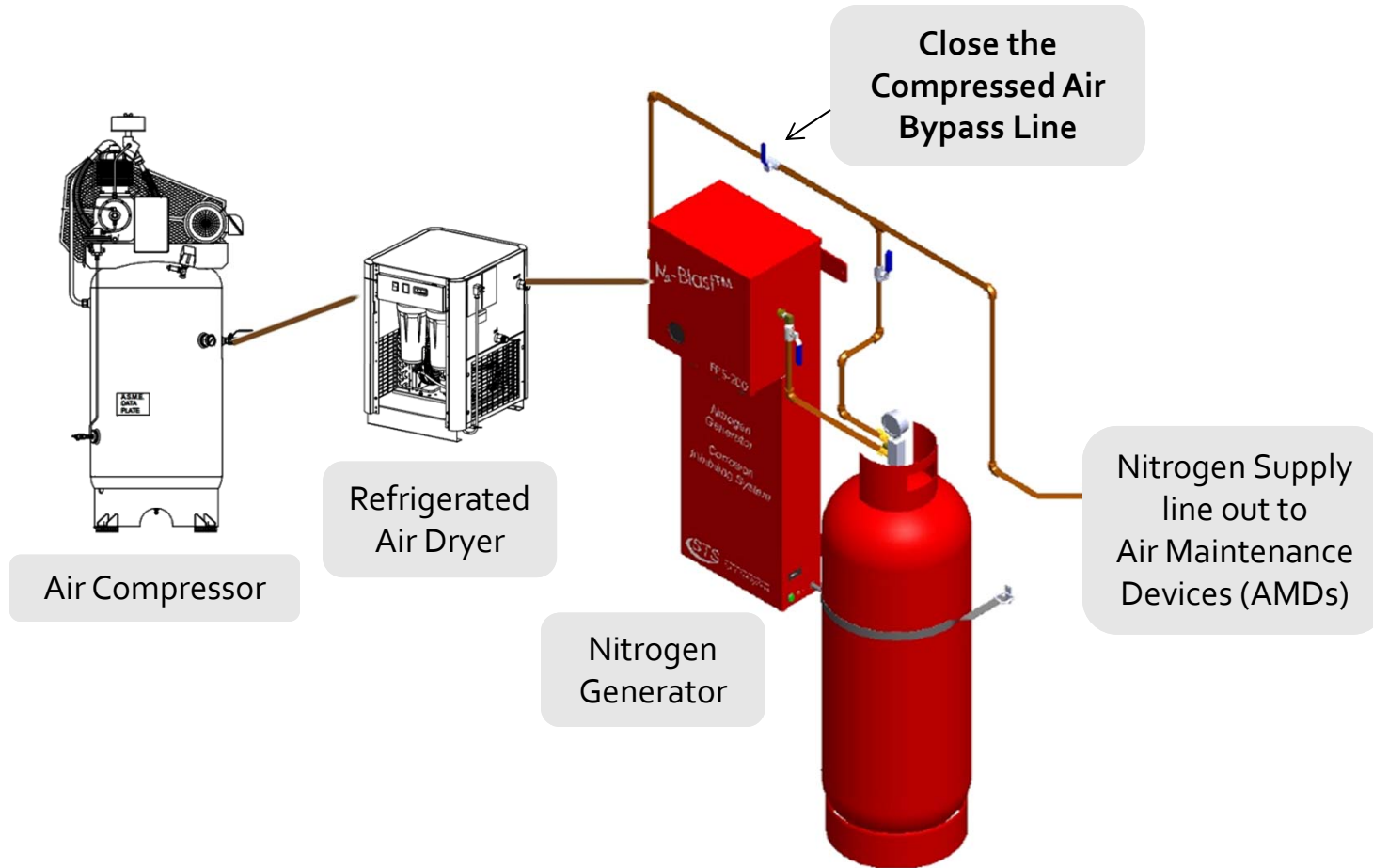
System fill with compressed air



**AutoPurge
System™**

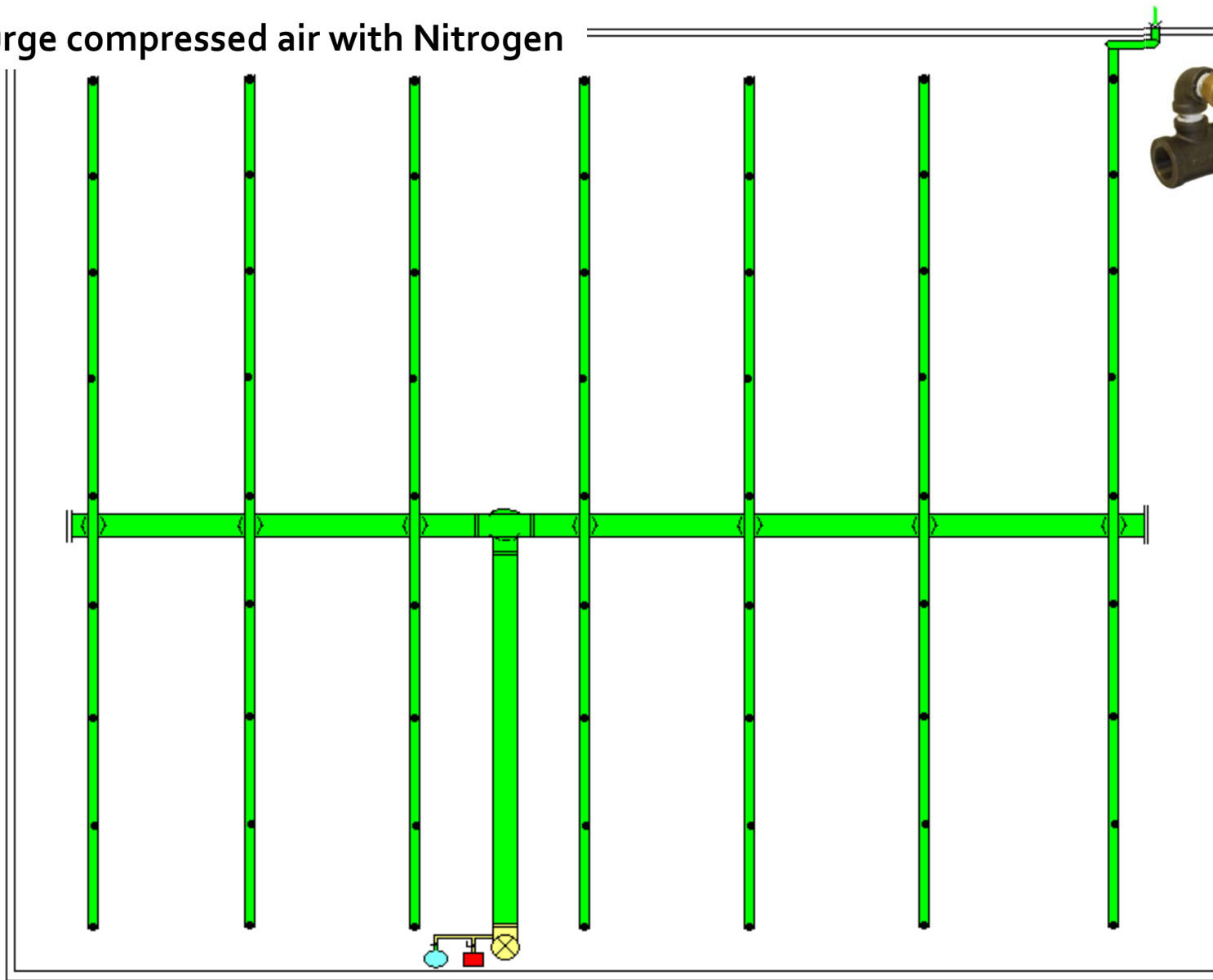
Dry or Preaction Riser

Introducing 98%+ Nitrogen



Note: Figures Not Drawn to Scale

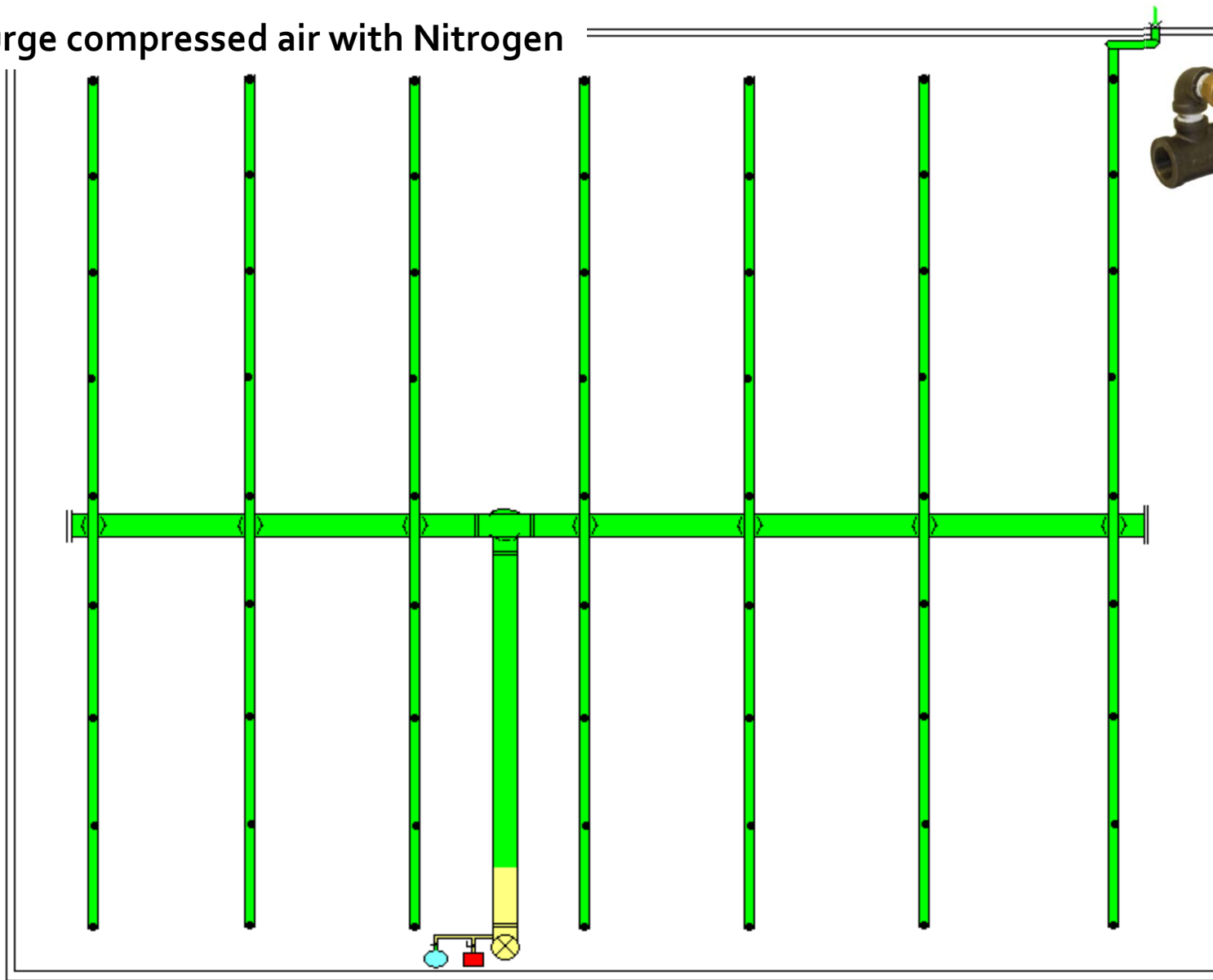
Purge compressed air with Nitrogen



**AutoPurge
System™**

Dry or Preaction Riser

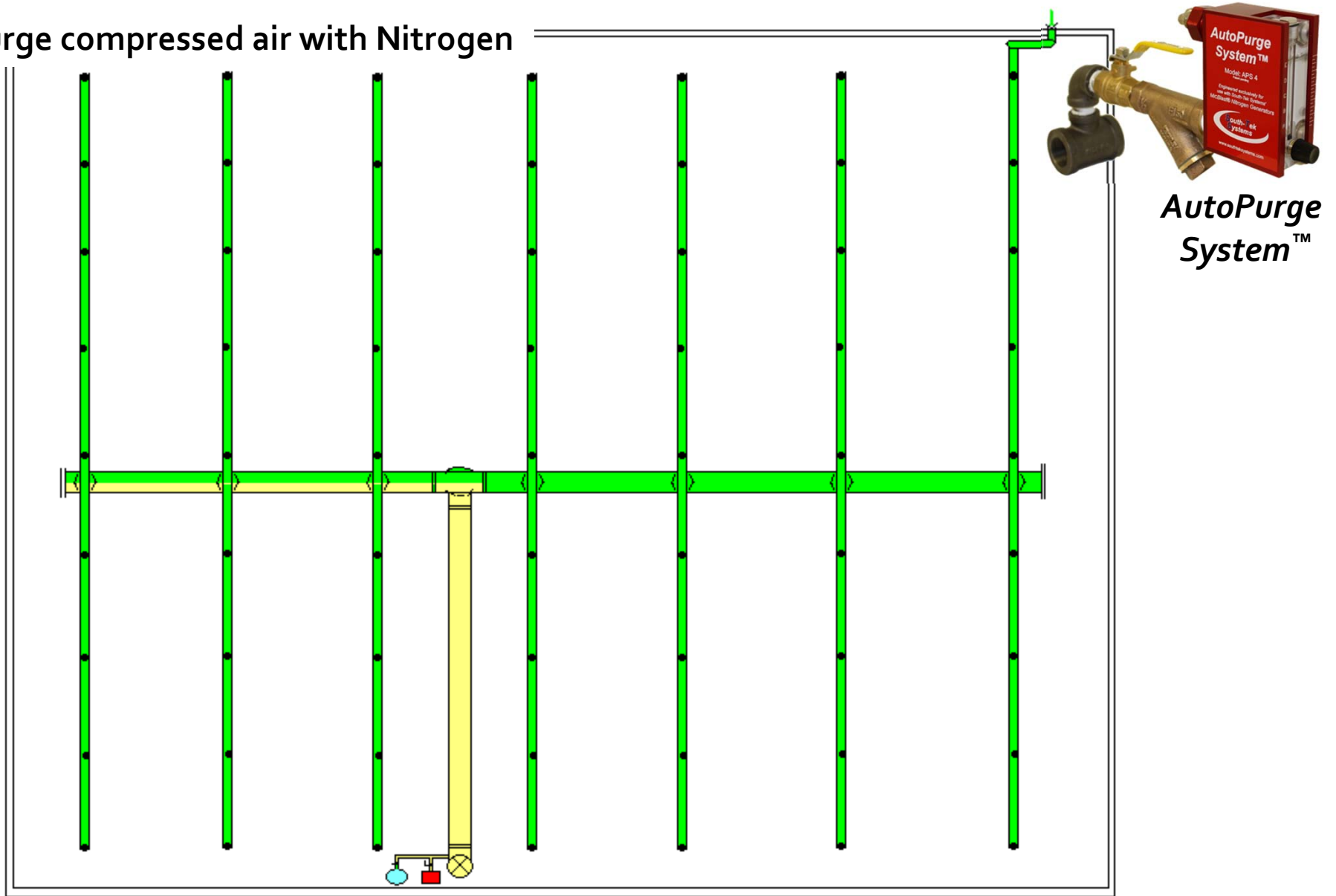
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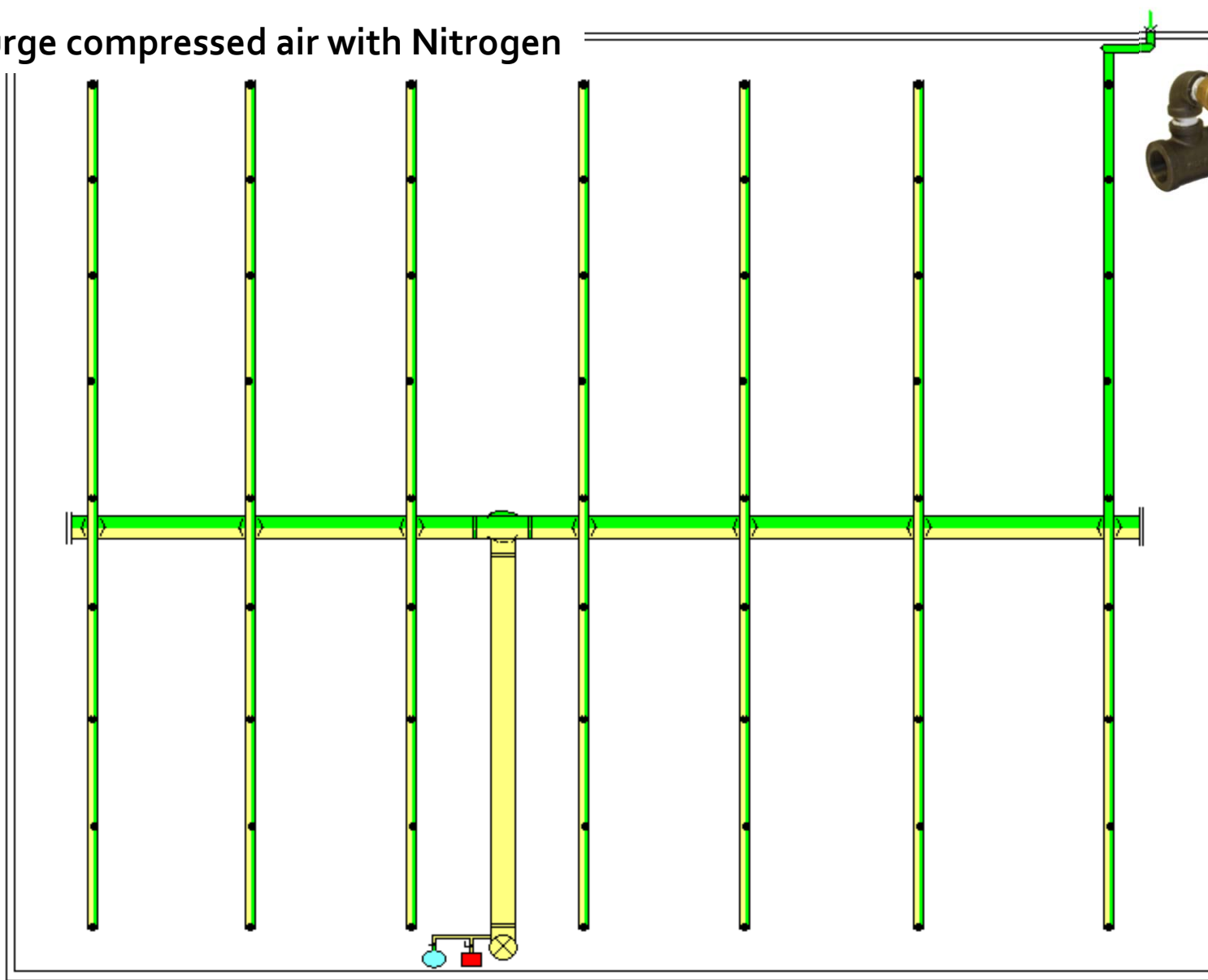
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Dry or Preaction Riser

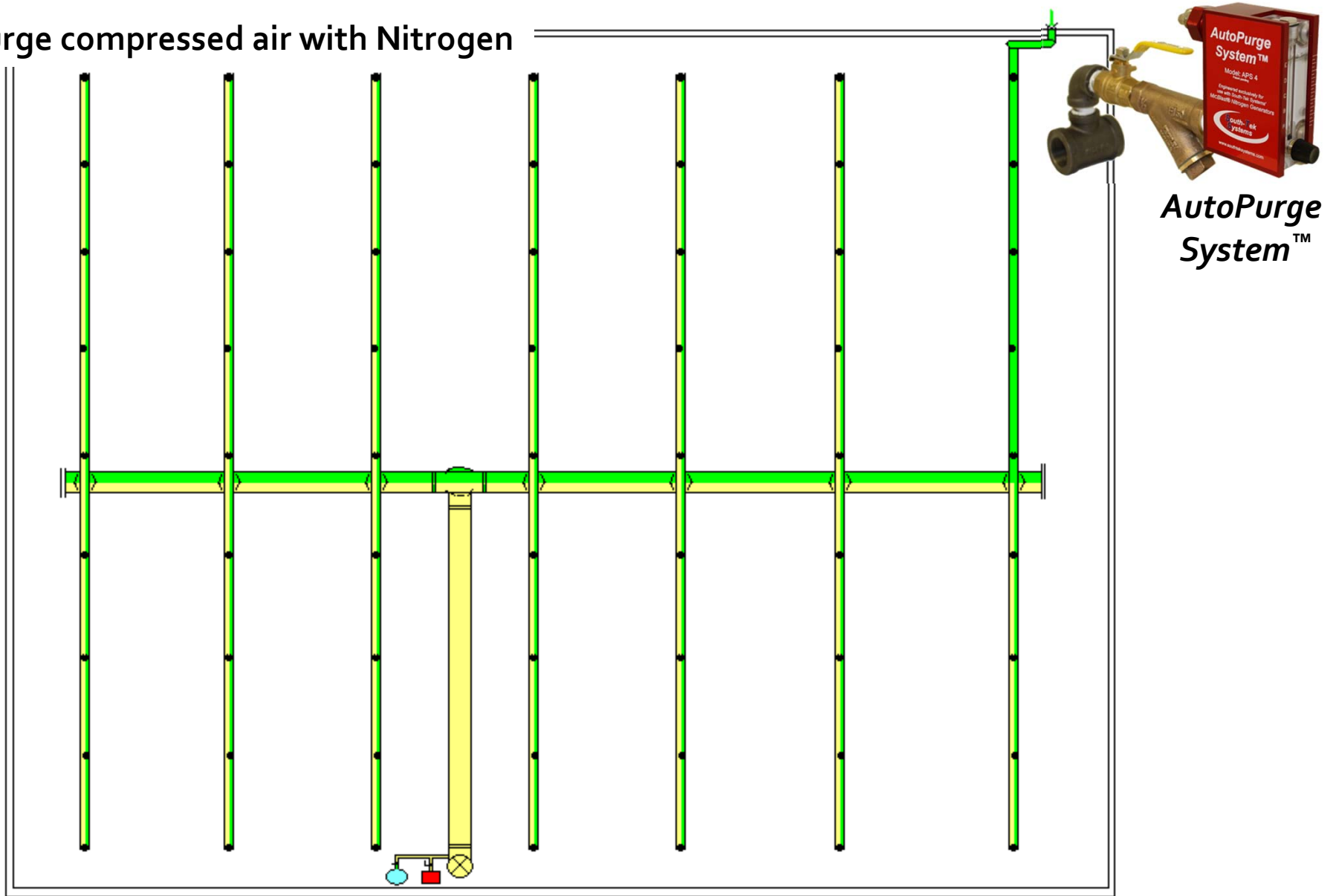
Purge compressed air with Nitrogen



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Dry or Preaction Riser

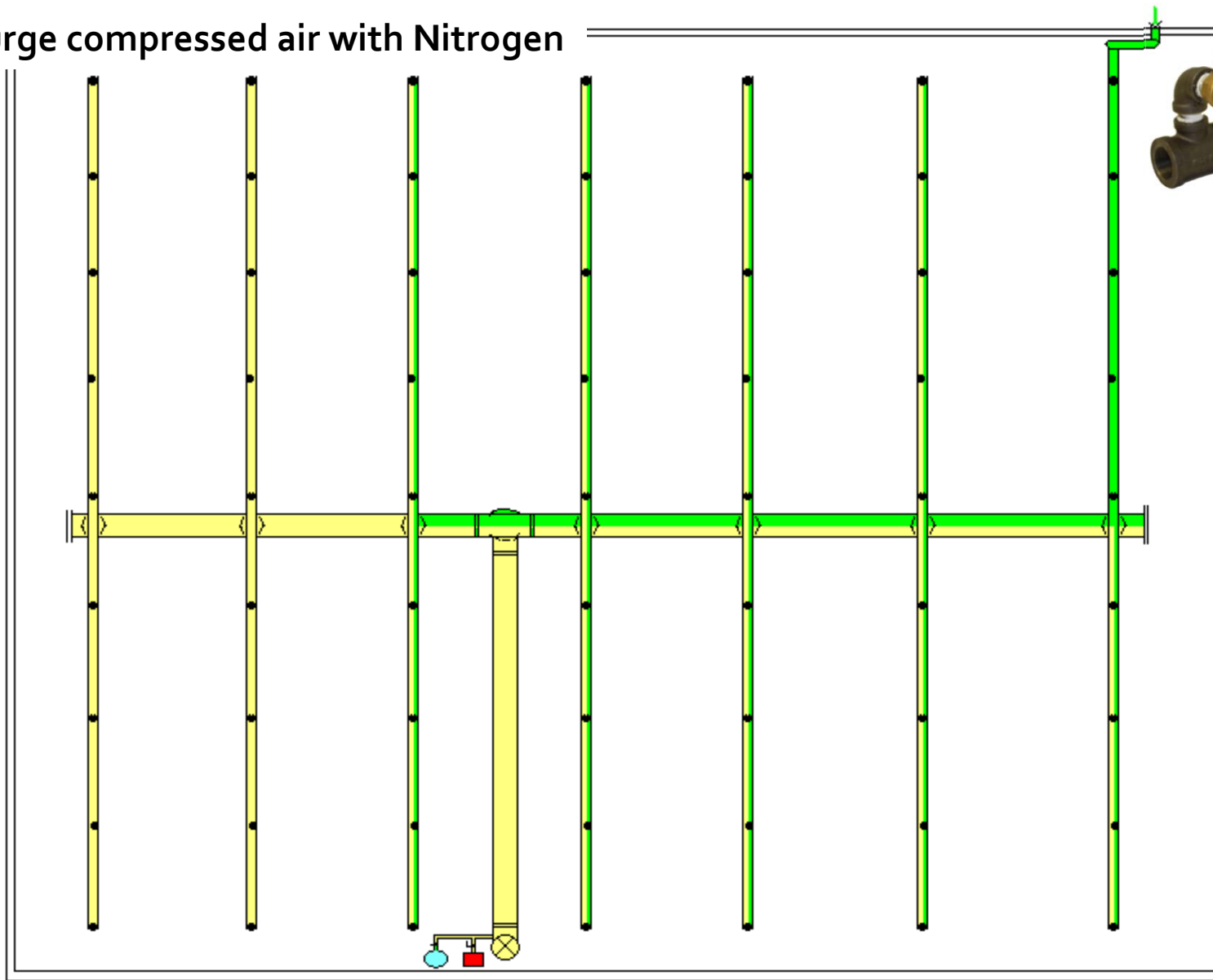
Purge compressed air with Nitrogen



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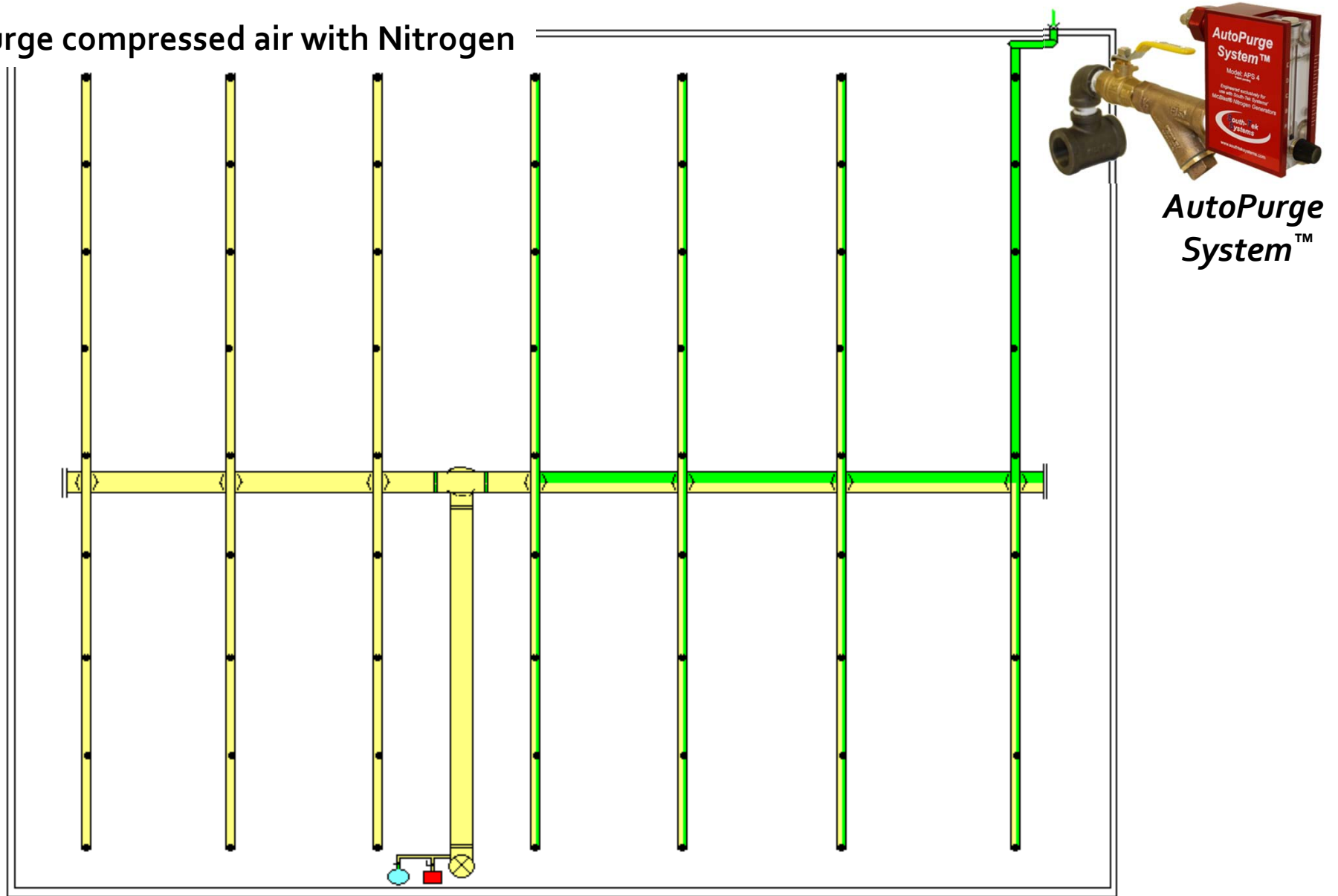
Purge compressed air with Nitrogen



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Dry or Preaction Riser

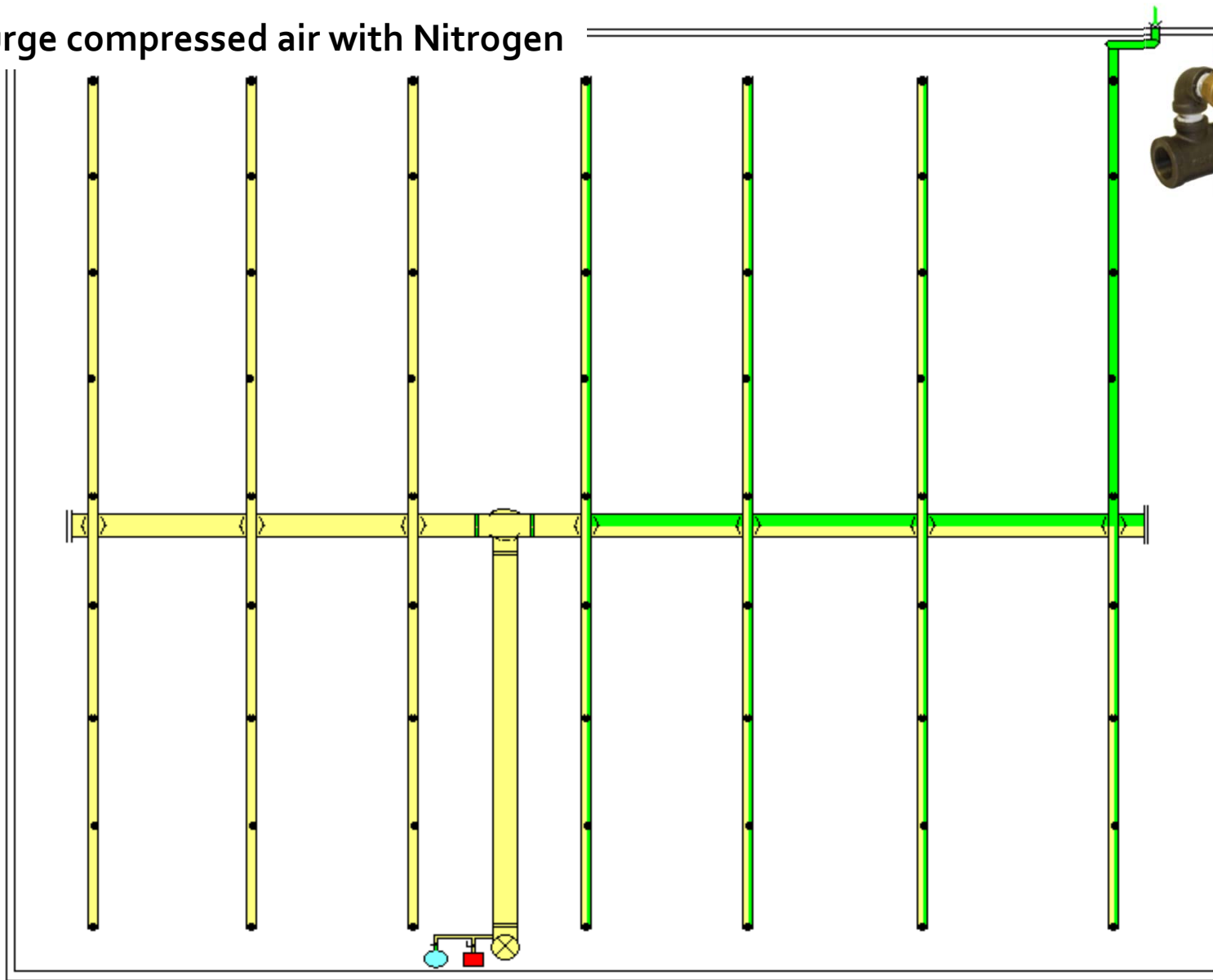
Purge compressed air with Nitrogen



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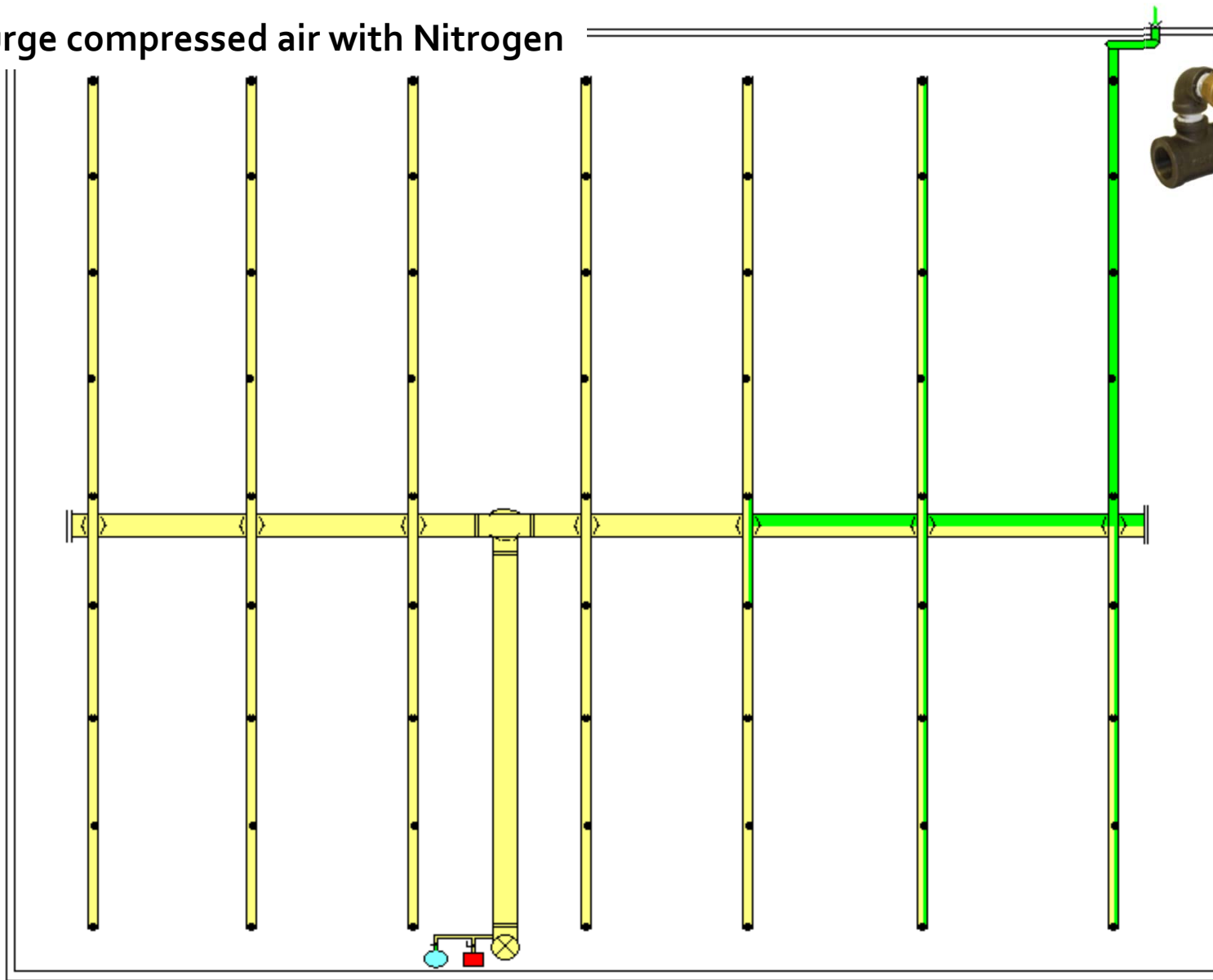
Purge compressed air with Nitrogen



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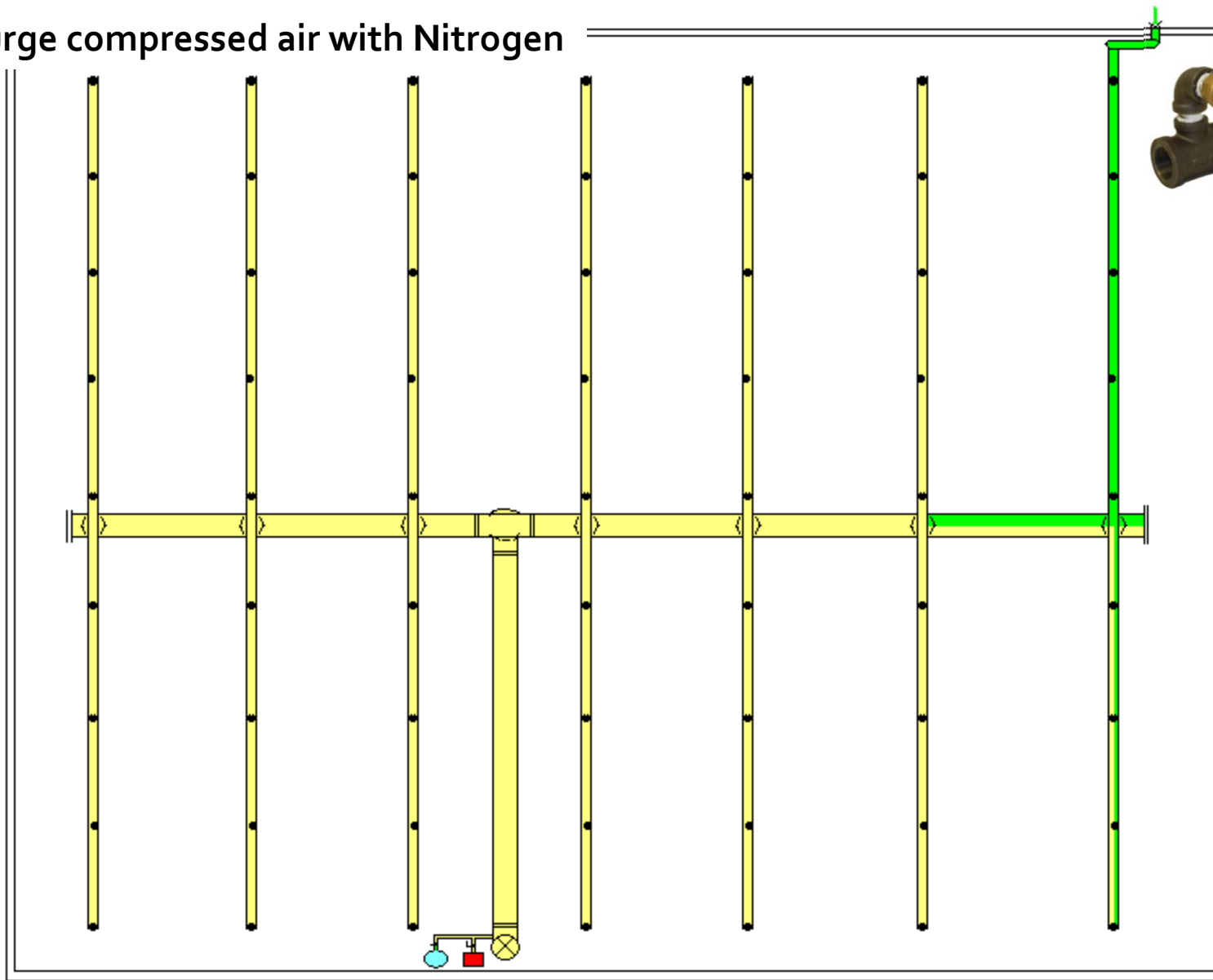
Purge compressed air with Nitrogen



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Dry or Preaction Riser

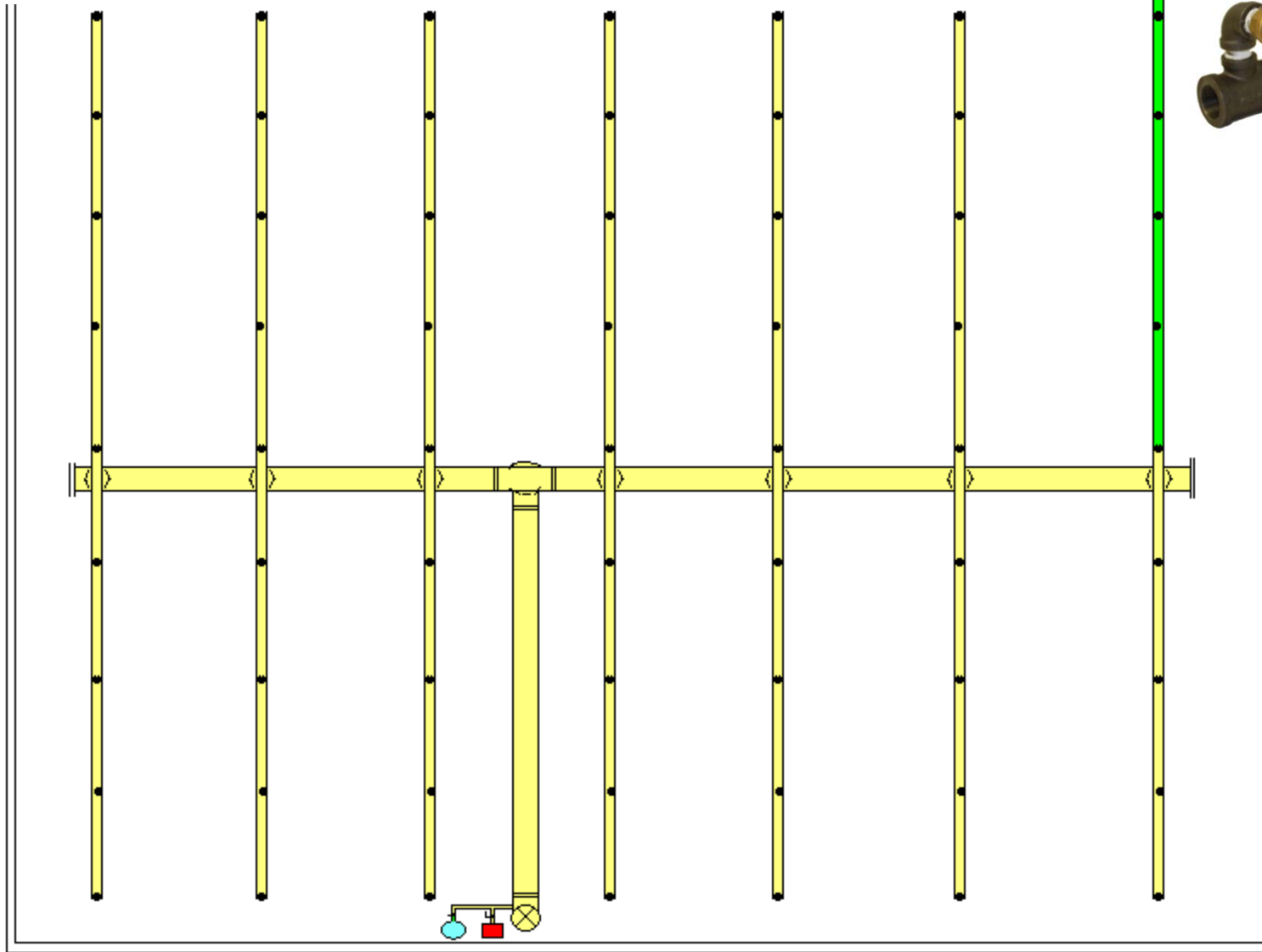
Purge compressed air with Nitrogen



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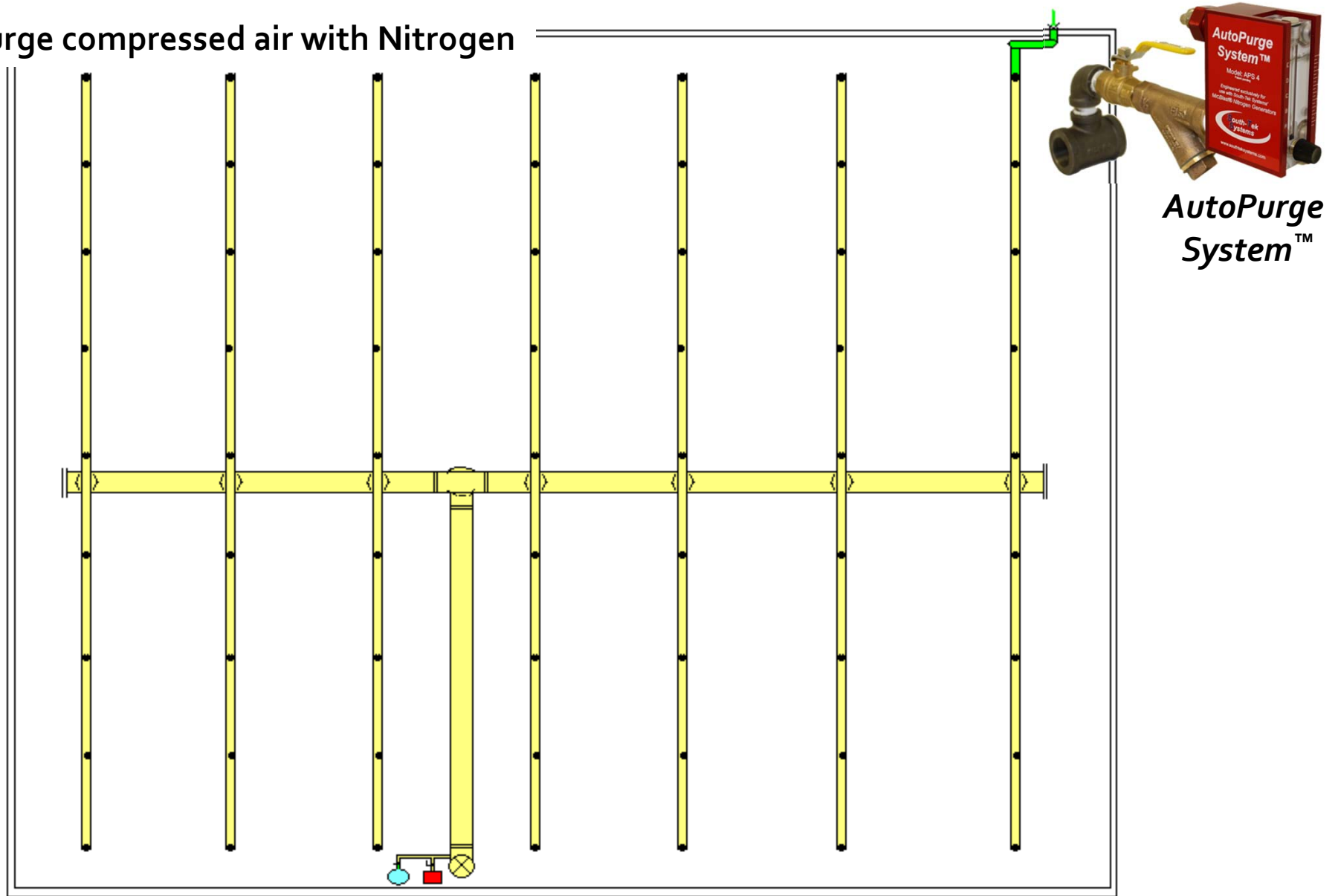
Purge compressed air with Nitrogen



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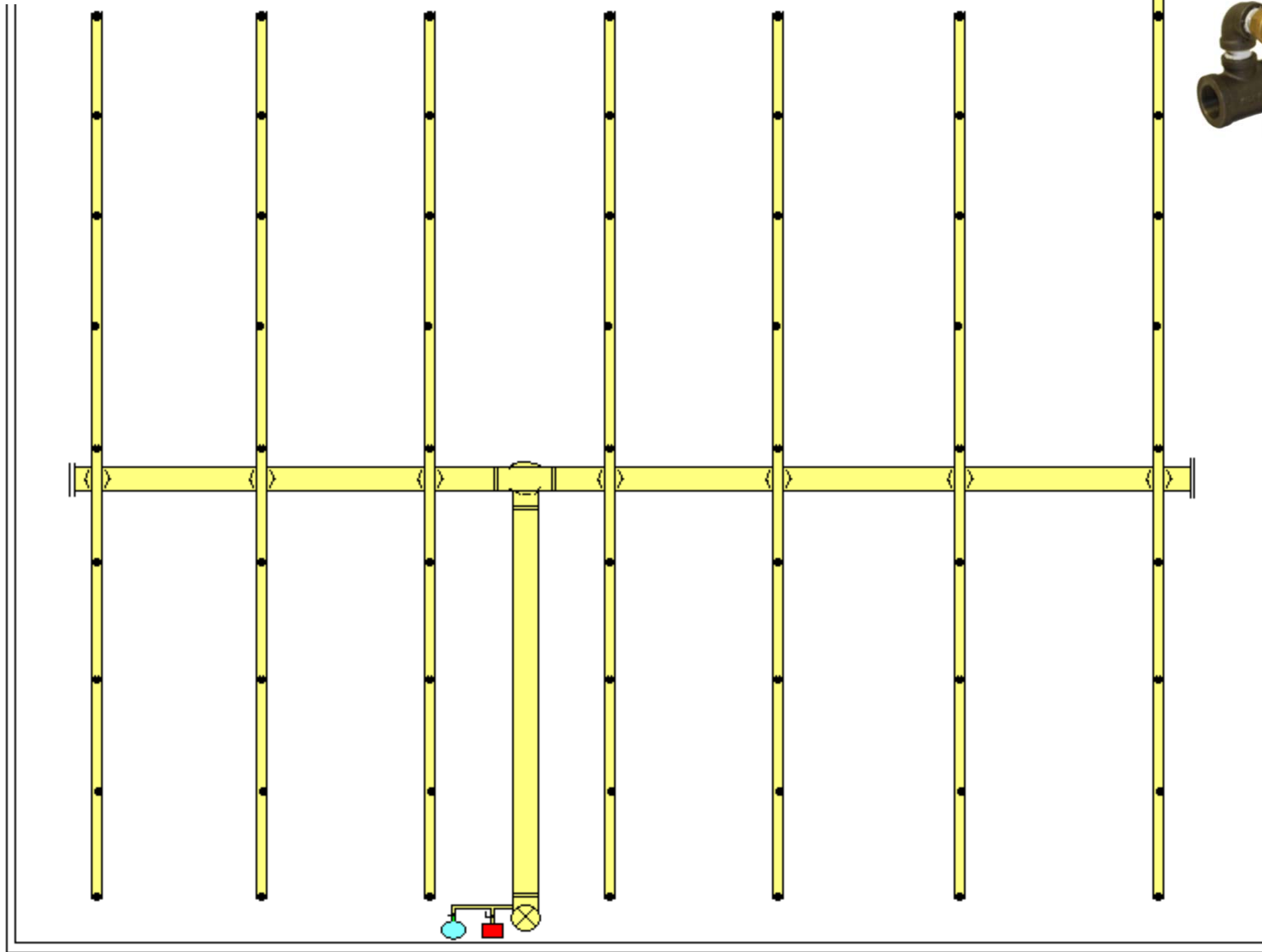
Purge compressed air with Nitrogen



**AutoPurge
System™**

Dry or Preaction Riser

Purge compressed air with Nitrogen



**AutoPurge
System™**

Dry or Preaction Riser

Portable Nitrogen Purity Sensor

Designed for Building Management Personnel to periodically obtain a quick, visual display of the Oxygen content within the system

- Ensures that the inner walls of the Sprinkler Piping are blanketed with 98%+ pure Nitrogen



|| Nitrogen Monitoring Manifold

Provides the Building Manager with a true indication of the Nitrogen purity content within each FPS and ultimately minimizes power consumption

- LCD screen tracks the Nitrogen purity content within each specific Zone
- Samples the Nitrogen purity at remote points within the FPS
- Stops the purging process once Nitrogen purity has been achieved
- Limits the runtime of the Air Compressor and Nitrogen Generator
- 110V/60Hz/1Ph, 8 amp power required



Preventative Maintenance

Quarterly

- Air Compressor
 - Check belt, wipe down surfaces, and inspect oil level
- Nitrogen Generator & Related Accessories
 - Clean strainer on each AutoPurge System
 - Check that 98% or greater Nitrogen purity content is being maintained within each Zone
 - Monitor runtime (should be less than 3 hours per day)
 - Wipe down all surfaces

Annually

- Air Compressor
 - Change lubricant, air filters and oil filter
- Nitrogen Generator & Related Accessories
 - Change all (3) filters
 - Rinse the inside of each filter bowl
 - Hour meter should be less than 1000 hrs/year
 - Wipe down all surfaces

LOCKHEED MARTIN



MISSION CRITICAL
TYPE 1 SYSTEM



DIGITAL REALTY
Data Center Solutions

Data Center Solutions



**DATA CENTER
TYPE 2 SYSTEM**



DATA CENTER TYPE 3 SYSTEM



**WET SYSTEMS:
DEOX - TECHNOLOGY**

Wet System Corrosion

Oxygen exists within **Water**

- Water is continuously being maintained within the steel piping.
 - That water contains ~ 10 parts per million (ppm) of dissolved oxygen. Therefore each wet system will experience initial corrosion because of dissolved oxygen .
 - However, this can become self-limiting in the sense that all of the dissolved oxygen will be consumed and will cease until the system is refilled with fresh, oxygenated water.
- Reduction of the dissolved oxygen in water to a level below 0.3ppm will result in inhibiting corrosion of the steel that is in contact with water.

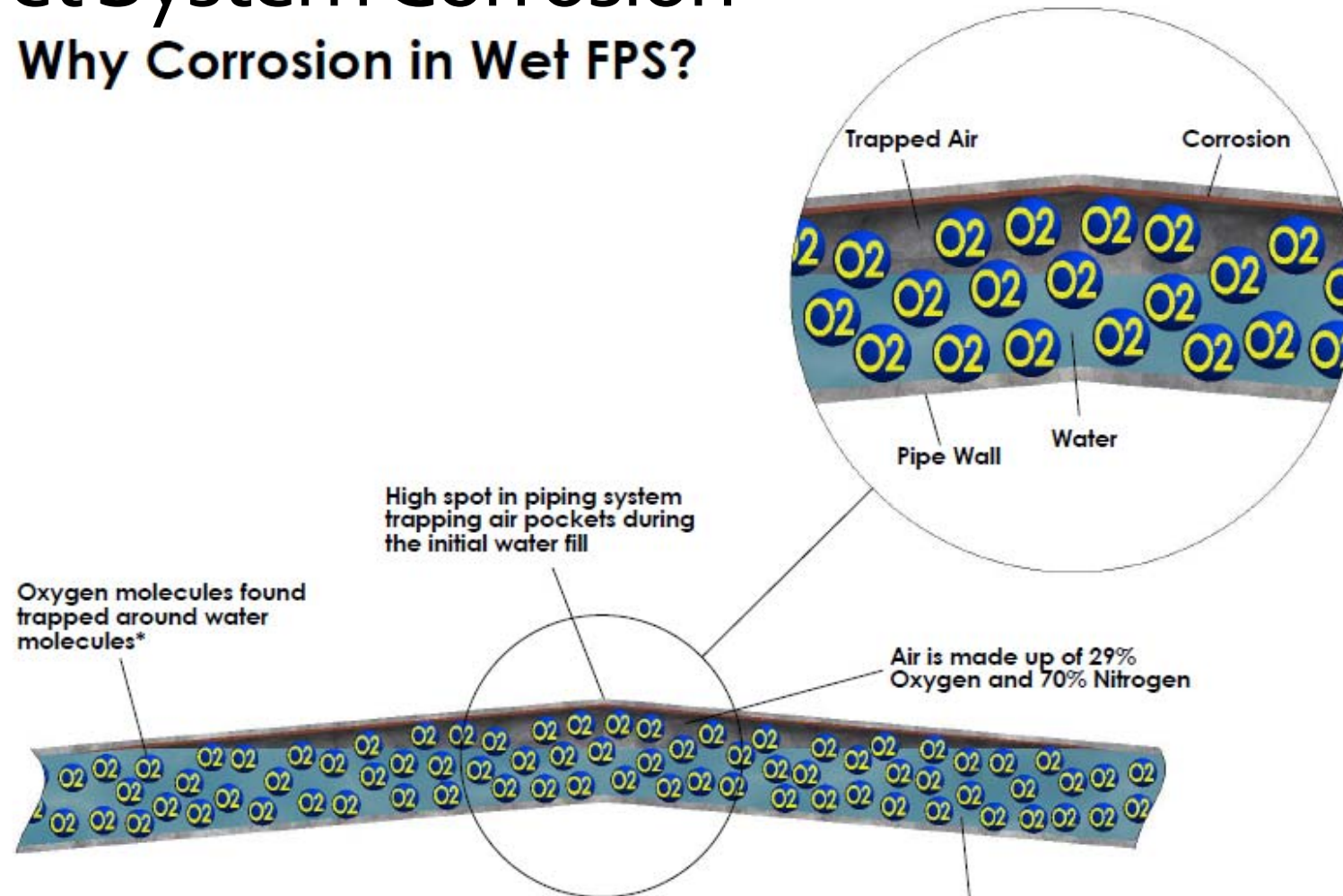
Wet System Corrosion

Oxygen exists within **Air Pockets**

- Trapped air pockets frequently exist within Wet systems
- These trapped air pockets contain 20.9% Oxygen and therefore electrochemical corrosion is fully sustained
 - As a result, pin hole leaks eventually develop at the location of the air-water interface
- Reduction of the 20.9% oxygen to a level below 2% will inhibit corrosion in the steel surrounding the trapped air pocket .
 - However, the oxygen concentration of the water surrounding the trapped air pocket must also be reduced.

Wet System Corrosion

Why Corrosion in Wet FPS?



*Note: Water is made up of H₂O molecules and that is a liquid. Trapped around H₂O molecules are separate Oxygen (O₂) molecules. Fish breathe the trapped O₂ molecules, not the O₂ in the H₂O molecules

The Main Water typically has up to 9 PPM oxygen. In order to arrest the galvanic corrosion process, less than 0.3 PPM of oxygen should be present

|| Mitigating Wet Sprinkler Pipe Corrosion

In order to slow down or completely eliminate internal wet system corrosion, the following must be accomplished

- Objective # 1
 - Reduce the dissolved oxygen in water to a level below 0.3ppm
- Objective # 2
 - Remove the Oxygen from within the trapped air pockets

How? Pre-purge with a N₂ gas and charge the sprinkler system with DeOx™ - Deoxygenated Water

- By pre-purging the system with Nitrogen, the pockets of trapped air will now be pockets of trapped nitrogen gas, no longer containing harmful Oxygen
- Then by charging the sprinkler pipe with DeOx™ - Deoxygenated Water, less than 0.1ppm of dissolved oxygen (under the Oxygen limits known to cause corrosion) remains in constant contact with the steel sprinkler piping.
- There isn't enough Oxygen in the water to dissipate into the trapped nitrogen gas pockets, hence protecting the piping area where in the past, corroded.
- In conclusion, by eliminating the trapped air pockets and removing all but .1ppm of dissolved oxygen from within the sprinkler piping, the overall threat of corrosion is eliminated.

|| South-Tek Systems

Key Contacts:

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