FM Approvals & Water Mist Systems

Paul Bardsley – Engineer, FM Approvals
• Introduction to FM Global

• Introduction to FM Approvals

• FM 5560 - Water Mist Systems
Who are FM Global?

- The largest industrial and commercial insurance company in the world.
- $5+ billion in annual premiums
- $6+ billion in reserves
- No outstanding debt
• Mutual ownership company
• Financially very strong (top 500 of Fortune 1000)
• Possess significant underwriting expertise
• Integrate engineering & insurance underwriting
• A genuine belief that all loss is preventable
• Possess an extensive global client base
• Global bet on FM Approvals’ engineering
FM Global Clients

- PEPSICO
- CATERPILLAR®
- EMERSON
- BMW
- Johnson & Johnson
- BOEING
- Intel
- GE
- Infineon Technologies
- ASML
- Danone
Over 110 Countries Represented
Over 133,000 insured locations
1871 Engineers
60,000 Annual Visits
Presentation Outline

• Introduction to FM Global

• Introduction to FM Approvals

• FM 5560 - Water Mist Systems
Introduction to FM Approvals

Member of the FM Global Group
FM Approvals approves and certifies products and services with unique focus on:

Objectively testing property loss prevention products and services and certifying those that meet rigorous loss prevention standards;

Encouraging the development and use of Approved products and services that improve and advance property loss prevention practices.
Put another way...

– FM Approvals conducts tests on property loss prevention products and services,

– the requirements that are applied are described in rigorous loss prevention standards which have been written by FM Approvals,

– the requirements in the standards are established from data and evidence collected through the research activities of FM Global.
An FM Approved product has achieved certain minimum levels of performance against a defined series of requirements.

FM Approved products are the ‘building blocks’ that can be used by FM Global and others to ensure loss prevention.

Once the risk has been identified and fully understood, FM Approved products can be used, together with the appropriate installation standards to protect property.
– What you are about to see is a FM Global research project looking at how much water is needed to control and extinguish a fire in a rack storage system of cardboard boxes containing expanded plastic food trays.

– You will see a fire introduced in the middle of the boxes and once the temperature at the ceiling level has achieved the required trigger temperature, water heads will be released at a known delivery rate.
Watch the colour of the smoke drawn into the 20 Mega Watt Calorimeter.

The fire will trigger the ceiling mounted extinguishing system which will deliver a constant 20 litres per minute per square metre.

There are 24 x1m$^3$ boxes, arranged in the racking in two rows.
– The water that was delivered was not enough to control or extinguish the fire.

– With this arrangement, there is a very high probability that the building and contents would have been destroyed.

– Can FM Approvals certify anything?

No!
What can Approvals do?

– After hundreds of these tests, run with different configurations and arrangements, the research tests will have established how much water is required to control and to extinguish the fire.

– When used with the correct installation standards, the combined effect of the FM Approved product and FM Global’s research knowledge, the property & commodity is protected.
In June 1897, the Inspection Department of the Associated Factory Mutual Fire Insurance Companies Approved its first Electrical Fittings.
FM Approvals in Europe

• Notified Body under Construction Products Directive
• EOTA member for innovative CPD products.
• Notified Body under the ATEX Directive
• IECEx Certification Body
• UKAS Accredited Certification Body
• Member of Standards Committees & Industry Groups
• Undertaking FM Approval projects for US, Canadian, European & International Markets
A look at the history of FM Approvals’ Test Laboratory
Hydraulics Laboratory
Hydraulics Laboratory
FM Approvals ‘Hydraulics’ Products

- Fire pumps,
- Fire pump controllers,
- Diesel engine fire pump drivers,
- Sprinkler system components & extinguishing systems,
- Water mist systems.
FM Approvals’ Offering in Europe
We have a common interest in the performance of the Water Mist System

This is what makes our Approval unique in the marketplace.
• Introduction to FM Global

• Introduction to FM Approvals

• FM 5560 - Water Mist Systems
• Defines the criteria for water mist system performance and test requirements for the FM Approval of land based systems.

• When installed in accordance with the recommendations described in FM Global Data Sheets will provide a ‘Highly Protected Risk’.

• Will be a truly living document which will be refined and expanded as needed for new applications of occupancy protection and for new water mist technology.
FM Global Property Loss Prevention Data Sheet 4-2 provides evaluation and installation criteria for FM Approved Water Mist Systems.
FM Approval requires successful compliance of the overall system operation and reliability against the requirements of FM Standard 5560 including …

– General Requirements,
– Performance Requirements and
– Operational Requirements.
FM Standard 5560 includes specific requirements for the components that make up the Water Mist System including ...

Nozzles; Valves; Gas storage Cylinders; Detection Devices; Fittings & Piping; Hoses; Pneumatic Components; Switches; Tanks and Pumps.
FM Standard 5560: Water Mist Systems

FM Standard 5560 also examines the performance of the system with respect to ...

–Verification of Hydraulic Calculations; Design, Installation,
–Operation and Maintenance Manuals;
–System Acceptance and Commissioning Documents and
–Fire Test Performance.
Occupyancy Protection Applications

1. Machinery Spaces & Special Hazard Machinery Spaces
2. Protection of Combustion Turbines
3. Light Hazard Occupancies
4. Protection of Wet Benches and Other Similar Processing Equipment
5. Local Application
6. Industrial Oil Cookers
7. Protection of Computer Room Sub Floors
1. Machinery & Special Hazard Machinery Spaces

**Machinery Spaces:** Rooms with machinery using fuel or lubrication fluids with volatiles less than or equal to light diesel

**Special Hazard Machinery Spaces:** Rooms with machinery using fuel or lubrication fluids with volatiles less than or equal to Heptane & Storage of less than 110 gallons of flammable liquids
1. Machinery & Special Hazard Machinery Spaces

Fire Test Protocol

- Test protocol is dependent upon the volume of the enclosure;
- Combination of shielded and unshielded spray and pool fires up to 6MW in size;
- Conducted with machinery mockup in place and
- Spay cooling (no fire) test to assess for casing warp
2. Protection of Combustion Turbines

• Total Flooding Application
• Prevent and limit damage from fires internal and external to the turbine
2. Protection of Combustion Turbines

Fire Test Protocol

• Test protocol is dependent upon the volume of the enclosure;
• Combination of shielded and unshielded spray and pool fires;
• Conducted with combustion turbine mockup in place and
• Spay cooling (no fire) test to assess for casing warp
3. Light Hazard Occupancies

- Non-storage and non-manufacturing areas:
- Inappropriate for ordinary hazard occupancies
- Limited Ceiling heights, Water supply conditions & room size.
3. Light Hazard Occupancies

Fire Test Protocol

• Restricted & Unrestricted Ceiling Height Approval
• FM Approved quick response nozzles must be used.
• Nozzles are set at manufacture's maximum spacing
• All fire tests conducted for 10 minutes after the activation of the first nozzle and any remaining fire shall be extinguished manually
Thermal images of Light Hazard Small Compartment fire (first) & Large Compartment fire (second).
4. Wet Benches & Other Similar Equipment

Equipment which consist of ventilated and unventilated compartments, spin rinse dryers, alcohol vapor dryers, chemical and mechanical polishing tools, and step and repeat exposure systems.
4. Wet Benches & Other Similar Equipment

Fire Test Protocol

- Specific FM Approvals simulated clean room and wet bench mock-up
- Water mist system installed as specified by manufacturer
- Air flow of the open face wet bench shall be the maximum specified by the manufacturer
- Subsurface and working surface polypropylene and flammable liquid pool fires
5. Local Application

Protection of Special Hazards and Equipment:

- Paper machines and pulp dryers,
- Dip tanks & coaters,
- Belt Conveyers,
- Waste solvent recovery,
- Mechanical refrigeration.
5. Local Application

Fire Test Protocol

• **Seven test fire scenarios:**
  – Square diesel pool; channel diesel pool; heptane spray; diesel spray and pool; obstructed pool; offset pool & diesel spray with external ignition source

• **Suitable automatic interlocks are required as part of overall system FM Approval, i.e., electrical system shutdown, fuel supply shutoff and ventilation shutdown.**
6. Industrial Oil Cookers

Non-Insulated conveyor fryers & batch kettles where the main hazard is overheating of oil to Actual Ignition Temperature (AIT)
6. Industrial Oil Cookers

Fire Test Protocol

- Mock-up size determined from manufacturers specifications
- Open flames extinguished within one minute from start of discharge
- Water mist cannot cause thermal damage to cooker
Protection of mainframe electronic computer systems and major equipment or process control computer systems located in the sub-floor.
7. Computer Room Sub Floors

Fire Test Protocol

- Three type of Fire Test
- Conducted at maximum nozzle spacing
- Water shall be supplied for at least 10 minutes
FM Standard 5560: Water Mist Systems

General Examination & Performance Tests

• Seat Leakage
• Hydrostatic Strength
• Operating Pressure
• Durability – Cycling
• Extreme Temperatures Operation
• Salt Spray Corrosion (Residue Build-Up)
• Vibration Resistance
• Valve Locking/Supervision Ability
• Friction Loss Determination
• Seals and Gaskets
Water Mist Nozzle Tests

- Assembly Load/Frame Strength
- Strength of Heat Responsive Element
- Leakage
- Hydrostatic Strength
- 30-Day Leakage
- Water Hammer
- Operating Temperature (Liquid Bath)
- Air Bath
- Hang-Up of Operating Parts
- Strength of Deflector (Flow Endurance)
- Vacuum
- High Ambient Temperature Exposure (90 Day Test)
- Thermal Shock (Glass Bulb Nozzles Only)
- Discharge Coefficient, K-Factor
- Moist Air
- Corrosion - Salt Spray
- Corrosion - Stress Cracking
- Corrosion - Carbon Dioxide-Sulfur Dioxide
- Corrosion - Hydrogen Sulfide
- Vibration
- Rough Use and Abuse
- High Temperature Exposure
- Freezing
- Minimum Operating Pressure
- Process Residue
- Conductivity (C-Factor)
- Sensitivity - Response Time Index (RTI)
- Sensitivity (Recessed, Flush, and Concealed Types)
- Sensitivity (Air Oven)
- Water Mist Discharge Characteristics
- Impingement
- Protective Caps

FM Standard 5560: Water Mist Systems
Other Performance Requirements and Examinations

- Complete System Documentation Review
- Hydraulic Calculations Method
- Installation, Operation and Maintenance Manual
- Manufacturing and Production Tests
- Demonstrated Quality Control Program
- Facilities and Procedures Audit (Quality Assurance)
- System Acceptance and Commissioning
- Installation Inspections by FM Global Field Engineers with feedback for continuous improvements
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Thank You

‘Believing that all losses are preventable’