

POWER & ENERGY SOCIETY
INDUSTRY APPLICATIONS SOCIETY
LIFE MEMBERS AFFINITY GROUP
NEW YORK SECTION

**INNOVATIONS IN FIRE PROTECTION DESIGN
FACTORS TO CONSIDER FOR TODAY'S PRACTICES**

***Rick Seidel – Fike Corporation
Regional Sales Manager***

Agenda

- **Inert Gas Fire Suppression**
 - “Clean Extinguishing Agent”
 - Evolved Enhancements
 - Advantages
- **Watermist Fire Suppression**

Definition of a Clean Extinguishing Agent

- As Defined by NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems
 - *Electrically nonconducting, volatile, or gaseous fire extinguishant that does not leave a residue upon evaporation.*



Mission Critical Protection

- Asset Protection
- Minimizes Downtime
- Safe for People and Assets
- Non-Conducting
- No Residue
- Space Efficient
- 3-Dimensional Fire Fighting

Back to business.....



Why Not Water?



Sprinkler flow time of 30 minutes

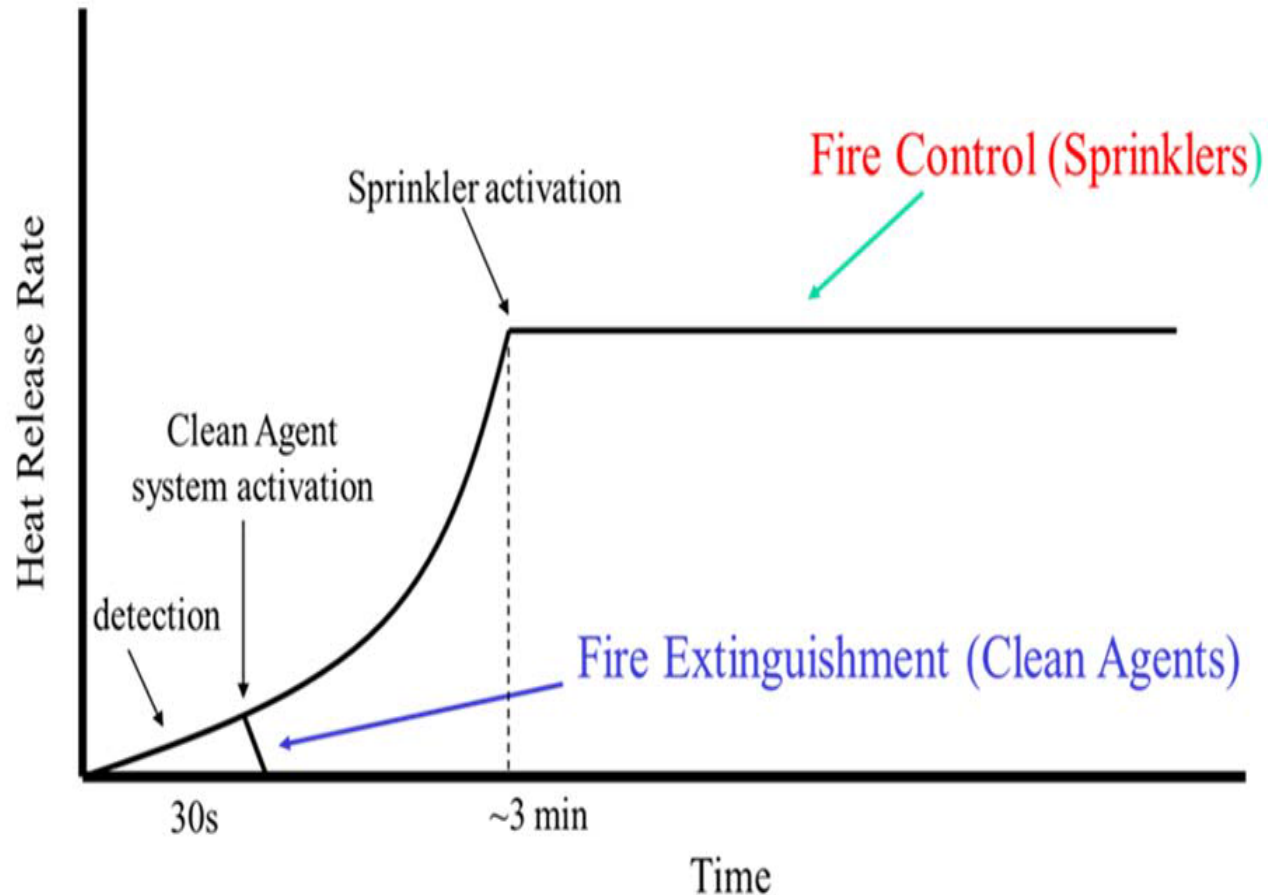


Each sprinkler discharging 18 to 35 gpm of water

**That's 540 to 1,050 gallons of
water on
your valuable assets!**

**Discharge of two sprinkler heads
is common – that's 1,080 to 2,100
gallons of water!!**

Fire Extinguishment vs. Fire Control



Clean Agent Systems Primary Advantages

- Ability to extinguish shielded, obstructed, 3-D fires
- Provide rapid extinguishment
- Significantly reduces collateral Smoke and water damage caused by delayed extinguishment and Sprinklers
 - Odorless, Colorless, No residue left behind

Clean Agent Fire Protection



Halon 1301

Halon



Halon 1301

Agent Characteristics

- Chemical name – Bromotrifluoromethane
- Vapor Pressure – 235 psi
- Molecular Weight – 148.9
- Boiling Point – -72 F
- Design Concentration, occupied spaces 5% - 7%
- Global Warming Potential – **6,290**
- Ozone Depleting Potential – **16**
- Safe for Occupied Spaces? **YES!**

Halon 1301.....

- Production Ceased in countries that signed the Montreal Protocol in 1994
 - Ozone Depletion
- No longer sold for new systems
- Only sold as recycled / reclaimed agent that is used for recharging systems
- Thousands of systems remain in service, with many users actively seeking replacement due to:
 - Corporate Environmental Initiatives
 - Long-term Supply Availability
 - Cost of Replenishment



NFPA 2001; Present Day

- Commercially available agents
 - HFC-227ea (FM-200, FE-227)
 - HFC-125 (FE-25, ECARO-25)
 - HFC-236fa (FE-36)
 - IG-55 (Argonite, ProInert)
 - IG-541 (Inergen)
 - FK-5-1-12 (Novec 1230, Sapphire)



Most Common Halon 1301 Replacements



Two Categories of “Clean Agents”

Man-Made Agents

- ✓ Zero-Ozone Depleting
- ✓ **LOW-** Global Warming Potential (GWP)

• Waterless Flash Gases

- FM-200® 1994
- ECARO-25® 2003

• Fluids – Fluoroketones

- Novec™ 1230
2005

Naturally Occurring Gases

- ✓ Zero-Ozone Depleting
- ✓ Zero-Global Warming Potential (GWP)

• Inert Gases

- 1st Generation: Inergen®
1994
- 2nd Generation: ProInert2
2009
- Agronite®

100% Green Fire Protection

Inert Agents

Argonite®





- Launched in 1994 by Ansul.
- Is a mixture of three natural occurring gases: Nitrogen, Argon & Carbon Dioxide.
- Environment-friendly, people-safe agent with ZERO ozone depletion potential, ZERO global warming potential, and ZERO atmospheric lifetime.

Inert Gases

Extinguish a fire by **reducing the residual oxygen** concentration to a level that will no longer support combustion, but will still sustain human existence.

Agent Characteristics



- **Chemical name – Mixture of Inert Gases & Carbon Dioxide
52% N₂, 40% Ar and 8% CO₂**
- **ASHRAE Designation – IG-541**
- **Molecular Weight – 34**
- **Boiling Point – -320.8F**
- **Design Concentration, occupied spaces – 38.5% - 52%**
- **Maximum Human Expose Time – up to 43% is 5 minutes**
- **Maximum Human Expose Time – 43 to 52% is 3 minutes**
- **Ozone Depletion Potential - 0**



ProInert2 was launched in to the US market in 2008 by Fike.

Inert systems for Fike make up 90% of their clean agent fire systems sold in Europe.

ProInert2 does not use CO2 in its mixture.

IG-55 is the same mixture as you will find in Argonite.

What Is ProInert?



- Inert Gas Fire Extinguishing System
 - Extinguishes Fires by Oxygen Reduction
 - Gas stored as a compressed gas/vapor
- Extinguishing Gas
 - IG-55 = 50% Ar / 50% N₂
 - IG-541 = 50% AR / 40% N₂ / 10% CO₂

Agent Characteristics

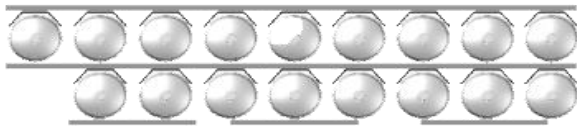


- **Chemical name - N²/Ar (50% - 50% blend of Nitrogen & Argon)**
- **ASHRAE Designation – IG-55**
- **Molecular Weight – 33.95**
- **Boiling Point – -310.2F**
- **Design Concentration, occupied spaces – 39% - 52%**
- **Maximum Human Expose Time – up to 43% is 5 minutes**
- **Maximum Human Expose Time – 43 to 52% is 3 minutes**
- **Ozone Depletion Potential - 0**

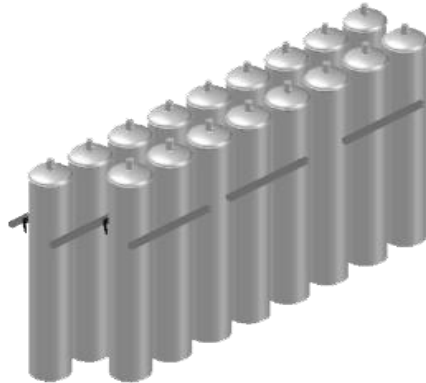
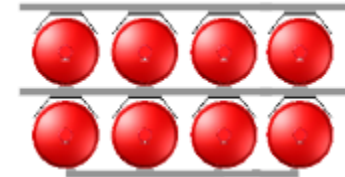
ProInert² - Storage Footprint



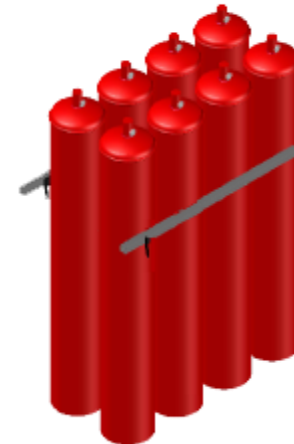
Traditional Inert Systems:



Up to 40%
less

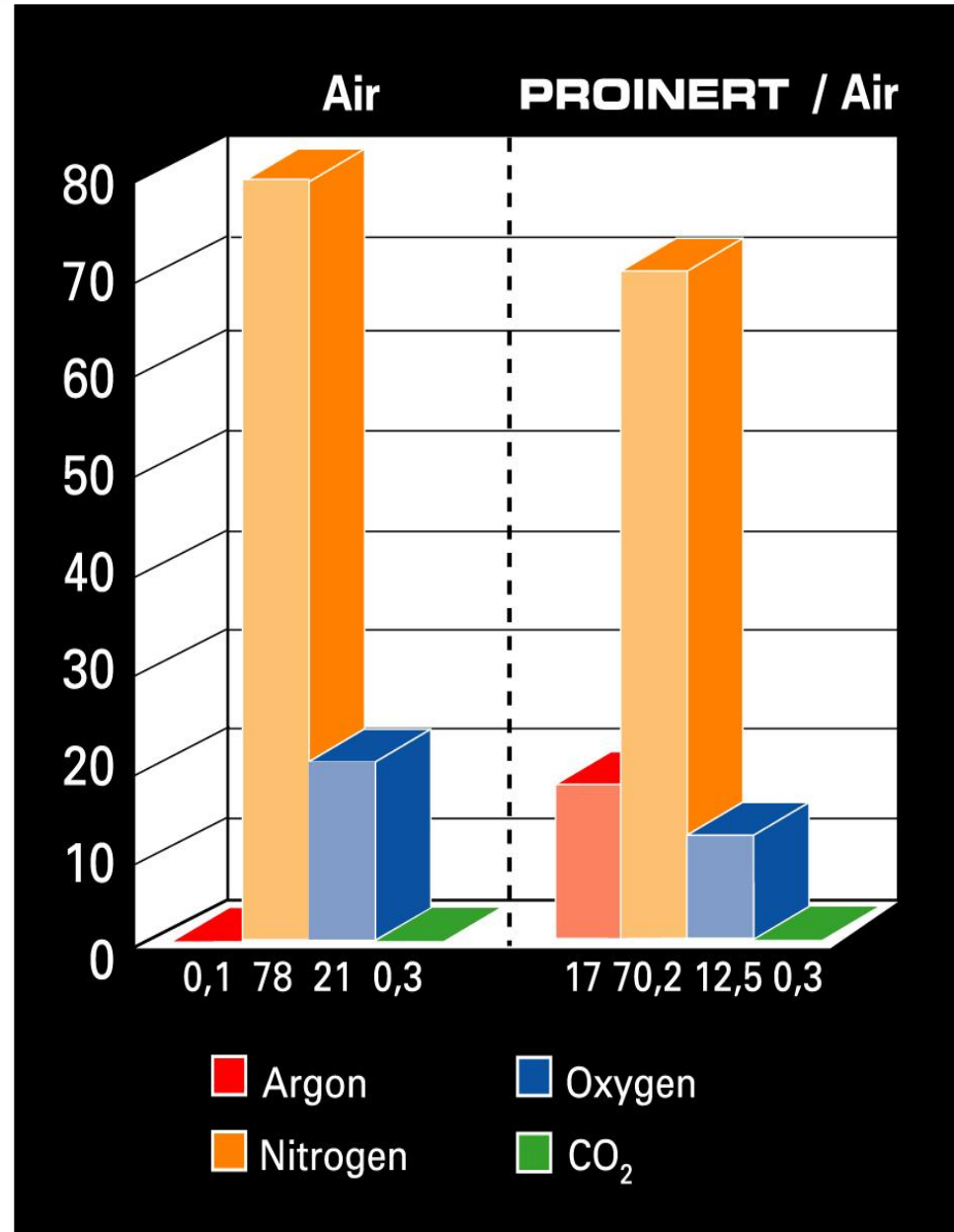


Reduced Storage



Safe for People

ProInert is completely safe for use in occupied spaces.



What does 12.7% Oxygen Mean to You?

Pikes Peak, Colorado

- Mountain in North

sea level

>25 % Safety Factor

minimum allowable design concentration for egress = 10%



Inert Agents

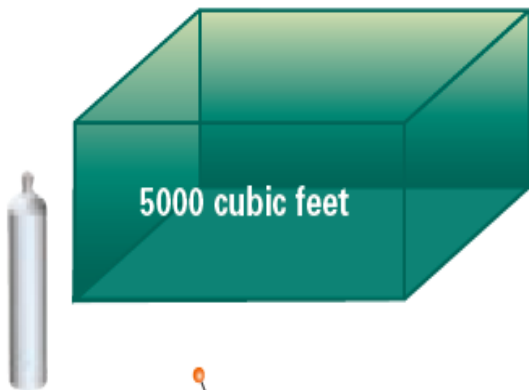
- **Benefits:**

- Equipment and installation costs close to other clean agents
- Similar maintenance costs to other clean agents
- Full height walls not an issue
- Remote agent storage capability up to 200' away
- Upgrade Any Existing Halon or Clean Agent System Utilizing All Original Piping
- Low refill costs



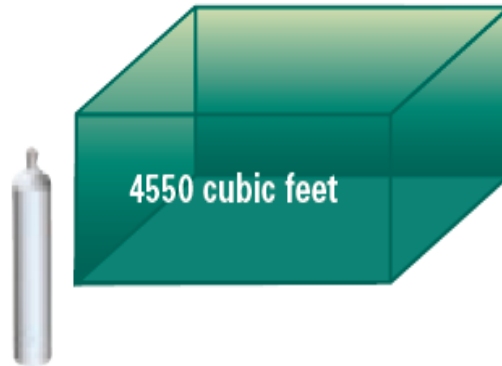
Agent Comparisons

Man Made Agents



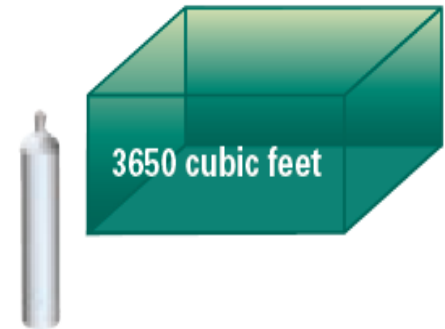
ECARO 25
156lb protects 5000 cubic feet

(7) Of IG-541
(4) Of PI2



HFC-227ea
156lb protects 4550 cubic feet

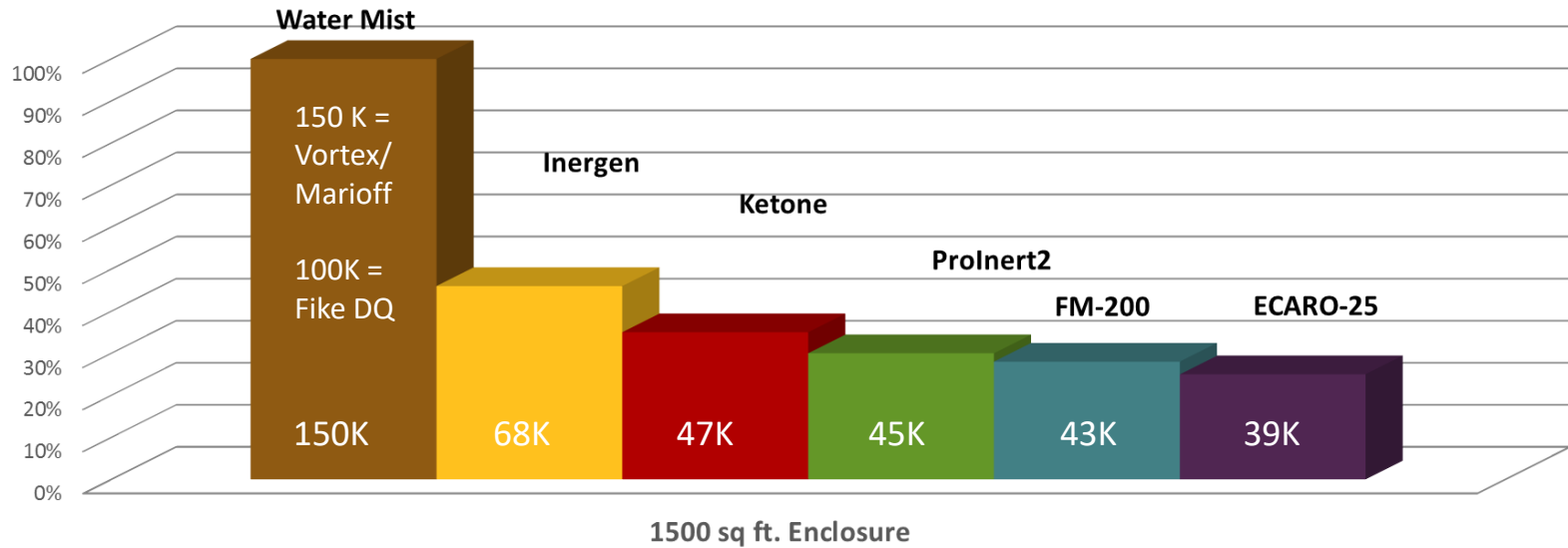
Inert Gas Need:
(6) of IG-541
(3) of PI2



FK-5-1-12
156lb protects 3650 cubic feet

(6) of IG-541
(3) of PI2

Complete System Cost Comparison



Agent Comparisons

Agent	ASHRAE	Molecular Weight	Global Warming Potential	Boiling Point	Concentration %	Ozone Depletion
Halon 1301	n/a	148.9	6290	-72 F	5 – 7%	16
FM-200	HFC-227ea	170.3	3350	2.5 F	6.25 – 10.5%	0
ECARO -25	HFC-125	120.2	3170	-54.7	8 – 11.5%	0
Novec	FK-5-1-12	316.04	<1	120.6 F	4.5 – 6%	0
Inergen	IG-541	34	0	-320.8 F	38.5 – 52%	0
Argonite	IG-55	33.95	0	-310.2 F	39 – 52%	0
Carbon Dioxide	CO2	44	1	-109.3F	34% +	0
“Air”		29	0	-319F		0

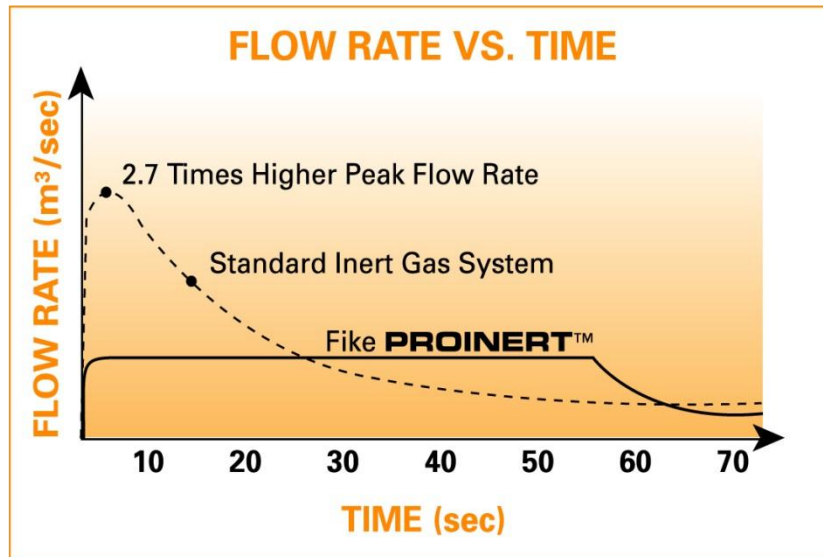
***What About Pressure
Displacement During
An Inert Gas System
Discharge?***

Pressure Venting

- Inert Agents displace the oxygen in the room.
- Pressure venting is required to avoid over-pressurizing the room.
- If you forget to do it, the system has a built in method of correcting the problem



Fike's ProInert system is the only system that uses a **constant flow rate valve** that discharges the agent at a constant low pressure (645 psi / 42 bar) over the required 60 seconds discharge time.



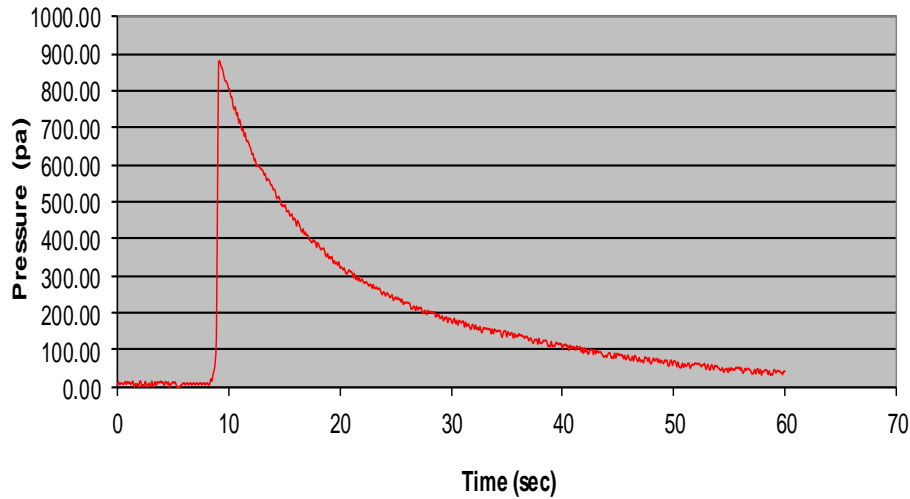
Other systems have an aggressive initial discharge, and then decrease flow over time. This can lead to room and equipment damage, and does not extinguish a fire any faster than Fike's steady flow system.

Inert Gas Systems	IG-541 Inergen™	IG-55 Argonite™	IG-55 Prolnert™	IG-55 Prolnert²
Storage PSI	150 Bar 200 Bar	200 Bar	200 Bar	300 Bar
Discharge PSI	2175 PSI 2900 PSI	2900 PSI	645 PSI	645 PSI
Pressure Reducer	Orifice Plate	Orifice Plate	Fike Patented Modulating Valve	Fike Patented Modulating Valve
Minimum Nozzle PSI	150 Bar 325 PSI 200 Bar 375 PSI	200 Bar 430 PSI	116 PSI	116 PSI

An important advantage of Prolnert is the lower pressure at discharge, which allows for a controlled flow of gas into the room to extinguish a fire it can also result in lower cost (lower pressure) piping, fewer nozzles, and smaller venting requirements compared to other inert gas systems.

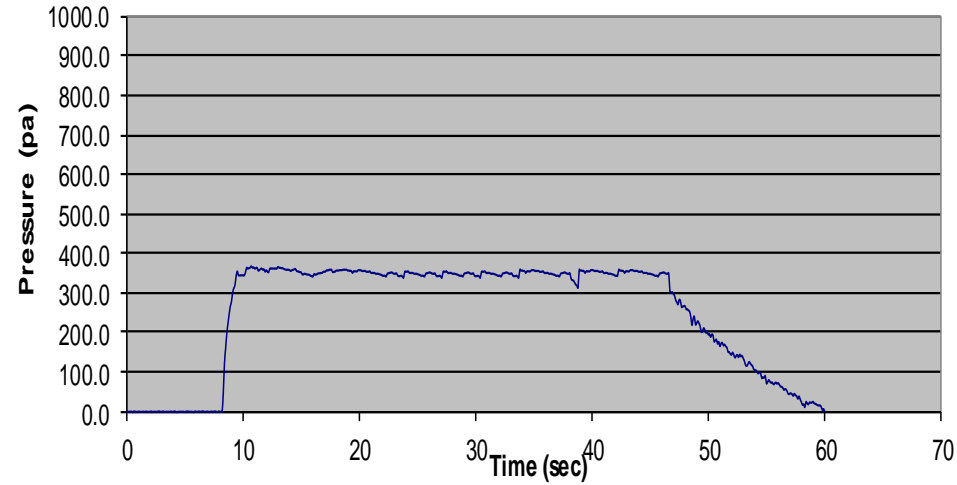
Natural Agents Discharge Room Pressure

1st Generation Natural Agents Room Pressure



900-950 Pa=19-20 PSF

ProINERT² Room Pressure



<400 Pa= 8.35 PSF

Wall Strength Specs:

250 Pa (5 PSF) 2x4 walls 16" OC

500 Pa (10 PSF) 2x6 walls 16" OC

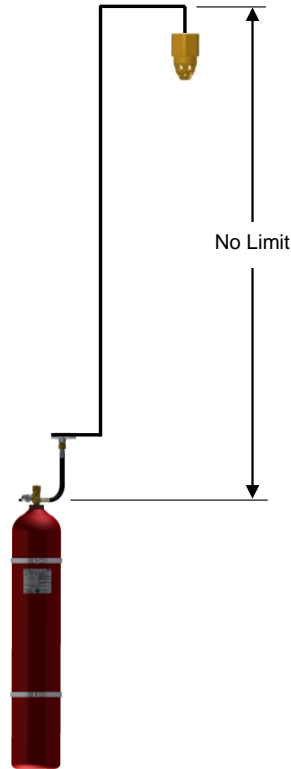
What are the Advantages of the Fike valve?

- All piping used in the system from the cylinder to the nozzle is the same as used in chemical systems, Schedule 40 piping and 300 pound fittings
- Competition's inert gas systems require the use of Schedule 160 piping before their required pressure reducing orifice plate and Schedule 80 piping above 2 ½" throughout system.
- Competition fittings are 2,000 or 3,000 forged steel before their required pressure reducing orifice plate
- Significant savings on installations because of:
 - Lighter scale piping requirement
 - Greater flexibility with piping networks configuration and length

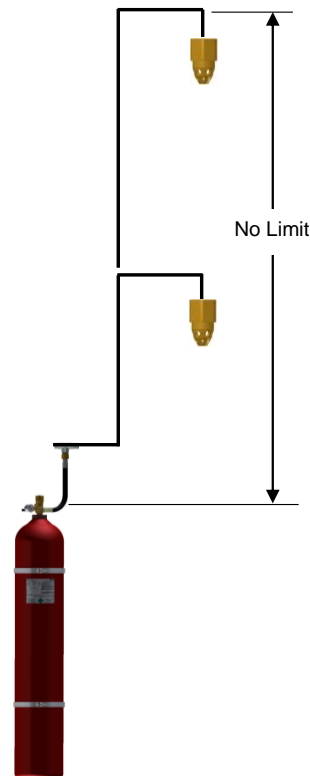
Design Factors

Maximum Elevation Differences in Pipe Runs = UNLIMITED

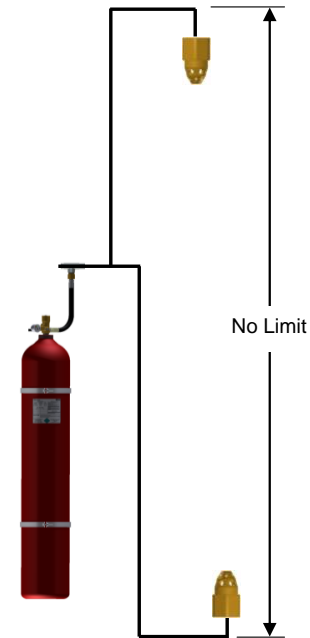
(Old Limit = 20.4 ft.)



System with a single level of Nozzles



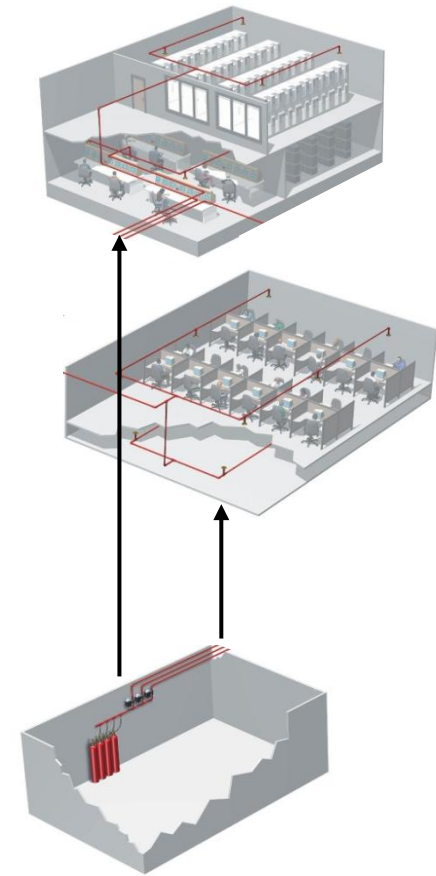
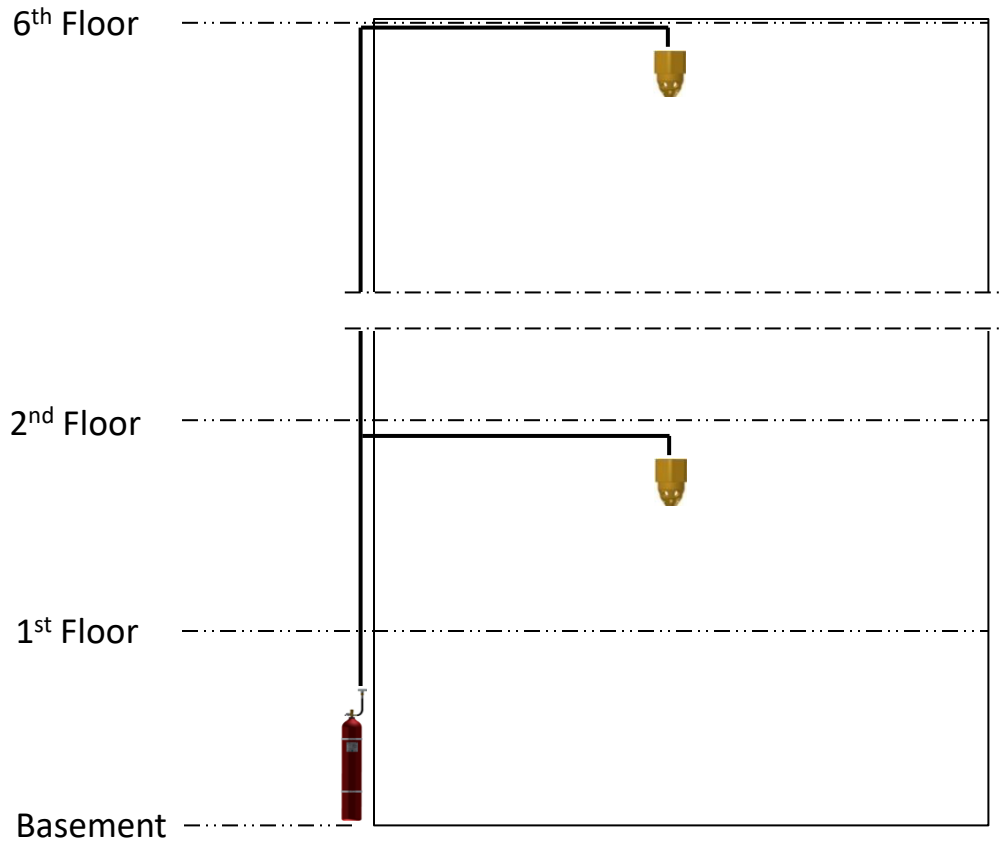
System with multiple levels of Nozzles



System with ceiling and sub-floor Nozzles

Design Factors

Now you can do this . . .



Why Not Water.....Mist?

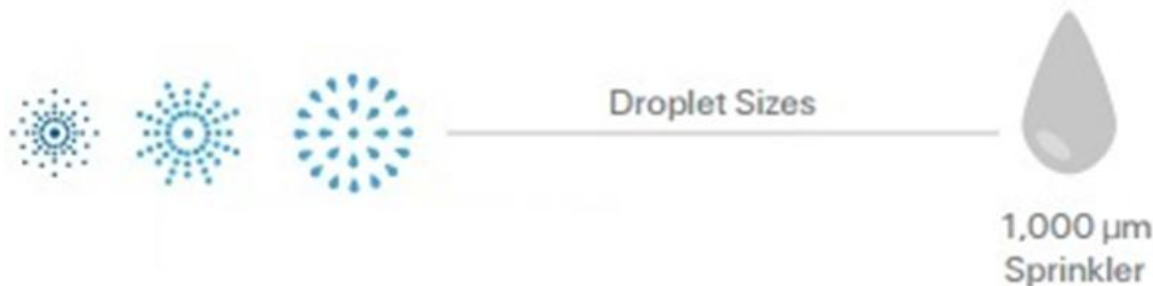
Water Mist Overview: What is Water Mist?

- Extinguishes fire using a very fine water spray with **droplets <1,000µm**.
- The fine droplets; **cools the flame, displaces O²** with water vapor and **reduces radiant heat**.
- Designated for use in **Class A**: Combustible materials (wood, paper, fabric, refuse), **Class B**: flammable or combustible liquids as the fuel source., and **some Class C**: electrical hazards; such as transformers (in enclosures).
- Class A requires larger droplets to help penetrate fuel source (fuel wetting).
- Class B requires finer droplets to avoid agitating fuel surface.
- First systems approved, aimed for smallest droplet size, high pressure.
- Newer, low pressure systems have obtained FM approvals with larger droplet sizes at much lower pressures.



Water Mist Overview: Droplet Size

- A larger droplet is more effective at penetrating down into the fire plume (Fuel Wetting) using its momentum (= mass x velocity)
- Small droplets do very well in small spaces, smaller the space the better the droplets can be directed to the fire.
- The larger the space gets the small droplet now gets difficult to control, it loses velocity as soon as it leaves the nozzle, it then does not know where to go.
- Smaller droplets means smaller waterways within the nozzle, now the water quality and impurities become extremely important.



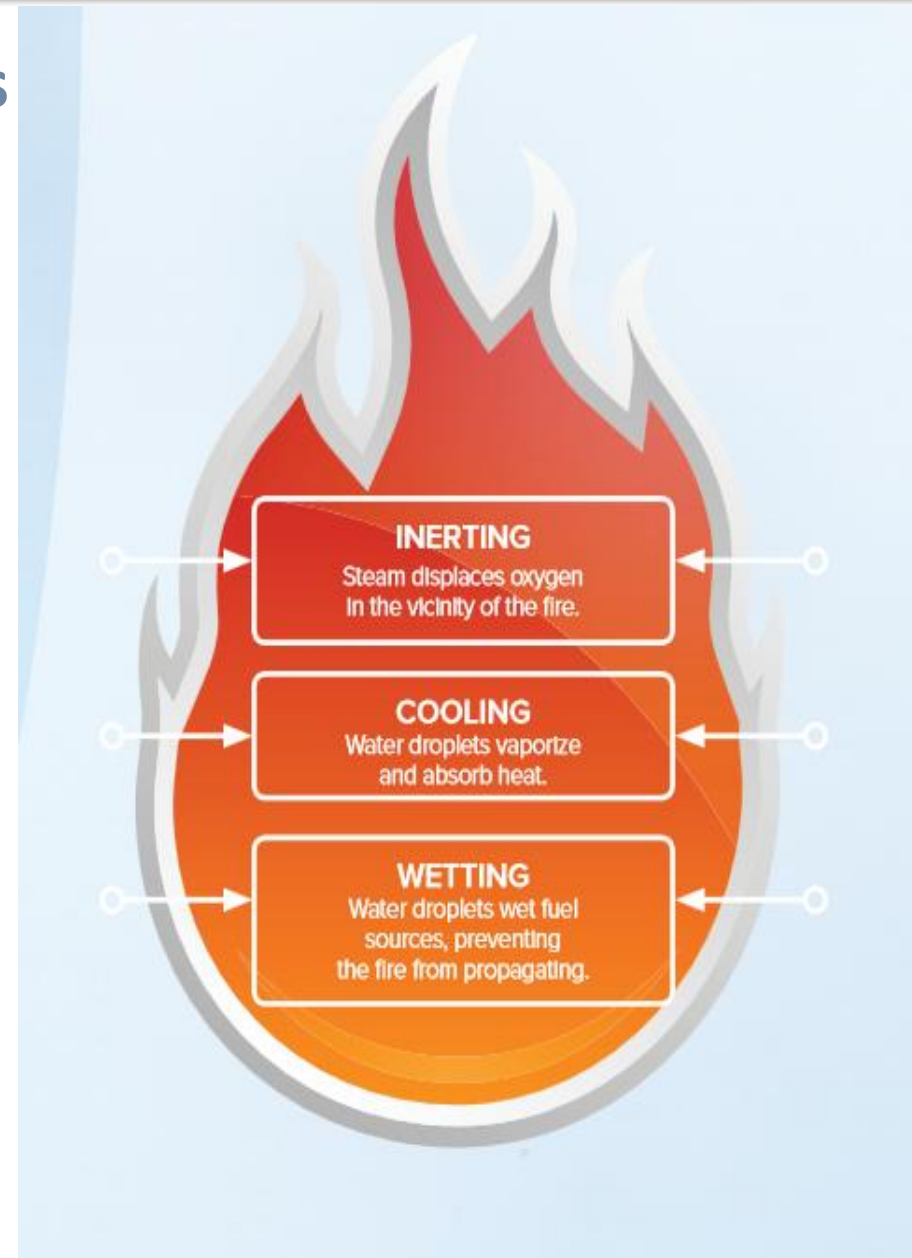
Water Mist Overview: Concepts

* 3 Main Concepts/Functions:

1. Inerting
2. Cooling
3. Fuel wetting

All three are very important.

- Inerting = Oxygen Displacement
 - Cooling = Heat Extraction
 - Fuel wetting = Blocking of Radiant Heat, preventing the fire from propagating.
- Droplet size impacts the relative presence of each effect
- * **Different Fires require different amounts of each element!**

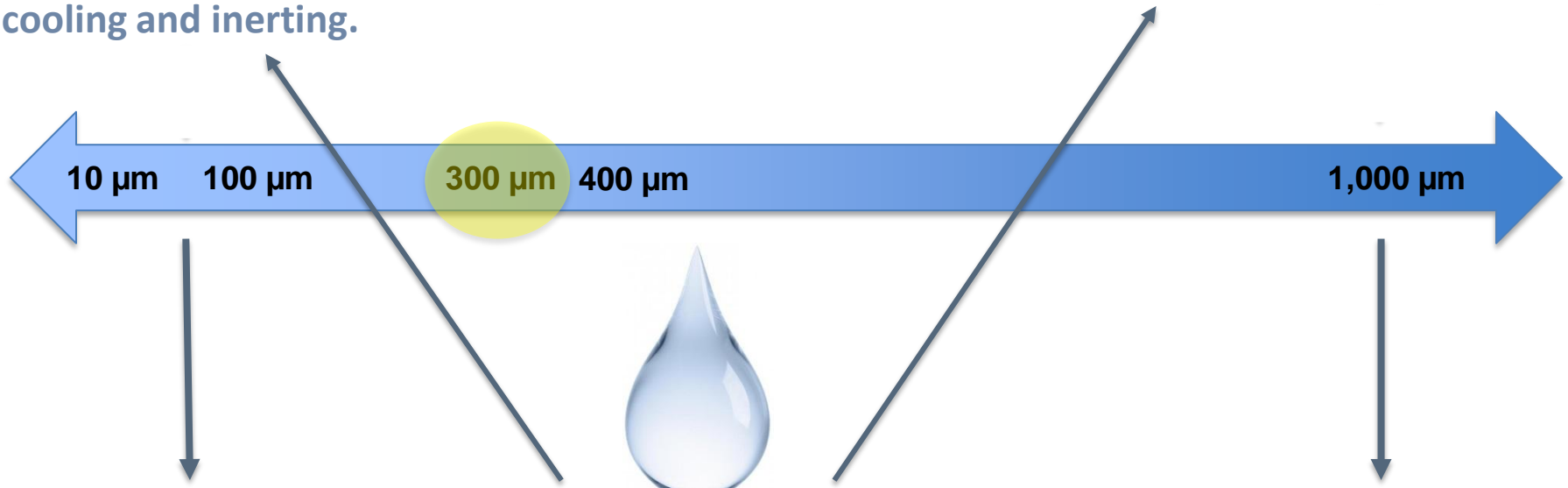


Water Mist Overview: Droplet Size

Smaller Droplet: More efficient vaporization, cooling and inerting.

SWEET !

Larger Droplet: More efficient fuel wetting. Storage applications.



10 μm

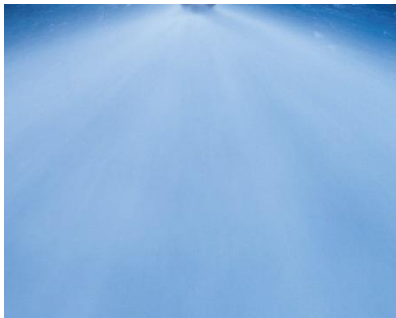
100 μm

300 μm

400 μm

1,000 μm

Water Mist Nozzle



300 μm gives the droplet the best of both efficient vaporization and fuel wetting.

Sprinkler Heads



Water Mist Overview: Benefits

- As the water mist turns to steam, it expands immensely (1700 times) forcing oxygen away from the flame.
- Takes the energy out of the fire.
- Water mist incorporates a smoke scrubbing element.
- Provides extinguishment, not control.
- Provides 3D fire protection.
- Only need about 6-8 psi bar inlet pump pressure (wet pipe system), this is an estimate as the amount is determined by the Net Positive Suction Head Required (NPSHR) for the pumps plus our manual's safety margin of 2 psi. (Deluge system needs 29psi to keep the valve shut).
- Uses up to 80% less water than sprinklers (deluge app), and 50% less water than sprinklers (Light Hazard app).

Water Mist Overview: System Types

High Pressure

- A water mist system where the distribution system piping is exposed to pressures of 500psi or greater and up to 2000psi.
- Uses ultra-high pressure pipe, fittings, & valves.



Low Pressure

- A water mist system where the distribution piping is exposed to pressures 175psi or less.
- Uses standard pipe, such as Sch 40 SS, plus Class 150 300psi fittings.



Fixed Supply

- Driven through system by N₂ pressure
- Must be refilled after discharge
- System cannot fight against any possible re-ignition of fire.



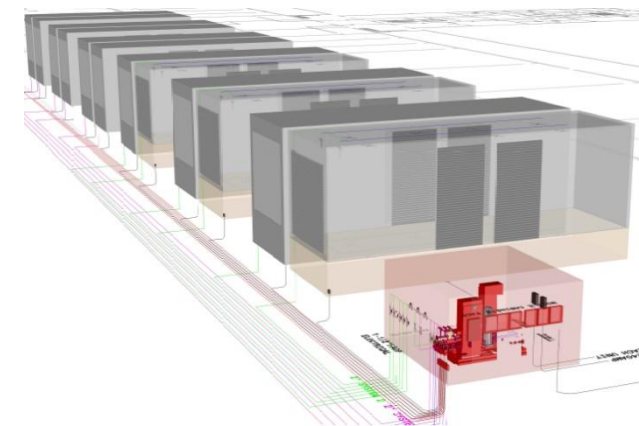
Continuous Supply

- Uses building water supply
- Driven by pump
- Unlimited discharge time



Water Mist Overview: System Design

- No universal design method is recognized for water mist protection systems.
- Fike's design is different from others.
- Design & install in accordance with each manufacturer's **Design, Installation, Operation, and Maintenance Manual (DIOM)**, requirements of FM Global (where applicable), NFPA Standards (750), and the requirements of the AHJ.



DuraQuench™ Benefits: *Simplicity* vs:



Fike® DuraQuench™

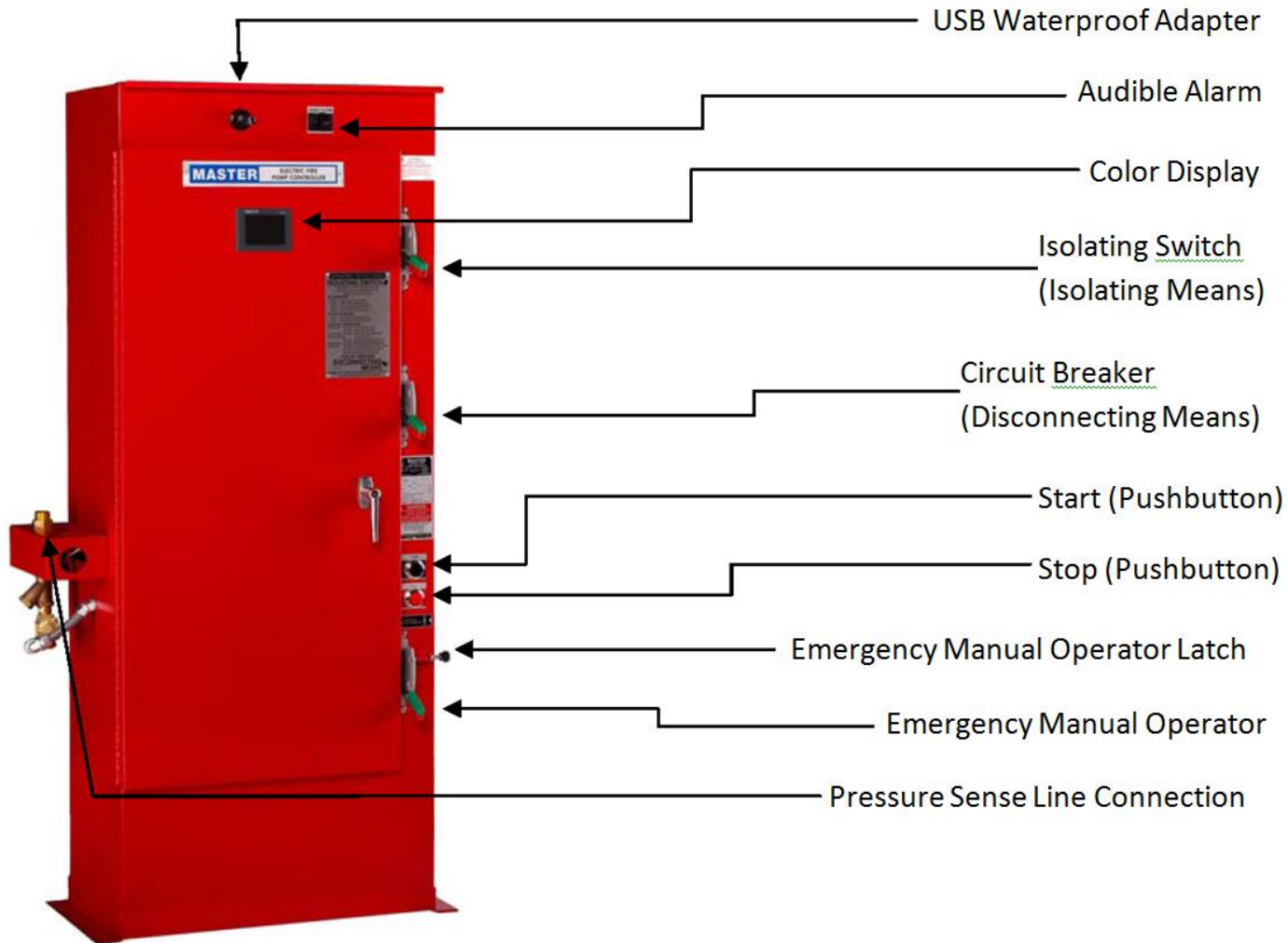
Versatile, Affordable Water Mist Fire Suppression



- **LOWER OPERATING PRESSURE**
175 psi versus 2000 psi
- **MORE PIPE & FITTING OPTIONS**
Easily sourced pipe, fittings, and tools
Stainless steel, copper, CPVC
- **SIMPLE LAYOUT & DESIGN**
Use any hydraulic flow-calc software
- **STANDARD FIKE LEAD TIMES**
Made from readily available components
- **FM APPROVED, NFPA-750 COMPLIANT**
- **WATER**
Only need 6-8 psi inlet pump pressure
50-80% less water than sprinkler



Pump Controller



DuraQuench™ Benefits: Largest Machinery Space & Turbine Enclosure Approved Volume

Company	Maximum Approved Room Volume	Max Ceiling Height
Fike - DuraQuench™	162,801 ft³	39.4 ft
Marioff – HI-FOG GPU	53,000 ft ³	32.8 ft
HI-FOG MT4 Water Mist System	48,600 ft ³	36.1 ft
Tyco - AquaMist®	45,203 ft ³	26 ft. 3 in
FOGTEC Water Mist System	9,535 ft ³	Not available
HI-FOG MT4 Water Mist System	48,600 ft ³	36.1 ft
Securiplex - FIRE-SCOPE® 5000	42,380 ft ³	36 ft Not FM Approved for insulated turbines.
TomCO2 Fogex® System	17,657 ft ³	Not available

DuraQuench™

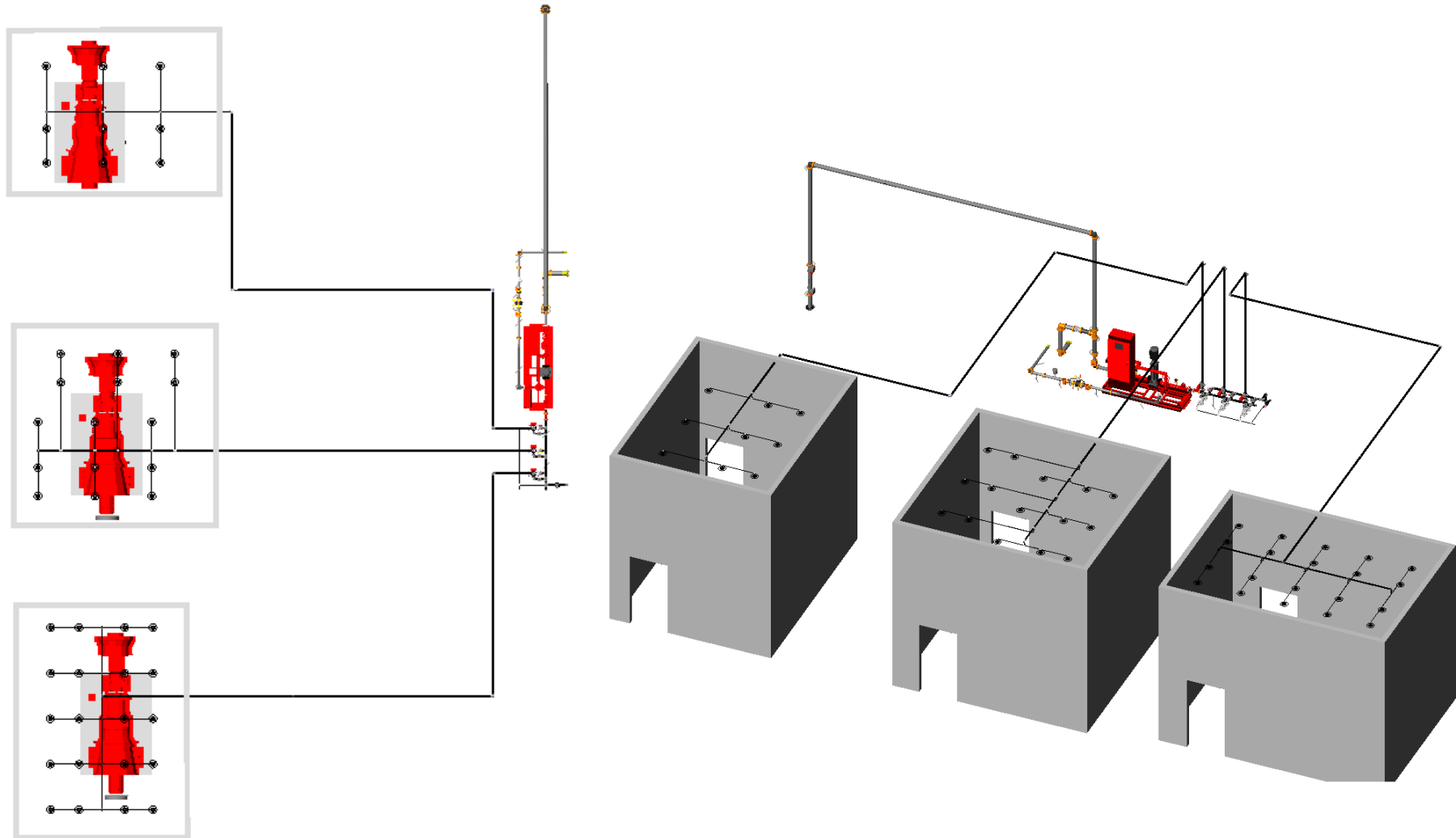
**Deluge Systems in
Industrial Applications
Wet Pipe Systems
Commercial Applications**

DuraQuench™ Deluge: System Info

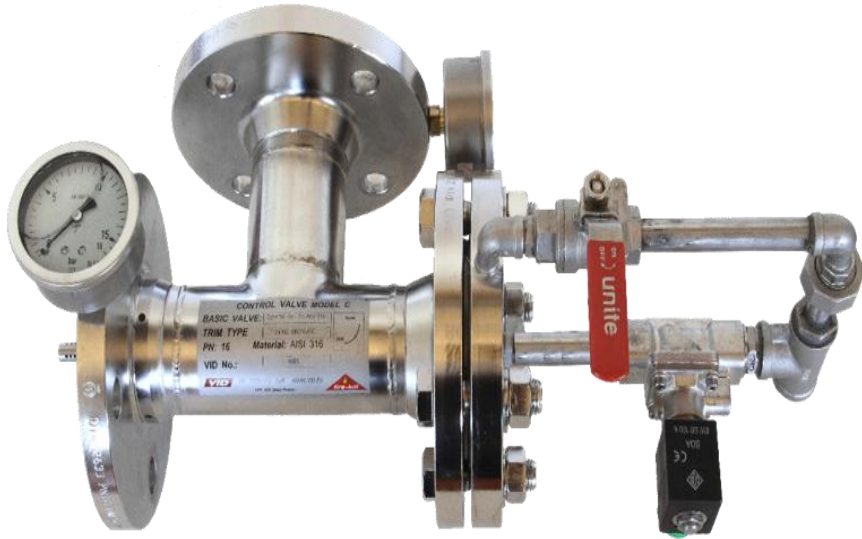
- Utilizes **Open Nozzles. Total Flood.**
- **Piping network is empty** (open to atmosphere) from the system deluge valve to the nozzles during normal system operation.
- Water supply is held back by the deluge valve.
- Deluge valve is opened automatically through the activation of the solenoid installed on the valve trim in response to the activation of the fire detection system installed in the protected area.
- Simultaneously, the detection system activates the fire pump sending pressurized water through the piping network to the open nozzles.
- **ONLY Stainless steel** Sch 10 and/or Sch 40 pipe can be used along with Class 150 (300psi) threaded fittings.



DuraQuench™ Deluge: Zoned System



DuraQuench™ Deluge: C-EL Control Valve



- Used as a full flooding deluge valve or as a zone valve.
- 29 psi needed to keep closed.

Weight	2" = 46 lbs.(20.8 kg) 3" = 74 lbs. (33.6 kg)
Working Pressure	232 psi maximum 29 psi minimum
Factory Tested Pressure	348 psi maximum
Materials	Stainless Steel, ANSI 316L
Gasket Materials	EPDM
Pressure Gauge Locations	Valve Inlet and Primary Valve Outlet
Activation Options	<ul style="list-style-type: none"> – Manual Release Lever – Electric Impulse Solenoid (24 VDC, 10W, NC)
Listing / Approvals	Factory Mutual

DuraQuench™ Deluge: Open Nozzle

- Open head nozzle
- **4.1 GPM per nozzle** at minimum pressure.
- Tested by FM for hazard volumes up to 28,252ft³ and 162,801ft³
 - Nozzle spacing and ceiling height varies according to enclosure volume approval.
- K Factor = 0.387 g/min/√psi (**5.6 L/min/bar**)



FM Approved Volume (max.)	28,252 ft ³	162,801 ft ³
Ceiling Height (max.)	26.2 ft	39.4 ft
Nozzle Spacing (max.)	117.3 ft ² 10.8 ft x 10.8 ft	96.8 ft ² 9.8 ft x 9.8 ft
Distance to wall (max.)	5.4 ft	4.9 ft
Water Density	0.055	0.067

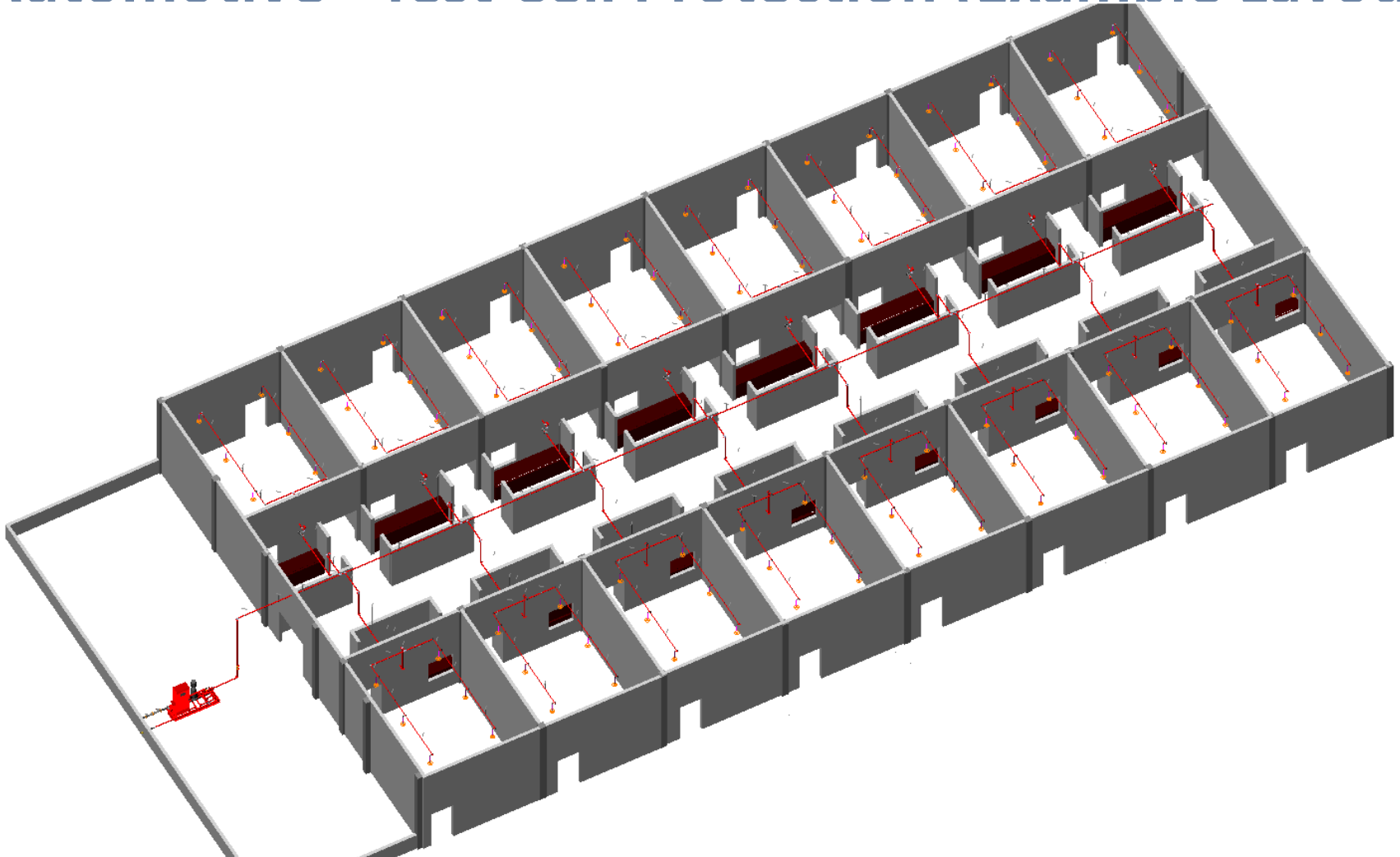
Specifications	
Minimum water pressure	112 psi (8 bar)
Maximum water pressure	232 psi (16 bar)
K-Factor	0.387 gal/min/√psi
Drop size	DV ₉₀ < 300 μm
Material	Brass (NiSn Coated) Stainless Steel 316L

DuraQuench™ Industrial Applications: General Machinery Space Protection

- Diesel generators / Turbines
- CNC areas
- Gear boxes
- Drive shafts
- Bearings
- Lube skids
- Transformer rooms



DuraQuench™ Industrial Applications: Automotive - Test Cell Protection (Example Lavout)



DuraQuench™ Wet Pipe: System Info



- Utilizes **Closed Head automatic nozzles**.
- Operates just like a traditional sprinkler system.
- **Wet Pipe network is filled with water** to the nozzles during normal system operation.
- **Thermal element** designed to open the nozzle when the temperature surrounding the nozzle reaches 135°F.
- Must be installed in areas where the temperature is reliably maintained above 40°F so that pipes do not freeze.
- Optional pressure maintenance (jockey) pump.

DuraQuench™ Wet Pipe: Applications – Light Hazard (HC-1)

Hazard

- Non-Storage Occupancies, Hazard Category 1
- Lightly loaded non-storage, non-manufacturing areas
- Examples: **Apartments, churches, concealed spaces, hospitals, hotels, kitchens, libraries, museums, nursing homes, offices, restaurants, schools, un-used heated attics**



Design Considerations

- Closed head nozzles with glass bulb rated for 135°F (Fike).
- Wet Alarm system, water is present in pipe at all times.
- Designed to provide water (FM) for 60 minutes to the nine most hydraulically remote nozzles or all nozzles in 1500 ft² space, whichever is greater.



FM Approvals

- Unlimited area
- **Approved pipe: Stainless, Copper, & CPVC.**



DuraQuench™ Wet Pipe: Closed Nozzles

- Closed head nozzle works just like a traditional sprinkler head.
- **12.50 GPM per nozzle** at minimum pressure, 50% less water than a traditional sprinkler head (1/2" 5.6k sprinkler at 25-30gpm).
- Chrome or white cover plate, plus custom color options.
- K-Factor 1.16 g/min/vpsi



Specifications

Minimum water pressure	116 psi
Maximum water pressure	232 psi
K-Factor	1.16 g/min/vpsi
Drop size	DV ₉₀ < 300 μm
Material	Brass (NiSn Coated)
Nominal Release Temp	135°F

Nozzle Spacing Specifications

Ceiling Height (max.)	16.4 ft
Nozzle Spacing (max.)	14.8 ft x 14.8 ft
Distance to wall (max.)	7.4 ft

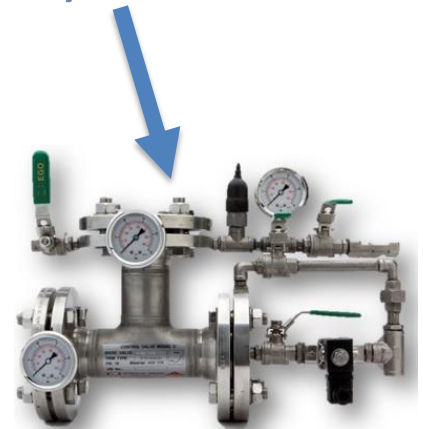


DuraQuench™: “Accepted” or “Performance Based Design” Applications

- FM has testing protocols for applications that Fike hasn't pursued...yet. So these, by definition, are outside of our current approvals.
- However, we can get the design “Accepted” by the Local AHJ based on the design and fire testing that has been completed.
- Fike can provide you with fire testing documents and design information on most applications.

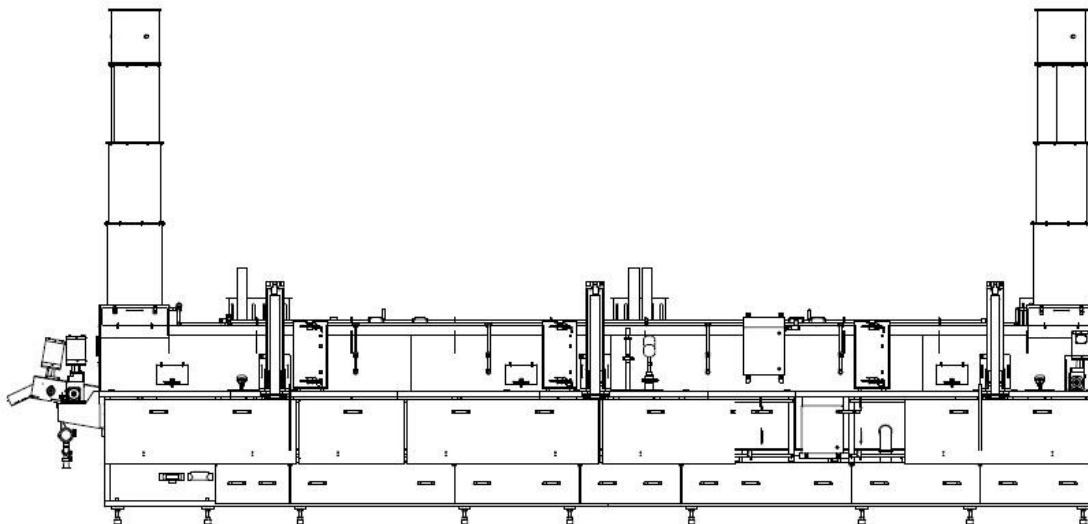
DuraQuench™ Accepted Design: Application - Pre-Action Protection

- Protection of Data Centers with pre-action valves & closed nozzles.
- We already have a Pre-Action valve so an “Accepted” system can be designed.
- Data Center FM Approvals coming in Q4 2018:
 - Above Floor Protection
 - Below Floor Protection – Area of Coverage Design
 - Below Floor Protection – Local Application Design



DuraQuench™ Accepted Design: Application - Industrial Fryer Protection

- Can provide an Industrial Oil Cooker Nozzle that is FM Approved, use that with **DuraQuench™**'s FM Approved system components for easy acceptance by AHJ.
- **DuraQuench™** installed protecting 7 industrial oil cookers at a peanut facility in North Carolina. AHJ accepted system after conference call and live system demonstration at the peanut facility.



In Closing.....



- Most Environmentally Friendly Clean Agent
- Now can use 40 - 50% less cylinders
- Controlled Discharge to minimize violence

DuraQuench™

- Low Pressure & Easy to Flow
- Unlimited & CLEAN Water Supply
- Easily sourced and lower cost hardware and installation

In Closing.....

Fike Fire Protection Solutions

Systems

- Fire alarm
- Fire detection and control
 - Intelligent alarm
 - Video image
 - Early warning detection
- Fire suppression

Suppression

- Clean agent
- CO₂
- Water based



Thank You!

Questions?



The logo for Fike, featuring the word "Fike" in a bold, white, sans-serif font. The letter "i" has a dot above it. A registered trademark symbol (®) is located to the upper right of the letter "e".

Fike[®]

The slogan "BECAUSE SO MUCH IS AT STAKE" in a white, all-caps, sans-serif font. The text is arranged in two lines: "BECAUSE SO MUCH" on the top line and "IS AT STAKE" on the bottom line. A trademark symbol (™) is at the end of the second line.

**BECAUSE SO MUCH
IS AT STAKE[™]**