

Piping. Systems. Solutions.

FOR OVER 80 YEARS

Victaulic Vortex™

Next Generation Fire Suppression System



Victaulic Corporate History

- **Est. in 1925, Employs over 3,300 with global facilities**
- **Industry standard in grooved end technology and fire protection**
- **Philosophy of constant innovation and challenging the status quo**
 - R&D driven company with over 150 patents
 - Staff of 100 R&D engineers and technicians
 - UL approval for fire protection use in 1954
 - Revolutionary dry, preaction, deluge devices since 1997
 - Sprinklers since 1998
- **2003 Victaulic began research into special hazards market**
 - After 5 years of fire testing with Factory Mutual (FM)
 - In 2008 Victaulic established a presence on NFPA 750 as a board member as a result of the approval of the Vortex system by Factory Mutual.

Victaulic Vortex™ Fire Suppression System for Special Hazards

Victaulic Vortex

- **What a hybrid system is:**
 - **Patented supersonic emitter creates a multi-layer shock wave of nitrogen which atomizes the water to a sub 10 micron level**
 - **Creates a *homogenous* suspension of nitrogen gas and water**
 - **Vortex is a twin fluid system as described under NFPA 750, 3.3.18**

Victaulic Vortex

- **How it works as an inert gas**

- Nitrogen gas actively dilutes the oxygen level to quickly suppress small fires
 - Even in large rooms
 - Room integrity is NOT required for the Vortex System

- **How it works as a water mist system**

- Atomized water absorbs heat from the fire to vaporize as steam
 - As effective as high pressure water mist system in larger fuel based fires
 - Flame is cooled while steam displaces oxygen at fire
 - No high pressure pumps are required

Victaulic Vortex

- **Operational / Design Overview**

- **Homogeneous Suspension**

- **Created using**

- Nitrogen pressure at emitter of 25 psig
 - Water pressure of only 5 psig at emitter

- **Emitter:**

- **Typical Coverage 1500-2500 ft³ per emitter (application dependent)**

- **Nitrogen flow**

- 150 Standard Cubic Feet per Minute per MS emitter
 - 250 Standard Cubic Feet per Minute per DC emitter

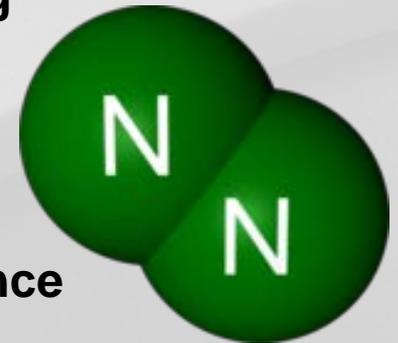
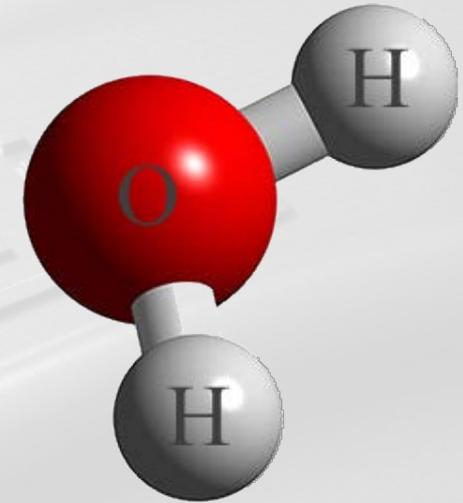
- **Water flow from:**

- .26 gpm (Data Center)
 - 1.06 gpm (Machine Space)

- **Tested and approved by FM for use up to 128,570 cubic feet (3600 cubic meters). Not a pre-engineered system**

Victaulic Vortex

- **Created a new fire suppression system per FM and the EPA**
 - Hybrid total flooding system per FM 5580
 - Vortex is compliant with NFPA 750 per FM 5580 Listing
 - Incorporates the beneficial features of:
 - **NFPA 750 - Water Mist**
 - **NFPA 2001 - Clean Agent Gas System**
 - Both are proven FM and UL tested systems since the early 1990's
 - Vortex is based on both of these proven technologies



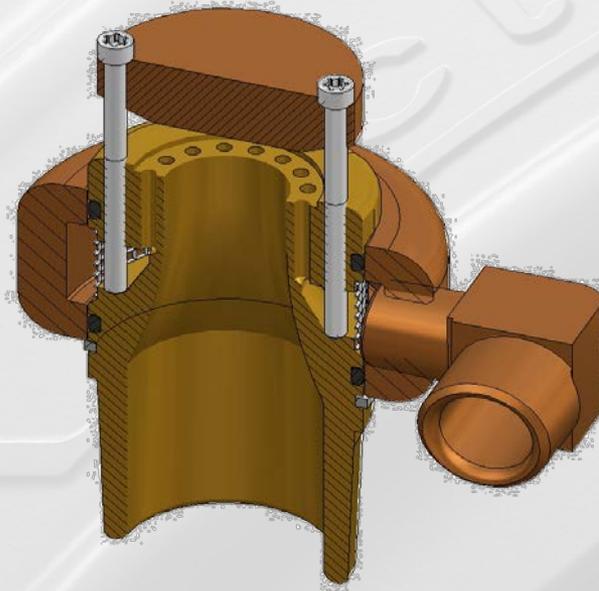
Victaulic Vortex

- **Atomization Method**
 - Emitter Description
 - Droplet Distribution
 - Explanation of Atomization

Victaulic Vortex

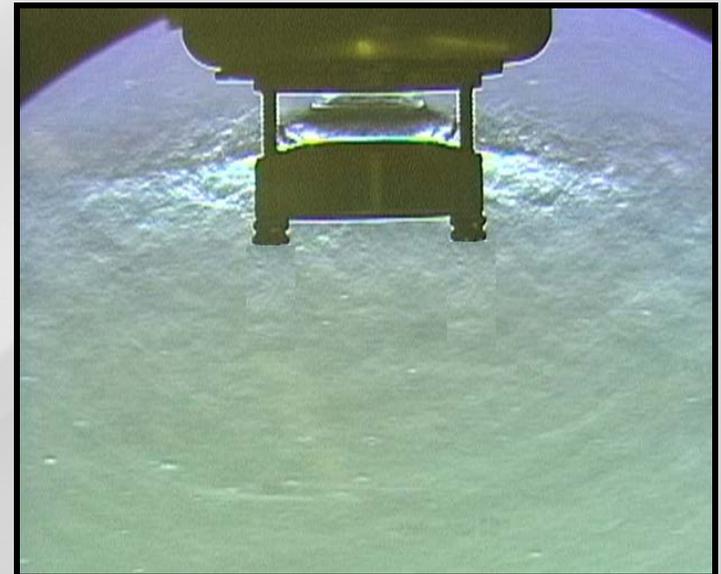
- **Emitter Details**

- 1/8", 1/2" or 5/8" Opening for Nitrogen Flow



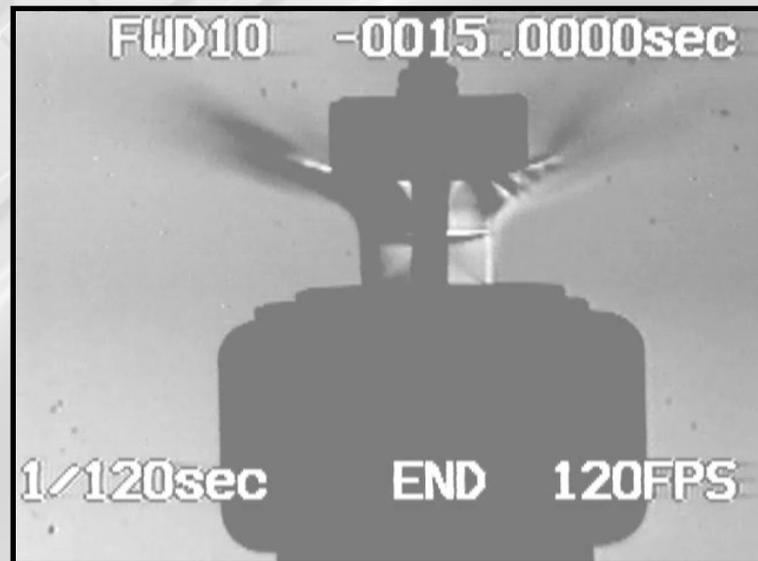
Victaulic Vortex

- **Emitter Details: Penn State Research**
 - **Schlieren Photography**
 - **Shock disc between foil and emitter**
 - **Secondary shock fronts at foil**
 - **Velocity**
 - **At emitter:**
approx. Mach 1
 - **At 2 ft.:**
approx. 80mph
 - **At 8ft.:**
approx. 40 mph



Victaulic Vortex

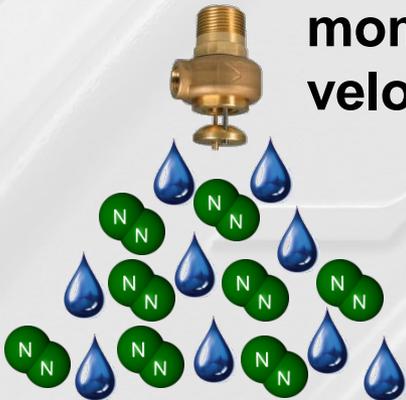
- **Emitter Details:**
 - Shadow Photography
 - Demonstrates 4+ additional shock waves at foil
 - **Shockwave = instantaneous transition from supersonic to subsonic velocity**



Victaulic Vortex

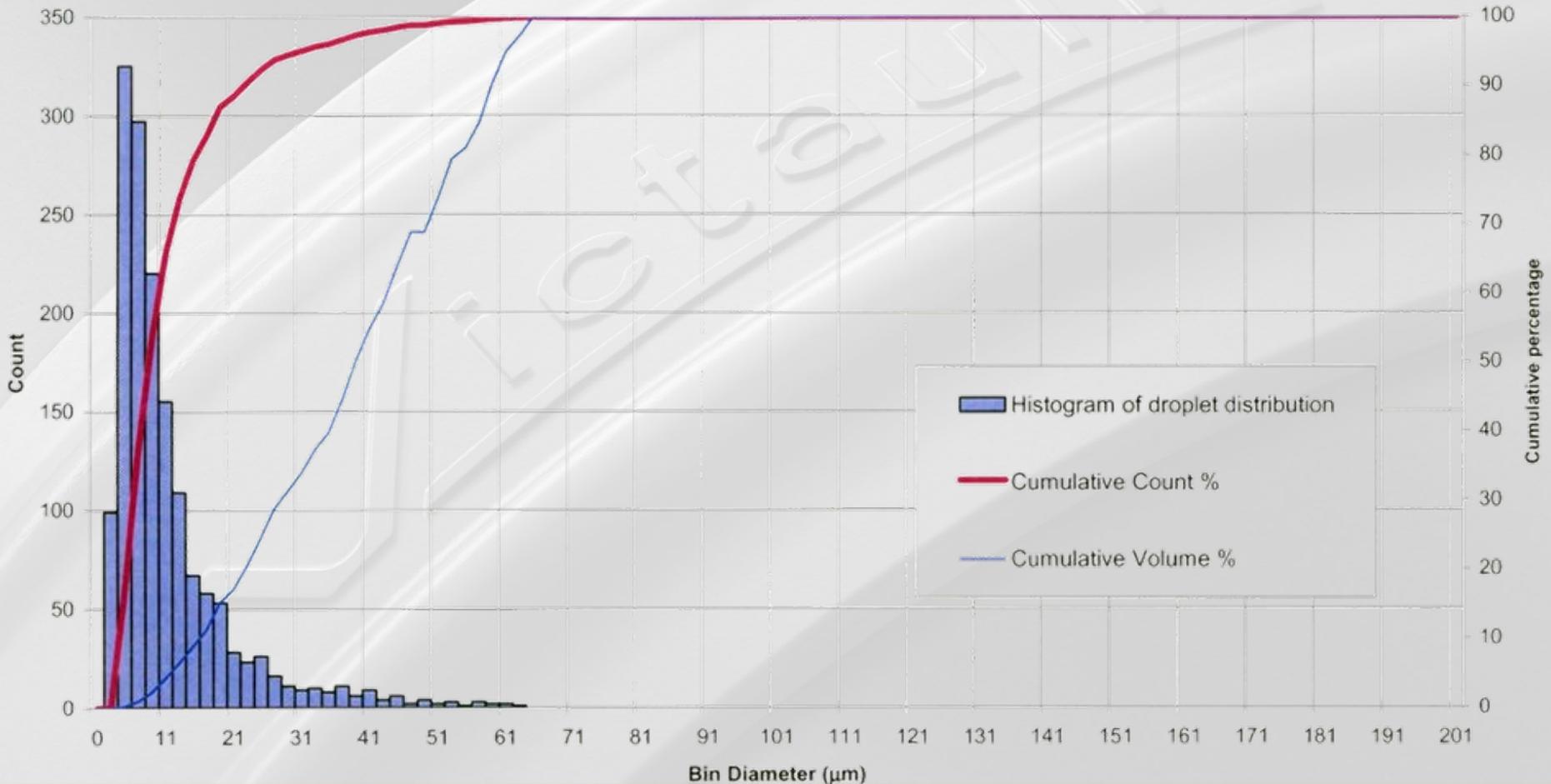
- **Atomization**

- Atomization occurs at the emitter (atomization zone):
 - **N2 velocity VERY HIGH**
 - **H2O velocity at zero**
 - **High We Number**
- Resulting suspension has high momentum due to the high gas velocity



UL Droplet Pattern Disbursement

Victaulic Water Mist Nozzle
Test Number 48
Position; Y = 1 m, X = 0.2 m, Angle = 90

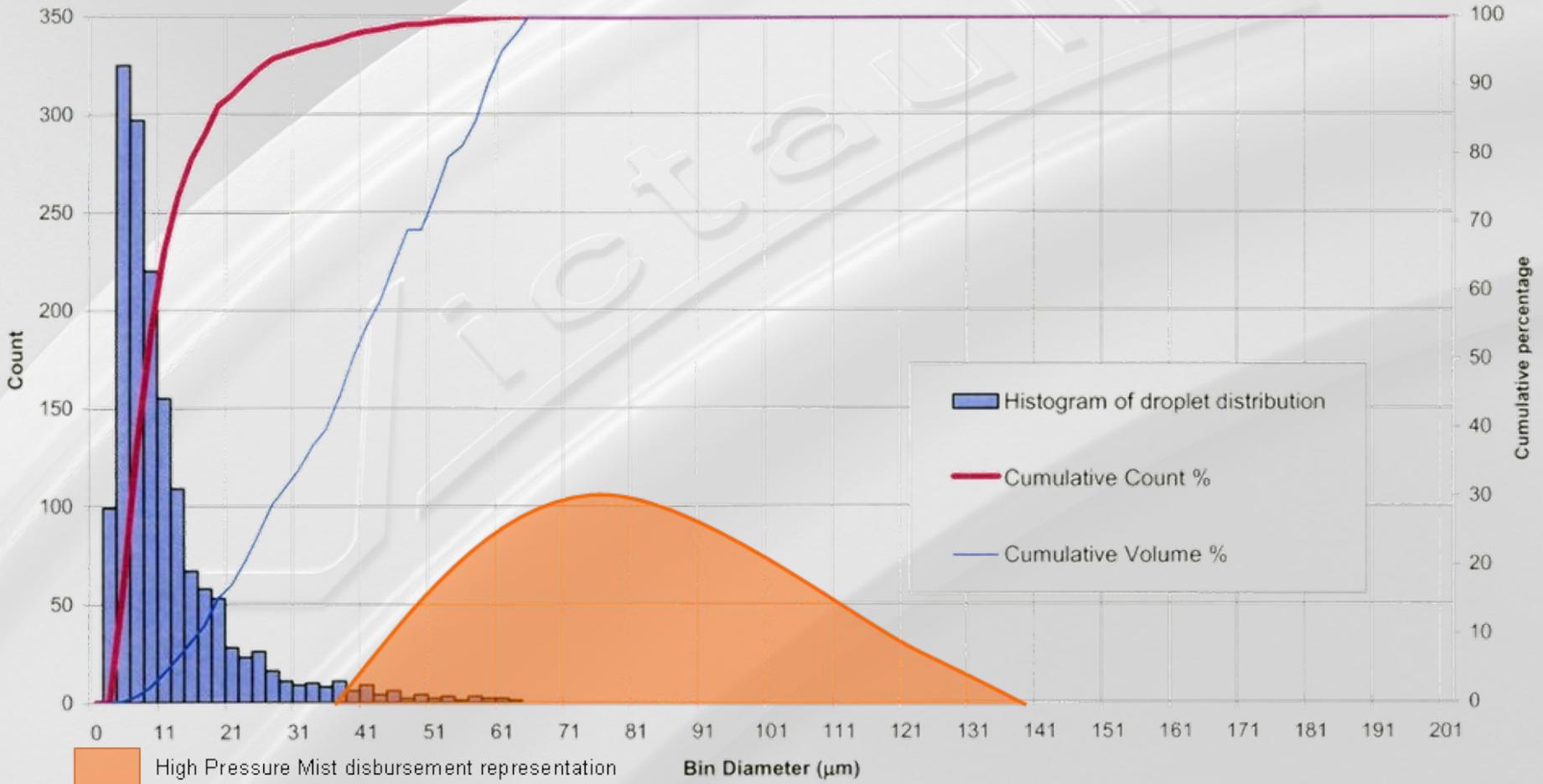


Droplet Pattern Disbursement

Victaulic Water Mist Nozzle

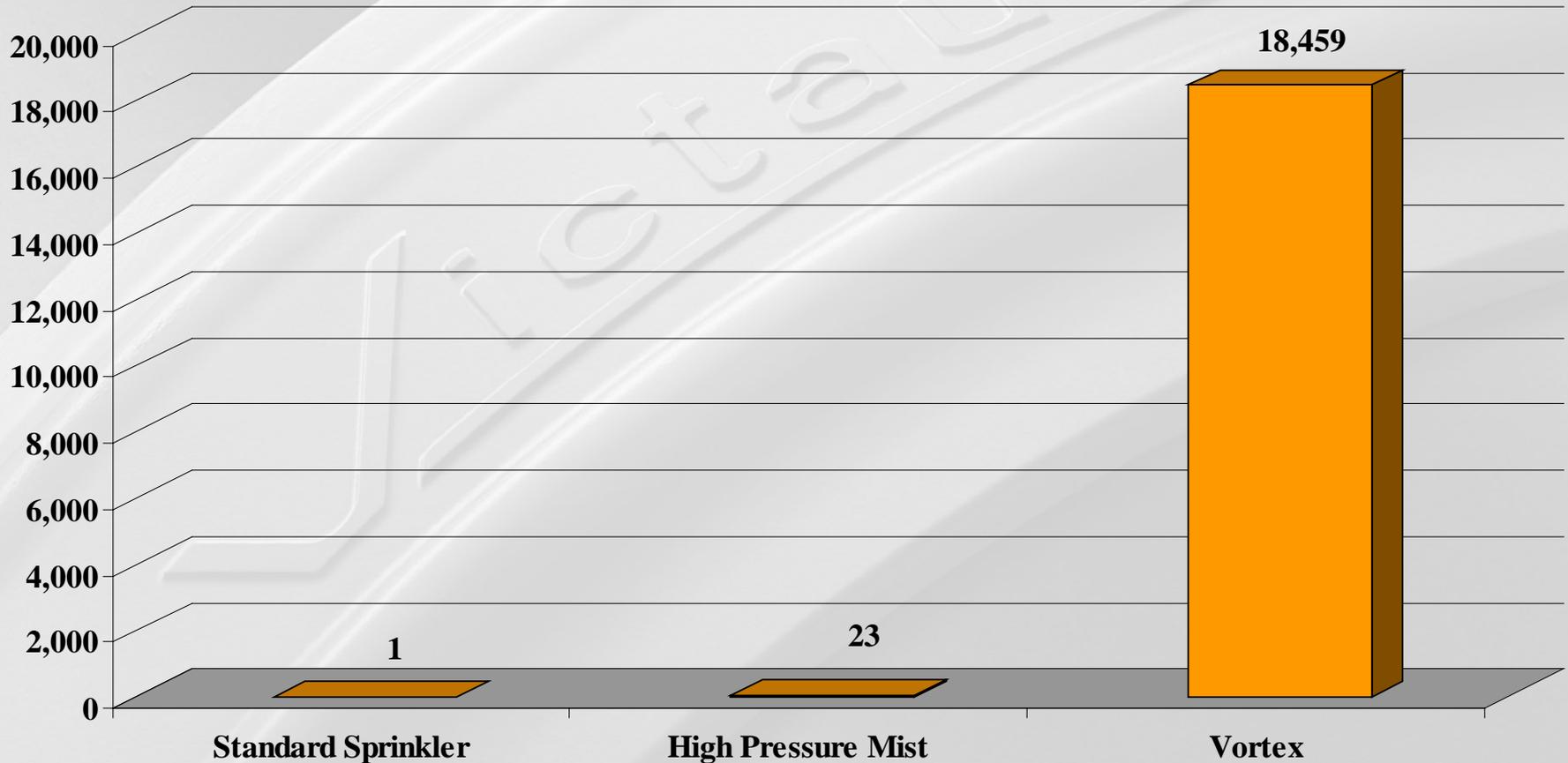
Test Number 48

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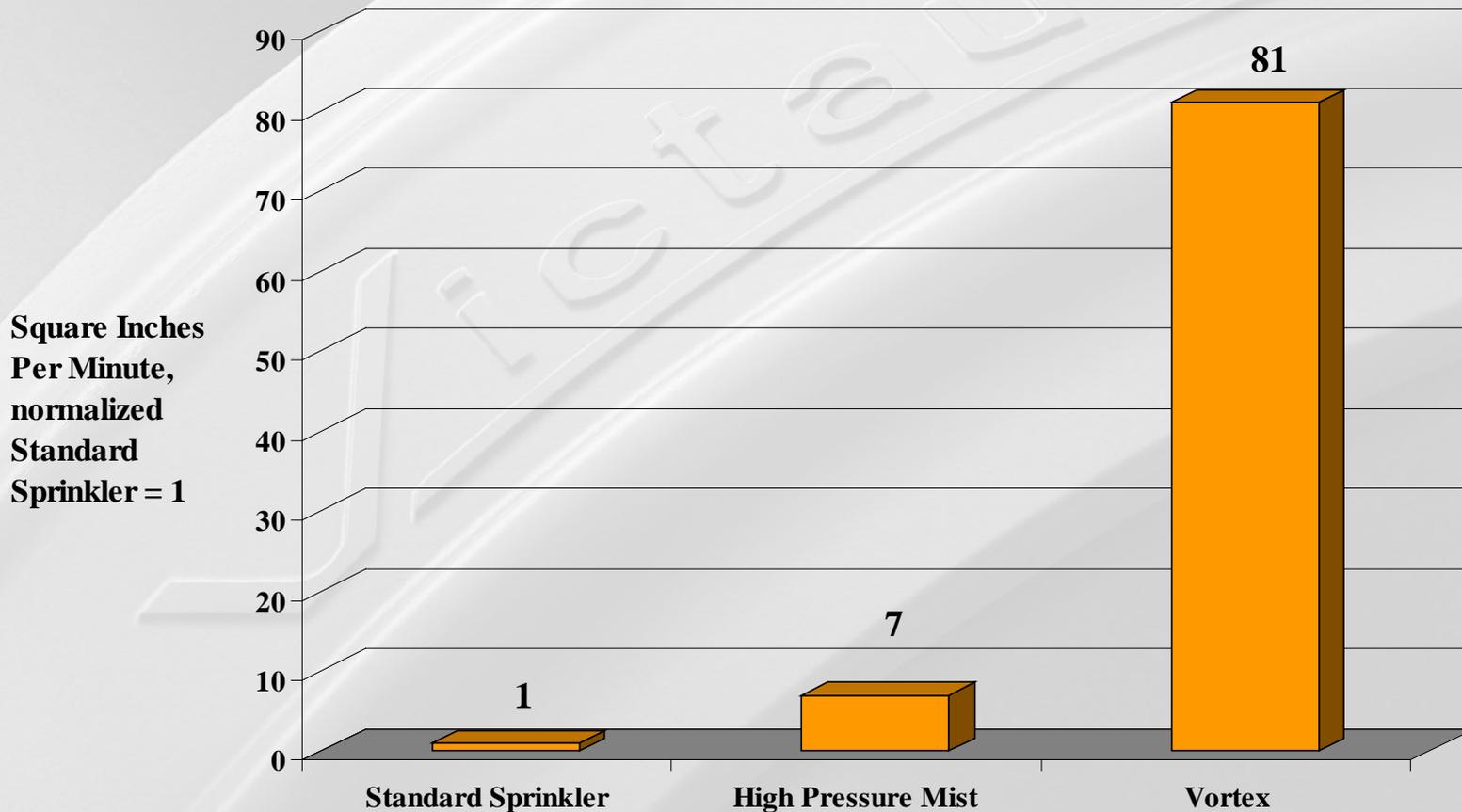
Victaulic Vortex

- **Relative Droplets Per Minute**



Victaulic Vortex

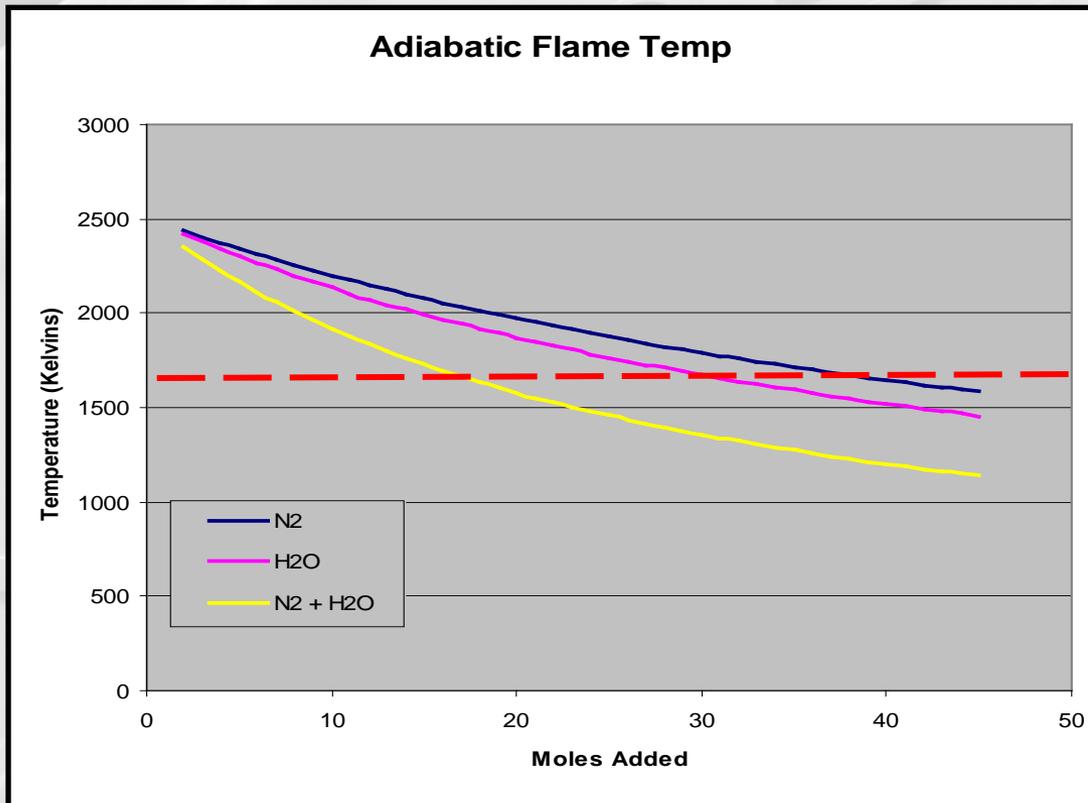
- **Relative Surface Area of Heat Exposure**



Victaulic Vortex

- **Droplet Distribution**

- **Adiabatic Flame Temp with N2, H2O, & N2 + H2O**



****1600 K required to sustain flame**

Victaulic Vortex

- Major Components
- System Overview
- Layout Design



Vortex System Components

- **Detection**
 - Smoke, Flame, or Heat Detection or Air Sampling Are All Acceptable (Provided by Contractor)
- **Releasing Panel**
 - Any FM Approved Agent Release Panel (From Victaulic or Contractor)
- **Nitrogen Supply**
 - 80 L/540 SCF, 49L/310 SCF Cylinders or Bulk Tubes
- **Auxiliary Battery Box**
 - Available From Victaulic or Vortex Contractors
- **Water Supply**
 - Small, Integrated Tanks or Municipal Potable Water Supply
- **Victaulic Needle Valve**
- **Victaulic Emitter**
- **Nitrogen Pipe**
 - Victaulic grooved system on light wall black pipe
- **Water – NFPA 13 Standard**
 - Copper / galvanized or stainless steel pipe
 - Victaulic's Vic-Press for Schedule 10S recommended

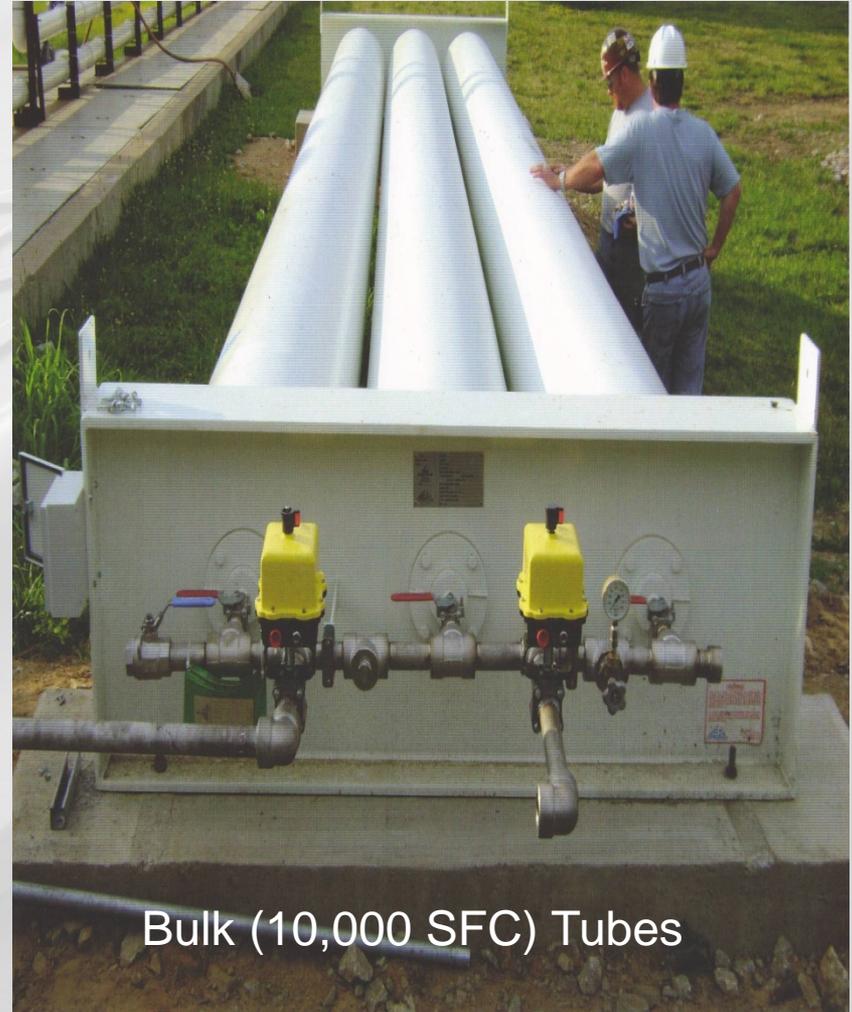
Victaulic Vortex

- **Nitrogen Supply**
 - Can Be Designed for Single or Multiple Zones
 - Nitrogen sized per largest volume area
 - **Multiple Zones Enhances Vortex System Cost Efficiency**
 - Better economics
 - Smaller footprint
 - Purpose of Nitrogen
 - **Dissipates O2 Content to 14-15%**
 - N2 Flow Regulated to 25 PSI at the Emitter(s)
 - Size/Number of Tanks Based on Zone Volume

Two Nitrogen Supply Options



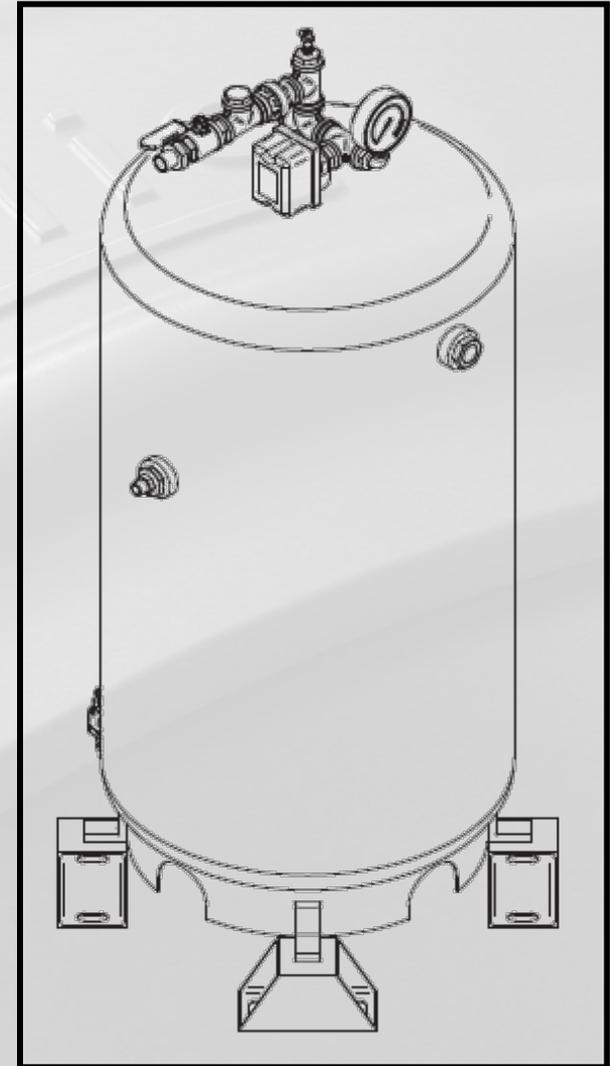
80L Cylinders



Bulk (10,000 SFC) Tubes

Victaulic Vortex

- **Water Supply**
 - **Purpose**
 - **Cools Room and Extinguishes the Fire**
 - **Water pressure**
 - **5 psi at the Emitter**
 - **Water flow**
 - **.26 to 1.06 GPM per Emitter**
 - **Water supplied by:**
 - **Integrated Tank or Potable Municipal Supply**
 - **Water inlet supervised by:**
 - **Victaulic Style 728 Ball Valve**
 - **Tank Pressurized with System Nitrogen**
 - **Does not require a pump**



Victaulic Vortex

- **Automated Needle Valve**

- **Purpose:**

- **Regulates the nitrogen flow in the system**
 - **Maintains a constant 25psi discharge at the emitter**

- **Consists of:**

- **3000 psi bubble tight needle valve**
 - **Intelligent (Programmed) motor driver**
 - **safety relief valve**

Programmable Motor Driver

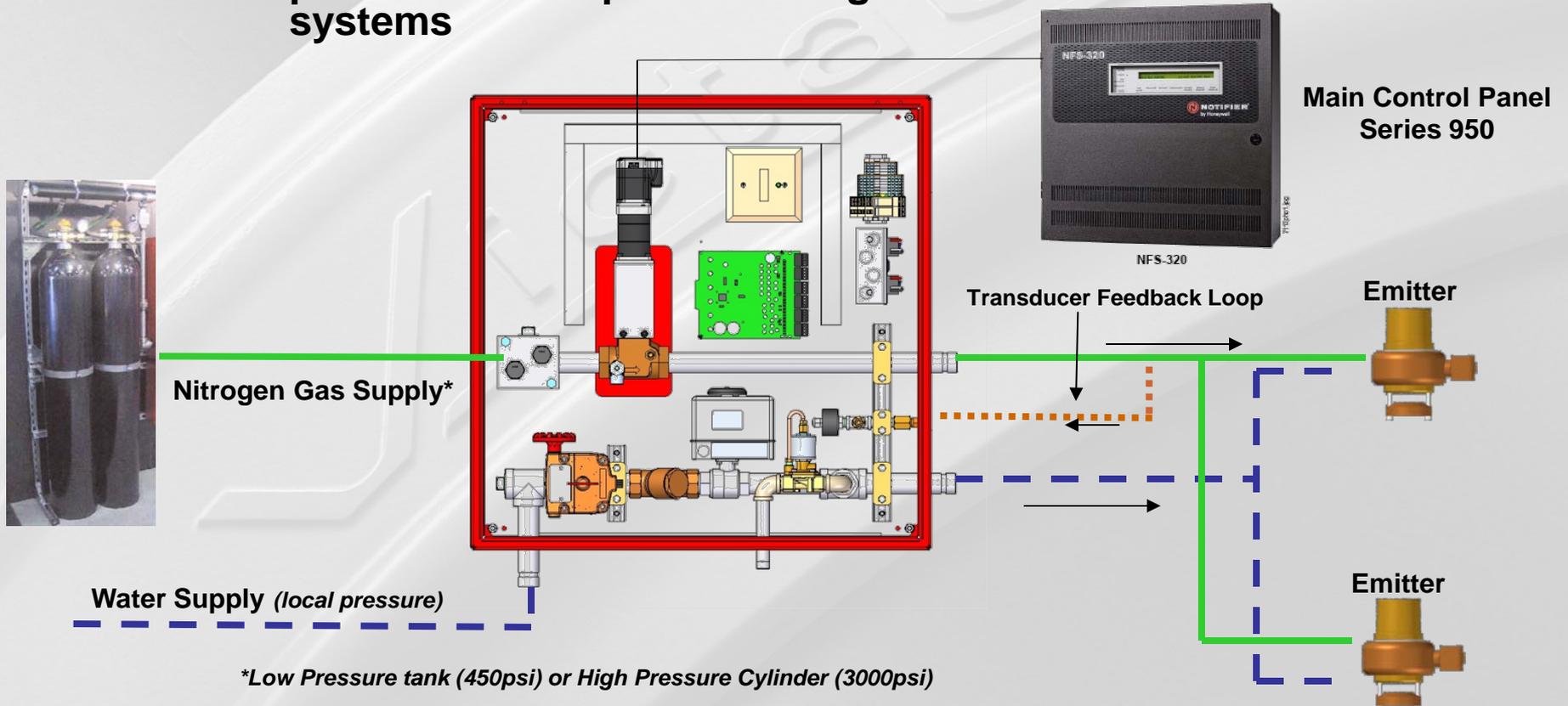
Needle Valve

High Pressure Safety Valve



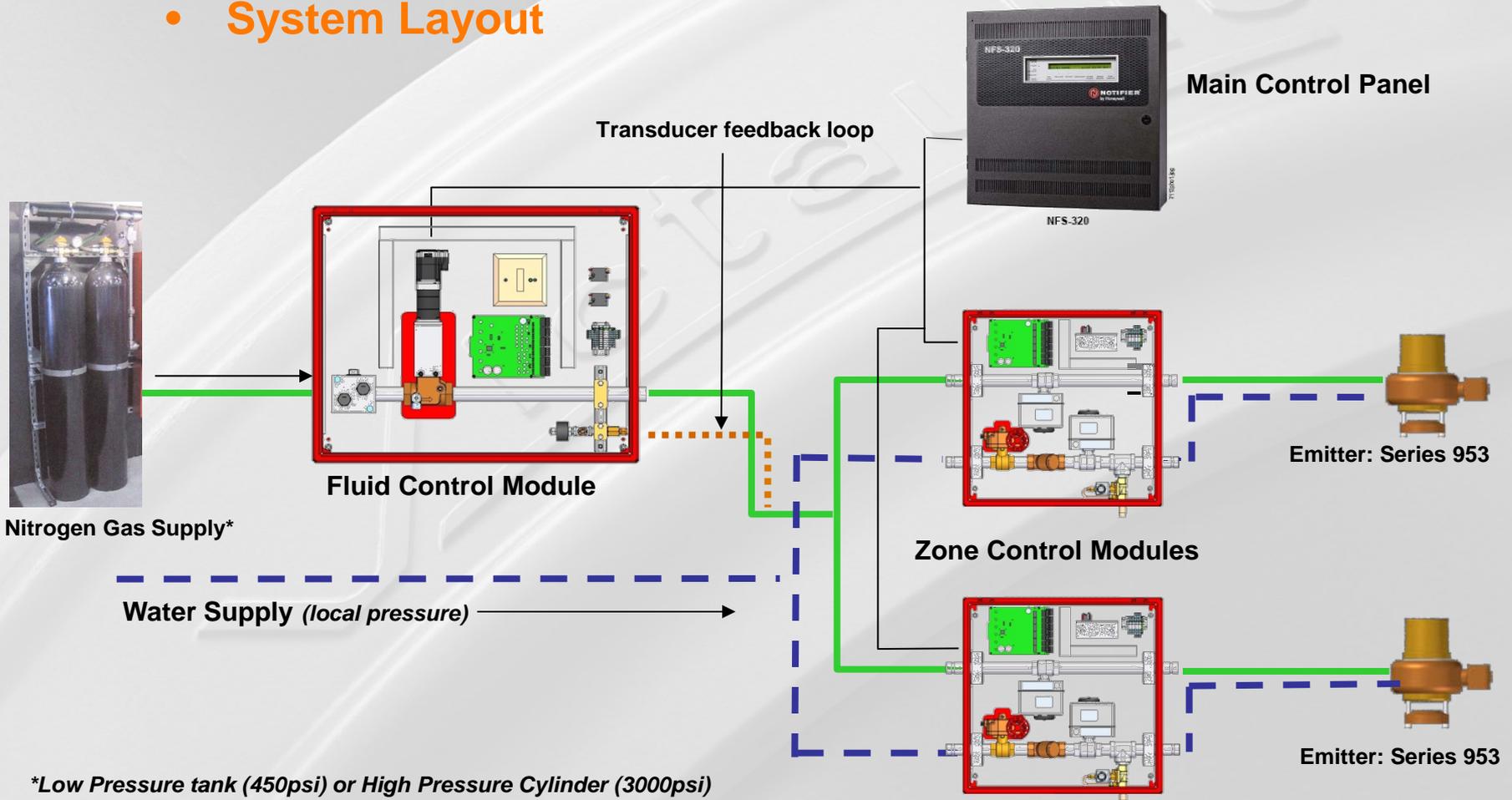
Typical Combo - Panel

- **System Layout**
 - Combines fluid control / zone control panels into one panel for single zone systems



Typical Multi-Zone

- System Layout



*Low Pressure tank (450psi) or High Pressure Cylinder (3000psi)

Victaulic Vortex

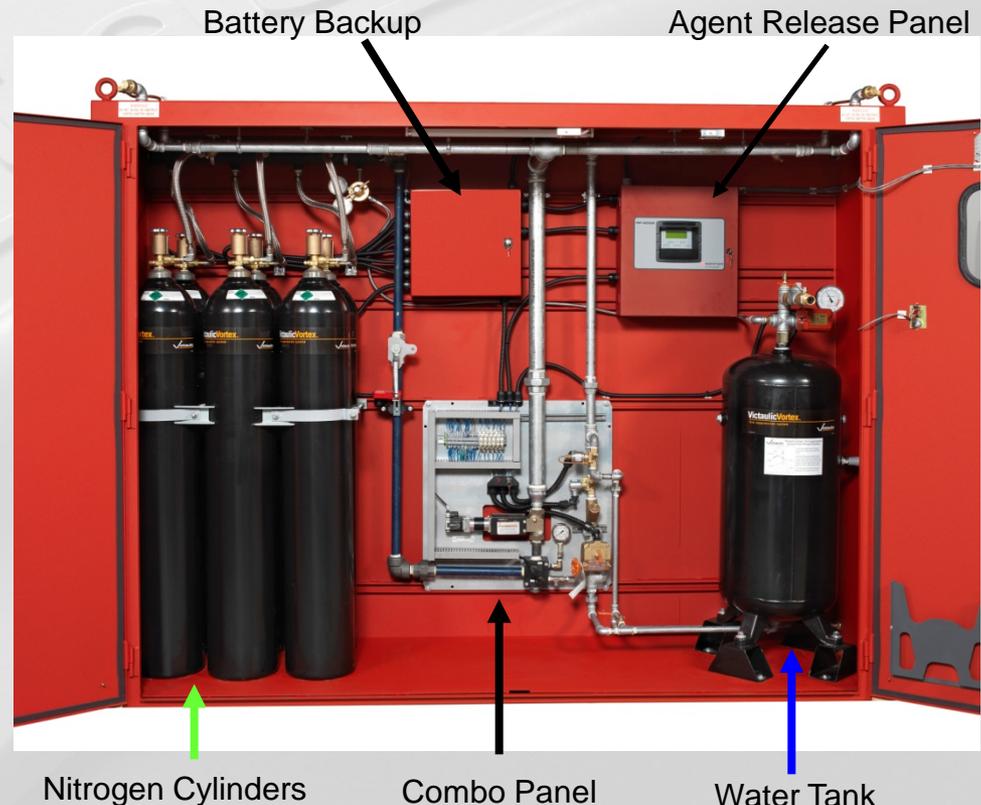
- **Vortex Fire - Pac**
 - **Computer Rooms**
 - **Choose:**
 - **Control Options**
 - **Dry Contacts**
 - **Standard Release Panel**
 - **Number of emitters**
 - **Time of nitrogen discharge**
 - **Pre-build and test assembly**
 - **Customer could choose integrated fluid tank**



Victaulic Vortex

- **Pre-built Cabinet**

- **Optional integrated fluid supply**
- **Eliminates need for water hookup**
- **Cabinets for any number of nitrogen cylinders**
- **May be chained together with one master panel**



Victaulic Vortex

Performance Analysis

Agent	Flow, gpm	Drop Size, μm	Pressure, psig	Momentum
Vortex	≤ 1	< 10	25	High
Intermediate Pressure Water Mist	3-5	400-1000	350	High
High Pressure Water Mist	8	100	1500-2500	Low to Moderate
Sprinkler Systems	>25	>1000	20-min	High
Inert Gases	NA	NA	2500	NA
Halogenated Agents	NA	N/A	350	NA

Victaulic Vortex

Performance Analysis: *Continued*

Agent	Fuel Wetting	Oxygen Depletion	Temp. Reduction	Block Radiative Heat Transfer	Reduce Convective Heat Transfer	Total Flooding
Vortex	Minimal	Gradual	Fast	Yes	Yes	Yes (minimal wetting)
Intermediate Pressure Water Mist	High	Gradual	Moderate	Moderate	Moderate	Deluge (significant wetting)
High Pressure Water Mist	Minimal	Gradual	Fast	Yes	Yes	Yes (minimal wetting)
Sprinkler Systems	High	Gradual	Moderate	Moderate	Moderate	Deluge (significant wetting)
Inert Gases	No	Rapid	Minimal	No	No	Yes (no wetting)
Halogenated Agents	No	N/A	Moderate	No	No	Yes (no wetting)

Vortex Approvals

- **Vortex is compliant with NFPA 750**
- **All Vortex Equipment is FM Approved**
- **FM Approval**
 - **Based on FM 5580 Standard for Hybrid Systems**
 - **Applications**
 - **Machine Spaces**
 - **Combustion Turbines**
 - **Special Hazards Machine Spaces**

Vortex Approvals (cont'd)

- **Vortex is SNAP Approved**
 - Replacement for Halon 1301 Systems
 - Per US EPA Vortex has received the SNAP Approval as a “hybrid inert gas water based system”
 - Applications
 - Data processing area
 - Paint mixing rooms,
 - Automated information storage areas,
 - Libraries
 - Museums
 - Pharmaceutical storage areas,
 - Forensic labs
 - Pickle and annealing lines in steel plants, etc.
 - Turbines
 - Generator protection
 - All machines spaces

Vortex Approvals (continued)

- **UL 2127 Clean Agent Tests**
 - Vortex has demonstrated its ability to extinguish numerous Class A & B fires requested by UL&FM
 - Both Agencies witnessed these fire tests
 - Victaulic has letters are on file from both agencies affirming that Vortex successfully extinguished all the fires

Applications

- **Power Generation**
 - Base Load Plants
 - Co-Generation and Combined Cycle Plants
 - Power Parking Units
 - Coal Conversions
 - Coal Storage/Handling/Pulverizing
 - Gas Turbines
 - Machinery Spaces
- **Generator Rooms**
- **Cement Plant/Blast Furnace**
 - Indirect Coal Firing Systems
- **Industrial Ovens**
 - Carbon Fiber Manufacturing Ovens
- **Metal Production and Processing**
 - Electrical Furnaces
 - Continuous Casters
 - Rolling Mills (steel and aluminum)
 - Coating Lines
 - Packaging Areas
 - Pickle and Annealing Lines
 - Pulpits
- **Automotive**
 - Assembly
 - Paint application
 - Mixing and storage
 - Parts
 - Machining
 - Heat Treating

Applications

- **Electronic Operations**
 - Computer Areas
 - Automated Information Storage Areas
- **Electronic/Computer Production**
 - Wet Benches
 - Wave Soldering Machines
- **Data Processing Rooms**
- **Underground Storage Vaults**
- **Research Facilities**
 - Test Facilities
 - Anechoic Chambers
- **Telecommunications Facilities**
- **Rare Book Libraries**
- **Museums**
- **Petrochemical and Medical Facilities**
 - Laboratories
- **Printing**
 - Newspaper Production
 - Periodical Printing
- **Coating Lines**
- **Food Processing**

Vortex: The “Solution Product”

- **Does the application have room integrity issues?**
 - Sometimes virtually impossible or so expensive to achieve
 - Halocarbons need room integrity
 - Vortex does not require fan tests and room integrity
 - Room sustainability – retrofits for new conduit, etc in walls or floors can render gaseous systems less effective or ineffective

Vortex: The “Solution Product”

- **The customer wants a green system!**
 - Vortex is totally green with its use of nitrogen (most common element of air) and water
 - Most gaseous systems are not



Vortex: The “Solution Product”

- **Recharge costs can be high for alternative systems!**
 - FM-200 sells to end customer for around \$20 / lb, plus labor to replace
 - 10,000 lb system - \$200k!
 - In contrast, equivalent amount of nitrogen is \$12.5k

Vortex: The “Solution Product”

- **Containment of a discharge**
 - If containment systems for a sprinkler discharge are needed, safe to assume collection is hazardous.
 - Expensive to dispose of collected waste
 - **Containments oversized because don't know when sprinklers will be shut off**
 - **Do not know how much water will be collected**
 - The containment system cost can be more expensive than the Vortex system installed!

Vortex: The “Solution Product”

- **No water or little water is available at the site**
 - Running water lines is very costly
 - Fire pumps and tanks are also
 - Vortex uses very little water, and can provide standalone water tanks



Vortex: The “Solution Product”

- **The material in the application is valuable**
 - Needs to be protected from damage in fire incident or accidental discharge
 - Data Center emitter flows only .26 GPM
 - **High Pressure water mist – 8 GPM and will run for ten minutes**
 - If comparing against closed heads – expect bigger fire before activation – Vortex would go off faster on smaller fires



Vortex: The “Solution Product”

- **Some projects are so volatile – there was no really good answer before Vortex was developed**
 - **Protection of Annealing & Pickling lines – Victaulic’s design team worked with manufacturers to jointly develop an automated system – presented at IWMA – NFPA at Factory Mutual’s request**
- **Victaulic welcomes the opportunity to work with you on high-challenge installations**

Vortex: The “Solution Product”

1. *If Room integrity is not attainable*

- Air tight rooms are not required

2. *Green System is wanted*

- Nitrogen and water are green

3. *Hazard area has no water*

- Vortex discharges as little as .26 gpm

4. *Recharge cost is a \$\$ concern*

- Clean Agents can be up to 100 times more expensive than nitrogen

5. *Worried about containment costs*

- No residue from discharge to be contained

6. *Water damage is not tolerable due to valuable artifacts or conductivity can not be tolerated due to electrical equipment.*

- Virtually no wetting of protected area

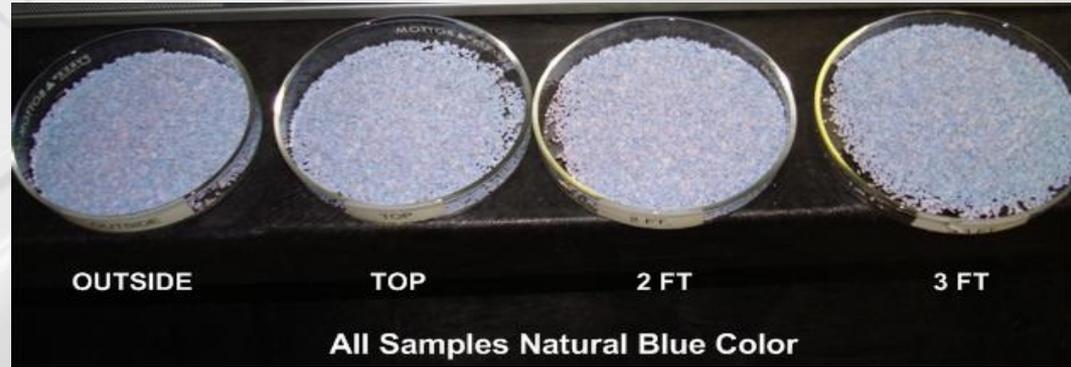
Vortex Testing

- **Moisture Accumulation**
- **Sensitive Electronics**
- **High Voltage Exposure**

Sub Floor Testing-FM Global

- **ANSI/FM 5560 Computer Cabinet**
 - Cabinet used for AS 400 system
 - Placed on vented sub floor
 - 4 dishes of Anhydrous Calcium Sulfate (Dririte) placed through out the cabinet along with 2 mirrors.
 - System discharged through vented sub floor

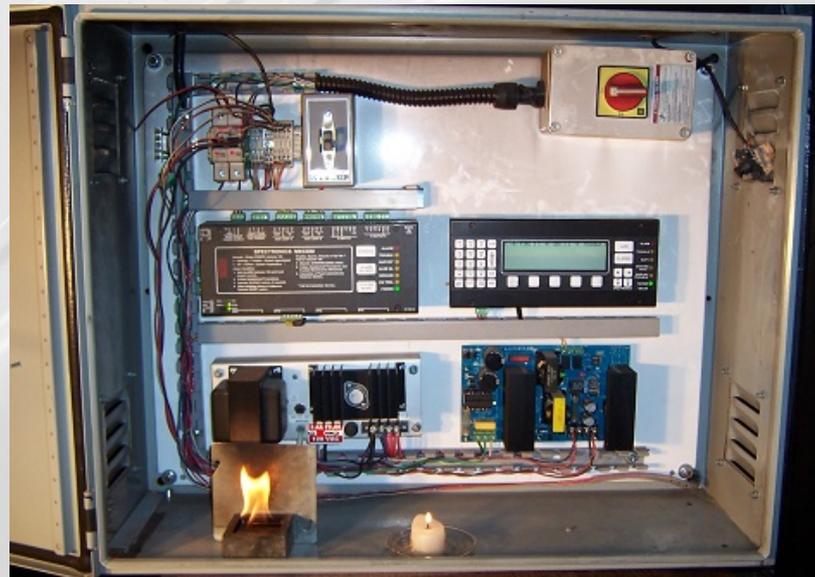
Post Test



← Vented Floor

Safe For Sensitive Electronics

- **Test1: Energized PLC Equipment**
- **Side vented enclosure with door closed**
- **Placed in corning of room**
- **Microprocessor based electronics along with LCD display and 2 - 24VDC power supplies**
- **Cup of heptane and wax candle are lit and allow to burn**



- **Test2: Tower and Laptop Computer**
- **Desk top PC with vented CRT type monitor**
- **Placed between 2 emitters (4 total in system)**
- **Both computers running while system is discharged**
- **2 dishes of Dririte- 1 inside PC and the other placed under the emitter**
- **RH sensor placed inside enclosure**
- **Pan fire with heptane placed in room**



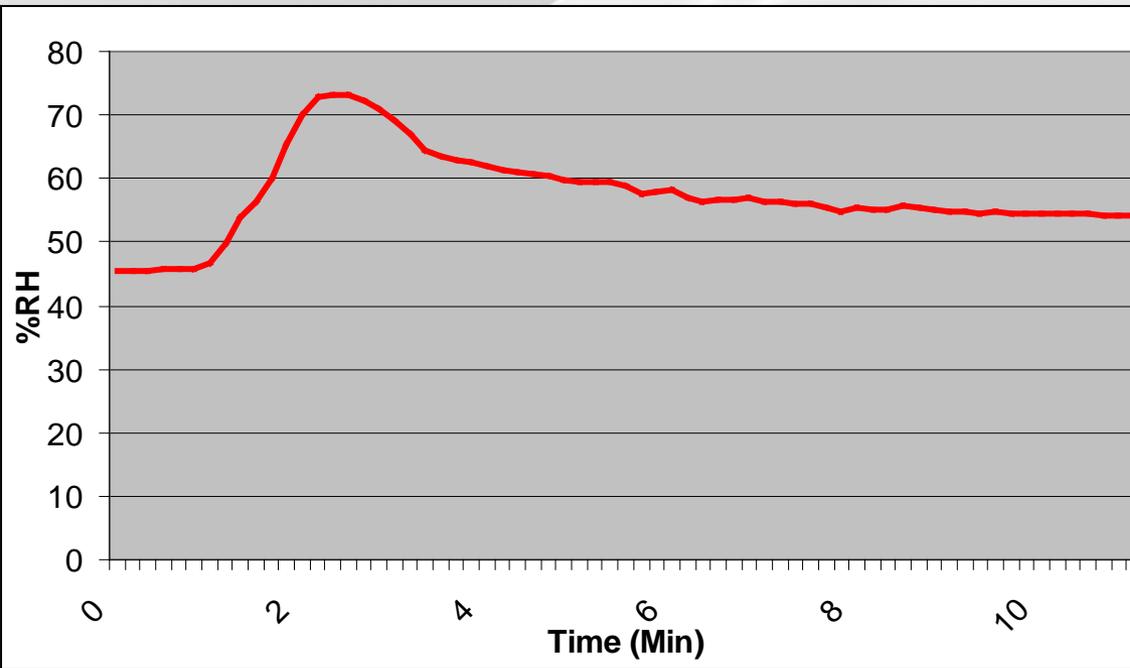
Test Results

- Fire extinguished in 96 seconds
- Relative Humidity (RH) of 73.9% Peak (Net 30% increase)
- Dri-rite remained blue in color
- Evaluation after 36 months of operation shown no corrosion of components
- Equipment remains functional today

Result Data



Chip Inside PLC



RH Reading



DriRite Samples

Safe For Use On High Voltage

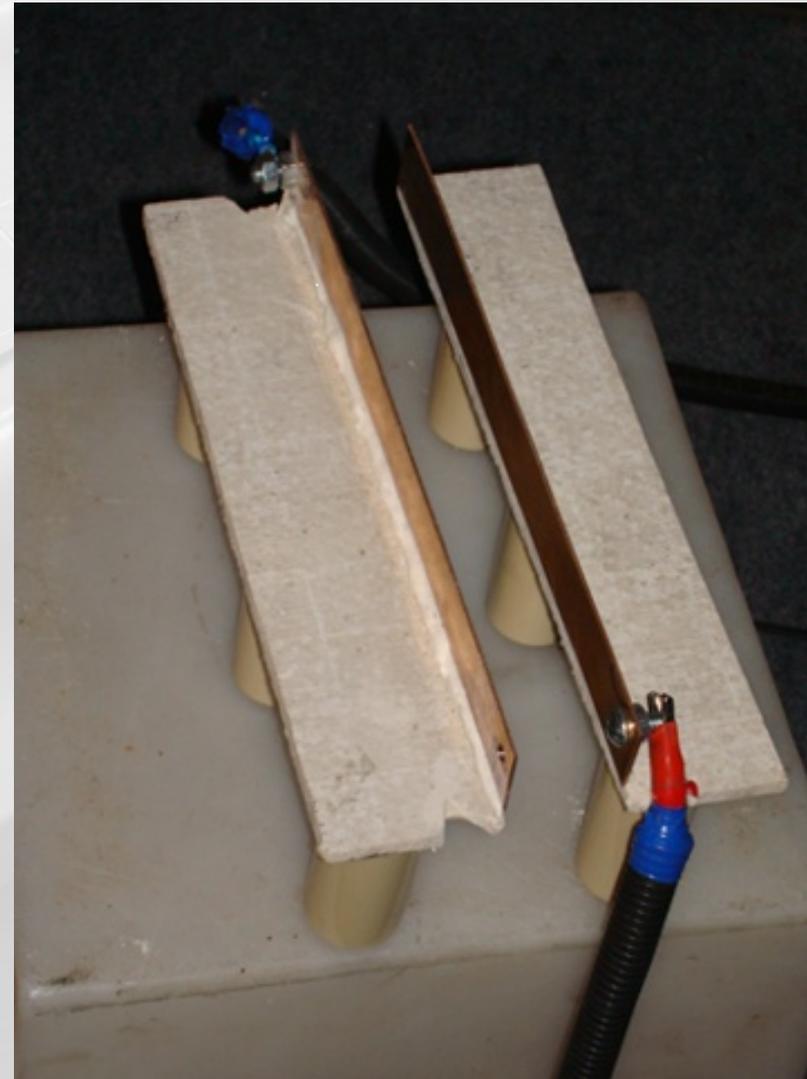
- Test1: Direct Discharge Onto Plate
- Test similar to ANSI/UL 711 for rating class “C” fire extinguishers
- 10KV,23 MA power supply
- Emitter electronically isolated from system and grounded
- Copper plate placed from 10” to 2” from emitter



- **Test2: Enclosed Bus Bar**
- **2 - Copper bus bars placed 1.5" apart inside a vented enclosure**
- **10KV,23 MA power supply**
- **Heptane fire lit in enclosure then door closed**
- **System discharged for 5 minutes**



- **Test3: Unshielded Bus Bar**
- **2 - Copper bus bars placed 1.5” apart**
- **Placed 7 feet directly below emitter**
- **10KV,23 MA power supply**
- **System discharged for 5 minutes**



Results

- **No arc was measured in any test arrangement**
- **Test 1 Plate- reached a net current of 169 μ A at 2”**
- **Test 2 Enclosed Bus Bar- max current of 68.9 μ A**
- **Test 3 Unshielded Bus Bar- net current of 463 μ A**
- **All results are far below NIOSH* standards**

*National Standard For Occupational Health

-1mA “Barely Noticeable” Current

-16mA Max “Let Go” Current

Maintenance: Simple, Inexpensive

•Weekly Visual Inspection

- Inspect N₂ & H₂O supply lines
- Review Annunciator Panel history
- Inspect Emitters to be sure they are not obstructed
- Verify that emitter covers are in place

•Semi-Annual Inspection

- Complete weekly inspection steps
- Inspect Nitrogen tank pressure levels. If low pressure condition exists, determine root cause, repair and refill tanks
- Inspect water storage tank level (if applicable), fill if required

Maintenance Simple, Inexpensive

•Annual Inspection

- Complete weekly and semi-annual steps
- Cycle N2 & H2O Valves for proper operation (discharge not required)
- Replace H2O in storage tank
- Inspect all system hoses, replacing any damaged or deteriorated hoses

•Five-Year Inspection

- Complete annual inspection items
- N2 cylinders that are continually in service without being discharged shall be given a complete external visual inspection a minimum of every 5 years
- All hoses shall be tested or replaced a minimum of every 5 years

So, What Can Vortex Offer You?

- **Installation Flexibility**
- **No Room Integrity Issues**
- **Extinguishes Small Fires in Large Rooms**
- **Inexpensive Agent to Recharge**
- **No Residual Damage from the Agent**
- **A Totally Green Product**
- **Simple, Inexpensive Maintenance**

Piping. Systems. Solutions.

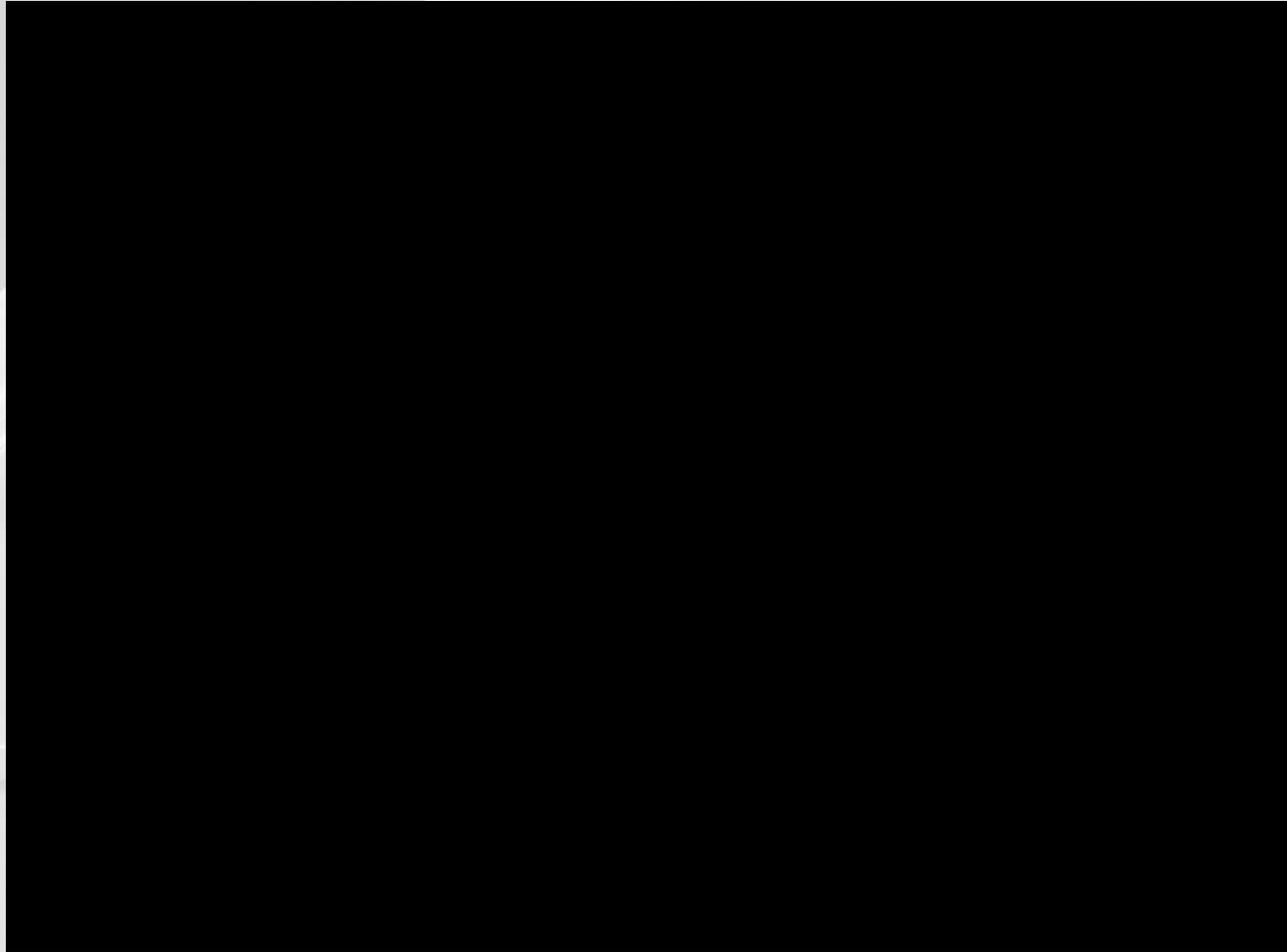
FOR OVER 80 YEARS

Victaulic Vortex™

Next Generation Fire Suppression System



Vortex Videos



Vortex Video



Vortex Video

