Watermist – State of the Art Technology

IWMA Seminar

19th January 2014

Dubai, UAE

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Agenda:

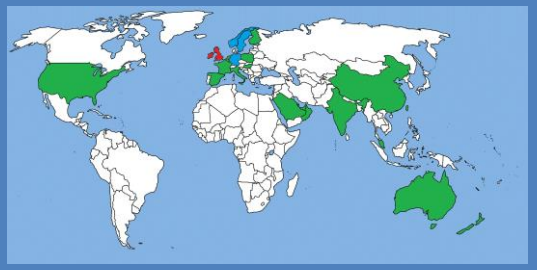
1) Introduction to VID Fire-Kill.
2) What is a fire.
3) What is Watermist and how does it fight fires.
4) How to accept Watermist and where can it then be applied.
5) Some Watermist Benefits and Limitations.

1. VID Fire-Kill

In-house Production and Testing

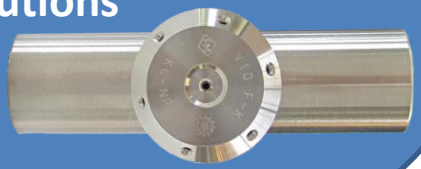
Covering most applications found on - and offshore

World wide Player



Low Pressure, low flow

Environmentally friendly solutions



Smart Designs

Tested and Approved

DNV

Lloyd's Register

ISO 9001 Management System Certification BUREAU VERITAS Certification Denmark A/S

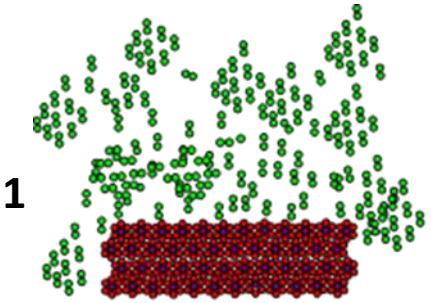
FM APPROVED

CE Ex II 3G/D nA T4

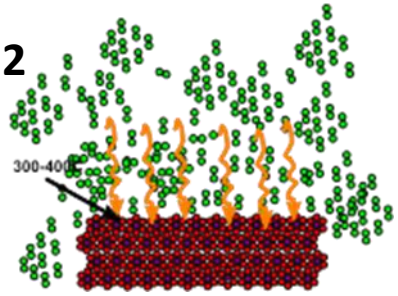
2. What is a Fire?

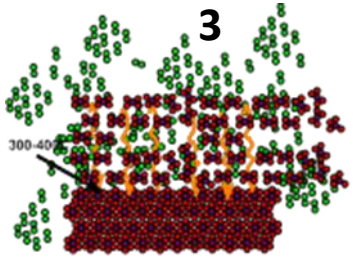
Air: 21% O_2+78,8% N_2 + ?

Fuels: Carbon + Hydrogen + ?



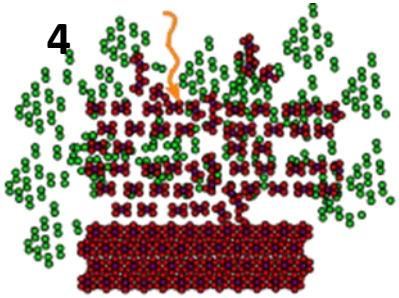
Energy to
Fuel (heat)



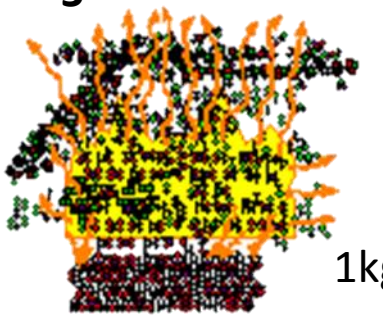


Pyrolysis process
Fuel => Pyrolysis gasses
Example: CH_4

Energy to
Pyrolysis gas +
Atmosphere =>
Oxidation process



Fire ignition



Fire example:

CH_4+2O_2

$=>2H_2O+CO_2$ + **E**

1kg O_2 => 13.000.000 joule

1. Pyrolysis gasses are created.
2. Oxidation process happens.
3. Energy is released (seen as flames).

As more heat will create more pyrolysis gasses,
A fire will grow exponential until there is no more O2 or fuel.
This creates the big risk of fat fire spread (flashover).

3. What is Watermist and how does it fight fires?

Watermist consist of small water droplets. Water is:

H(1)

O (16) **Mole**

H (1) 18g

- Water = Liquid H_2O
- 1 mole Water Vo=18 ml
- Steam = Gas H_2O
- 1 mole steam V_o =0,0224m³ (0°C, 1 bar) = 22,4l steam

Phase change

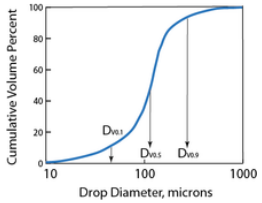
1mole Water + 47000 Joule

=> 1mole Steam

What is watermist?

NFPA

By definition, water mist is a water spray for which the 99% of the total volume of liquid (Dv0.99) is in droplets of diameter smaller than 1000 microns at the minimum design operating pressure of the water mist nozzle.



Europe

By definition, water mist is a water spray for which the 90% of the total volume of liquid (Dv0.90) is in droplets of diameter smaller than 1000 microns at the minimum design operating pressure of the water mist nozzle.

Watermist can perhaps also be seen as a way to develop new optimized products without having to follow existing product approval standards. E.g. minimum requirements for sprinkler orifices and water density inhibits sprinkler to use less water.

How is watermist created?

The small droplets are created with specially designed nozzles at a certain water pressure. Nozzles exist in many forms:

Automatic Nozzle (glassbulb type)

Open Nozzle (deluge type)

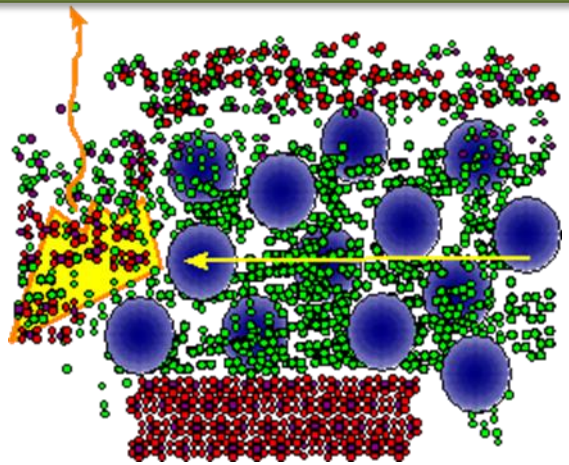
Special Nozzle (pop-up type)

However the Water pressure and droplets size alone does not determine the performance of a watermist system, only fire – and component tests does.

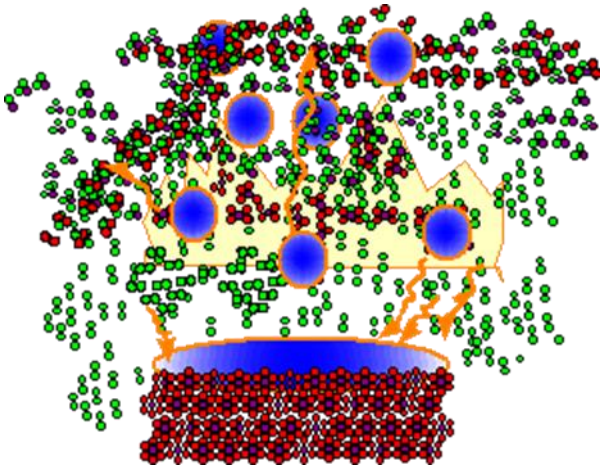
How does watermist fight fires?

Focus on pyrolysis process

Blow away pyrolysis gasses => **blow fire out**

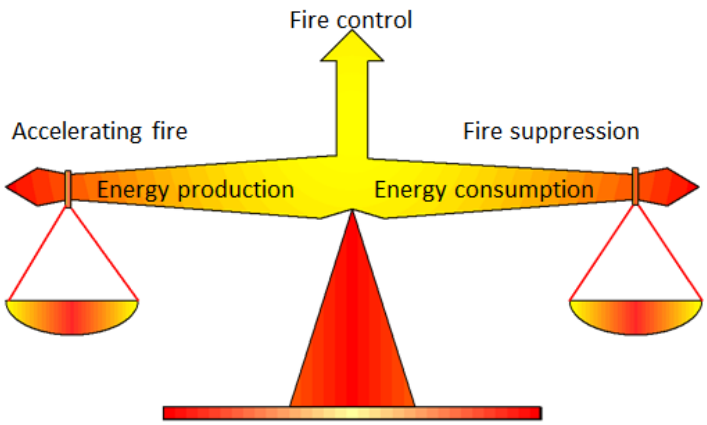


Cooling fuel => **reducing the pyrolysis gas production**

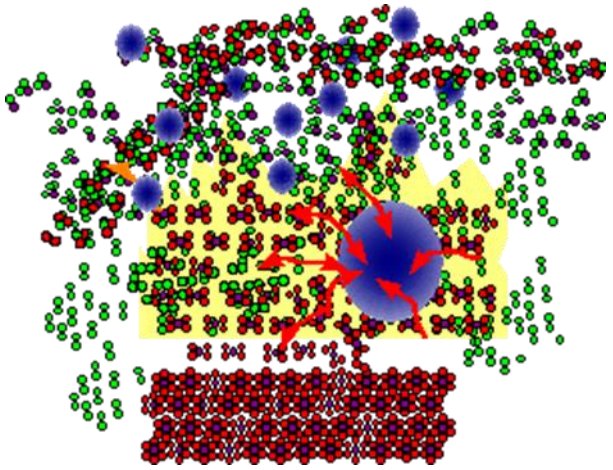


How is does watermist fight fires?

Focus on oxidation process



Cooling oxidation process => **slow down process**



Reduce oxygen concentration => **reduce heat output**

Inert gasses from fires

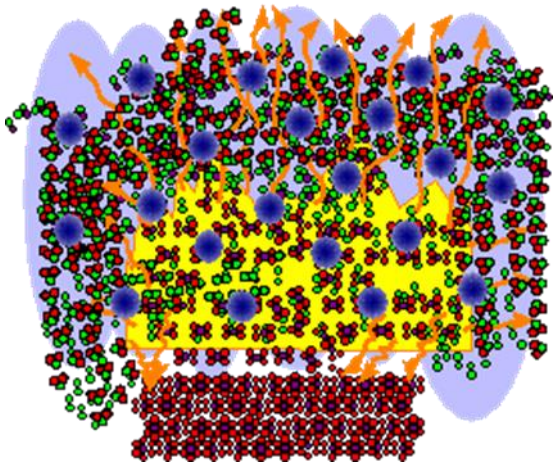
Oxidation processes connects atm.oxygen to hydrogen and carbon from fuel, nitrogen remains in atmosphere => CO2, H2O (combustion) + N_2

+

Water Steam (inert gas)

=

Inert gasses reduces O_2 % in the vicinity of oxidation processes. => **making it harder for the oxidation process to run**



Watermist on fires

Water mist spray primarily fight fires by cooling chemical processes and inerting ambients of oxidation processes.

=>

1. Water mist is **most** effective in locations with
    1. Large fires => large steam production
    2. High heat => Large steam production & little steam condensation
    3. Enclosures => Reduced oxygen supply => fast oxygen depletion
    4. Little ventilation => increased oxygen depletion effect.

2. Water mist spray **primarily** fights fires by
    1. Cooling pyrolysis processes
    2. Inerting ambients where the oxidation processes occur.

3. Water Mist sprays **may** in some situations be applied to blow fires out.

4. How to accept Watermist and where can it then be applied.

Notifying Body Approval / Official Approval.

Examples

- FM5560: US light Hazard (EU OH1), machinery rooms/tubines,
- UL2167: Residential areas, LH, OH1.
- VDS: Hotels, Offices, car parks, cable tunnels,
- LPS1283: Hotel, offices.
- CEN/TS14972 annex A: Offices, atriums, cable tunnels, fat fryers.
- Etc.

Testing to an application.

Examples

- CEN/TS 14972 Appendix B.
- Fire test ”demonstrations”

Example - FM5560 ”HC1”

32 component tests

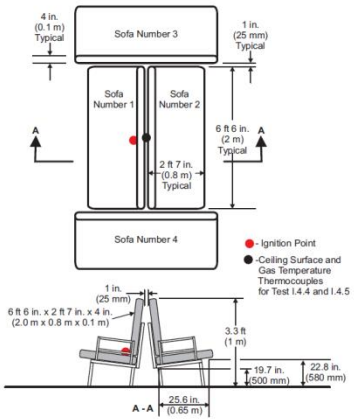
Approval proccess:

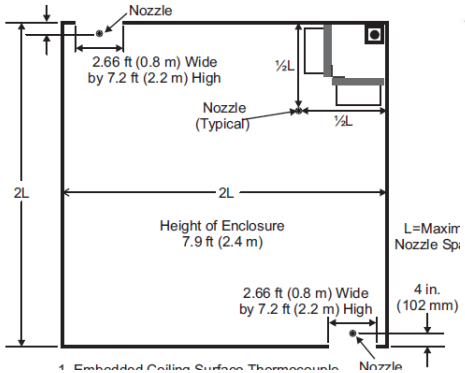
- Fire tests
- Component tests
- Design manual approval
- Production facility approval
- Periodically follow-up (4 times per year)

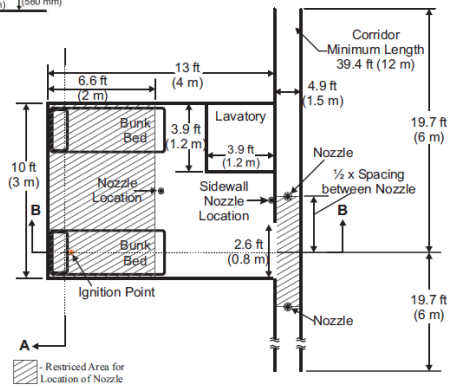
Limitations:

-5m ceiling height.
-Pendent automatic nozzle
-Sidewall only for small compartments.
-flat ceilings (less than 8.3%)

5 fires tests







Example - FM5560 ”HC1”

Scope (well defined):

- Apartments
- Atriums
- Churches
- Concealed spaces
- Gymnasiums
- Hospitals and hospital laboratories*
- Hotel rooms
- Institutions
- Kitchens
- Libraries*
- Meeting rooms in convention centers and hotels
- Metalworking shops with nonhydraulic cutting operations
- Mineral processing such as: glass, cement, ore treating, gypsum processing, etc.
- Museums
- Nursing or convalescent homes
- Offices
- Restaurant seating areas
- Schools and universities classrooms
- Unused attics

* = additional limitations.

Final proof – an approval certificate:

Example – CEN/TS 14972 annex B

Scope (limited)

The Application / scenario tested.

Verification process:

- Fire tests conducted in ISO17025 acc. test lab
- Production facility shall be ISO9001.
- AHJ often involved from beginning.

Limitations:

The results do only reflect exactly what tested.

21 component tests

1) Operating temperatures
2) Water flow
3) Water distribution
4) Water droplet size
5) Functional tests
6) Strength of nozzle body
7) Strength of release element
8) Leak resistance
9) Heat exposure
10) Thermal shock
11) Stress Corrosion
12) Salt spray corrosion
13) Moist air exposure
14) Water hammer
15) Dynamic heating (RTI, C)
16) Resistance to heat
17) Resistance to
18) Impact Test
19) Lateral discharge test
20) Thirty-day leakage test
21) Vacuum test

Process to develop a fire test standard

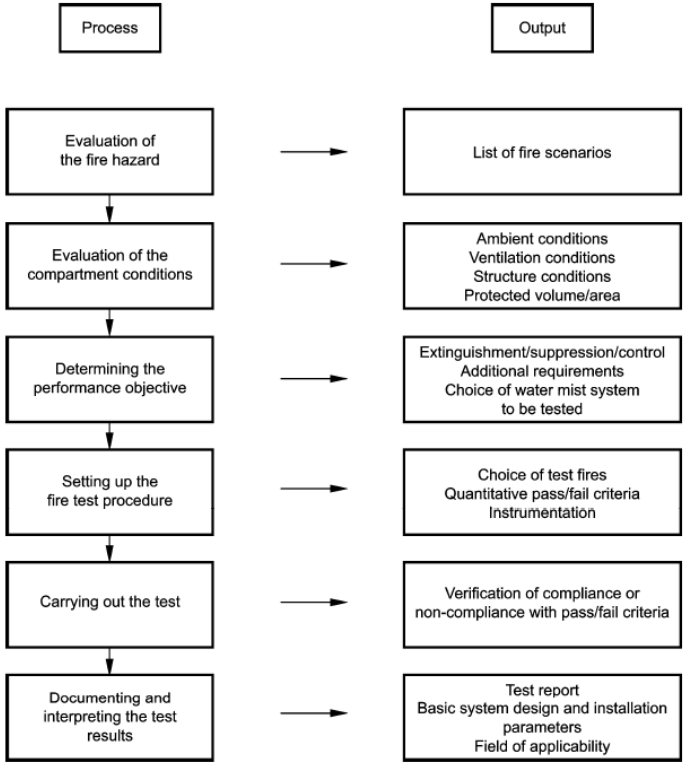


Figure B.1 — Process of developing a fire test procedure

Example – CEN/TS 14972 annex B

Wooden Church, Norway:

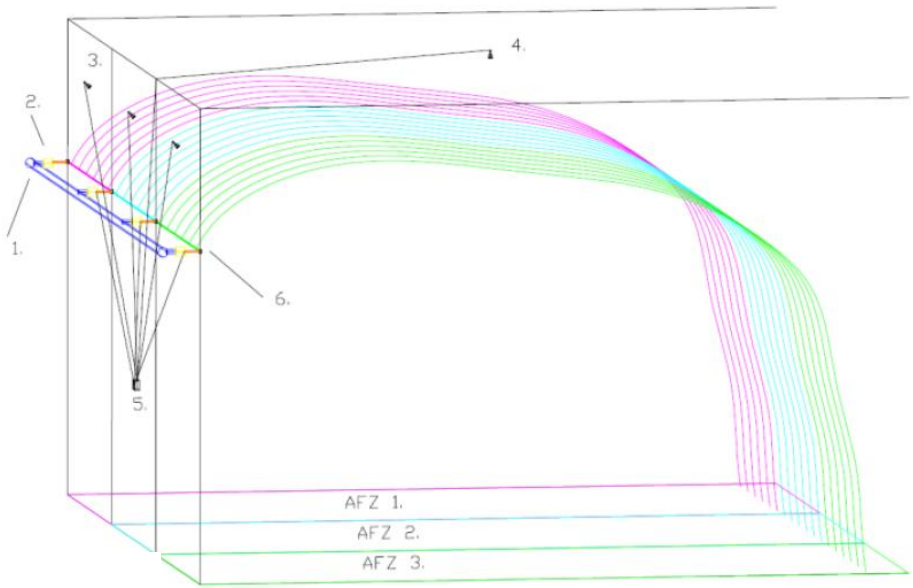
-Large and high open space with low fuel loads (sofas, benches) placed at floor. Fire spread risk high due to all wood.

-Heated and unheated areas with natural ventilation.

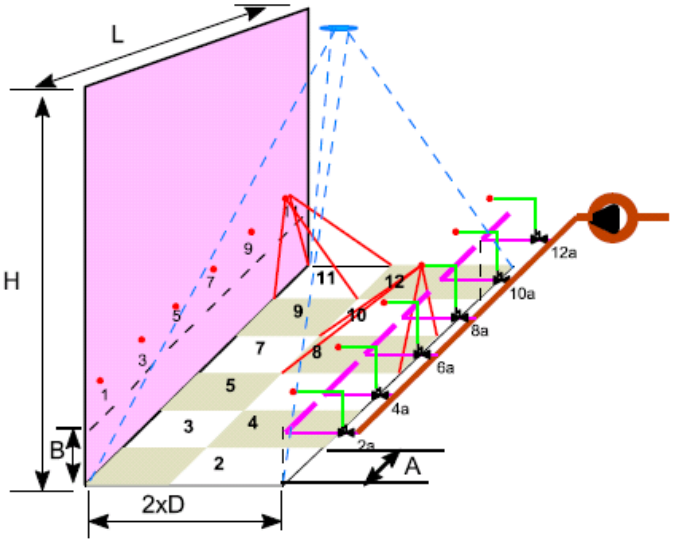
-Ceiling painting not to be destroyed by installation or water spray

-Authority was fire brigade.

System chosen: SPECIAL WATERMIST SYSTEM tested to the application

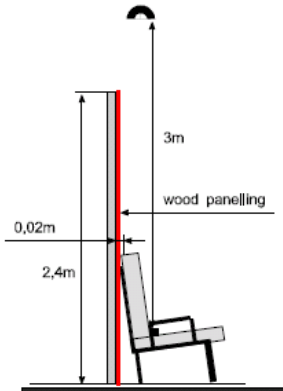


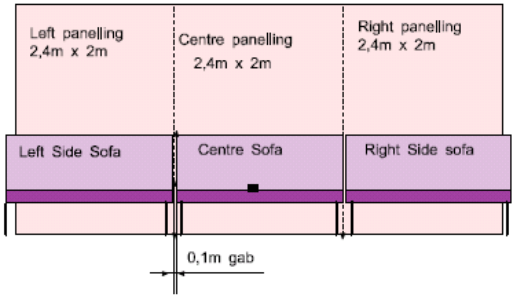
Length (L):	unlimited
Height (H):	unlimited
Width (2xD) Type A	max. 16m
Type B	max. 20m
Type C	max. 26m
Nozzle wall height (B):	3,5m – 7m

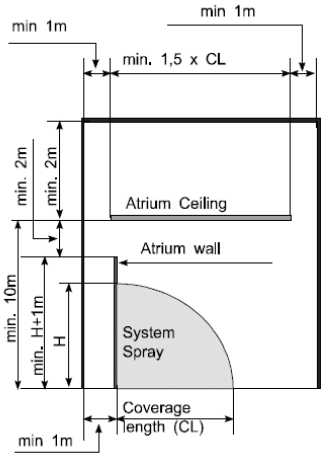


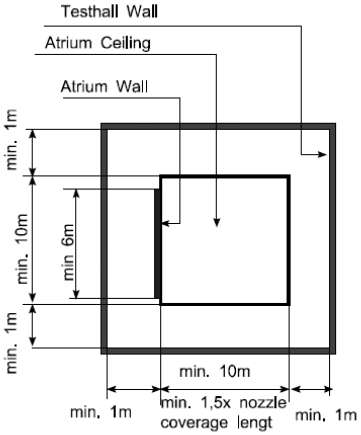
Example – CEN/TS 14972 annex B

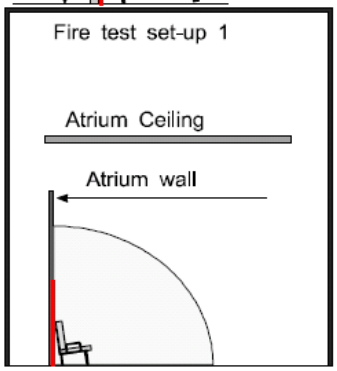
Test scenarios from test method designed in accordance to CEN/TS 14972 Annex B.

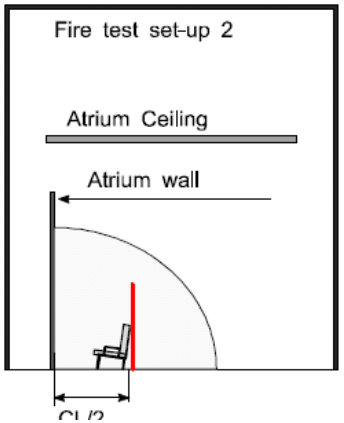


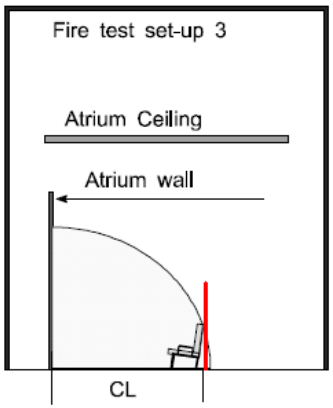












Example – CEN/TS 14972 annex B

Test 1:
No system

Example – CEN/TS 14972 annex B

Test 2:
Sprinkler ref. Test

5 l/min/m2
0,6 bar
3.7m spray

Example – CEN/TS 14972 annex B

Test 3:
WM system:

2 l/min/m2
6 bar
10m spray

Example – CEN/TS 14972 annex B

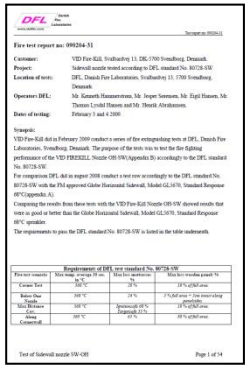
<u>Scope:</u>

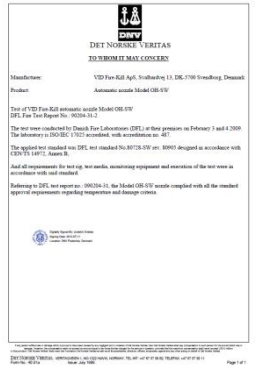
Church main hall floor and wooden walls with no large obstructions hanging in the air and with main fuel load being wooden chairs, benches with upholstery.

<u>Design limitations:</u>

- Horizontal installed zoned deluge system activated with electrical detection system not being slower than 2 min from a 0.25MW fire.
- Installation height: 4 -7m
- Minimum zone size: 13m x Ym
- Minimum zones to activate: 3 (4)

<u>Final proof</u> – a test report and perhaps witness letter:





5. Some Watermist Benefits and Limitations.

Benefits

- Optimization of water use which gives many other benefits such as smaller reservoirs, less water damage, smaller system dimensions, etc.
- Posibility to create ”special” products for the industry which otherwise could not be accepted and used.
- Good fire performance which is proven in actual fire tests.
- Safety factor inbuilt for fires in enclosures – the larger the fire the better the system perform.

Limitations

- Can only be used in applications and scenarios where realistic tested and where approved to.
- More caution is needed when treating the systems as less experience is available.
- Knowledge on test standards, design codes, and system design manuals are needed to work with watermist therefore more time is required to use watermist.

Thank you for your attention.

The full presentation including videos can be requested on sales@vidaps.dk