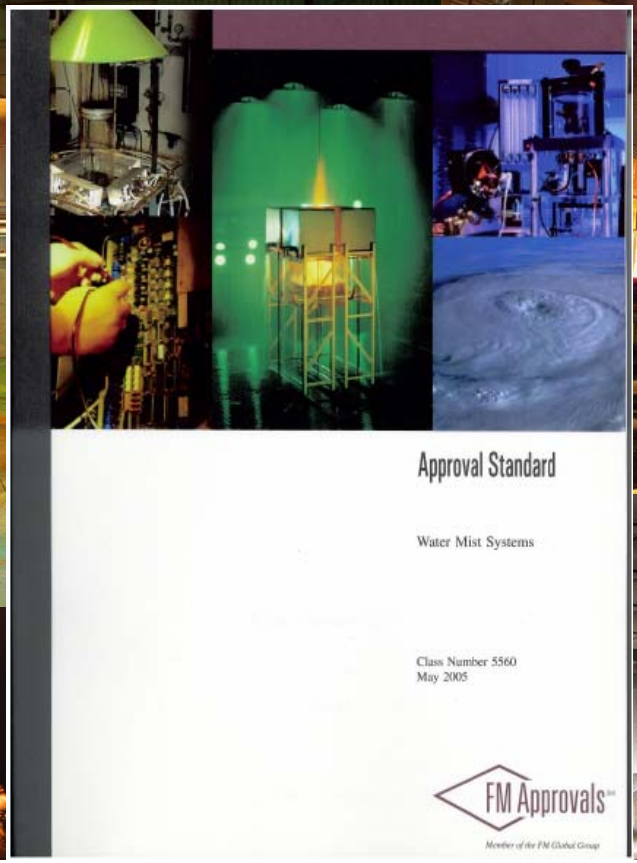
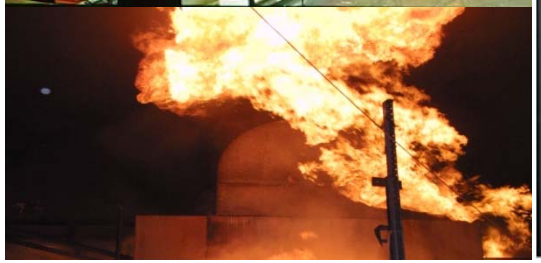
Research Advancements in Certification of Water Mist Systems

FM Approvals





Safety & Security Design in Buildings

Intersec Conference

Dubai Convention Centre Trade Centre 2, Sunday, January 17, 2016

Course Description

Water mist systems are seen more and more commonly as a mean of fire protection method especially for certain specific application. As with other fire protection equipment, it is critical to ensure the reliability and performance of the components as well as the entire system. The presentation aims to discuss how research contributed to the development of the testing regime for water mist systems. In addition, how continuous research increases efficiency on the testing and certification of water mist systems which in turn, help encourage new technologies that promote loss prevention.

Presenter

Paris Stavrianidis

General Manager, FM Approvals

Paris Stavrianidis is general manager of FM Approvals, a member of the FM Global group. He began his career with FM Global as a fire research scientist in 1987. During his tenure with FM Global, Stavrianidis has led as well as participated in several committees for the Instrument Society of America, the National Fire Protection Association, the International Electrotechical Commission (IEC), and the American Society of Mechanical Engineers (ASME). He chaired ASME's Safety Engineering and Risk Analysis Division from 1999 to 2000, and served on the editorial board of the Reliability Engineering and System Safety Journal from 1995 to 1997. He has served on the Board of Directors of the American National Standards Institute (ANSI) and is currently on the Board of directors of the International Fire Sprinkler Association (IFSA), and a member of the United States National Council of IEC. He has authored over 30 research reports and has published 25 technical papers in national and international journals.

Learning Objectives

1. *Understand how water mist systems are tested and certified*
2. *Sharing of technical knowledge in standards development for product testing and certification*
3. *Understand how research contributes to advancements of certification of water mist systems*

The purpose of this presentation is to convey technical knowledge to the conference participants.

The presentation also contains slides with text that summarises the content of the presentation and the main learning objectives.

These may be used to update CPD records for relevant organisations including the Chartered Institute of Building (CIOB).

Since 1886 the FM Approvals' Certification Mark is recognized and accepted in markets throughout the world

Mission Statement

FM Approvals approves and certifies products and services with unique focus on:

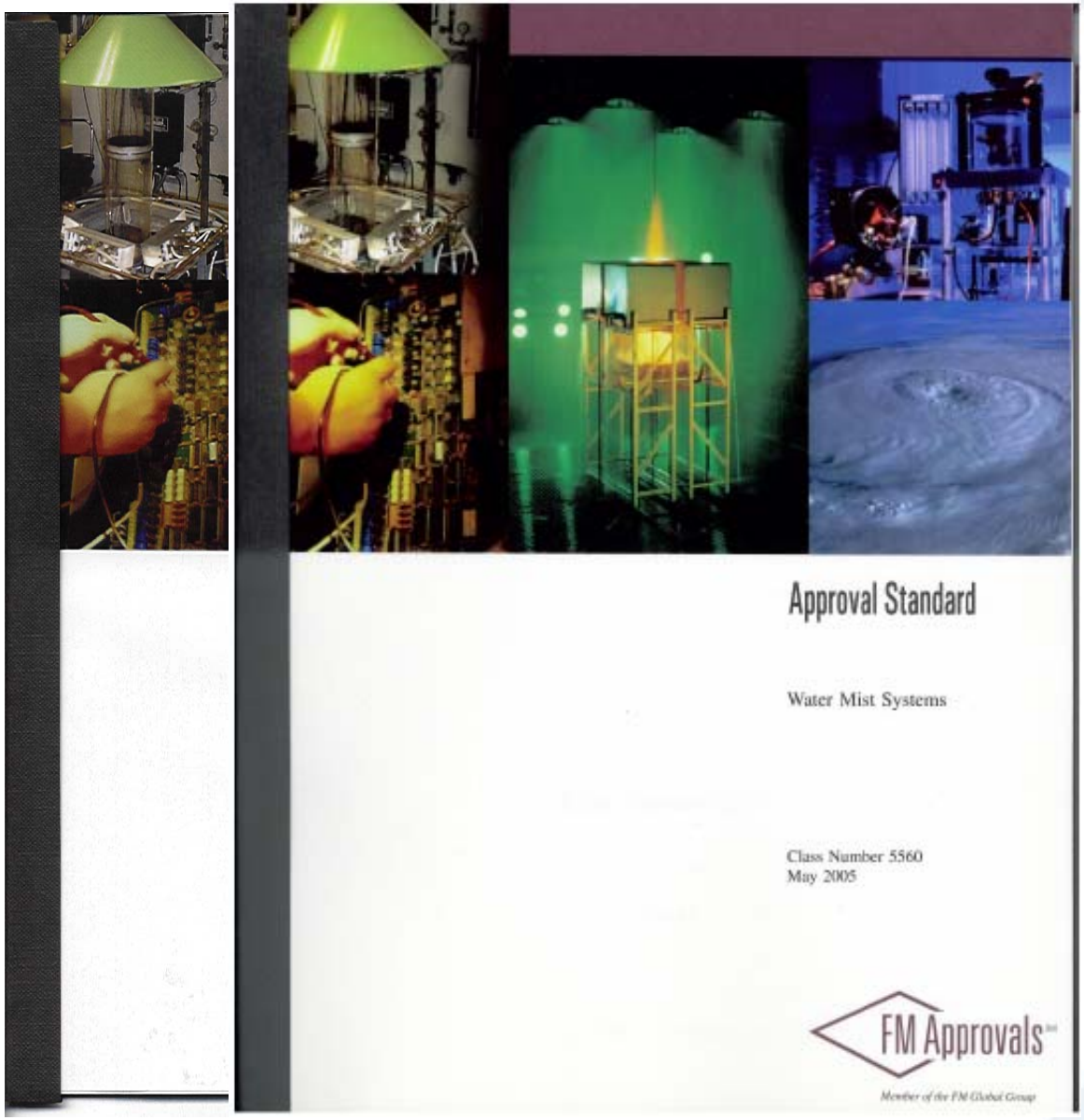
- Objectively testing property loss prevention products and services and certifying those that meet rigorous loss prevention standards;

FOCUSED TESTING AND CERTIFICATION

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

DEPTH OF KNOWLEDGE

Write Product Testing Standard



- Over 210 standards
- Based on Research
- Publicly Available for free through www.fmapprovals.com
- ANSI , OSHA, ASTM, BSI, EN, GB Recognized

Sprinkler System Equipment, General
Deluge Sprinkler Systems
Pre-Action Sprinkler Systems
Refrigerated Area Sprinkler Systems
Limited Water Supply Deluge Sprinkler Systems
Temporary Automatic Sprinkler Systems
Automatic On-Off Multicycle Sprinkler Systems
Automatic Water Control Valves
Dry Pipe Valves
Thermal Control Valves
Accelerators with Built-In Anti-Flooding Device
Accelerators & Exhausters
Air Pressure Maintenance Devices
Anti-Flooding Device
Air Drying Units for Refrigerated Area and Dry Pipe Systems
Excess Pressure Pumps
Waterflow Detector & Excess Pressure Maintenance Device
Alarm Check Valves
Waterflow Detectors (Vane Type)
Testers for Vane Type Waterflow Indicators
Fire Service Meters
Waterflow Detector Check Valves
Fire Pump Flowmeters
Automatic Drip Valves
Water Motor Gongs
Sight Drains
Sprinkler Contractors, General and Misc. Mfrs.
Indicator Posts
Indicator Post Valve Assembly
Indicating Valves
RIMO-Remote Indicating, Manually Operated Sprinkler Control Valves
OS&Y and NRS Gate Valves
Valves, General and Specifications
Valves (Quick Open Type), Ball Valves
NOVA-Normally Open Constant Energy to Close Valve Assembly
Single Check Valves
All Bronze Check Valves
Backflow Preventers - Reduced Pressure Principle Type
Anti-Water Hammer Check Valves
⅛ through1-1/4 in. Trim Check Valves
Centrifugal Fire Pumps, Horizontal Split-Case
Centrifugal Fire Pumps, Vertical Shaft, Turbine Type
Positive Displacement Fire Pumps (Rotary Gear Type)
Limited Service Fire Pumps
Fire Pump Units - Gasoline Engine Driven
Fire Pump Units - Portable
Jockey Pumps
Centrifugal Fire Pumps, End Suction Type
Control Panels For Fire Pumps
Fire Pump Controllers for Electric Motor Drive
Fire Pump Controller Circuit Breakers
Fire Pump Controllers for Diesel Engine Drive
Battery Chargers for Fire Pump Service
Batteries for Internal Combustion Engines
Diesel Engines for Fire Pump Drive
Gasoline Engines
Gas Turbine Engines for Fire Pump Drive
Pump Drive Couplings
Right Angle Gear Drives
Replacement Rubber Discs for Steam Fire Pumps
Air Release Valves
Trim Water Pressure Relief Valves ¼ inch through 2 ½ Inch Nominal Size
Water Pressure Relief Valves
Water Pressure Reducing Valves
Water Pressure Regulating Valves
Surge Dampers (Fire Pumps)
Vortex Inhibitors for Fire Pump Suction Lines
Centrifugal Fire Pumps, Vertical Turbine Barrel Type
Centrifugal Fire Pumps, In-Line
Underwriter Playpipes
Short Playpipes
Monitor Nozzles
Hydrants (Dry Barrel Type) for Private Fire Service
Fire Hydrants (Wet Barrel Type) for Private Fire Service
Hose Manifolds
Hose Valves
Angle Hose Valves
Straightway Hose Valves
Hydrant Valves, Bolted Type
Hose Station Control Valves
Fire Department Connections
Wall Hydrants
Pipe & Fittings & Couplings, Underground, Ductile Iron
Pipe & Fittings, Underground, Asbestos-Cement (AC)
Pipe & Fittings, Underground, Polyvinyl Chloride (PVC)
Pipe & Fittings, Underground, Polyethylene (PE)
Pipe & Fittings, Underground, Fiber-Reinforced Composite (FRP)

Mildew-Proof Treated
Friction Loss
Approved Hose - Mfd. Under Different Trade Names
Chemical Engine Hose
Woven Jacket Lined Fire Hose
Unlined Linen Fire Hose
Hose Couplings
Hose Racks and Reels
Hose Houses & Cabinets
Padlocks for Hose Houses
Air, Steam, & Water Type Gauges
Circular & Strip Chart Pressure Recorders
Flood Water Barriers
Fire Alarm Systems (Heat, Smoke, Manually, Electrically Actuated or in Combination)
Central Station Service Fire Alarms
Proprietary Supervising Continuous Attendance
Local
Auxiliary, Supervised
Public Municipal Systems
Remote Signal, Supervised
Supervisory Signal Systems, Sprinkler Service
Watchman Supervisory Systems
Central Station Service, Burglar Alarms
Climate/Liquid Alarm Systems
Robot Watchman Systems
Fire Alarm Boxes
Supervisory Control Panels
Signal Transmitters
Secondary Station Transmitters
Water Pressure Actuated Transmitters
Temperature Actuated Transmitters
Tank Water Level Actuated (Water Level Transmitters)
Alarm Valve Transmitters (Clapper Actuated)
Supervisory Valve Transmitters
Signal System Switches
Liquid Level Switches
Water Pressure Actuated Switches
Air Pressure Actuated Switches
Gravity Tank Temperature Switches
Sprinkler Valve Position Switches
Process Control Valve, Supervisory Switches
Alarm Valve Switches (Clapper Actuated)
Annunciators
Automatic Transmitting Recorded Telephone Messages
Digital Communicator Systems
Coded Radio Signaling Systems
Audible Signal Appliances
Burglary, Industrial Signaling
Thermostats (Room Type)
Fixed Temperature Thermostats
Combination Fixed Temperature & Rate-of-Rise Thermostats
Radiation Thermopile Thermostats
Carbon Monoxide Detection Equipment
Line Type Thermostats
Expandable Gas (Rate-of-Rise) - Expandable Liquid Thermostats
Smoke Detectors - Photoelectric and Ion
Airborne Particle Meter for Detector Calibrator
Aerosol Type Detection Systems
Smoke Detectors, Duct Type
Flame Radiation - U.V. and I.R.
Electrically Operated
Static Collectors
Static Electricity Detectors
Electrical Conductive Floors
Anti-Static Material
Permanent & Electro Magnet
Switches, Gas Flow and Pressure Safety for Combustion Controls
Electrical Interlocking Switches
Time Delay Switches
Fire-Pumps or Combustion-Control Circuit Switches
Combustion Control Circuit Switches
Temperature Supervisory Switches
Temperature Controllers
Temperature Limit and Supervisory Switches
Liquid Level (Limit) Switches
Disconnect Switch for Vehicles
Lightning Detection System
Automatic Actuated Shutoff Switches - Air and Electric
Deflection Monitoring Device (DMD)
Non-electrical equipment certified under European Directive 94/9/EC (ATEX)
Communication Equipment Repair Service
Repair of Hazardous (Classification) Location Equipment
Intrinsically Safe Equipment - Class 1, Class II, Class III, Div. 1
Electric Equipment - Class 1, Div. 2 - Non-Incendive
Encapsulation for Division 1
Electric Flashlights and Lanterns for use in Class I, Division 2, Zone 2

Roof Coverings (Including Hail Damage)
Standing Seam Roofs
Specification Test Protocol for Impact Resistance Testing of Rigid Roofing Materials by Impacting with Freezer Ice Balls
American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures
Class 1 Steep Slope Roof Coverings
Spray Foam Insulated Steel Roof Deck
Roof Contractor Services
Lightweight Insulating Concrete Roof Deck Contractors
Fire Endurance Tests
Gypsum Wallboard Manufacturers
FM Rated Wall and Partition Assemblies
Acoustical Office Dividers and Partitions
Floor/Ceiling Fire Endurance Tests
Roof/Ceiling Fire-Endurance Tests
FM Rated Floor/Roof and Ceiling Assemblies
Suspended Ceilings
Plastic Ceiling Panels
Beam Fire Endurance Tests
FM Rated Beam Assemblies
Building Column Fire Endurance Tests
FM Rated Column Assemblies
ASTM-E84 - Factory Mutual Tests
ASTM-D1929 - Factory Mutual Tests for Manufacturers
ASTM-ET36 Testing - Factory Mutual Tests for Manufacturers
Laboratory Research - FM, UL, SWRI
FM Construction Materials Calorimeter
Smoke Density and Toxicity
Floor Coverings
FM Wall/Ceiling Channel Tests
Class 1 Insulated Wall or Wall & Roof/Ceiling Panels, Plastic Interior Finish Materials, Plastic Exterior Building Panels, Wall/Ceiling Coating Systems, Interior or *Exterior Finish Systems
Exterior Wall Systems
Class 1 Interior Wall Panels in Smoke Sensitive Occupancies
Insulation, Exposed Interior
Poured-In Insulation
Treated Cellulose - Loose Fill
Insulation Mineral
Insulation Foam - Plastic
Packaging - Materials
Furnishings
Third Party Certifications
Material Explosion Characteristics
Clean Room Materials Flammability Test Protocol
Wafer Carriers for Use in Cleanrooms
Air-handling Facilities
Air Filters, Dust Collectors, Exhaust Cleaners, Kitchen Hoods
Ducts, Plastic and Glass Fiber
Filters for Compressed Gas
Pipe Insulation
Air Compressors
Chimney Liners
Cooling Towers
Storage Tank Exterior Insulation
Storage Tank, Floating Roof
Cranes and Crane Equipment
Welding Leads, Welding Cables and Welding Cable Connectors for Hot Work Operations
Fire Retardant Treated Products (Other than Lumber)
Battery Blankets
Incinerators
FM High Temperature Furnace Tests, General
Fireproofing of Steel, High Hazards
LPG Tank Fireproofing, Coatings
Fire Retardant Paints and Coatings
Plastic Building Materials
EPS Insulation
Doorway Spill Barriers
Penetration Seal & Fire Stop
Fire Stop Contractors
Expansion/Seismic Joint Systems
Plastic Pallets and Totes
Classification of Idle Plastic Pallets as Equivalent to Wood Pallets
Conveyor Belts
Spray Booth Chemicals
Pump Tanks
Anti-Freeze Extinguishers
Water-Filled Extinguishers
Wet Chemical Portable Fire Extinguisher - Class K – Rating
Soda-Acid Extinguishers
Conversion Equipment
Pressure Gauges – Water and Foam
Chemical Foam, Portable
Air-Foam
Foam Charges
Chemical-Foam Generators

Fusible closures for steel drums
Bonding and Grounding Connections
Flexible Couplings for Liquids other than Fuel Oil Systems
Fuel/Water Separators
Fire Resistive or Flameproofed
Waterproofed (Waterproof Covers)
Welding Cloth
Portable Gas Indicators
Fixed Gas Indicating Systems
Performance Requirements for Open Path Gas Monitors
Alarm or Limit Control Systems
Low Concentration (PPM) Gas Analyzers
H2S (Hydrogen Sulfide) Detectors
NH3 (Ammonia) Detectors
CO (carbon Monoxide) Detectors
O2 (Oxygen) Detectors
Household Fuel Gas Detectors
Halon & Carbon Dioxide Concentration Measuring Device
Cleaning Compound for Spray Booths
Drum Racks
Drum Lifters
Hydrogen Peroxide Storage Tanks
Floating Manhole Covers for Hydrogen Peroxide Storage Tanks
Oily Waste Cans and Refuse
Containers for Combustible Waste
Oil Absorbent Compounds
Less Flammable Hydraulic Fluids
Quench Fluids
Heat Transfer Fluids
Transformer Fluids
Transformer Fluids, Less Flammable
Industrial Fluids, Non Flammable, Specification Tested
Fire Retardant Paints
Fire Retardant Treated Paper
Insecticides and Mothproofing
Paint Spray Gun Cleaning Station
Web Press Automatic Blanket Cleaner
Safety Solvents
Finishing Materials
Flux Applicator
Surface Active) Agents
Fire Equipment Location and Identification Markers
Illuminated Exit Signs
Pipe Soldering Heaters - Chemical
Couplings for Pneumatic Conveying Systems
Aerosol Flammability Testing
Sterilizers, ETO Type
Acetylene Generators
Portable Type
Control Unit
Gas Generators (Other then Acetylene)
MAPP Industrial Gas
Regulators, Compressed Gas
Torches
Hydraulic Flame Arresters
Dry Type Flame Arresters (Restricted Use)
Station Outlet Valves
Reels for Gas Hose
Oxygen Separators, Line Filters
Gas Fluxers
Powder Dispensers
Manifolds for Compressed Gases
Flammable Gas Generators
Gas Manifolds - Gases Other Than Acetylene, Stationary and Portable
Enclosures for Aerosol Filling Equipment Using Flammable Gas Propellants
Propane and Butane Fuel Systems
LP-Gas Vaporizers
LP-Gas Tank Relief Valves
LP-Gas Tank Gauges
LP-Gas Vaporizer/Mixer
LP-Gas Mixer
LP-Gas Breakaway Couplings
Compressed Gas Handling Equipment Cylinder Valve Protector
Liquid Natural Gas Equipment
Airless Spray Equipment
Tire Spray Machines
Spray Booths, Water Wash Type
Powder Coating Booths
Continuous Spray Coater
Combination Spray Booth and Oven
Spray Booth Ventilating Fans
Spray Material Containers
Paint and Lacquer Mixers
Paint Filters, Overspray Collectors
Paint and Lacquer Heaters
Electrostatic Finishing Equipment
Electrostatic Spray Equipment - Hand Operated Atomizers

- Sprinklers
- Fire Pump Assemblies
- Flood Mitigation Products
- Roofing
- Valves
- Walls and Ceilings
- Couplings
- Fire Doors and Frames
- Water Mist Systems
- Hazardous Location Equipment
- Pallets and Totes
- Detection and Alarm
- Clean Room Materials
- Gaseous Extinguishment Systems

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Centrifugal Fire Pumps, Vertical Shaft, Turbine Type
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Fire Pump Units - Portable
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Pipe & Fittings & Couplings, Underground, Ductile Iron
Pipe & Fittings, Underground, Asbestos-Cement (AC)
Pipe & Fittings, Underground, Polyvinyl Chloride (PVC)
Pipe & Fittings, Underground, Polyethylene (PE)
Pipe & Fittings, Underground, Fiber-Reinforced Composite (FRP)

Mildew-Proof Treated
Friction Loss
Approved Hose - Mfd. Under Different Trade Names
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Unlined Linen Fire Hose
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Hose Racks and Reels
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Radiation Thermopile Thermostats
Carbon Monoxide Sensitive Detector
Line Type Thermostats
Expandable Gas Rate-of-Rise) - Expandable Liquid Thermostats
Smoke Detectors, Photoelectric and Ionization
Duct Smoke Detectors for Detector Cabinets
Aerosol Smoke Detection Tests
Smoke Detector - Gas Sensing
Flame Radiation, U.V. and I.R.
Manual Alarm Devices
Signal Detectors
Static Electricity Detectors
Electrically Conductive Shoes
Anti-Static Material
Equipment, Electro Magnetic
Switches, Gas Flow and Pressure Activity for Commission Controls
Rotational Interlocking Switches
Time Delay Switches
Fire-Pumps or Combustion-Control Circuit Switches
Combustion Control Circuit Switches
Temperature Supervision Switches
Temperature Controllers
Temperature Limit and Supervisory Switches
Liquid Level (Limit) Switches
Pressure Switches for Vehicles
Lightning Detection System
Seismic Actuated Shutoff Switches - Air and Electric
Deflection Monitoring Device (DMD)
Non-electrical Equipment certified under European Directive
Wireless (RF)
Communication Equipment Repair Service
Repair of Hazardous (Classification) Location Equipment
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Floor/Ceiling Fire Endurance Tests
Roof/Ceiling Fire-Endurance Tests
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Suspended Ceilings
Plastic Ceiling Panels
Beam Fire Endurance Tests
FM Rated Beam Assemblies
Building Column Fire Endurance Tests
FM Rated Column Assemblies
ASTM-E84 - Factory Mutual Tests
NFPA 701-21 Factory Mutual Tests for Manufacturers
ASTM-E136 Testing - Factory Mutual Tests for Manufacturers
Laboratory Research - FM, UL, SWRI
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Smoke Density and Toxicity
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Class 1 Interior Wall Panels in Smoke Sensitive Occupancies
Insulation, Exposed Interior
Poured-In Insulation
Treated Cellulose - Loose Fill
Insulation Mineral
Insulation Foam - Plastic
Packaging - Materials
Furnishings
Third Party Certifications
Material Explosion Characteristics
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Water Filled Extinguishers
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Air-Foam
Foam Charges
Chemical-Foam Generators

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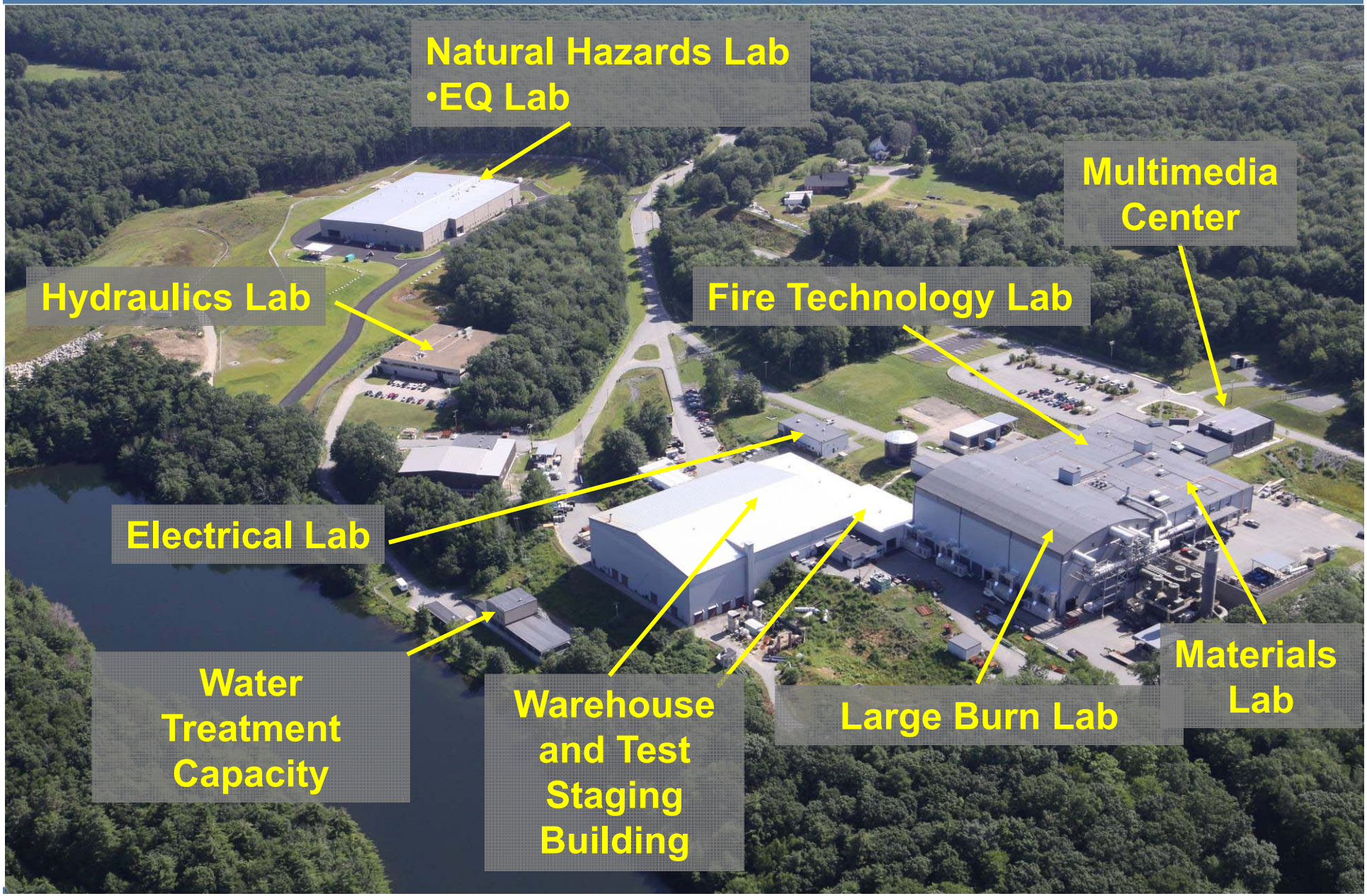
Drum Racks
Drum Lifters
Hydrogen Peroxide Storage Tanks
Floating Manhole Covers for Hydrogen Peroxide Storage Tanks
Oily Waste Cans and Refuse
Containers for Combustible Waste
Oil Absorbent Compounds
Less Flammable Hydraulic Fluids
Quench Fluids
Heat Transfer Fluids
Transformer Fluids
Transformer Fluids, Less Flammable
Industrial Fluids, Non Flammable, Specification Tested
Fire Retardant Paints
Fire Retardant Treated Paper
Insecticides and Mothproofing
Paint Spray Gun Cleaning Station
Web Press Automatic Blanket Cleaner
Safety Solvents
Finishing Materials
Flux Applicator
Surface Active) Agents
Fire Equipment Location and Identification Markers
Illuminated Exit Signs
Pipe Soldering Heaters - Chemical
Couplings for Pneumatic Conveying Systems
Aerosol Flammability Testing
Sterilizers, ETO Type
Acetylene Generators
Portable Type
Control Unit
Gas Generators (Other then Acetylene)
MAPP Industrial Gas
Regulators, Compressed Gas
Torches
Hydraulic Flame Arresters
Dry Type Flame Arresters (Restricted Use)
Station Outlet Valves
Reels for Gas Hose
Oxygen Separators, Line Filters
Gas Fluxers
Powder Dispensers
Manifolds for Compressed Gases
Flammable Gas Generators
Gas Manifolds - Gases Other Than Acetylene, Stationary and Portable
Enclosures for Aerosol Filling Equipment Using Flammable Gas Propellants
Propane and Butane Fuel Systems
LP-Gas Vaporizers
LP-Gas Tank Relief Valves
LP-Gas Tank Gauges
LP-Gas Vaporizer/Mixer
LP-Gas Mixer
LP-Gas Breakaway Couplings
Compressed Gas Handling Equipment Cylinder Valve Protector
Liquid Natural Gas Equipment
Airless Spray Equipment
Tire Spray Machines
Spray Booths, Water Wash Type
Powder Coating Booths
Continuous Spray Coater
Combination Spray Booth and Oven
Spray Booth Ventilating Fans
Spray Material Containers
Paint and Lacquer Mixers
Paint Filters, Overspray Collectors
Paint and Lacquer Heaters
Electrostatic Finishing Equipment
Electrostatic Spray Equipment - Hand Operated Atomizers

Research and Testing Campus



Mission Statement

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;

FOCUSED TESTING AND CERTIFICATION

- Encouraging the development and use of Approved standards and processes that improve and advance property loss prevention practices.

DEPTH OF KNOWLEDGE

Depth in Knowledge (Research)

FM Approvals

103 Scientists, Engineers and Technicians

Fully Funded Internally!

Focused Research!

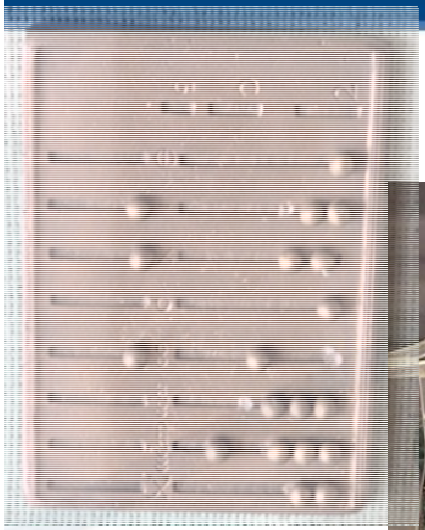
Why Invest in Research?

To develop new knowledge for property loss prevention that finds its way in our product testing standards.

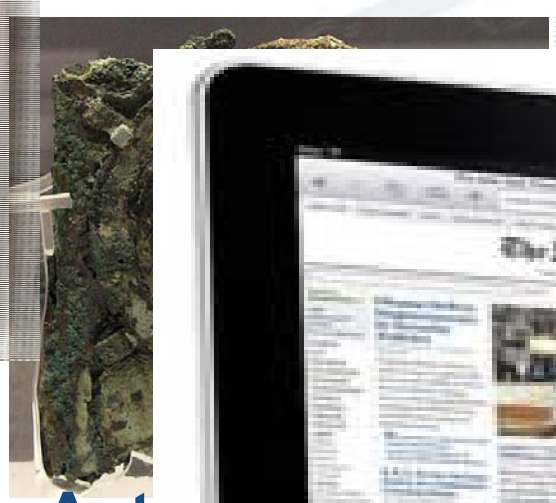
To utilize new knowledge in standards in order to reduce the cost and cycle time to the manufacturing industry while maintaining technical integrity.

To significantly increase the number of FM Approved products, thus making our working environment a safer place.

Well Traveled Journey of R & D……



Roman
Abacus
300 BCE



Ant
mec

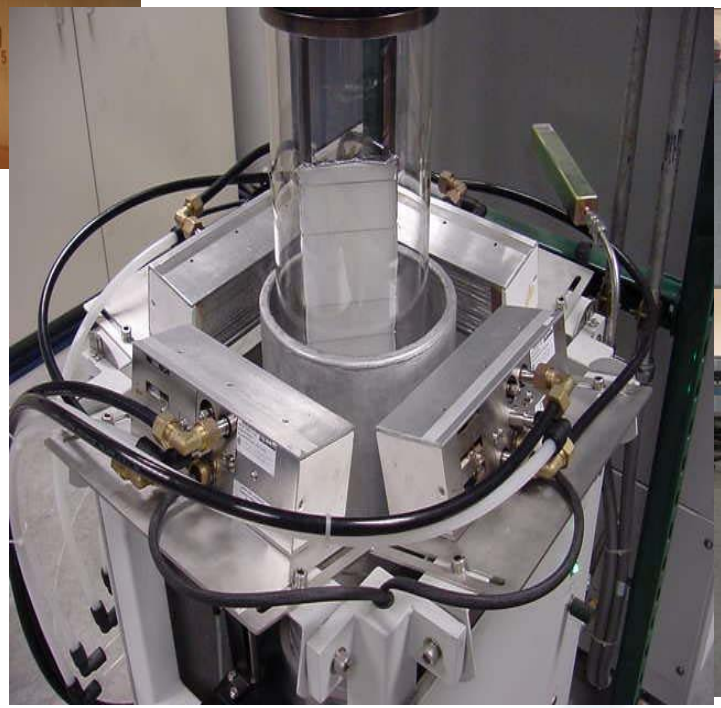
Over 2000 year Journey

R&D Journey for Wall Panel Systems

FM Approvals

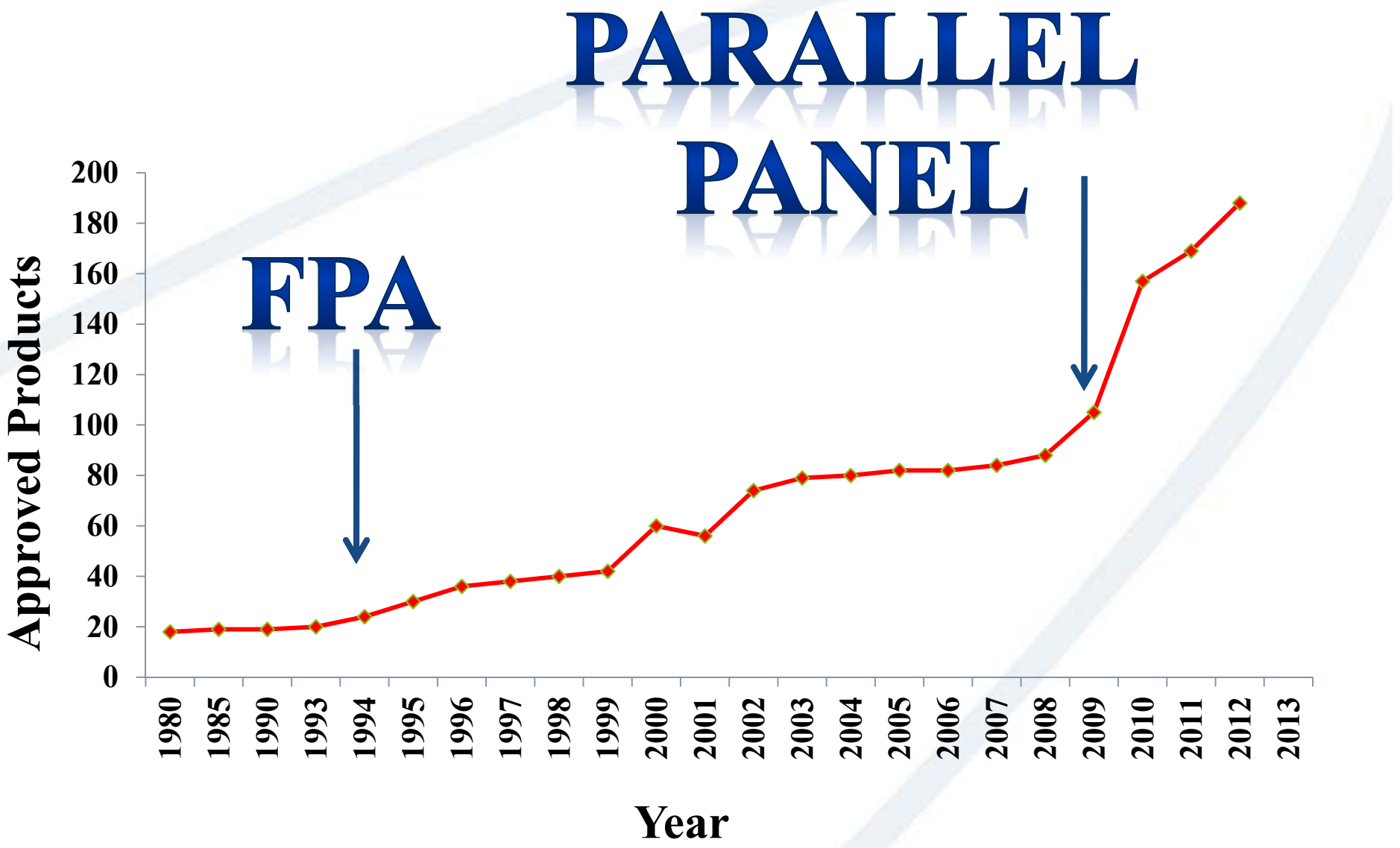
41 year journey

Small Scale Mechanism
2009 CE



Full Scale Mechanism
1973 CE

Wall Panel System Certification



R&D Journey for Water Mist System

- In 1993 we were approached by 2 manufacturers outside the USA interested in protecting gas turbines

- Over the next 18 months we defined the:
  - Objective - Suppress fires without overcooling turbine casing

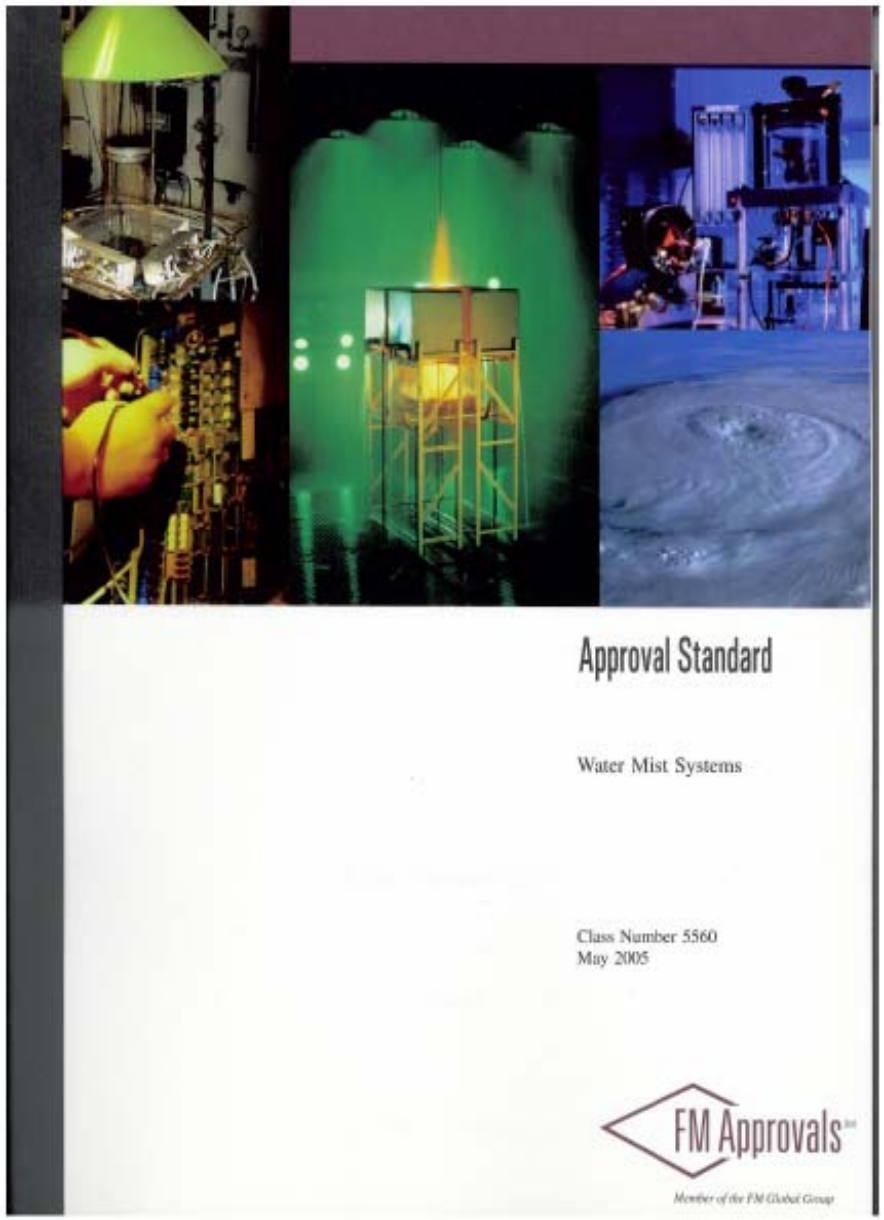
  - Enclosure Volume of 80 m^3

  - The fire test protocol:
    - Spray fires
    - Pool fires
    - Insulation blanket fires

- Published the FM Approval Standard in early 1995

R&D Journey for Water Mist System

- First Application in 1995
- ANSI/FM 5560
- Parts adopted by BSI, EN and GB standards
- Continuously update standard with new applications
- All applications full scale fire tested



Water Mist Certified Applications

CURRENT APPLICATIONS

- Combustion Turbines in Enclosures
  - Volumes Not Exceeding 2825 ft³ (80 m³)
  - Volumes Not Exceeding 9175 ft³ (260 m³)
  - Volumes Exceeding 9175 ft³ (260 m³)
- Chemical Fume Hoods
- Computer Room Raised / Sub Floors
- Continuous Wood Board Presses
  - Industrial Oil Cookers
  - Local Application
- Machinery in Enclosures
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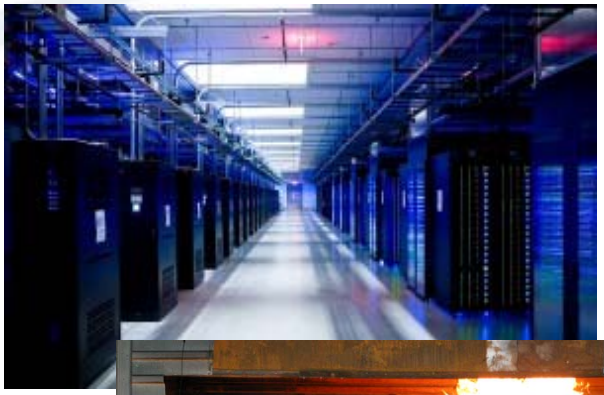
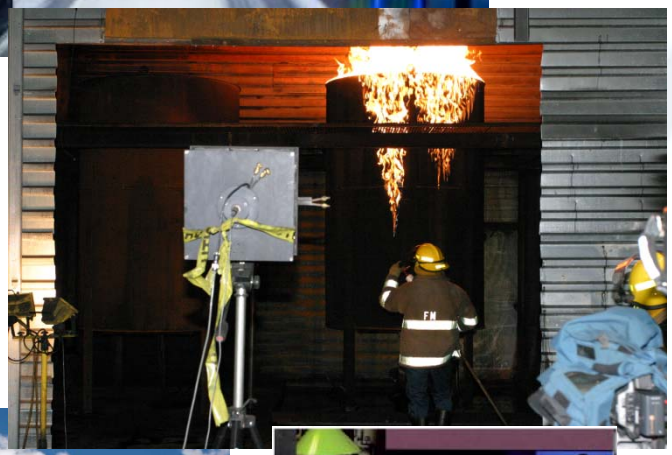
- Non-Storage Occupancies , Hazard Category 1 (HC-1) *[Formerly Designated As Light Hazard Occupancies]*
- Wet Benches and Other Similar Processing Equipment
- Ignitable Liquid Use
- Hybrid (water mist + inert gas) system: Approvals and NFPA standards
- Off Road Vehicles
- Data Centers





Approval of Water Mist Systems

System Component Tests

- Valve 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

Example of Water Mist Nozzle Tests

Automatic Nozzles: Traditional Sprinkler Tests

- Discharge Coefficient (K-Factor)
- Moist Air
- Corrosion
- Vibration
- Rough Use and Abuse
- Minimum Operating Pressure
- Process Residue
- Water Mist Discharge Characteristics
- Protective Caps
- Frame Strength
- Strength of Heat Responsive Element
- Leakage
- Hydrostatic Strength
- Water Hammer
- Operating Temperature
- Air Bath
- Hang-Up of Operating Parts
- Strength of Deflector
- Vacuum
- High Ambient Temperature Exposure
- Freezing
- Conductivity (C-Factor)
- RTI

Example of Water Mist Nozzle Tests

Open Nozzles:

- Discharge Coefficient (K-Factor)
- Moist Air
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- Vibration
- Rough Use and Abuse
- Minimum Operating Pressure
- Process Residue
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- Protective Caps
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Example of Water Mist Nozzle Tests

Open Nozzles:

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- Rough Use and Abuse
- Minimum Operating Pressure
- Process Residue
- Water Mist Discharge Characteristics
- Protective Caps

Detection System

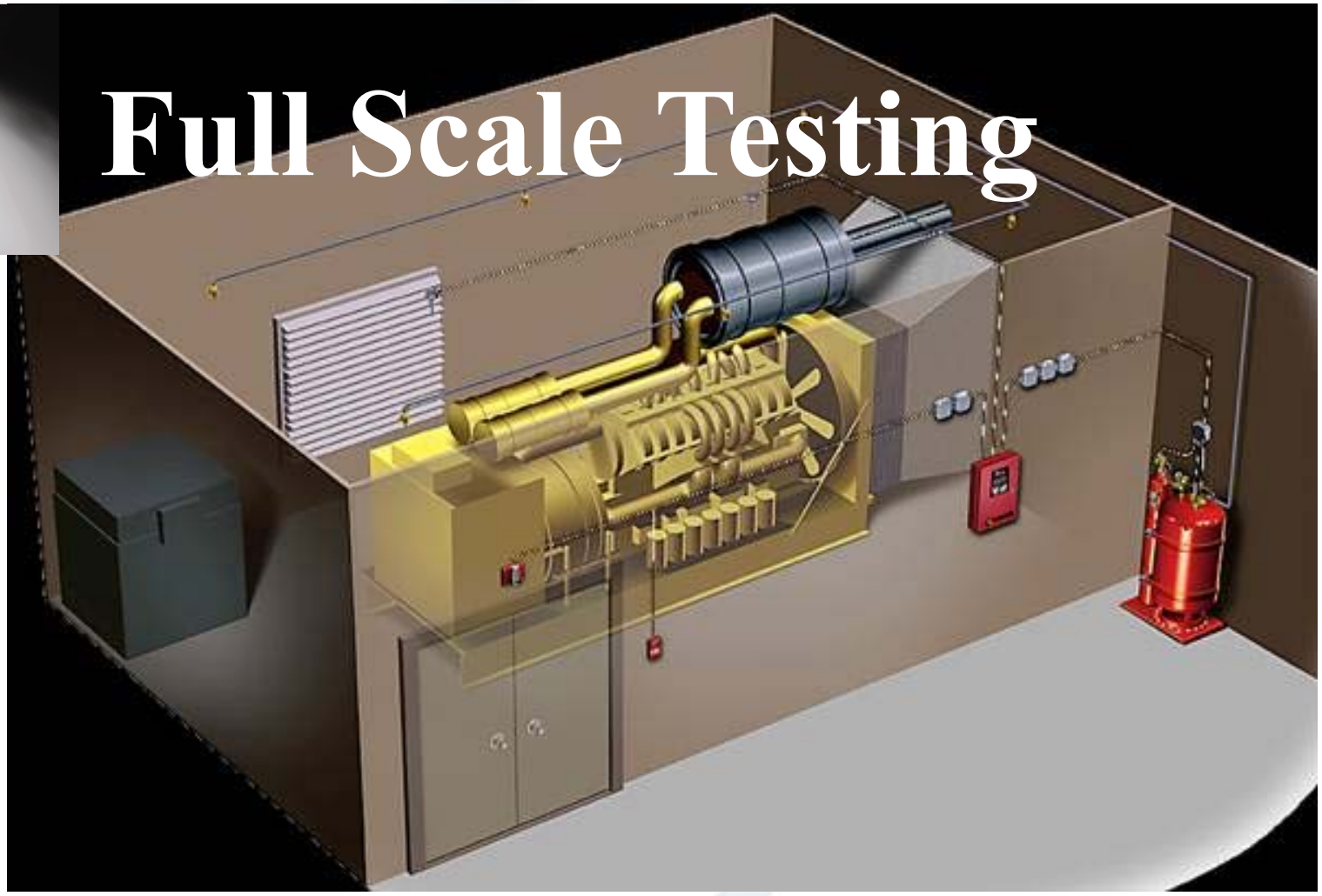
- FM Approved

  or

- Tested to FM Approvals Standards

Water Mist Systems Certification

Full Scale Testing



Water Mist Systems Certification

FM Approvals

Sharing of Technical Knowledge

FM 5560 referenced in GB/T26785-2011 "Water mist extinguishing system" system and components general technical requirements"

"GB/T26785-2011 "细水雾灭火系统的系统和组件通用技术要求"参考及引用了FM5560"

UDC

中华人民共和国国家标准

P GB××-201×

细水雾灭火系统技术规范

Technical standard for water mist fire protection systems

（送审稿）

201×-××-××　发布　　201×-××-××　实施

中华人民共和国住房和城乡建设部
中华人民共和国国家质量监督检验检疫总局　联合发布

Sharing of Technical Knowledge

EN draft CENT/TS 14972:2011
Committee has adopted seven (7) FM 5560 test protocols out of a total of 12 in the draft to be published in the next version of the draft standard.

UK – draft BS 8489
All of the test protocols and requirements, including component tests, from FM 5560 (with the exception of Appendix H – Wet Benches, which is not included in the BS scope) are referenced as being acceptable to display compliance with BS 8489 itself.

What are the Challenges?

- Takes too long!
- Not very efficient process!
- Lack of system optimization!
- Costs too much!
- Not easily changed!

- Iterative Large Scale Fire Testing Process

What are the Challenges?

- Takes too long!
- Not very efficient process!
- Lack of system optimization
- Costs too much!
- Not easily changed!

- Location of nozzles
- Spacing of nozzles
- Pressure
- Flow
- Nozzle type

What are the Challenges?

- Takes too long!
- Not very efficient process!
- Lack of system optimization
- Costs too much!
- Not easily changed!

- Optimize for Commercial Purposes
  - Reduce commercial cost
  - Optimize system (less nozzles)

What are the Challenges?

- Takes too long!
- Not very efficient process!
- Lack of system optimization
- Costs too much!
- Not easily changed!

- 70%-75% of testing cost is large scale fire tests

What are the Challenges?

- Takes too long!
- Not very efficient process!
- Lack of system optimization!
- Costs too much!
- Not easily changed!

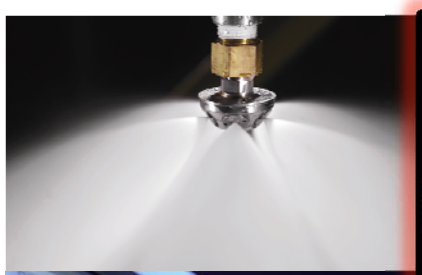
- Restricted to:
  - System Tested
  - Enclosure
  - Ventilation
  - Fire Challenge

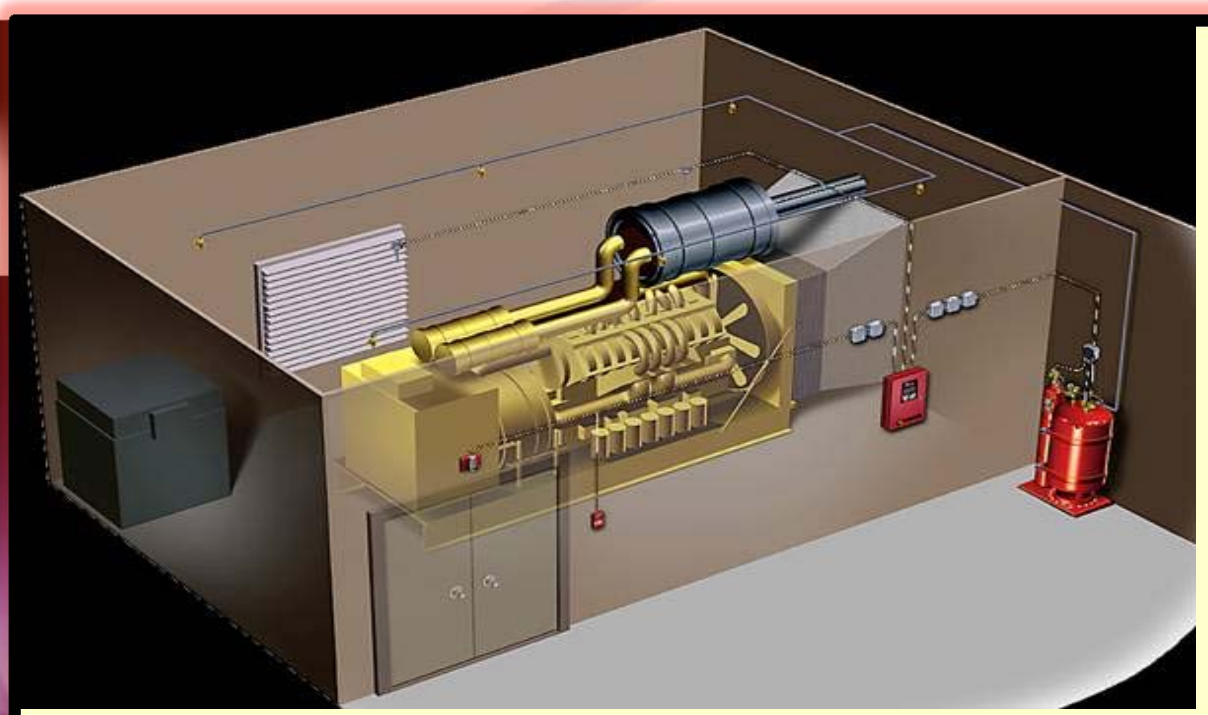
Water Mist Systems Research Strategy

Develop methodology for water mist system testing and certification with screening protocol and reduced full-scale fire testing

- Nozzle water droplet characterization (drop size distribution, droplet momentum, spray angle/pattern, etc.)
- Well mixed model – the use of a proprietary model to identify potential for success of a particular nozzle protecting a particular application (screening)
- Scaling methodology to scale down/up the large scale fire tests. The scale could be 1/2 or 1/3 of previous large scale fire tests.

Well Traveled Journey of R & D……





1/4 ,1/3 or 1/2 scale

20 year journey, so far….

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- Ignitable Liquid Use
- Hybrid (water mist + inert gas) system: Approvals and NFPA standards
- Off Road Vehicles
- Data Centers

FUTURE APPLICATIONS

- Cable Spreading Room / Cable Tunnels
- CNC Machines
- Combustion Turbine - Large Spray Fire
- Combustion Turbine - Re-ignition Fire (Decaying Pressure System)
- Conveyor Belts
- Engine Test Cells
- Flight Simulators
- Flue Gas Oil Coolers
- Ignitable Liquid Storage / Cut-Off Rooms
- Industrial Exhaust Ducts
- Kitchen Cooking Surfaces / Hoods / Ducts
- Libraries
- Ordinary Occupancy Hazard - Group I
- Paint Spray Booths
- Paper Machine / Paper Machine Dryer Hoods
- Printing Presses
- Rack Storage
- Semiconductor Mini-Environments
- SX Plants - Ignitable Liquid Pool / Tank (Local Application)
- Ventilated Emergency Generators

What WERE the Challenges?

- Takes too long!
- Not very efficient process!
- Lack of system optimization
- Costs too much!
- Not easily changed!

- Expected initial reduction in FM Approvals cycle time by approximately 40%.
- Initial reduction in certification cost by at least 35% due to screening model
- Significant reduction time and resources for manufacturers
- Potential reduction in required number of reduced scale tests in the future (after gaining some experience)
- Easily modified through the screening model

Benefits of New Approach

- Takes too long!
- Not very efficient process!
- Lack of system optimization
- Costs too m
- Not easily c

- Expected initial reduction in FM Approvals cycle time by approximately 40%.
- Initial reduction in certification cost by at least 35% due to screening model

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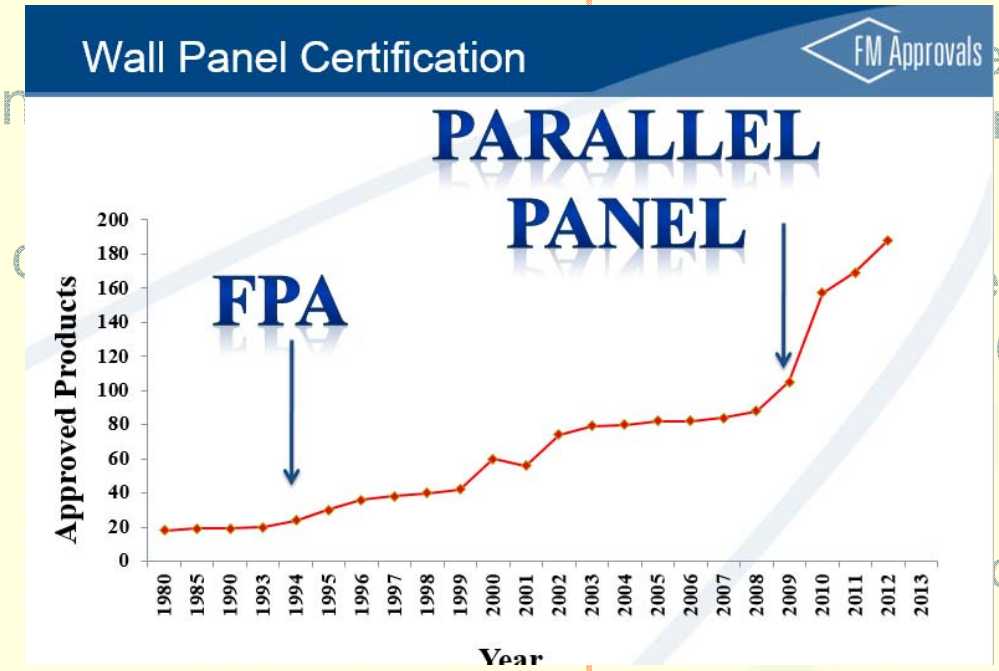
Increase number of FM Approved Applications



FM Approvals

THANK YOU