Vortex: What It Is

- A hybrid system incorporating liquid and gaseous extinguishing agents.
- In total flooding applications - nitrogen and water.
- The system atomizes the water to <10µm, forming a dense homogeneous suspension of nitrogen and water.
Vortex: What It Is

- In this manner, two extinguishment mechanisms are occurring simultaneously: cooling and flame extinguishment.
- The water enriched nitrogen forms a dense suspension that blocks radiative heat transfer.
Vortex: What It Is

- This homogeneous suspension is created using a gas pressure at the emitter of 25 psig and a water pressure of <5 psig.
- High Momentum of the nitrogen allows the <10μm water droplets to maintain velocity.
**Victaulic Vortex System**

**Homogeneous Suspension Atomization**

When system activates, atomization occurs at the emitter (atomization zone):

- \( \text{N}_2 \) velocity VERY HIGH
- \( \text{H}_2\text{O} \) velocity at zero
- High \( \text{We} \) Number

Resulting suspension has high momentum due to the high gas velocity.
As suspension disperses, $N_2$ reduces air drag and $H_2O$ particles maintain velocity.

Air is pushed out of the way and drawn in, causing wrapping around dispersion – “Vortex” effect.
Emitter Details - 1/2" (15mm) Opening for Nitrogen Flow
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. 80 mph
- at 8ft.: approx. >30 mph
Emitter Details, Droplet Flow Field
Using Particle Image Velocimetry (PIV)
testing conducted at Penn State, Gas Dynamics Lab
UL Droplet Pattern Disbursement

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

- Histogram of droplet distribution
- Cumulative Count %
- Cumulative Volume %

Bin Diameter (μm)

Count

Cumulative percentage
Relative Droplets Per Minute

Relative Droplets per minute

Droplets

Standard Sprinkler 1
High Pressure Mist 23
HVLP

System
Relative Surface Area of Heat Exposure

Relative Surface Area

square inches per minute

Standard Sprinkler  High Pressure Mist  HVLP

System
Typical system layout

- High Pressure Valve
- Supervisory Switch
- Main Control Panel
- Fluid Control Module
- Zone Control Modules
- Nitrogen Gas Supply
- Water Supply
- Emitters
Summary of Results

- Vortex has successfully extinguished all fire scenarios to FM Water Mist Standard 5560 in room sizes of 260, 500, 880 and 3600m$^3$
- UL 2127, Clean Agent fire scenarios successfully extinguished
Summary of Results

• Test results indicate a relationship of Fire Size (HRR) / Unit Volume to Agent Discharge Quantity
• The larger the HRR/Volume the greater efficiency of water
• As HRR/Volume decreases, Nitrogen becomes the dominant extinguishing fluid