BRE FIRE CONFERENCE 2015

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Water mist systems as an alternative to sprinklers

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Introduction

1. Fundamentals
2. Standards
   - Design, installation and maintenance
   - Fire performance tests
3. System verification
   - Component examination
4. Summary
Fundamentals
To extinguish a fire:

- Remove heat
- Remove oxygen
- Remove fuel
- Inhibit flame chemistry
Why is water so efficient?

– Water has one of the highest latent heat of vaporisation, 2256 kJ/kg and specific heat capacity, 4.2 kJ/(kg·K)
– Heat transfer for water to steam, 1 litre of water ≈ 2600 kJ
– 1,600 x volume expansion liquid to steam

– 1,900 sprinkler drops (1mm), 1 litre of water or 15 million watermist droplets (50μm)
Why is watermist so efficient?

- Watermist droplets present ≈ 60 times greater surface area
  - results in increased rate of heat absorption & evaporation
- Watermist droplets have significantly increased exposure time in fire/smoke/airflow
  - 1 mm drop falls @ 1.4 m per s
  - 50 μm droplet falls @ 0.3 m per s
Extinguishing systems – flammable liquids (Class B)

- Watermist spray applied onto potential large flaming fire hazards in small enclosures
  - Rapid droplet evaporation
    - Heat removal (flame, fuel), radiation barrier
  - Rapid water vapour production
    - Oxygen displacement by steam
  - Sustained attack
    - Droplets contained and recirculated
    - Oxygen consumed by fire
    - Some fuel wetting
    - Momentum into/across flames

- Examples, Engine rooms, Deep fat fryers (where spray envelope creates a quasi small room)
Watermist Challenges

- Indirect spray – reduced water penetration into fire & fuel, wetting solid combustibles, wetting fuel
- Ventilation and buoyancy induced flows
- Reduced momentum, decrease drop size, increases influence by other flows
Suppression systems - solid combustibles (Class A fires) e.g. office, residential

- Volume protection by ceiling mounted automatic nozzles
- Works by inhibiting fire spread (heat transfer, radiation barrier, near flame water vapour), extinguishment is not generally possible
- Assisted by compartment, closed doors, ventilation off, minimal obstructions
- Challenged by deep-seated fires, obstacles, open spaces, tall ceilings, air flows
Critical design parameters, nozzle spacing and flowrate

- 6.25 m² spacing (5 mm/min)
- 9 m² spacing (3.5 mm/min)
Critical room parameters e.g. large open space vs compartment

- In open
  - 850° C above crib
  - Not control

- In compartment, open door
  - 120° C at ceiling
  - Control

- Nozzle offset from fire 1.8 m, manual extinguishment < 20 mins
Standards
Best practice
Example design

- Nozzle (detector, actuation)
- Pipe
- Pump
- Tank
- Switches
- Control panel
- Alarm
## Standards

- DD 8489 Fixed fire protection systems, commercial and industrial watermist systems – *under revision (BS)*
- DD 8458 Fixed fire protection systems, residential and domestic occupancies – *under revision (BS)*
- LPS 1283 LPCB approval of fixed watermist systems for use in commercial low hazard occupancies within buildings

- FM Approval Standard 5560 – application specific
- NFPA 750 – general
- IMO A.800 - shipboard
- CEN/TS 14972 – not applied in UK
Design, installation and maintenance (DD8489, DD8458)

- General requirements
- Design and installation
  - Scope of application
  - Duration of protection
  - Pipework
  - Alarms
- Components
- Water supply
- Pumps, tanks and cylinders
- Commissioning
- Inspection and maintenance

Watermist system challenges:
- specialist nozzles
- small orifices
- range of pressures

Watermist systems are not interchangeable dependent on
The manufacturer’s design and installation manual
Fire test protocols (DD8489, DD8458)

- No generic design approach – e.g. water flux density covering a range of applications
- Watermist requires application specific fire performance tests
- Standard test protocols
  - Specified system design
  - Particular hazard type
- All tests shall be undertaken with the watermist system components
- Only when an application is not covered by an appropriate standard test protocol, should you need to conduct ad-hoc application specific tests
Fire test protocols, DD8489 – Class B

- Local Applications
- Combustion Turbines & Machine Spaces <80m³
- Industrial Oil Fryers
Fire test protocols, DD8489 – Class A

– Category 3 – 500 MJ/m²
– Category 1 & 2 – 150 MJ/m²
Fire test protocols, DD8458 – Class A

- Fire test protocol based on fire test for residential sprinklers BS 9252
  - e.g. ceiling heights, nozzle locations, additives
- With additional consideration for:
  - fire load positions
  - ventilation conditions
  - ceiling height (optional up to 5m)
System verification
Approvals
Approval methodology

- Approvals are based on evidence
- Compliance with standards
- Assessment of staff, processes and systems
- Periodic audits, including testing as appropriate
- Listing and approval
Watermist approval

- Component tests
- System verification
  - Design methodology assessment
  - Fire performance tests
- Certification assessment
## Component tests

<table>
<thead>
<tr>
<th>Water nozzles</th>
<th>Water pumps</th>
<th>Water strainers and filters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water control valves</td>
<td>Water tank and valves</td>
<td>Water pipe hangers</td>
</tr>
<tr>
<td>Water check valves</td>
<td>Water flow, level pressure switches</td>
<td>Manual release</td>
</tr>
<tr>
<td>Water pipe, fittings and couplings</td>
<td>Water manifold</td>
<td>Water additive</td>
</tr>
</tbody>
</table>

- Examination
- Marking
- Strength test
- Internal pressure test
- Leakage test
- Corrosion tests
- Function tests
- Operation tests
- Long term ageing tests
- Thermal shock test
- Nozzle clogging test
- Pump running test
System verification

- Manufacturer’s watermist system
- Fire test protocols, DD8489, DD8458, other
  - Additional tests for maximum pressure, higher ceiling and ventilation
- Design manuals
- Hydraulic calculations
Certification assessment

- Assessment of performance requirements of components, systems and fire tests against standardised methodologies
- Assessment of quality control, ISO 9001
- On-going assessments of product, system and management through regular Factory Production Control (FPC) and product audits.
Certificate and listing

- Product description
- Scope of application

<table>
<thead>
<tr>
<th>Type</th>
<th>Parameter</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>domestic and residential</td>
<td>Floor area of compartment</td>
<td>32 m² or tested area</td>
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<tr>
<td></td>
<td>Ceiling height</td>
<td>2.5 m or tested height up to 5 m</td>
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<tr>
<td></td>
<td>Ventilation</td>
<td>≤ 1 m³/s total, from any source</td>
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<tr>
<td></td>
<td>Fire load</td>
<td>“Normal” layouts covered</td>
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</table>
Key facts

- Watermist is a complex technology
  - Increased efficiency
  - Increased vulnerability
  - Increased engineering
- No generic system design methodology, all systems are bespoke
- There are critical watermist parameters, e.g. nozzle spacing
- There are critical fire / room parameters, e.g. compartmentation
- There are critical design, installation and maintenance requirements
Summary

- Watermist standard - based on good practice and comprehensive research and testing
- Watermist product testing – based on established protocols and application specific fire test protocols
- Third party approvals - confidence in product and system performance
Thank you

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Watermist office test demo
http://www.youtube.com/user/BREVideoUK#p/u/11/kq8N-9TaoZc