



Protection of OH compartments with horizontal sidewall low pressure Water Mist nozzles

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Global Product Manager Water Mist



➤ **Started Tyco FPP in 2004**

- Design Software Specialist
- Application Engineer
- Sprinkler Systems
- Senior Technical Services
- Manager Technical services



Global Product Manager Water Mist

Born: 03-01-1970

Living together with Wendy

- 2 daughters, Joy & Tess



Education:

University of Applied Sciences

- Industrial Product Design

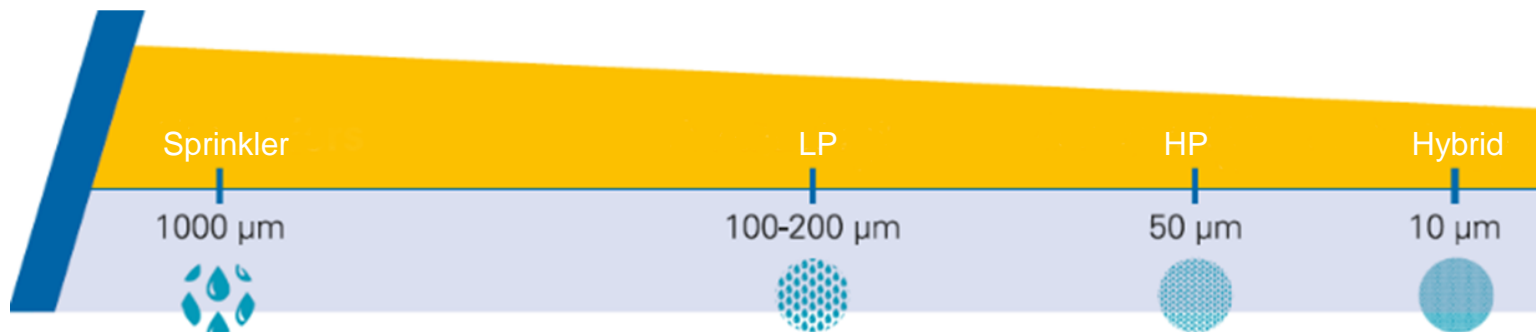
Graduated Sprinkler Engineer

Content

- Definitions Water Mist
- Applicable Protocols
- Impact of type of test material
- Successful VdS test sidewall
 - Test movie
- Characteristics low pressure nozzles
- Conclusion
- Questions

Definition

- Water Mist CEN/TS 14972:
A water spray with $D_{v0.90}$ of the droplets less than 1mm
- Water Mist NFPA750:
A water spray with $D_{v0.99}$ of the droplets less than 1mm
- The cumulative volumetric diameter of 90% respectively 99% of all water droplets is less than 1000 μm .



Type of Water Mist Systems (NFPA750)

High Pressure Water Mist System

A water mist system where the distribution system piping is exposed to pressures of 34.5bar or greater (500psi).

Intermediate Pressure System

A water mist system where the distribution system piping is exposed to pressures of greater than 12.1 bar (175psi) but less than 34.5 bar (500psi).

Low Pressure Water Mist System

A water mist system where the distribution system piping is exposed to pressures of 12.1bar or less (175psi).

Does Pressure Matter?

- NFPA 750 introduced pressure definitions – high, intermediate & low
- But, identical applications proven by technologies based on all pressure – third party approval critical
- New CEN and BS draft standards removed pressure definition
- If it is MIST, it is MIST, independent on how it is generated

Droplet Size

The mode of operation of water mist systems is essentially based on the use of very small water droplets.

Diameter (mm)	Number of Drops	Surface Area	Example
10	2	X	ESFR
1	2,000	10X	Residential
.01	2,000,000,000	1,000X	Water Mist

Due to the comparatively larger specific surface area, a rapid absorption of heat and an evaporation of the smallest water droplets will occur.

Thermal Properties of Water

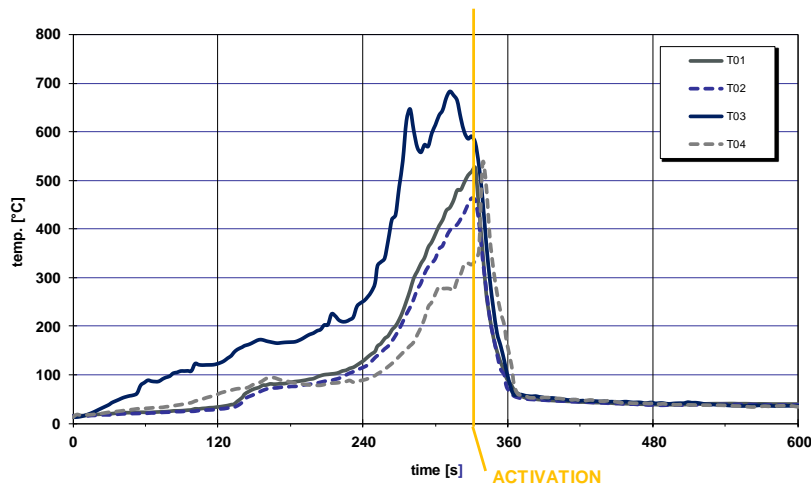
Energy absorption:

- 335 kJ to heat 1 liter of water from 20°C - 100°C
- 2257 kJ to convert water to steam

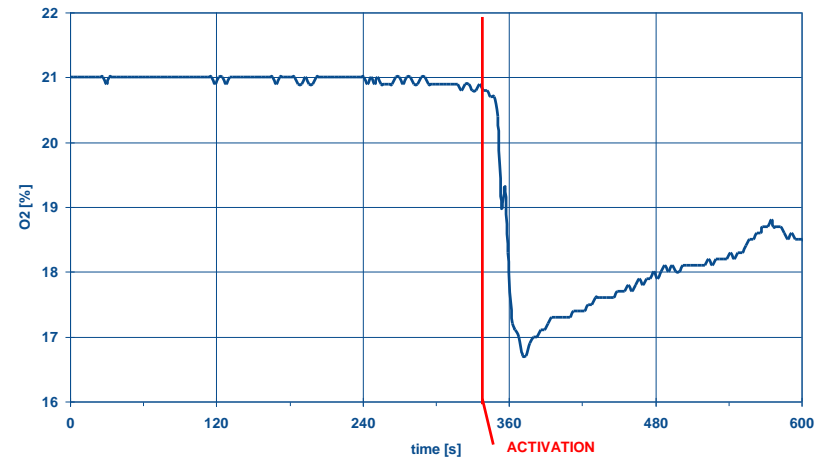
Volume expansion:

- Vaporization displaces air equivalent to 1650 times its original volume.

Cooling Effect



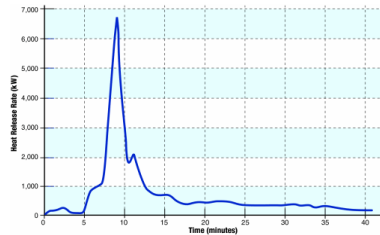
Oxygen Displacement



Types of Water Mist Systems

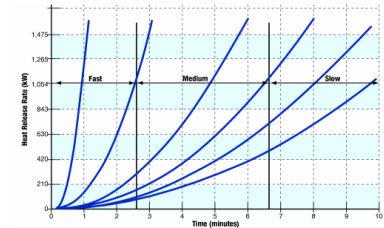
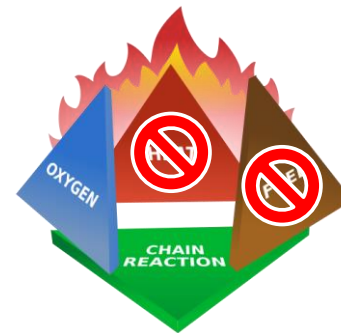
Extinguishing

- Class B & K
- Hydro-Carbon, high heat release
- Global/local oxygen displacement
- Flame cooling
- Radiant heat blocking
- Alternative to traditional sprinklers and gaseous suppression/CO2



Control

- Class A
- Ordinary combustibles, low heat release
- Flame / smoke cooling
- Radiant heat blocking
- Pre-wetting combustibles
- Alternative to traditional sprinklers



Protocols

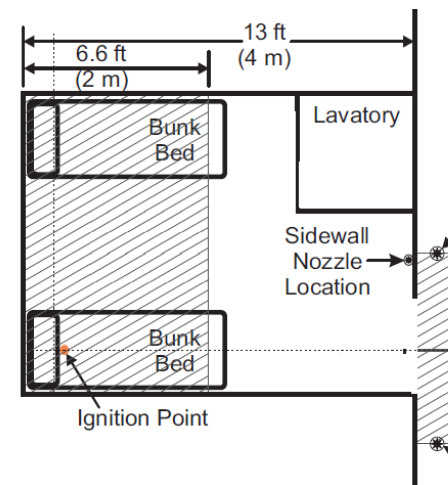
Approval Standard for Water Mist Systems

- FM Global Class Number 5560
- Appendix G: Fire tests for Water Mist Systems for the protection of non-storage occupancies, hazard category 1 (HC-1) formerly Light Hazard occupancies

- a) The maximum gas temperature over ignition 76 mm below the ceiling shall not exceed 316°C;
- b) The maximum ceiling surface temperature over ignition shall not exceed 260°C.

Damage lower bunk bed 40% by volume or dry weight

Two approval options: Restricted and unrestricted. Unrestricted approval is NOT valid for sidewall as such only two of the 5 tests needs to be conducted. These are the small (with bunk beds) and large compartment (with corner crib) tests.



Water Mist nozzles for fire protection service



- UL 2167
- 44 Residential Area Fire Tests

water mist nozzles intended for use in dwelling units shall limit temperatures as specified in (a) – (d) and operate no more than one nozzle.

- The maximum temperature 76 mm below the ceiling shall not exceed 316°C;
- The maximum temperature at the location 1.6 m above the floor shall not exceed 93°C;
- The temperature at the location described in (b) shall not exceed 54°C for more than any continuous 2-minute period; and
- The maximum ceiling material temperature 6 mm behind the finished ceiling surface directly over the center of the wood crib shall not exceed 260°C.



Fixed fire protection systems – Industrial and commercial Watermist systems



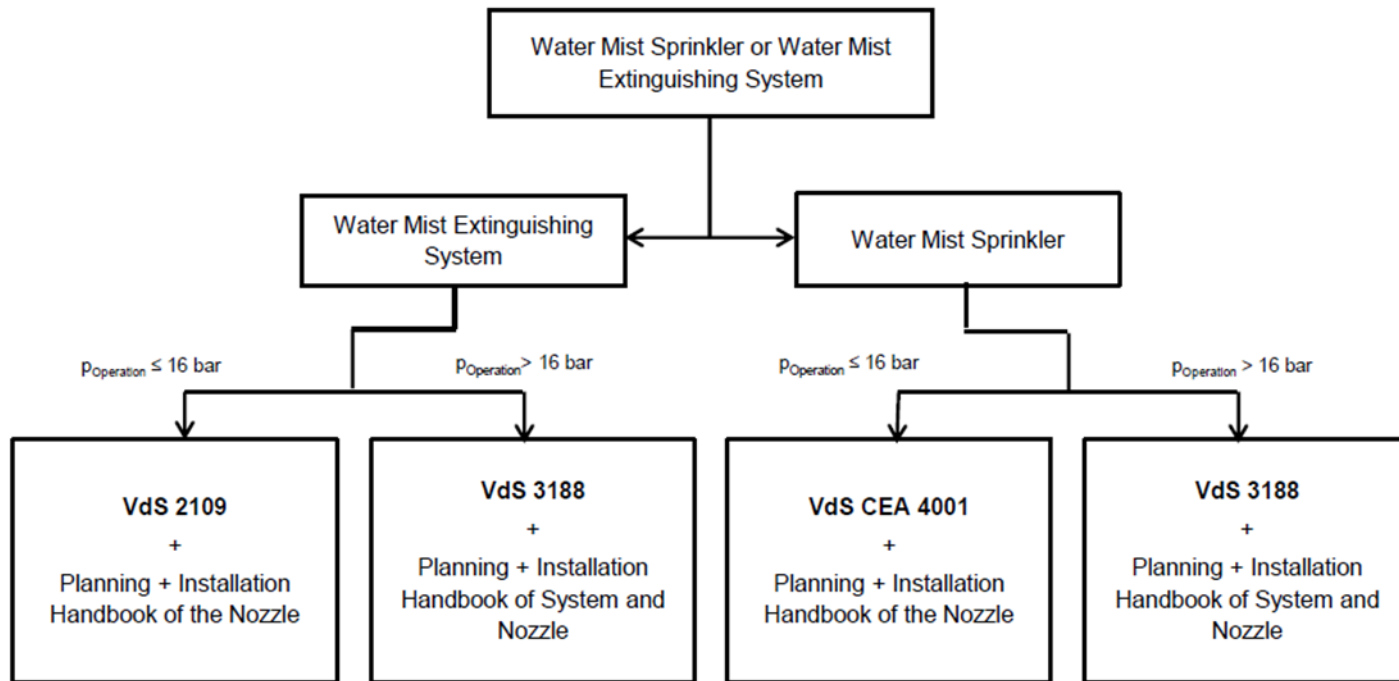
- **BS 8489-7**
- Part 7: Fire performance tests and requirements for Watermist systems for the protection of low hazard occupancies

The low hazard occupancy tests comprise small, large and open compartments, plus open plan office simulations. The water mist system needs to pass all the tests for the category(ies) for which it is to be used.





Guidelines for Water Mist at VdS



VdS Fire Test Protocol for Water Mist Sidewall Sprinkler Systems

Protection of Office Spaces and Accommodation Areas with Water Mist Sidewall Sprinklers – 04/2016

- offices
- public areas of low fire load
- hotel rooms
- rooms in hospitals, care homes, senior citizens residences
- schools and other educational establishments
- flats
- accommodation areas
- as well as any other comparable risk



Only water mist sidewall sprinklers of a “quick” response sensitivity shall be used. Water mist sidewall sprinklers are allowed in rooms up to 120 m² if those are separated in a fire-retardant manner. All walls shall be made of non-combustible material.

Sidewall specifications

Target specifications:

- Spacing Width: 4 m
- Spacing Length: 5 m
- Distances to Ceiling: 101.6- 304.8 mm

Including safety factors:

- Fire Test Spacing Width: 4.7 m
- Fire Test Spacing Length: 5.8 m
- Distances to Ceiling: 101.6- 304.8 mm
- Min. Nozzle Pressure: 10% below manufacturer's instruction

Increases the density by 45%
of the tested amount



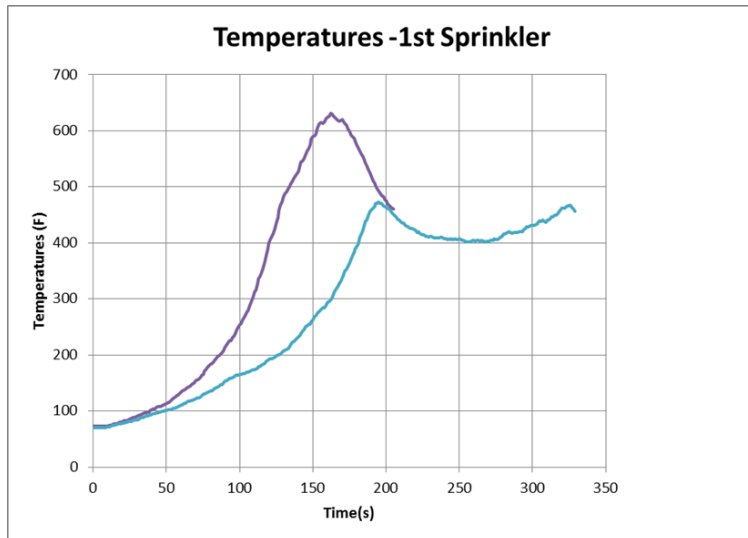
Fuel Package in General

■ Free Burn Testing and Results

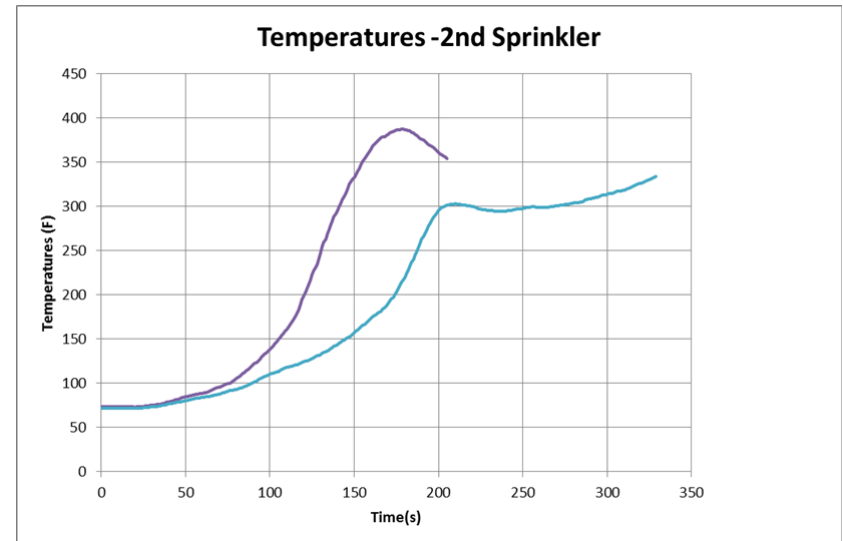
comparison tests were conducted using the plywood and wood cribs from the different suppliers. In the fire test, plywood panels (identical to those that support the foam) were put in their normal location in order to minimize any changes to the dynamics of the fire corner.

	Test 1	Test 2
Test date	5/9/2017	5/9/2017
Test time	10:36:35 AM	1:44:50 PM
Starting ambient room temperature	70°F	72°F
Supplier of plywood and crib stick	Supplier X	Supplier Y
Crib starting weight	6.54 lbs.	6.55 lbs.
Test duration	329 seconds	205 seconds
Termination trigger	500°F in ceiling tile	500°F in ceiling tile

Temperatures versus Time



1st sprinkler thermocouple temperatures at 3" from ceiling



2nd sprinkler thermocouple temperatures at 3" from ceiling

As can be seen in the figures above, the fire using **Supplier Y** materials resulted in a faster rise in room temperatures.

Side by Side of the two tests



Figure 18: Fire video comparisons 1 minute into tests



Figure 19: Fire video comparisons 1.5 minutes into tests

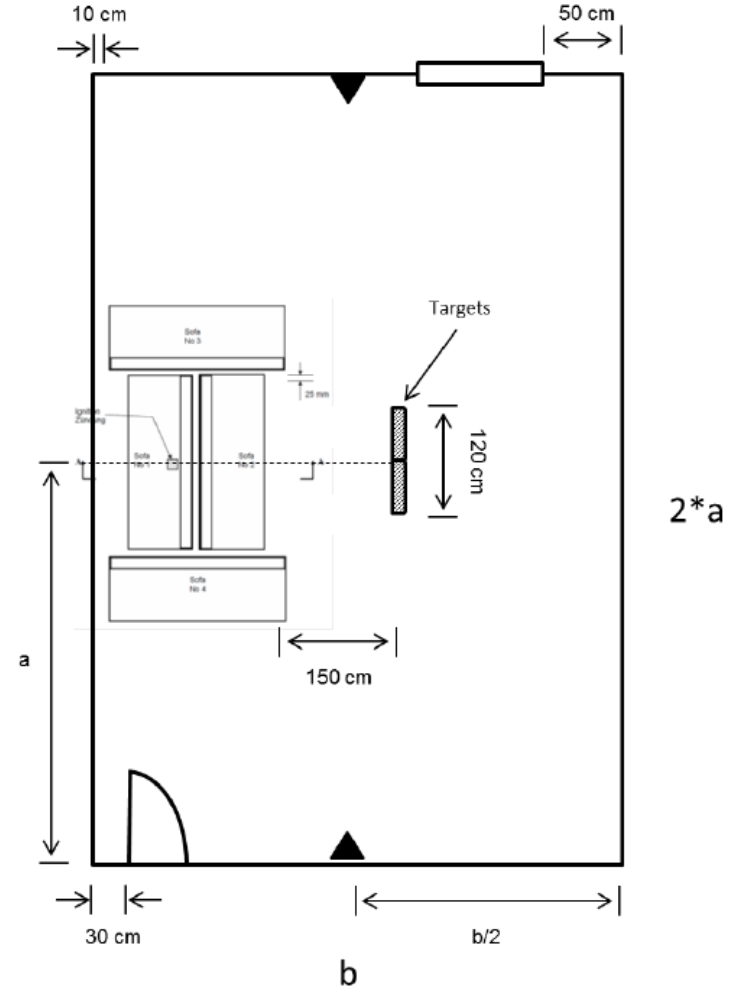
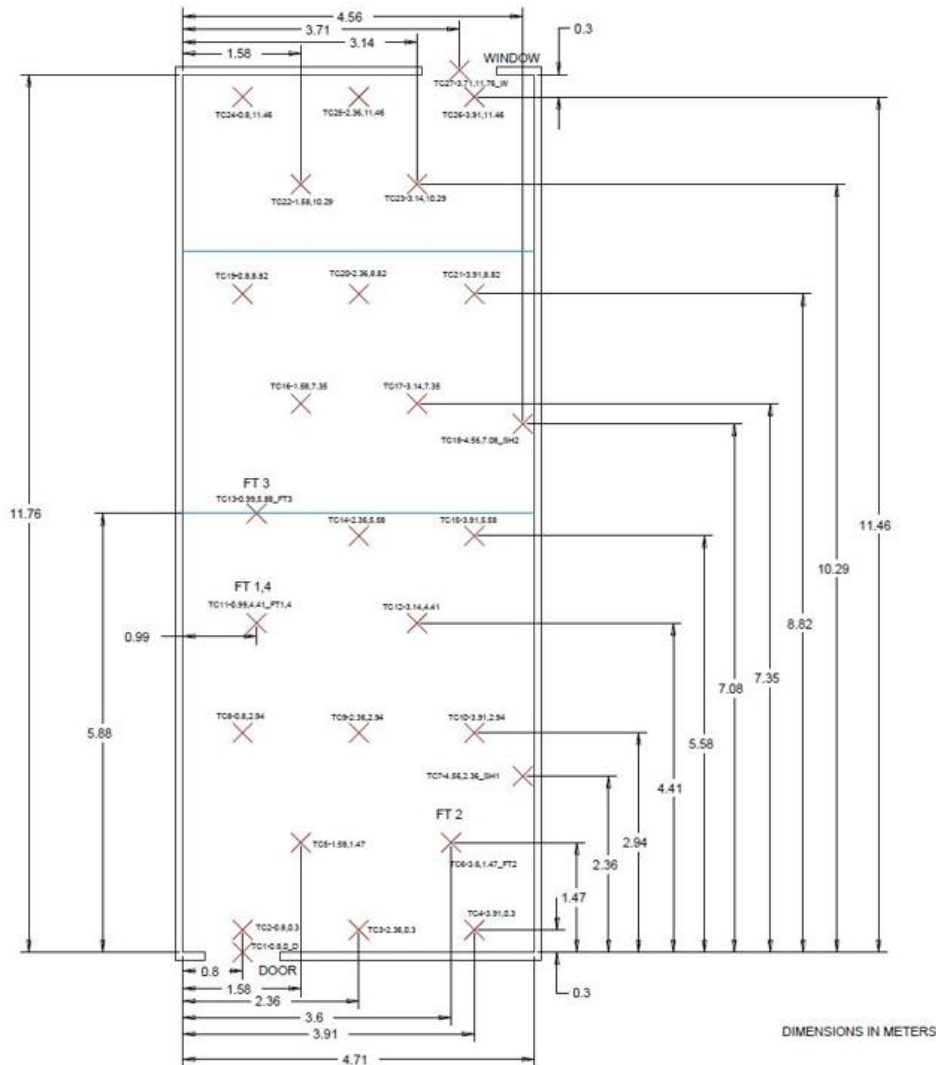


Figure 20: Fire video comparisons 2 minutes into tests



Figure 21: Fire video comparisons 2.5 minutes into tests

Test set up



Passing Criteria

As laid out in the VdS protocol, the test was considered a pass if the following conditions are met:

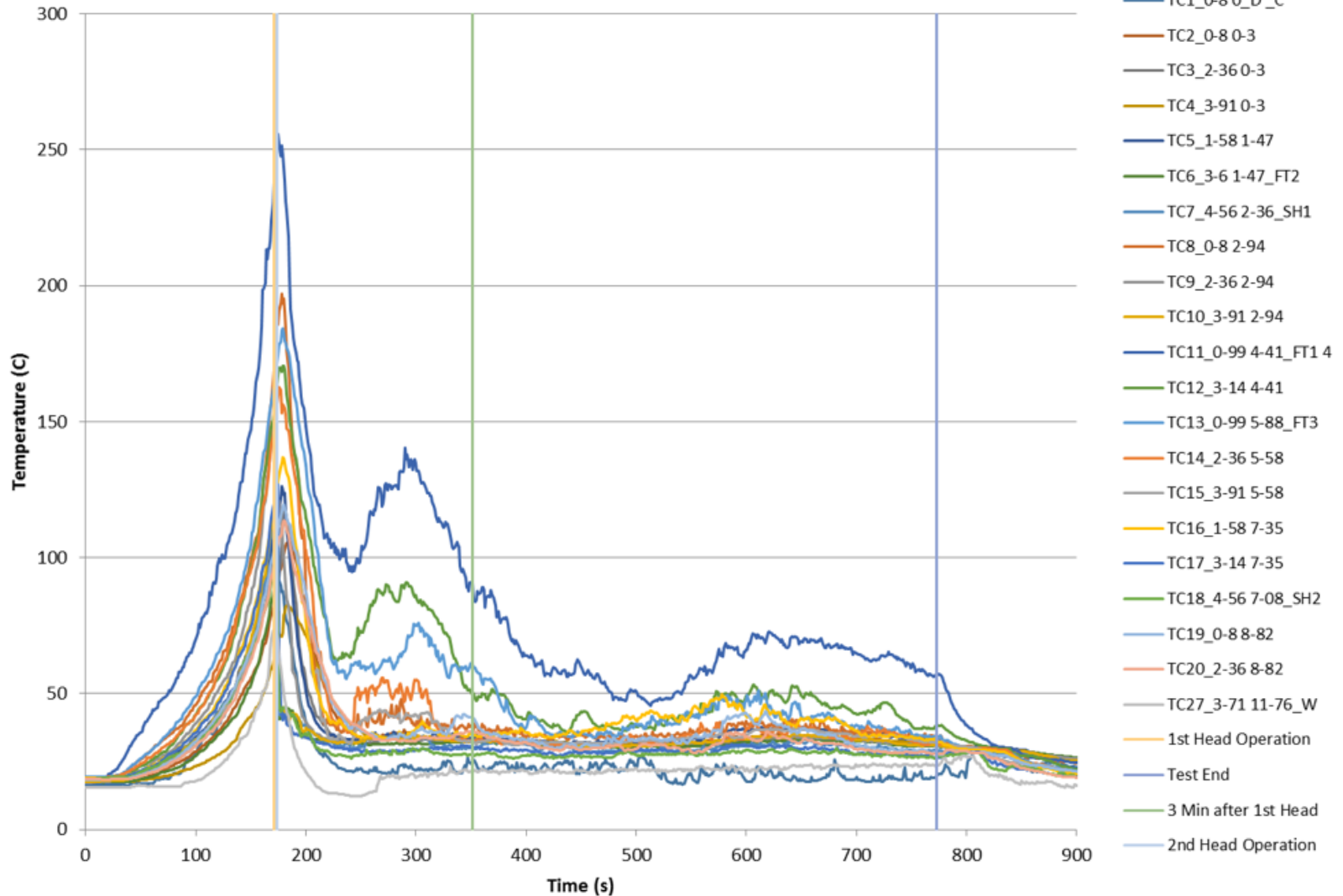
- The fire loss of all mattresses amounts to a total of $\leq 40\%$ by surface area.
- All temperatures do not exceed 100°C , 3 minutes after the release of the first water mist nozzle.
- No damage has occurred to the targets.

Required Test Number (corresponds to section 10)	Date	Scenario	Intended Pressure (bar)	1 st Nozzle Activation Time (s)	2 nd Nozzle Activation Time (s)	Percent Damage	Temperature Graph Figure Number	Pressure Graph Figure Number	Average Test Pressure (bar)	Average Test Water Flow (lpm)
3	4/16/18 AM	3	6.89	165	176	26.61	Figure 19	Figure 20	6.83 ¹ 6.88 ²	133 ³

Test Scenario 3



Scenario 3: Room Ceiling Temperatures °C



Approved Nozzles

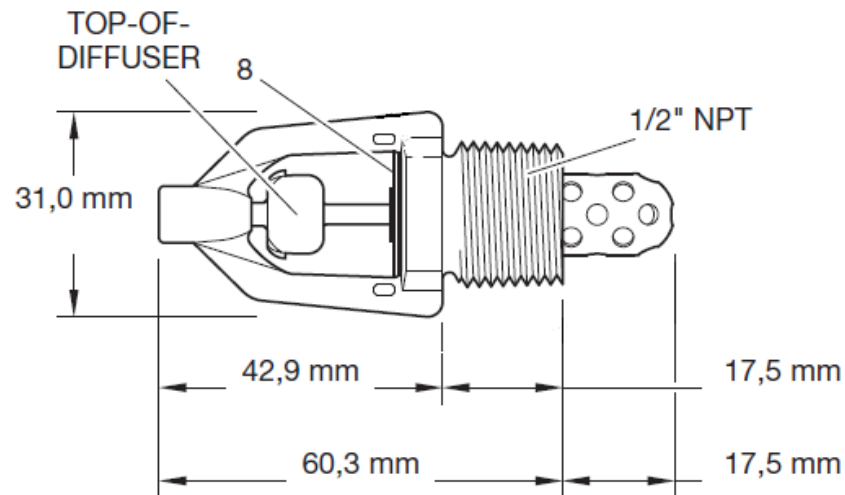
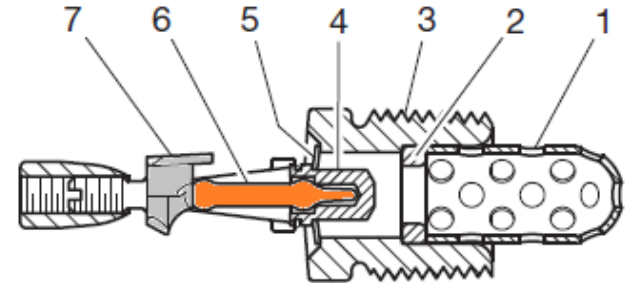
ULF AM34 Horizontal Sidewall Nozzle



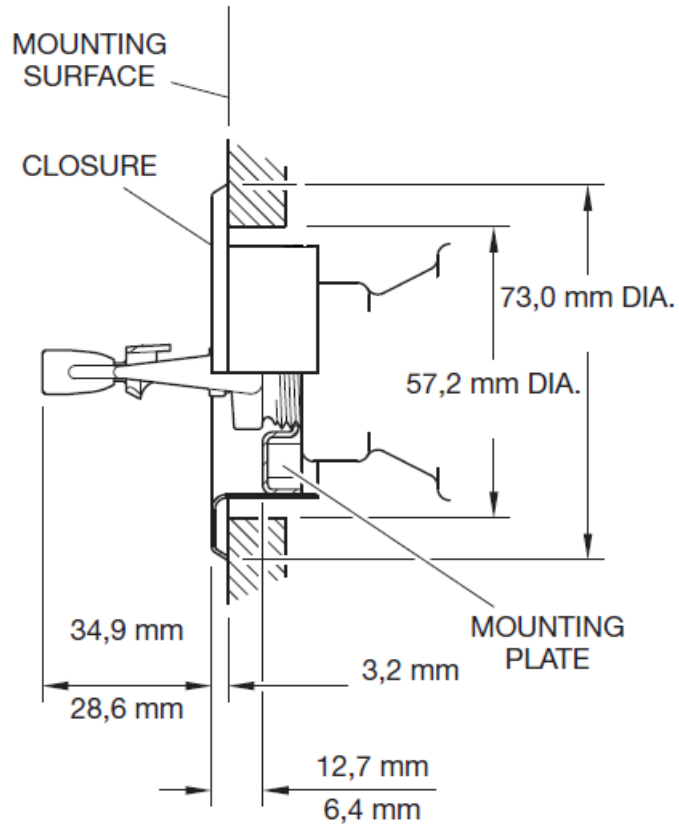
- Spacing Width: 4 m
- Spacing Length: 5 m
- Distance to Ceiling: 101.6- 304.8 mm
- K-Factor: 25.9 LPM/bar^{1/2}

Components:

- 1 - Strainer
- 2 - Orifice Insert
- 3 - Frame
- 4 - Button
- 5 - Sealing Assembly
- 6 - Bulb
- 7 - Diffuser
- 8 - Ejection Spring

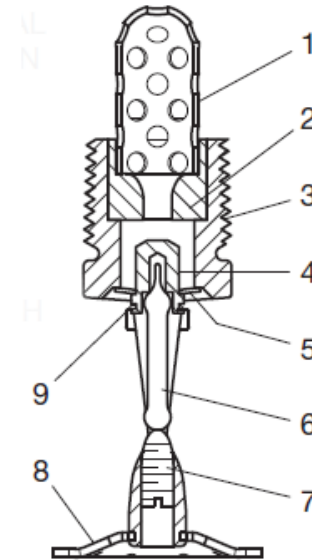
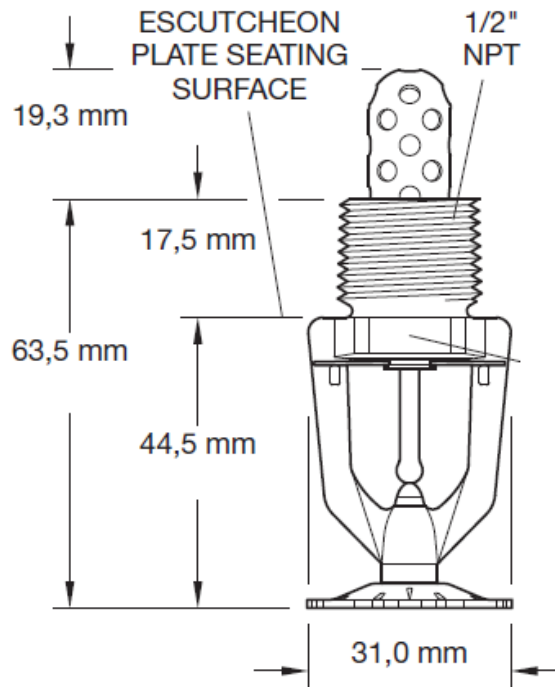


ULF AM34 Horizontal Sidewall Nozzle



ULF AM28 Pendent Nozzle

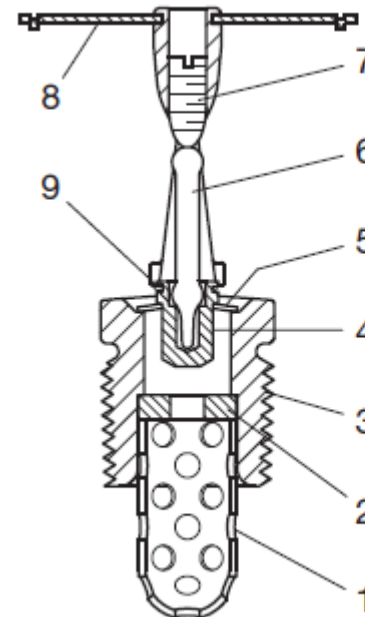
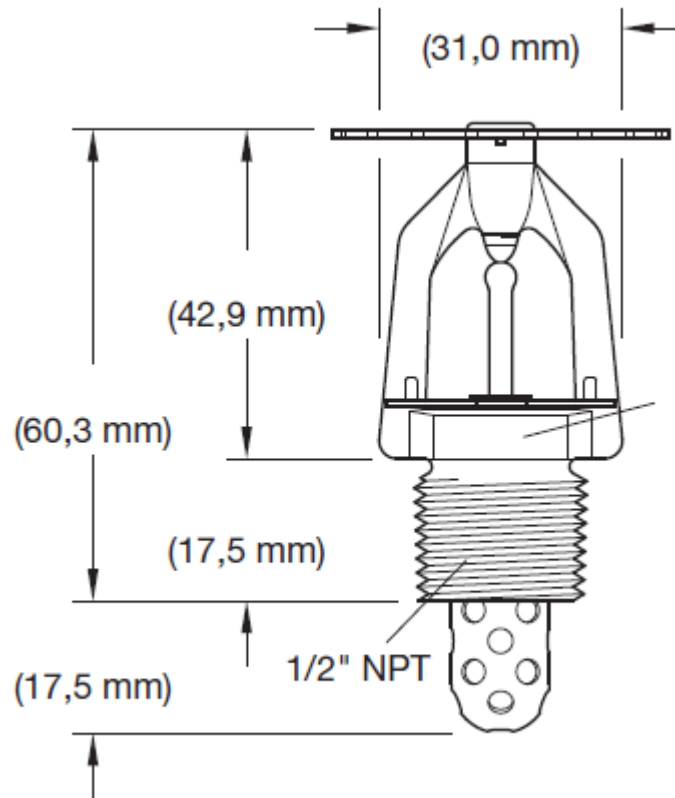
- Spacing 3,5m x 3,5m (offices)
- Spacing 3,0m x 3,0m (accommodations)
- K-Factor: 11.7 LPM/bar^{1/2}



- Components:
- 1 - Strainer
 - 2 - Orifice Insert
 - 3 - Frame
 - 4 - Button
 - 5 - Sealing Assembly
 - 6 - Bulb
 - 7 - Loading Screw
 - 8 - Diffuser
 - 9 - Ejection Spring

ULF AM30 Upright Nozzle

- Spacing 3,75m x 3,75m
- Diffuser to ceiling distance 25 – 76 mm
- K-Factor: 11.7 LPM/bar^{1/2}



- Components:
- 1 - Strainer
 - 2 - Orifice Insert
 - 3 - Frame
 - 4 - Button
 - 5 - Sealing Assembly
 - 6 - Bulb
 - 7 - Loading Screw
 - 8 - Diffuser
 - 9 - Ejection Spring

Conclusion





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