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Challenges for the Fire Sprinkler Industry

An exploration of design, specification, maintenance and education issues with suggestions for positive change.

By Kenneth E. Isman, P.E., FSFPE, National Fire Sprinkler Association

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In the article that begins on page 6, Kenneth Isman notes that many fire sprinkler contractors have reported that engineering design documents frequently do not contain the minimum criteria necessary to establish the design intent of these systems. Unfortunately, this criticism is not new. Concerns such as Isman’s are the reason that SFPE, in partnership with the National Society of Professional Engineers and the National Institute for Certification in Engineering Technologies, developed a position statement on the roles of engineers and engineering technicians in the design of fire protection systems.1

The position statement recognizes that engineers and engineering technicians have important roles in the design of fire protection systems. The engineer serves two roles in the design of fire safety systems: (1) serving as an agent of the building owner or similar client, and (2) designing fire safety systems that adequately provide public health, safety and welfare.

To achieve the goals associated with these two roles, certain minimum responsibilities are placed on engineers. As the representative of the owner, the engineer needs to develop an understanding of how the building will be used and what will be put inside it. The engineer should also determine if the building owner has any specific desires with respect to sprinkler system aesthetics or performance. To address public health, safety and welfare, it is necessary to identify the hazards associated with a building and determine appropriate mitigation strategies.

The position statement identifies several tasks that an engineer should perform when designing sprinkler systems. The engineer should first select the type of system that will be used. Based on the fire hazards that are identified, the engineer should determine the appropriate hazard and commodity classifications for the building and establish the minimum design areas and water flow requirements. The engineer should research the available water supply, and determine if it is adequate or if it will need to be augmented by the provision of pumps or supplemental water storage. Additionally, the engineer should design interfaces with other fire safety systems, like fire alarm systems.

Since these tasks associated with the design of sprinkler systems constitute the practice of engineering, it is not acceptable to delegate them to people who are not engineers unless they will perform the work under an engineer’s direct supervision. Providing design documents that consist of little more than reflected ceiling plans and a statement to the effect of “provide a fire sprinkler system in compliance with NFPA 13” is not sufficient.

Some engineers justify delegating engineering tasks to contractors by saying that the engineer will review the contractor’s shop drawings. However, while this could work in theory, it does a disservice to the engineer’s client. If the engineer notices design elements that were missed when reviewing shop drawings, and these design elements were not identified in the contract drawings or specifications, the result could be costly change orders.

Anecdotal feedback from sprinkler contractors is that some engineers do not comply with SFPE’s position statement when designing fire safety systems. This feedback is a main point of an article that Isman wrote in Consulting-Specifying Engineer.2 In most cases, those sub-standard designs were prepared by engineers who do not meet the definition of a “fire protection engineer.” Hence, it’s SFPE’s position that these substandard designs are prepared by engineers who are not members of SFPE. However, whenever any engineer performs a substandard design of a fire safety system, it makes the entire fire protection engineering community look bad. The SFPE/NSPE/NICET position statement provides a minimum standard of care for the design of fire safety systems.

Morgan J. Hurley, P.E., FSFPE
Technical Director
Society of Fire Protection Engineers

References:
1 “The Engineer and The Engineering Technician – Designing Fire Protection Systems,” Society of Fire Protection Engineers (SFPE), National Society of Professional Engineers (NSPE) and the National Institute For Certification In Engineering Technologies (NICET), 2008.

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USFA Releases New Civilian Fire Fatalities in Residential Buildings Report

The Federal Emergency Management Agency’s (FEMA) United States Fire Administration (USFA) recently issued a special report examining the characteristics of civilian fire fatalities in residential buildings. The publication, *Civilian Fire Fatalities in Residential Buildings (2008-2010)*, reports the following:

- Ninety-two percent of all civilian fatalities in residential building fires involve thermal burns and smoke inhalation.
- The leading specific location where civilian fire fatalities occur in residential buildings is the bedroom (55 percent).
- Fifty percent of civilian fire fatalities in residential buildings occur between the hours of 10 p.m. and 6 a.m. This period also accounts for 47 percent of fatal fires.
- Thirty-six percent of fire victims in residential buildings were trying to escape at the time of their deaths; an additional 35 percent were sleeping.
- “Other unintentionally set, careless” actions and “smoking” (each accounting for 16 percent) are the leading causes of fatal residential building fires.
- Approximately 44 percent of civilian fatalities in residential building fires are between the ages of 40 and 69. Thirteen percent of the fire fatalities in residential buildings were less than 10 years old.

*Civilian Fire Fatalities in Residential Buildings (2008-2010)* is part of the Topical Fire Report Series.

For more information, go to [www.usfa.fema.gov](http://www.usfa.fema.gov)

Cal Poly FPE Program Continues to Flourish

The Fire Protection Engineering (FPE) Program at Cal Poly is pleased to announce that the first three full-time students in its MS degree program are scheduled to graduate this March. All three already have employment agreements in place. Mark Ferraresi has already started working for Hughes Associates, Inc. Will Fletcher plans to work at Aon Fire Protection Engineering Corp., and David Phillips will be working at RJA Group.

Fletcher and Phillips had both been awarded Honeywell Life Safety scholarships. Ferraresi had been awarded scholarships from the Greater Atlanta and Northern California/Nevada chapters of SFPE. The Greater Atlanta chapter also granted a scholarship to first-year student Laura Radle.

In other Cal Poly news, Professor Christopher Pascual is working on a 2-year grant from the U.S. Nuclear Regulatory Commission to develop the FPE 501 course on Fundamental Thermal Sciences. Professors Lonny Simonian and Thomas Korman have received a grant from the Fire Protection Research Foundation to perform a gap analysis related to the Smart Grid and the National Electrical Code.

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CHALLENGES FOR THE SPRINKLER

By Kenneth E. Isman, P.E., FSFPE
There are a number of challenges that face people in the fire sprinkler industry. Many of these challenges are associated with the design of fire sprinkler systems. However, there are other important challenges facing the sprinkler industry that are of interest to fire protection engineers, but could not be classified as “design” issues.

This article outlines challenges in the design, standards, specifications, maintenance and education arenas and will suggest methods for dealing with these challenges.

**DESIGN CHALLENGES**

After 130 years, one would think that the design of fire sprinkler systems would be pretty well in hand, but there are always new challenges surfacing. Usually, these challenges relate to a new device being used in buildings that somehow affects the sprinkler system, or some new commodity or hazard coming into the marketplace. But, every once in a while, a challenge surfaces because some long-standing practice gets questioned due to new experience,
Challenges for the Fire Sprinkler Industry

or some long-standing problem
gets a new solution based on
research or a new way of looking
at the problem. A few of the more
interesting and more recent of
these follow.

HVLS Fans

High Volume Low Speed (HVLS)
fans have been used in commercial
occupancies for some time, yet
their impact on fire development
and sprinkler system performance
has been relatively unknown
until recently.

The Fire Protection Research
Foundation (FPRF) conducted two
series of tests.1,2 The results of these
tests showed that the situation with
HVLS fans was much better than it
originally appeared to be. By fol-
lowing some basic installation rules
for the fans, such as keeping the
fans at least 36 inches (900 mm)
below the sprinklers, centering the
fans between four sprinklers, and
stopping the fans upon a waterflow
signal from the sprinkler system (no
more than 90 seconds after dis-
charge from the first sprinkler), the
fans do not appear to adversely
affect sprinkler performance.

Preventing Pipe
From Freezing

Antifreeze systems consisting
of glycerine or propylene glycol
have been used successfully in fire
sprinkler systems for more than 60
years. Their use started in small
systems protecting loading docks
and attics and spread to larger
systems as the demand for sprinklers
in residential occupancies and large
freezer/refrigerated storage occup-
cancies grew. Recent experience,
confirmed by fire testing, has shown
that certain concentrations of these
fluids should not be used.3

Antifreeze solutions that appear
safe to use at this time include
glycerine not exceeding a concen-
tration of 48% by volume and pro-
pylene glycol not exceeding a con-
centration of 38% by volume. Other
antifreeze solutions may surface that are safe to use, but chemicals other than glycerine and propylene glycol will need to go through a compatibility analysis to show that they will not adversely affect other components in the fire sprinkler system. For systems that cannot use the known acceptable antifreeze solutions, a new challenge will be to keep the water in these systems from freezing, or to install a type of sprinkler system that will not have water in the piping unless a fire occurs (dry-pipe or preaction).

Potential solutions for protecting wet pipe from freezing include being more creative about running pipe in interior (heated) walls and tenting insulation over piping in attic spaces. It is also possible to run pipe in exterior walls and put sufficient insulation between the pipe and the exterior skin of the building. Many of these options are non-traditional and will require coordination with other construction trades.

**Sloped Ceilings in Warehouses**

Almost all of the full-scale fire testing that has been done to justify the protection criteria for storage warehouses has been done with a horizontal ceiling. The small body of work that has been done with sloped ceilings has indicated that the design areas in NFPA 13 (and the predecessor storage documents) are insufficient to control or suppress fires consisting of the same commodities under sloped ceilings (slopes exceeding 2 in 12). Unfortunately, it is unknown how large the design area needs to be or how much extra flow is necessary to overcome the delay in opening sprinklers over a fire when the ceiling is sloped.

More research is scheduled for this topic for the near future, but not in time to be included in the 2013 edition of NFPA 13. Until such time as data is developed, building owners of storage warehouses with ceiling slopes greater than 2 in 12 have two choices. The first is to install a drop ceiling that is horizontal and place sprinklers beneath the drop ceiling. The second is to hire a fire protection engineer to perform a dynamic analysis to determine sprinkler criteria unique to the client’s situation.

A dynamic analysis would need to take into account two consequences of the situation that the sprinklers immediately above a fire might be delayed in opening as hot gasses follow the slope of the ceiling and collect at the ridge. The first consequence is that sprinklers higher in the building and
remote from the fire might open. Such sprinklers would need to be included in the design area, even if they do not contribute to fire control or suppression. A variety of sprinkler actuation models can be used to model this situation, but as with all models, must be used within their limitations.

The second consequence of the delay in opening sprinklers is that the fire will be bigger, so a greater discharge (density, flow or pressure) would be expected to be needed from the sprinklers over the fire. It might be possible to estimate what might be necessary in discharge by performing calculations on fire size (or using data from fire tests under flat ceilings) for fires where known discharge characteristics (k-factor and pressure) have proven to be successful. For example, calculations or fire tests might show that a fire consisting of 20 ft (6 m) high storage of some commodity under a sloped ceiling would have a heat release rate of 3700 BTU/s (3.9 MW) when sprinklers over the fire opened. And if calculations or fire tests under a flat roof showed that the same commodity at 30 ft (9 m) in height achieved a similar heat release rate of 3700 BTU/s (3.9 MW) when sprinklers over the fire opened, then that discharge criteria (k-factor and pressure) for the 30 ft (9 m) storage under a flat ceiling might be adequate for 20 ft (6 m) storage under a sloped ceiling. But this flow and pressure information would still need to be applied to the greater design area.

**Rack Storage of Exposed Plastics**

Another unknown regarding protection in NFPA 13 is the protection
As far back as the first edition of NFPA 231C, this issue has not been addressed in the NFPA standards. A few years ago, some criteria were added for protection of exposed unexpanded plastics stored over 25 ft (7.6 m) in height. For the 2013 edition of NFPA 13, the committee will add protection criteria for storage of exposed unexpanded plastics up to 25 ft (7.6 m) high. Presently, no information is available in the NFPA standard for protecting exposed expanded plastics except for in the section on “Miscellaneous Storage.”

When designing for a storage facility that has exposed expanded plastics, engineers must develop criteria on their own. One popular way of finding criteria is to turn to sources outside the NFPA. For many years, Factory Mutual (FM) has published discharge criteria to protect exposed plastics (since their clients have this material) in their Data Sheet 8-9, “Storage of Class 1, 2, 3, 4 and Plastic Commodities.” The FM criteria are based on following all of the FM requirements, not just the flow and pressure at the sprinkler. So, if one is going to use FM discharge criteria, one should use all of the FM rules.

**Flammable and Combustible Liquids**

NFPA 30 has come a long way in recent times with sophisticated sprinkler discharge criteria. Before the 1990 edition, NFPA 30 only had sprinkler criteria in the annex (Appendix D). But after a number of full scale fire tests using sprinkler systems and foam/water systems, more specific criteria was moved into the body of the document.

However, NFPA 30 still does not cover all of the different combinations of commodities and containers that building owners may want to use. When a situation comes up that is not covered by any of the sprinkler protection tables...
in Chapter 16 of NFPA 30, the fire protection engineer needs to develop their own discharge criteria for protecting the commodity.

STANDARDS CHALLENGES

In addition to the design challenges discussed above, one of the most significant developments in recent years has been the publication and promulgation of standards for the design and installation of fire sprinkler systems by organizations that are not the NFPA and are not using the NFPA as a basis for their requirements. The most significant of these organizations is Factory Mutual (FM).

Prior to 2010, FM published their own standards, but they used the NFPA standards as a starting point where such standards existed. FM would publish a document showing the NFPA rules where they would delete any rules that did not apply and write in their own rules, which were almost always more stringent than the NFPA’s. During this time, it was fairly easy for a sprinkler designer to comply with both FM and NFPA standards by reading the FM document and taking the more stringent of the two sets of rules.

But that all changed in 2010 when FM published their own set of standards that was independent of the NFPA standards. Since the FM documents do not follow the same format as NFPA standards, it is more difficult to lay the standards side-by-side and compare the requirements. There are some requirements in the FM standards that are no longer more stringent than the NFPA, and there are some circumstances where compliance with both documents is impossible.

One example of a situation where the FM standards are no longer as stringent as NFPA 13 is in the maximum size of a “system”. NFPA 13 limits the size of a system to 52,000 sq ft (4,800 m²) per floor for light and ordinary hazard systems and 40,000 sq ft (3,700 m²) per floor for extra hazard and high-piled storage. But FM Global Data Sheet 2-0, Fire sprinkler contractors report that the majority of specifications that they see do not include the basic criteria necessary to convey the design intent, such as the hazard classification of the occupancy, the commodity classification of any storage, or a thoughtful analysis of the adequacy of the water supply.

“Installation Guidelines for Automatic Sprinklers” allows much more area per system. FM originally published their standards in March 2010 without any limitation to the size of a system. Then they changed their standard in January 2011 to a maximum system size of 60,000 sq ft (5,600 m²) (total, not per floor). It is possible that this requirement will change again in the future.

FM proposed the expansion of the rules in NFPA 13 to 100,000 sq ft (9,300 m²) per floor for the 2013 edition, but the committee rejected the change. Discussions regarding the rejection were based on concern for the size of the system and amount of unprotected property when a single valve was closed, the time it would take to drain such a large system and refill it when maintenance needed to be done, the amount of trapped air that would occur in such a large system, and the alarm delays that might occur in such a large volume system.

An example of a situation where it is impossible to comply with both FM standards and NFPA 13 is the installation rules for sprinklers under sloped ceilings where the slope exceeds 2 in 12. FM Data Sheet 2-0 requires the sprinklers to be installed with their deflectors horizontal (parallel with the floor) while NFPA 13 requires them to be installed parallel to the ceiling. Both organizations have interesting concerns here.

FM is concerned that the discharge from a sprinkler parallel to the ceiling slope may not protect the floor area directly under the sprinkler. This requires the sprinkler down the slope to protect more of the area under the higher slope, which further delays when water will get to the fire. FM has also expressed concerns over the downward thrust of the discharge and the ability of sprinklers to get water to penetrate the fire plume (which is vertical) if the sprinkler spray is not vertical.

On the other hand, the NFPA committee counters with the fact that sprinkler deflectors have always been installed parallel to the slope and that there has been significant positive experience with sprinklers in this position. Whatever the effects of spray patterns and downward thrust, the rule of following the slope of the
ceiling is working. From a practical perspective, the installation of sprinklers parallel to the slope is easy, as the branch lines tend to follow the structural members at the roof. For sprinklers to be installed parallel to the floor when the roof is sloped may require a swing joint at every sprinkler, and the NFPA committee has not seen the data to require such an expense.

While these two respected organizations continue to work on this subject, the engineer is caught in the middle. There is no way to comply with both NFPA 13 and the FM standards on this subject at this time. Engineers should be careful to determine which set of rules they want to follow and make this clear to the sprinkler contractor through carefully written specifications.

If the engineer wants to follow the FM rules, it may take some special consideration from the Authority Having Jurisdiction. In most places in the United States, NFPA standards are adopted as law and there is no option but to follow these standards. In order to use the FM standards where they are less stringent than NFPA 13, or where they differ from NFPA 13, the AHJ will have to grant a variance or equivalency. In such cases, the engineer should not use a few of the rules from FM and then design the rest of the system to meet NFPA 13. Instead, the engineer should use all of the FM standards, in their entirety as a substitute for the NFPA rules. The FM documents are a set of rules that work well together, but only when they are used together, in their entirety, do they potentially achieve the same level of safety as the NFPA standards.

SPECIFICATION CHALLENGES

In the June/July 2011 edition of Consulting-Specifying Engineer magazine,9 there is an article on specifying sprinkler systems that matches the vision of the joint

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A position paper issued by the SFPE and others on what should be included in specifications. However, feedback from the fire sprinkler industry indicates that this is more of an ideal scenario than a real one.

Fire sprinkler contractors report that the majority of specifications they see do not include the basic criteria necessary to convey the design intent, such as the hazard classification of the occupancy, the commodity classification of any storage, or a thoughtful analysis of the adequacy of the water supply. Instead, contractors report that specifications generally show a layout of the sprinkler system that is less efficient and more costly to install than an alternate that the contractor could provide that is still in accordance with all relevant code requirements. It would appear that the engineering community has a long way to go in writing proper specifications for fire sprinkler systems.

The challenge for fire protection engineers is to make sure that they write adequate specifications, and that they reach out to fellow mechanical, civil and other engineers that are also writing sprinkler system specifications and get them to do the same. As an industry, everyone in fire protection will benefit from the improved efficiencies involved in having proper specifications that do not waste the client’s time and money.

MAINTENANCE CHALLENGES

Engineers may design fabulous fire sprinkler systems, but unless they are maintained properly, they may not work correctly when a fire occurs. Design engineers leave the responsibility for maintaining the system in the hands of the building owner, who often is the least knowledgeable person in the chain of quality control of fire protection systems. The challenge as engineers is to design systems with the least amount of complications and ease of maintenance.

For example, engineers can design systems to minimize the need for auxiliary drains and to make it clear where sectional control valves are installed. Likewise, engineers can write simple documents to pass over to the owner at the time of acceptance testing that explain what they have in their building, what they may need in the future, and what limitations they may have on what they can do in their own buildings. If there are antifreeze systems in the building, for example, these documents can clearly indicate the concentration of the fluid and the type of fluid they need to use for replacement. If there is storage in the building, these documents can indicate maximum heights and commodity types so that the owner knows what they can do and can pass it on to tenants or other future owners.

One interesting maintenance challenge that has come up in recent times is in the control of bedbugs. It
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turns out that the best way to kill bedbugs is to heat the infested room to 170°F (77°C). Unfortunately, this also has the potential to set off the sprinklers in the same room. The National Fire Sprinkler Association (NFSA) is working with the sprinkler manufacturers and the listing labs to develop a protocol for leaving the sprinklers in place and heating the rooms. Until such time as a protocol has been developed, the only way to safely heat a room is to have a sprinkler contractor remove the sprinklers and then replace them when the treatment is done. Any other action has potential consequences that may impair the sprinkler system.

**EDUCATION CHALLENGES**

All of the issues discussed previously in this article have one thing in common. Every person in the fire protection business has to stay connected to a source of information to stay educated on what the problems are and what potential solutions exist to solve those problems. In many of the circumstances discussed here, the Fire Protection Research Foundation has played a significant role in developing a solution, or in starting research that will (hopefully soon) lead to a solution.

In other cases, the National Fire Sprinkler Association and the Society of Fire Protection Engineers are sources to look to for solutions to problems. Educational opportunities present themselves in many ways. Formal training is available in classrooms and over the Internet, and less formal opportunities arise at local Chapter and national conferences. With today’s quickly shifting codes, standards and research, the practicing engineer needs to stay plugged into a network of education and information to stay on top of all of the challenges, so that the client gets the best level of fire protection available.

*Kenneth Isman is with the National Fire Sprinkler Association.*

**References:**

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ISSUES AND FUTURE DIRECTIONS FOR WATER MIST FIRE PROTECTION SYSTEMS

By Jack R. Mawhinney, P.Eng., FSFPE
"Water mist" only became widespread as a formalized fire protection technology in the early 1990s. Initially, it was viewed as an alternative to gaseous fire extinguishing agents, for example the ozone-depleting halocarbon gases such as Halon 1301. At the same time (1990 to 1995), the International Maritime Organization (IMO) mandated the installation of sprinkler systems on passenger ships capable of carrying more than 36 overnight passengers.

This mandate created a second innovation motivator: to develop a new form of sprinkler system that would require less water and weigh less than conventional sprinkler systems of the day. Thus, in the marine sector, water mist systems were simultaneously developed for deluge-type, total-flooding fire protection systems for machinery spaces, and “water mist sprinkler systems” that were recognized by maritime authorities to be equivalent to automatic sprinkler systems.1,2

Creating and delivering water mist as an effective fire suppression agent demanded different types of hardware than traditional fire sprinkler equipment. The first decade of development saw the adoption of innovative ideas and hardware from non-fire related industries, such as positive displacement pumps from the hydraulics (machinery) field, and the use of compressed gas as an energy source.

By the end of the 1990s there were several distinct types of water mist systems on the world market: low pressure systems operating within the pressure range of conventional sprinkler pumps and fittings; intermediate pressure systems requiring slightly higher pressure than conventional sprinklers, and high pressure systems operating at pressures much higher than conventional sprinklers. The types of nozzles differed greatly, as different manufacturers attempted to “stake out” and patent their preferred atomization methods and lines of equipment.

Along with the innovations in hardware, the regulatory bodies and listing agencies such as IMO,1,2 Underwriters Laboratories, Inc. (UL)3 and FM Approvals (FM)4 began to develop test protocols to confirm the performance of water mist systems and to evaluate the reliability of components used in the systems. Component testing protocols were developed by IMO to test the corrosion resistance, serviceability and reliability of the new types of components being introduced.

Hardware such as positive displacement pumps and pneumatically-released deluge...
The details of how to properly select and install water mist piping and hardware are to be included in a Design, Installation, Operation and Maintenance (DIOM) Manual written by people who understand the cross-over equipment or materials better than NFPA 750 committee members.

Valves came from industries that did not have or need to obtain UL Listings or FM Approval. Therefore, the water mist approval protocols were designed to evaluate an assembly of components as a whole. Even if the individual valves/switches/motors contained in the assembly were not “listed” or “approved,” the assembly could be employed in a fire protection system if it passed the comprehensive performance tests.

A number of European testing laboratories became involved in the development of fire tests for water mist systems. Fire testing programs were developed at the Swedish National Testing Laboratory (SP); the Norwegian national fire laboratory (SINTEF); VTT Technical Research Centre and Verband der Schadenversicher (VdS) to show the performance of water mist against hydrocarbon fires in machinery rooms.1

Fire tests were also developed for Class A combustibles typical of accommodation spaces and shopping areas on cruise ships. The fire test protocols were discussed at meetings of the IMO fire protection committee over a number of years, and finally accepted as formal test protocols described in the Safety of Life at Sea (SOLAS) fire testing document.1

In North America, FM and UL initially borrowed both the component testing and fire test protocols developed for the marine sector, and began to modify them to reflect their own fire safety objectives for land-based applications. By 2005, FM Approvals had developed a water mist approval guide,4 which contains component testing requirements and fire test protocols for a variety of applications, including turbine enclosures, machinery spaces, industrial cookers, light hazard occupancies, wet benches and computer room subfloors.

The NFPA 750 committee was formed in the early 1990s and asked to write an installation standard for water mist systems. At first it was thought that the NFPA 750 document could be modeled on NFPA 13.5 Throughout North America and in several other parts of the world, NFPA 13 is used by all parties involved in manufacturing, designing, installing, approving and testing of sprinklers and sprinkler system components. Along with specifying materials and methods for pipe, fittings and hangers, NFPA 13 provides the design criteria needed
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to match the sprinkler system to the various occupancy classifications.

A major advantage of NFPA 13 is that it is an easily accessible installation standard. All manufacturers produce equipment that operates within its pressure limits and types of hardware; all engineers and designers refer to it for design criteria; Authorities Having Jurisdiction (AHJs) require compliance with it as the basis for their approval; and installers and maintainers are familiar with the installation and maintenance requirements.

The NFPA 750 committee observed that, in spite of its advantages, opportunities for increasing efficiency through innovation were limited by NFPA 13. If NFPA 13 requires a minimum density of, say, 8 mm/min (0.2 gpm/ft²), to control fire in a specific occupancy, any new technology utilizing less water density must utilize the equivalency or new technology generic sections to be accepted.

NFPA 750° was written with the purpose of allowing innovative ideas for increasing the efficiency of water-based fire protection systems. It was founded on the premise of performance-based design. NFPA 750 mandates that the application density for each type of water mist system be individually determined by fire testing to a comprehensive, unbiased fire test protocol.

Whereas NFPA 13 dictates that all pumps, pipes and fittings be of a certain type and pressure rating, NFPA 750 allows for a range of pressure regimes, energy sources and piping technologies. To support the use of non-traditional materials and piping methods, NFPA 750 sets only generic requirements, such as those needed for corrosion control and mechanical strength.

The details of how to properly select and install water mist piping and hardware are to be included in a Design, Installation, Operation and Maintenance (DIOM) Manual written by people who understand
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The cross-over equipment or materials better than NFPA 750 committee members. The DIOM manual is supposed to be reviewed and approved by the same listing or approval agency that conducted the fire tests and component evaluations. NFPA 750 establishes general design factors applicable to all water mist systems, such as hydraulic calculation procedures, acceptance testing, water quality and duration of protection. It also provides guidance to the testing agencies on what constitutes an adequate fire test protocol—e.g., it explains application parameters that must be taken into account in design of the fire test protocol, such as the geometry and ventilation conditions of the protected space. It relies on the manufacturers and the listing or approval agencies to have the expertise to generate the details needed to provide the design, installation, operation and maintenance requirements unique to the particular technology.

**HOW WELL HAS THE NFPA 750 MODEL WORKED?**

The basic model of NFPA 750 is supportive of performance-based design and allows innovation in the design of water-based fire protection systems. However, some potential end-users and manufacturers believe that the document is not an "installation standard" in the same mold as NFPA 13. NFPA 13 contains sufficient information to provide instruction on design criteria and detailed installation instructions for the hardware, that is, the pumps, pipe, fittings and hangers.

The designer may reference additional data sheets associated with special listed items, for example, special application sprinklers, but the majority of the technology associated with conventional sprinklers is contained in the standard itself or its appendices. The NFPA 750 approach is similar in principle, except that, because the content of technology utilized by different water mist equipment manufacturers may be new to the fire protection world, reliance on the external listing data sheet and DIOM manual is greater than with NFPA 13. Information that is necessary to accomplish a design and install the hardware is found only in the manufacturer’s proprietary DIOM
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manual. Water mist DIOM manuals may include instructions on piping or components that require special training by the manufacturer before a third-party engineer could specify a design. Therefore, although the NFPA 750 model is similar to current conventional practice with NFPA 13, the “technology transfer” experience with water mist technology is more involved, which appears to slow the acceptance of water mist systems.

There is interest among proponents of water mist systems in making NFPA 750 a more functional installation standard. Whatever change proposals are made, it is important not to lose sight of the original philosophy of allowing innovative technologies to be used to improve the efficiency of fire suppression systems. It would be a challenge, but not impossible, to incorporate critical design information for specific manufacturers into the document or as annexes. The document would be longer, but more readily useful to designers, end-users, authorities and installers.

A second barrier to the acceptance of water mist systems in land-based applications is that there are not enough approvals for the range of fire hazards encountered in buildings. Water mist sprinkler systems are already installed in accommodation spaces, shopping areas and public areas throughout passenger ships, and are approved under IMO as fully equivalent to sprinkler systems. However, there is limited comparable recognition for water mist sprinkler systems in land-based buildings.

There is growing interest in North America and Europe to have water mist systems installed throughout buildings and to be granted the same recognition under the building code as conventional automatic sprinkler systems. This objective is revealed in a recently released draft of proposed revisions to the European water mist standard, CEN/TS 14972.7. The CEN revision task group notes that in Europe the sales of land-based water mist sprinkler systems, similar in protection purposes to automatic sprinklers, now exceed the sales of machinery space systems, yet “sprinkler equivalent water mist systems” are not clearly identified as a distinct application in either CEN or NFPA water mist documents.

Both in the USA and in Europe there are water mist approvals for “light hazard” and “ordinary hazard” applications in buildings. Buildings potentially contain spaces such as extra hazard occupancies. Because of the limited approvals, the use of water mist to provide protection throughout some buildings may be limited.

Building codes have long recognized the increased safety provided by conventional sprinklers and provide various “trade-off” benefits in the construction of the building. Water mist systems are evaluated through performance-based testing, and have been shown to perform as well if not better than conventional sprinklers in fire tests. If a well designed water mist sprinkler system is
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installed throughout a building, and measures to ensure equivalent reliability to sprinkler systems are incorporated into the approval, the same building code recognition as conventional sprinklers should be allowed.

Gaining support for sprinkler equivalent water mist systems is likely to be the focus for water mist proponents for the next few years. Manufacturers must obtain approvals for the range of fire hazards in buildings, and they need to convince building and fire officials to grant appropriate trade-off recognition to water mist sprinkler systems as currently exists for conventional sprinklers. In addition, water mist may not be appropriate for all applications without further testing, just as sprinklers must be tested and listed for specific hazards. Examples include window or glazing sprinklers, and attic sprinklers.

On the other hand, sprinklers are sometimes granted a specific trade-off based on “tradition” rather than actual testing. It has occurred that when sprinklers were tested to the test standard to which water mist nozzles are tested, the sprinklers failed to meet the performance criteria demanded of the water mist system. Efforts to create a level playing field for comparison of the performance of conventional sprinklers and water mist systems are underway for the current NFPA 750 change cycle.

There is a further problem with NFPA 750’s deference to external fire test protocols for design criteria, and that is the matter of differences between the fire test protocols produced by different authorities for particular hazards. To give an example, IMO accreditation for total compartment flooding water mist systems for marine machinery spaces is based on the IMO published test protocol. In addition, FM grants an approval for water mist systems for machinery spaces, special hazard machinery spaces and combustion turbine enclosures, based on test protocols in the FM 5560 document. These two apparently similar approvals for “machinery spaces” are not equal in terms of performance. Explaining the significance of the differences to end-users and to the AHJ potentially contributes to doubts about the technology. It would better serve the users of NFPA 750 if it could provide enforceable language to resolve uncertainties created by inconsistencies between approvals from different organizations.

THE NEED FOR GOOD INFORMATION

Widespread acceptance of protecting buildings entirely by water mist systems is potentially limited by people’s perceptions of the capabilities of the systems. Many engineers who do not have a full appreciation for the capability of water mist believe that water mist systems rely on sealed enclosures to extinguish fires. In fact, systems that rely on “enclosure effects” are only one category of water mist application.

Such systems are defined as “total-compartment flooding type” in NFPA 750 and are suitable for Class B hydrocarbon fires in machinery spaces and turbine enclosures. However, water mist also works to extinguish or control fires in Class A combustibles in fully open
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This is the basis of performance for water mist sprinkler systems approved by FM Approvals for accommodation spaces and public spaces on passenger ships. Water mist sprinkler systems are tested in environments identical to automatic sprinkler testing and have been found to achieve equal or superior performance using significantly less water than conventional sprinklers.

In the other extreme, manufacturers or vendors who are enthusiastic about their water mist system may exaggerate its applicability. For example, the use of water mist as an alternative to gaseous extinguishing agents in computer rooms is subject to debate. For a computer room containing electronic equipment, there are many factors to consider in selecting an appropriate fire suppression agent. These factors potentially include the user’s objectives, the potential for certain types of electronic circuits to be irreversibly damaged by wetting or by corrosive products of combustion, the capability to extinguish a fire concealed in a computer cabinet, and both capital and life-cycle costs.

Water mist systems have been approved by FM Approvals for computer room subfloors and inside electronic cabinets, which may cause no more collateral damage than a gaseous clean agent. However, a different type of water mist system (i.e., sprinkler equivalent) will be required for general computer room protection. The use of water mist as an appropriate technology for protection of electronics is not clearly established in either NFPA 750 or the CEN standard. Further open discussion on this application, with input from approvals agencies such as FM Approvals, is needed.

It is in the interest of proponents of water mist systems to prevent harm being done to the credibility of the technology by spread of misinformation and inappropriate performance claims of water mist. Reported successes and demonstrated capabilities provide a foundation upon which confidence in water mist systems will rest. Successful control of fires by water mist should be documented for all types of water mist systems, including land-based systems and marine systems similar to automatic sprinkler systems. Failures in badly designed fire protection will potentially occur, as they do with all fire protection systems. Accurate reporting of such incidents is needed.

One avenue for improving general understanding of the capabilities of water mist systems is to invest in technology transfer opportunities, such as conferences and webinars, to provide accurate information about the successes and uses of water mist systems. This is where a strong industry organization of manufacturers could play a valuable role, in reporting incidents where water mist systems have successfully controlled fires, and at the same time providing a degree of control over the types of claims made by its members. This type of self-managed quality management among competing manufacturers would benefit all.

LONG TERM MAINTENANCE AND LIFE-CYCLE COSTING

Maintenance of water mist systems is vital to the long-term reliability of the protection. If not properly maintained, the potential for plugging of small orifices in nozzles is higher for water mist systems than with conventional sprinkler systems. Therefore, it’s important to monitor water quality and evaluate the functionality of components.

Certain maintenance needs will be unique to a manufacturer’s particular water mist system. This may limit the competition for choice of maintenance contractors, or special training will be needed for maintenance personnel within the organization. The on-going costs of the level of maintenance needed for a water mist system must be reflected in the presentation of life-cycle costs for a water mist system.

Some organizations have a well-established culture of maintenance of fire protection systems. One large industrial end-user of water mist systems with a well-trained staff dedicated to maintenance identified the following factors that increased the costs of maintenance and the skill required to accomplish it, over what they had expected:

- Some type of water mist system releasing valves proved to be difficult to reset after annual activation tests, increasing labor costs for servicing the systems over original estimates.
- It is useful to have a borescope (video camera on a flexible probe) to inspect the interiors of water storage cylinders to evaluate the condition of liners.
- Maintaining the quality of stored water in tanks is reported to be difficult, with accumulations of “gunk” showing up on strainers and screens after annual activations.

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end-user increased the frequency of maintenance inspections and specified details of the procedures. A borescope is now routinely used to inspect the interior of water storage cylinders or tanks; water tanks are drained and refilled with water of a specified quality semi-annually rather than annually, and screens and filters are inspected more frequently than was recommended in the manufacturer’s DIOM or in NFPA 750.

In discussing the possibility for installing water mist sprinkler systems in US embassies abroad, the advantages of a system requiring less water than conventional sprinklers were viewed favorably, but facilities managers were concerned about the ability of local contractors to install or maintain the systems. From their perspective, the reliability of the fire protection system should not depend on skills that are likely to be absent in the local work force.

The next edition of NFPA 750 (2013) will hopefully strengthen the message that water mist systems require quality maintenance to remain reliable over time. Inspection, testing and maintenance procedures must be frequent, thorough and sustained over the service life of the system. The true cost of maintenance should be factored into the life-cycle cost of the systems.

Jack Mawhinney is with Hughes Associates, Inc.

References:
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NFPA 13
SPRINKLER SYSTEM DESIGN

DENSITY CURVES - WHERE DID THEY COME FROM?

By Garner A. Palenske, P.E.
INTRODUCTION

The use of water as a fire suppression or control medium has proven reliable, effective and economical. Scientific methods to quantify, predict or explain why are still developing. One thing is evident—the track record of sprinkler performance is exceptional, so much so that automatic sprinklers are an important component of modern fire protection strategy.

NFPA 13 provides designers with a range of sprinkler densities and application areas. The design criteria applicable to typical residential and commercial buildings are based on matching the building occupancy to one of five classes of occupancy hazard—light, ordinary hazard (O.H.) groups 1 and 2, and extra hazard groups 1 and 2. NFPA 13 graphically describes multiple potential design points for each of these five occupancy classes.

The basis and development of these curves date back to 1972 in the era when hydraulic calculated sprinkler systems were becoming recognized as an alternative to the pipe-schedule method of design. During this time (‘70s and prior), pipe schedule systems were considered to have performed effectively. Relating pipe-schedule system performance to hydraulically calculated systems was the next step towards quantifying and engineering sprinkler system performance for the future. Additionally, there was interest in the hydraulic criteria needed to protect storage occupancies with increasingly higher storage arrays and with varying hazard levels of combustible contents.

The design criteria found today in NFPA 13 for storage occupancies can be traced mainly to fire tests conducted in the 1970s. These tests used standard 165°F (74°C), ½” (13 mm) orifice sprinklers and a test commodity intended to simulate cartoned wood and paper products. As with most historical data, one must view this in proper context. In the 1970s, standard 165°F (74°C), ½” (13 mm) orifice sprinklers were the only sprinklers commonly available. The performance characteristics of sprinklers, such as response time index or droplet size, were largely unknown. In addition, the world was just being introduced to plastics, as both packaging material and products themselves. The majority of the material found within a typical warehouse consisted of wood and paper products.

For rack storage, multiple area and density baseline testing was conducted on a Class II commodity. Standard 165°F (74°C), ½” (13 mm) orifice sprinklers were used in the majority of the tests. Specific application curves for various other commodities were developed by single design criteria testing and simply creating parallel curves to that of the Class II testing. No tests were performed to validate this concept of parallelism.

For other storage arrays, such as solid pile, palletized and shelf storage, approximations of design criteria were made based upon a reduction of the rack storage criteria. This was a prudent approach, given fires within such arrays were generally considered to be less severe than those within rack arrays.

OCCUPANCY AREA/DENSITY CURVES

The 1972 Edition of NFPA 13 contains the first appearance of area/density curves to be used for the design of hydraulically calculated sprinkler systems (Figure 1). Members of the NFPA 13 Committee report that the curves were based on studies of a number of pipe schedule systems. Chester Schirmer, past Chairman of the NFPA 13 Committee, reported the following explanation of the curves:

The basis for the NFPA 13 curves was a study by Jack Wood and one other (can’t at this moment recall who) of a number of pipe schedule system arrangements. These were evaluated to determine the area density characteristics of light, ordinary and extra hazard pipe schedule systems. The consideration here was the fact that historically, pipe schedule systems had a good (or excellent) performance record. A wide variety of system arrangements were reviewed to determine their density/area characteristics. This information, along with fire test data, provided the foundation for the curves.
A 1974 memo from the Insurance Services Office (ISO) cited comments of the Factory Insurance Association – Travelers, regarding proposed changes to the original 1972 NFPA 13 area/density curves. The comment as it appears in the 1974 memo is quoted as follows:

It is interesting to compare the curves proposed and the hydraulic calculation results submitted to the Chapter 2 subcommittee. The curves were drawn from the results of hydraulic calculation of schedule systems with 1,500 square feet (140 m²), 3,000 square feet (280 m²), and 5,000 square feet (460 m²) areas of application. With three curves (Ordinary Hazard 1, 2, and 3) and three pre-selected areas, this gave 9 points to graph. The intent of these calculations appears to be to determine what density over these specific areas of application will result in top line pressures of 15 psi (100 kPa), 30 psi (210 kPa), 45 psi (310 kPa), 60 psi (410 kPa), and 75 psi (520 kPa). This apparently in an effort to be competitive with table 2.2.1 (A) which asks for 15 psi (100 kPa) or higher for Ordinary Hazard Group 1 and 2. Interestingly enough, only 1 out of the 9 points were based on 15 psi (100 kPa) top line pressure (.08 gpm/sq.ft. [3 mm/min] at 5,000 sq.ft. [460 m²]) which is less than 7 psi (50 kPa) end head pressure per comment #2). Two points were the result of 30 psi (210 kPa) top line, three with 45 psi (310 kPa) top line, two with 60 psi (410 kPa) top line, and one at 75 psi (520 kPa) top line.

As a follow-up to the comment by Travelers, Jack Wood of the Viking Corporation provided a detailed explanation of the calculation for one 8-inch (200 mm) supplied pipe schedule tree system. It is apparent in Wood’s letter that it was arbitrarily assumed that O.H. Group 1, O.H. Group 2 and O.H. Group 3 pipe-schedule systems would be supplied, respectively, by 15 psi (100 kPa), 30 psi (210 kPa), 45 psi (310 kPa) top-of-riser residual pressure to sprinklers assumed operating over 5,000 ft² (460 m²). The central explanations of Wood’s study are found in items 1(a) and 5 of Wood’s May 7, 1974 letter:

**Item 1(a).** If we used the hydraulically most remote area in our calculations, the end sprinkler density would be 0.062, 0.090, and 0.110 GPM per square foot (2.5, 3.7 and 4.5 mm/min) for Groups 1, 2 and 3 (5,000 square feet [460 m²]) respectively. We moved the operating area to the center of the system where the cross main sizing is 6-inches (150 mm) and the densities increased to 0.081, 0.12, and 0.15 GPM per square foot (3.3, 4.9 and 6.1 mm/min) for Groups 1, 2 and 3. These values are the top points of our three proposed curves and would be used over the hydraulically most remote area per chapter 7. This amounts to about a 30% increase over the values we could have proposed had we selected the hydraulically most remote area.

**Item 5.** The pressures at the top of the sprinkler riser were selected arbitrarily; however, the only case in which we used the minimum pressure allowed in Table 2.2.1(A) is Class I with 5,000 square feet (460 m²) operating. These various pressures were used in order to provide a slope to the curves. In my opinion, this slope is as accurate as the [NFPA] 231C curves and really makes more sense. We have used the calculated amount of water an ordinary hazard system will deliver in the center of the system to produce these curves.
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An attachment to Wood’s 1974 letter contained a table that lists Wood’s data for the operating area calculated at the center of the system. Wood’s Summary Table is repeated in table 1 along with the resulting 1974 NFPA 13 area/density curves (Figure 2). The curves are annotated to show how Wood’s data served to anchor the top and bottom points used to form the curves.

The effect of Wood’s 1974 analysis is the 1972 O.H. area/density curves are shifted to the left, slightly reducing the design requirements for sprinkler density at any given area. Wood provided a comparison of the curve generated from his data to the NFPA 13 (1972 Edition) and the single point density and area recommendations of Factory Mutual’s Loss Prevention Bulletin 3-26. Chester Schirmer’s handwritten notes also provide for a comparison to NFPA 231.

In 1972, the NFPA 13 light hazard curve extended to an operating area of 5,000 ft² (460 m²) with a design density of 0.075 GPM/ft² (3 mm/min). The revision for the 1974 edition resulted in a reduction of the allowable operating area from 5,000 ft² (460 m²) to 4,000 ft² (370 m²), at which 0.05 GPM/ft² (2 mm/min) was indicated as the required design density.

Table 1. Wood’s Summary Table for Development of 1974 NFPA 13 Area/Density Curves

<table>
<thead>
<tr>
<th>Operating Area</th>
<th>AVERAGE PRESSURE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1,500 ft² (140 m²) (13 SPRKS)</td>
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<tr>
<td>PSI</td>
<td>kPa</td>
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<td>310</td>
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<td>60</td>
<td>410</td>
</tr>
<tr>
<td>75</td>
<td>520</td>
</tr>
</tbody>
</table>

The apparent basis for this change was related to the work done in the United Kingdom by the Fire Offices’ Committee (FOC). A letter from H.W. Marryatt of the Australian Fire Protection Association responds to correspondence of a NFPA 13 Committee member’s concern for the degree of light hazard and extra light hazard systems (per the FOC, “extra light hazard occupation included hospitals, hotels, institutions, libraries, museums, nursing homes, office buildings, prisons, schools, colleges”). Marryatt’s response to the NFPA 13 Committee member is quoted as follows:

In reading the copies of correspondence from members of the NFPA 13 committee, it appears that several people are concerned about two questions in particular regarding the design of systems for light hazard and extra light hazard occupancies. The point is whether the design density of discharge of 0.05 gallons per sq.ft. per minute [2 mm/min] is adequate, and one correspondent suggested that this figure should be doubled. Bearing in mind that the figure used in both the Australian standard and the F.O.C. Rules is in imperial gallons,
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I know that the research work carried out in the U.K. prior to the introduction of the 29th Edition of the F.O.C. Rules establishes pretty clearly that this density or discharge would establish control in an extra light hazard occupancy, and in fact it gave a reasonable factor of safety as tests indicated that control was reliable down to 0.05 gallons per sq.ft. per minute [2 mm/min].

Additionally, insight into the 1974 change to the 0.05 GPM/ft² (2 mm/min) density for light hazard occupancies is provided by Wood in his May 7, 1974 letter. Wood comments on the F.O.C. density requirements as follows:

I know the F.O.C. water supplies are considered too light by many, but they require a density of 5 mm per minute (0.12 GPM per square foot) regardless of whether the hazard is Ordinary I, II, III or III Special. They increase the area of application as follows: I – 775 square feet [72 m²], II – 1550 square feet [144 m²], III – 2324 square feet [216 m²], and III Special – 3874 square feet [360 m²]. Our proposed curves exceed their requirements in all cases.

The area/density waiver remained unchanged until the 1991 edition of NFPA 13, with one exception. In 1978, the extra hazard group 1 and group 2 area/density curves were added to the appendix of NFPA 13 as guidance for occupancies involving a wide range of variables that could produce severe fires.

For the 1991 edition, a number of changes were instituted affecting all of the area/density curves. The 1991 edition area/density curves are the curves currently found in the 2010 edition of NFPA 13 (Figure 3). It is noted that an O.H. 3 curve no longer appears as the O.H. 2 and O.H. 3 curves of prior editions were combined resulting in a revised O.H. 2 curve in 1991. Also, the curves are no longer arcs, but are all represented as straight line relationships.

**STORAGE AREA/DENSITY CURVES**

The rack storage fire protection committee was organized in August 1967 by representatives of rack manufacturers fire protection equipment manufacturers, and fire insurance interests. They were joined...
1. The state or quality of being efficient; competency in performance.
2. Accomplishment of or ability to accomplish a job with a minimum expenditure of time and effort.¹
3. Using quality products that provide a low life-cycle cost including ease of maintenance, low cost repair kits, high test reliability, superior corrosion resistant materials, from a company that provides excellent customer service and technical support, on-time delivery at competitive prices.²

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1. Definition by www.dictionary.com
2. Definition by Wilkins, a ZURN company
shortly by representatives from a wide cross-section of the industry. Committee members were interested in finding ways and means of providing effective protection for racked storage through a comprehensive, full-scale, fire test program.

In 1968, the NFPA committee on rack storage was organized. The data from the rack storage fire protection committee was given to the NFPA committee to develop a standard that was “supported entirely by actual fire test data.” This new standard, NFPA 231C, was first adopted in May 1971.

The requirements found in NFPA 231C were eventually integrated into the 1999 edition of NFPA 13. The sprinkler design requirements found in both NFPA 231C, and more recently in NFPA 13, were shown via curves.

The rack storage fire protection committee began by conducting over 70 small-scale commodity tests in an attempt to find a commodity that was representative of the broad range of combustibles that might be found in a warehouse situation. It was necessary to select a commodity that not only represented the burning characteristics of this range of combustibles, but one that would also be readily available and inexpensive enough to be used throughout the full series of tests.

A double, tri-wall carton (the equivalent thickness of six layers of corrugated cardboard) was selected. The first four full-scale tests (Test Nos. 60, 61, 62, and 63) were conducted using this commodity. These tests opened a large number of ceiling sprinklers and therefore were considered unacceptable. It was determined that the fire progressed in a normally expected manner until the fire penetrated the cartons. At that time, the entire interior of the carton started to burn and was shielded by the carton from sprinkler water discharge.

Full-scale Test No. 64 (Hallmark products – consisting of a mixture of various paper products, including greeting cards, paper party favors, cups, small amounts of table flatware, etc.) was conducted to observe fire conditions with a real-life commodity and compare these conditions with previous tests. Results more closely approximated real-life burning characteristics than previous tests.

Small-scale tests were also run with Hallmark products for comparison with the double, tri-wall carton and with a double, tri-wall carton containing a 24-gage (0.6 mm) 38” x 38” x 36” (970 mm x 970 mm x 910 mm) high metal liner. The presence of this metal liner in the double, tri-wall carton resulted in a commodity that had fire development characteristics that closely
resembled the Hallmark products, as well as those that might be found in many warehouses within the broad range of ordinary combustibles. This became the standard commodity to be used in future full-scale tests. The average weight per pallet load of the standard commodity was 226 lbs (103 kg). The average weight per pallet load of Hallmark products was 500 lbs (225 kg) and 3M products were 900 lbs (400 kg) (weights include pallets).

The testing utilized primarily 165°F (74°C) rated sprinklers. Tests were also conducted to evaluate the performance of 286°F (140°C) rated sprinklers. Of the 60 tests conducted with 20 ft (6 m) storage, 10 used 286°F (140°C) rated sprinklers. The results of these tests showed a reduction in design area of approximately 55% when 286°F (140°C) rated sprinklers were used. As a result, a 40% reduction in area was used to form the curve for the use of 286°F (140°C) sprinklers. One test of 212°F (100°C) rated sprinklers showed a marginal performance difference compared to that of a 165°F (74°C) sprinkler, and, appropriately, no specific design curve was included for 212°F (100°C) rated sprinklers.

Full-scale tests were conducted with the standard commodity (double, tri-wall carton with metal liner) Hallmark products, and 3M products (abrasives, pressure sensitive tapes of plastic fiber and paper, etc.). The committee reviewed these results and developed a new guide or relative scale, to classify products as follows.

Class I
Non-combustible products on wood pallets or in ordinary paper

Conservative requirements, such as designing to a constant sprinkler pressure, inclusion of hose allowances, and reduction in water supply capacity provide an additional factor of safety.

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cartons or wrappings on wood pallets, such as metal parts, empty cans, glass containers, non-combustible food stuffs or beverages, stoves, washers, dryers, and metal cabinets with plastic handles or knobs.

**Class II**
Class I products in slatted wood crates or solid wooden boxes on wood pallets.

**Class III**
Wood, paper, natural fiber cloth or products thereof (containing no more than a negligible amount of plastics in the product or in the packaging material) on wood pallets, such as natural fiber clothing or textile products, wooden furniture or wood products, bicycles, luggage (except plastic), combustible foods or cereal products, paper products, leather goods, and wooden cabinets with plastic knobs or handles.

**Class IV**
Class I, II and/or III mixed with more than a relatively negligible amount of plastics (used in the product or packaging material) on wood pallets, such as small appliances with thermosetting plastic cabinets, typewriters, cameras or electronic parts in plastic packaging in cartons, and plastic backed tapes.

High heat release products, such as plastics and flammable liquids, were considered outside the scope of that project.

The concept of parallelism was agreed upon. This involved the establishment of a base curve for a standard commodity with all variables constant except sprinkler discharge density. Additional curves, for Class III and IV, were constructed through a single point parallel to the base curve. For Class III commodities, Test No. 64 (Hallmark products).
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was used. For Class IV commodities, Test No. 78 (3M products) was used. Class I commodity densities were reduced 12% less than Class II, based upon a Class III/Class II comparison. If the slope of the developed curve was different from the base curve, the slope of the developed curve was changed to agree with the base curve (Figures 4 and 5).

The committee acknowledged that the concept of parallelism was somewhat arbitrary and that testing through three data points per curve was preferred; however, the project budget did not allow such effort. The use of automatic sprinklers to protect people and property from the consequences of fire has withstood the test of time. Anecdotal review of fire data shows that sprinklers perform well when designed and installed in accordance with NFPA 13. It should be noted that NFPA 13 includes design requirements that cloud understanding of the adequacy of the area/density curves. Conservative requirements, such as designing to a constant sprinkler pressure, inclusion of hose allowances, and reduction in water supply capacity, provide an additional factor of safety. Therefore, whether the outstanding performance of sprinklers is a measure of the adequacy of the area/density curves or a function of the conservative nature of sprinkler design as a whole has yet to be determined.

Garner Palenske is with Aon Fire Protection Engineering Corporation.

References:

This article is based upon the report, Palenske, G. & O’Connor, D. "Single Point Sprinkler Design Criteria vs. Traditional Design/Area Methods," Fire Protection Research Foundation, Quincy, MA, 2007.
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Automatic sprinklers have come a long way since Henry H. Parmalee introduced the first practical automatic sprinkler in 1874. Parmalee’s sprinkler led to a major step in the advancement of industrial fire protection. Prior to the introduction of his sprinkler, sprinkler systems typically consisted of steel pipes equipped with perforated holes through which water would flow, similar to today’s deluge-type sprinkler system. Roughly seven years after the introduction of the Parmalee sprinkler, Frederick Grinnell began modifications to the sprinkler that allowed for it to be more effective and produced at a lower cost.

With the advent of the automatic sprinkler system came guidelines for sprinkler system installations as well as guidelines for sprinkler system designs. On November 16, 1891, the Associated Factory Mutual Insurance Company (now known as FM Global) released the first automatic sprinkler system installation guideline entitled, Location and Spacing for Automatic Sprinklers. The design for automatic sprinkler systems became rooted on a pipe schedule basis where the size of the sprinkler system piping was based on the number of sprinklers located downstream of the pipe. The pipe schedule method was divided into three categories: light hazard, ordinary hazard and extra hazard pipe.
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schedule. Based on the anticipated hazard of the occupancy to be protected, the size of the sprinkler system pipe was then determined by the number of sprinklers that were installed downstream of it.

The pipe schedule design method offered a simple means for determining the proper size of a sprinkler system. It, however, did not take into account the water supply available for the automatic sprinkler system, nor did it allow for flexibility when the occupancy hazard protected by an existing sprinkler system increased.

Even with these drawbacks to the pipe schedule design method, automatic sprinkler systems prior to the 1950s did an excellent job of keeping fires under control until the local fire service was able to arrive and manually extinguish the blaze. This was due in large part to the combustible loading of the stored materials being relatively low, coupled with the relatively low storage and ceiling heights maintained in warehouse areas.

However, at the start of the 1950s, changes in industrial practices demonstrated the limitations of the pipe schedule design method. At this time came (1) an increased use of steel supported building structures, (2) the invention of the fork-lift truck and (3) an increased use of plastic materials.

Although the use of steel allowed buildings to be built higher than before, steel weakens at elevated temperatures. Since industrial fires can exceed these elevated temperatures, they create a condition where a building structure could possibly collapse due to the failure of a steel column even when automatic sprinkler protection was provided at ceiling level.

The invention of the fork-lift truck allowed storage height to be dramatically increased, which prior to the 1950s was only about 6 to 8 ft (2.0 to 2.4 m) high, or as high as a person could lift the stored item. In addition, most commodities maintained in storage areas prior to this timeframe consisted of ordinary combustibles, such as materials made from metal, glass or wood. The introduction of plastic materials increased the fire hazard within industrial facilities as the heat of combustion is two to three times higher than ordinary combustibles. ²

To account for these changes, research conducted at FM Global in the 1950s³ led to two major changes in fire protection. The first major change was the introduction of the standard spray automatic sprinkler, which modified the sprinkler deflector to discharge nearly all of the water towards floor level in a parabolic shape. The second major change was the introduction of the density/area design concept. This concept identified a specific flow rate per sprinkler for all sprinklers operating within an indicated area. Unlike the pipe schedule design method, the density/area design concept required the water supply to be evaluated to verify that it could provide the necessary flow and pressure for the required design.

Although the design/area design concept worked well, testing at FM Global in the 1960s and 1970s demonstrated that the sprinkler technology at that time was not very effective for storage-type occupancies. As a result, research was initiated at FM Global in the 1970s to develop a sprinkler specifically intended for the protection of storage. This research led to the development of the "large-drop" sprinkler. This advancement in sprinkler performance also led to a new design.
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format, one based on a specified minimum operating pressure at the most remote sprinkler while simultaneously opening an indicated number of sprinklers. A decade later, FM Global used the knowledge gained from the large-drop sprinkler program, coupled with another project from the 1970s that helped develop the quick-response thermal element, to develop the sprinkler concept that would eventually lead to the development of the “early suppression fast response” sprinkler, or ESFR for short. The design format for the ESFR sprinkler was also based on the same design format used with the large-drop sprinkler.

By the start of the 21st century, sprinklers were commercially available in various K-factor sizes, orientations, nominal temperature ratings, RTI ratings, finishes and spacing coverage. They had been grouped into three categories, known today by the terms “control mode density area” (CMDA), “control mode specific application” (CMSA) and “suppression mode” (formerly called ESFR) sprinklers. The first two categories group sprinklers by an assumed performance during a fire event (i.e., control of a fire) whereas suppression mode sprinklers are assumed to suppress any fire that they protect. The assumed suppression performance allows for a reduced number of sprinklers in the design area (typically 12 sprinklers) as well as a reduced hose stream allowance (250 gpm [950 Lpm]) and sprinkler system duration (1 hour). The CMDA sprinklers differ in design format as they utilize the density/area design format whereas both the CMSA and suppression mode sprinklers use the number of sprinklers at a given minimum pressure design format.

Automatic sprinkler protection is the best line of defense against fire within an industrial facility; however, since the release of the first installation and design guidelines back in 1891, the requirements for automatic sprinklers have become much more complex.

Automatic sprinkler protection is the best line of defense against fire within an industrial facility; however, since the release of the first installation and design guidelines back in 1891, the requirements for automatic sprinklers have become much more complex. Prior to 2010, FM Global’s installation guidelines for automatic sprinklers were provided in the following three data sheets: Data Sheet 2-2, Installation Rules for Suppression Mode Automatic Sprinklers, Data Sheet 2-7, Installation Rules for Sprinkler Systems Using Control Mode Specific Application (CMSA) Ceiling.
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Sprinklers for Storage Applications, and Data Sheet 2-8N, NFPA 13 Standard for the Installation of Sprinkler Systems, 1996 Edition, encompassing a total of 344 pages. In addition, the design guidelines for typical warehouse occupancies, covered in FM Global Data Sheet 8-9, Storage of Class 1, 2, 3, 4 and Plastic Commodities, consisted of 123 pages.

To help reduce the complexity of automatic sprinkler installation and design, FM Global established a new method of classifying automatic sprinklers in 2010. Instead of categorizing sprinklers based on an assumed performance during a fire event, such as control mode or suppression mode sprinklers, FM Global now categorizes sprinklers based on intended application using the terms “storage sprinklers,” “non-storage sprinklers” and “special protection sprinklers.” The intended application of storage sprinklers is for protection of storage-type occupancies as well as other high heat release occupancies. The intended application of non-storage sprinklers is for the protection of non-storage occupancies, such as offices as well as manufacturing or other moderate heat release rate occupancies. The intended application of special protection sprinklers is for the protection of occupancies not generally covered by the other two categories.

This new method allows for a clearer understanding of the compatibility of the sprinklers with the occupancy they are to protect and allows for a single design format for all sprinklers. FM Global has chosen the number of sprinklers at a given minimum pressure design format to allow the design of a sprinkler system to be based on the actual performance of the chosen sprinkler as opposed to an assumed performance or, in the case of the density/area design method, the performance of the least efficient sprinkler.

Based on this new approach, FM Global has taken its three data sheets for sprinkler system installation and combined them into a single document entitled Data Sheet 2-0, Installation Guidelines for Automatic Sprinklers. The installation guidance provided within this new document addresses the specific requirements for storage sprinklers, non-storage sprinklers or special protection sprinklers, coupled with the installation guidelines that are common to all three types of sprinklers.

Also, as a result of this new approach, FM Global Data Sheet 8-9 now references the use of FM Approved storage sprinklers at ceiling level and when needed, as in-rack sprinklers. In addition, the ceiling-level designs offered in Data Sheet 8-9 are now based on five attributes associated with a sprinkler: (1) K-factor, (2) orientation, (3) response time index (RTI) Rating, (4) sprinkler spacing and (5) temperature rating.

By going to the storage sprinkler concept, the design approach for sprinklers within Data Sheet 8-9 is now based on the number of sprinklers operating at a given minimum pressure. This means that the design approach of density/area has been eliminated from Data Sheet 8-9. To many in the fire protection community, this may appear illogical as sprinkler systems that have been installed using the density/area design format have
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performed very well since the design concept was introduced in the 1960s. However, FM Global feels there are limitations with this design approach. These limitations include: (1) current density/area protection tables must be based on the performance of the least effective sprinkler listed for the table, and (2) the ability of the most remote sprinkler’s design pressure must be dependent on the installed sprinkler’s spacing.

For the first point, consider two full-scale fire tests conducted at FM Global’s Research Campus. The tests involved open-frame rack storage of expanded plastics to 15 ft (4.5 m) high under a 30 ft (9.1 m) high ceiling with 8 ft (2.4 m) wide aisle provided between storage racks. The tests used CMDA standard-response K11.2 (K160) 160°F (70°C) nominally rated sprinklers on 10 x 10 ft (3.0 x 3.0 m) spacing. For the first test, this arrangement was protected using a 1.00 gpm/ft² (40 mm/min) density with an upright sprinkler, whereas the second test was conducted using a 0.60 gpm/ft² (24 mm/min) density with a pendent sprinkler. With the 1.00 gpm/ft² (40 mm/min) density and an upright sprinkler, the test resulted in 32 sprinklers opening, whereas only 10 sprinklers opened using the 0.60 gpm/ft² (24 mm/min) density with a pendent sprinkler. These two tests help to demonstrate that density is not a driving factor for sprinkler system design. In addition, using today’s density/area design concept, the design for both sprinklers would be the same and would have to be based on the results of the K11.2 (K160) upright sprinkler, which had the poorer performance in this particular test.

The test comparison outlined above is representative of many of the tests that FM Global has conducted over the decades when comparing various sprinkler attributes. In general, test results will differ when a sprinkler’s K-factor, orientation, RTI rating and nominal temperature rating is changed. What tests over the past 40 years have demonstrated is that the amount of water that is discharged from ceiling-level sprinklers in terms of temperature rating is changed. What tests over the past 40 years have demonstrated is that the amount of water that is discharged from ceiling-level sprinklers in terms of an applied density is not as important as the amount of water that actually reaches the fire area, which can be thought of as an actual delivered density (ADD). What helps increase the ADD during a fire event can be found.

### Table 7. Ceiling-Level Protection Guidelines for Class 1, 2 and 3 Commodities in Open-Frame Rack Storage Arrangements

<table>
<thead>
<tr>
<th>Ceiling Height, ft (m)**</th>
<th>Wet System, Pendent Sprinklers, 160°F (70°C)****</th>
<th>Wet System, Upright Sprinklers, 160°F (70°C)</th>
<th>Dry System, Upright Sprinklers, 280°F (140°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quick Response</td>
<td>Standard Response</td>
<td>Standard Response</td>
</tr>
<tr>
<td>K11.2 (K160)</td>
<td>20 @ (0.5)</td>
<td>20 @ (0.5)</td>
<td>20 @ (0.5)</td>
</tr>
<tr>
<td>K14.0 (K200)</td>
<td>25 @ (0.5)</td>
<td>25 @ (0.5)</td>
<td>25 @ (0.5)</td>
</tr>
<tr>
<td>K18.8 (K240)</td>
<td>30 @ (0.5)</td>
<td>30 @ (0.5)</td>
<td>30 @ (0.5)</td>
</tr>
<tr>
<td>K22.4 (K280)</td>
<td>35 @ (0.5)</td>
<td>35 @ (0.5)</td>
<td>35 @ (0.5)</td>
</tr>
<tr>
<td>K25.2 (K320)</td>
<td>40 @ (0.5)</td>
<td>40 @ (0.5)</td>
<td>40 @ (0.5)</td>
</tr>
<tr>
<td>K25.2EC (K360EC)</td>
<td>45 @ (0.5)</td>
<td>45 @ (0.5)</td>
<td>45 @ (0.5)**</td>
</tr>
</tbody>
</table>

Figure 1. Example protection table from FM Global Data Sheet 8-9, Storage of Class 1, 2, 3, 4 and Plastic Commodities

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* Based on maximum water delivery time of 25 seconds. ** Based on maximum water delivery time of 20 seconds. *** The protection options indicated in the protection table can be based on any ceiling height equal to or higher than the actual maximum ceiling height of the protected area. **** The protection options indicated in the protection table for upright sprinklers can also be used as an alternative option for pendant sprinklers having the same K-factor, RTI rating, nominal temperature rating and spacing requirements as the upright sprinkler. ***** The design of 8 @ 40 (2.4 ft) has a hose stream allowance of 250 gpm (950L/min) and a duration of 60 minutes when the maximum linear spacing is up to 12 ft (3.6 m), for linear spacing over 12 ft (3.6 m) the hose stream allowance is 500 gpm (1,900 L/min) and the duration is 120 minutes.

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in the aforementioned attributes of a sprinkler, namely orientation, K-factor, RTI rating, temperature rating and, in some degree, sprinkler spacing. Because of this, FM Global now uses these five attributes to define the protection required for storage arrangements handled by Data Sheet 8-9 using the number of sprinklers at a given minimum pressure design format. A protection table from Data Sheet 8-9 is shown in Figure 1.

In addition to being easy to read, this protection table actually replaces a total of 9 protection tables from the June 2009 version of Data Sheet 8-9, making it less complicated than prior versions.

By moving to the new categorization of Storage sprinklers, FM Global has created a new method by which the hose stream allowance and the duration of a sprinkler system is determined. FM Global now bases the hose stream allowance and the required duration of a sprinkler system, in general, on the number of sprinklers in the ceiling design chosen. Some of the protection options shown in Figure 1 are highlighted with a green background. What these highlighted options represent are options that require only a 250 gpm (950 Lpm) hose stream allowance and a duration of only 1 hour.

With these changes, coupled with anticipated future changes in both FM Global Data Sheets 2-0, 8-9 and other design-based data sheets, FM Global aims to provide the most effective installation and design protection options, which are intended to be simpler to understand, less costly to install, but a more sustainable choice.

Weston C. Baker Jr. is with FM Global.

References:
7. FM Global Property Loss Prevention Data Sheet 8-9, Storage of Class 1, 2, 3, 4 and Plastic Commodities, FM Global, Norwood, MA, 2009.
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Ames Fire & Waterworks Backflow Assemblies

Colt Series Backflow Assemblies from Ames Fire & Waterworks feature the most compact valve design in the industry. One of the most compelling reasons customers choose this series is its lightweight, versatile nature, which sacrifices nothing in strength and durability, but offers significant cost-savings in installation and maintenance.

Ames solutions feature an entire valve body and closure sleeve manufactured from 300 Series stainless steel. This makes them much easier and cheaper to maintain and service. Some competitors’ typical 4” assemblies can require three laborers and a crane or backhoe to install; with the Colt Series one person can carry the valve and perform the installation.

Versatility and durability are two other key benchmarks for backflow equipment, and the Colt series delivers there also. They offer the ability to use gate valves or UL/FM butterfly valves. They are configurable in horizontal, vertical, “N” pattern or “Z” pattern installations — with the smallest enclosure and the most compact design in the industry.

Colt assemblies feature the most advanced design on the market, with low pressure loss and short lay lengths. They use groove connections for ease of installation and pipe alignment and offer a link-check module for ease of serviceability. This complete line of solutions ranges from the 200 Series Double Check Assembly and 300 Series Double Check Detector Assembly to the larger 400 Series Reduced Pressure Assembly and 500 Series Reduced Pressure Detector Assembly.

The Colt 300 Series are used to prevent backflow of non-toxic pollutants. The Double Check Detector Assembly is used primarily on fireline sprinkler systems when it is necessary to monitor unauthorized use of water.

The Colt 500 Series is installed on fire protection systems connected to the public water supply in a high-hazard application — such as in colder climates, where anti-freeze might be added to the system. The Colt 500 is also used to monitor unauthorized use of water from the fire protection system.
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Eiffel Tower Victaulic Pre-action Fire Protection System Can Withstand Pressures of Up to 21 Bar

When the Safety and Security team at the Eiffel Tower was looking to install a new fire protection system they needed a system which would provide the highest possible level of safety for a construction which is 324 meters high and visited by around seven million people each year. Following a comprehensive process, SETE, the company that runs the Eiffel Tower, selected a Victaulic pre-action system to meet the stringent fire safety standards in the tower.

In a construction like the Eiffel Tower, a premature water response could be as disastrous as a fire. In a pre-action system, the pipelines are pre-charged with pressurized air. Water is held from the piping by an electrically actuated solenoid, which is activated by an alarm signal. If an alarm system detects smoke, for example, the valve opens to fill the system piping. If temperatures rise from an actual fire, the sprinkler bulb bursts to distribute water immediately. As a result, water is only then distributed to the site after a sprinkler is heat-activated – minimizing false alarms by requiring two events to occur before the system is activated.

The Victaulic pre-action system was selected for its pressure rating of up to 21 bar where most systems are only rated up to 17.5 bar. The system is also approved by the CNPP (National Centre for Prevention and Protection), which was a major consideration as it would have been difficult to insure such a public building without it.

According to Rodolphe Winiarski, Head of Sales for Fire Protection for Victaulic in France, “The dual-action sprinkler system installed in the Eiffel Tower provides the highest level of fire safety and reliability possible. Right from the start it was clear that the key here was maximum safety and top quality.”

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2012 SFPE Annual Meeting

2012 SFPE Annual Meeting: Professional Development Conference and Exposition
October 14 - 19, 2012
Hyatt Regency Savannah, Savannah, GA

Engineering Technology Conference
The Week begins with a two-day engineering technology conference on October 15 - 16. This conference will highlight presentations on advanced and cutting-edge practices in fire protection engineering that are used to protect people, property and the environment from fire.

2012 Keynote Presenters are:
> George Hadjisophocleous, Carleton University, Canada
> Michael Larranaga, Oklahoma State University, USA
> Michael Stromgren, SP Technical Research Institute of Sweden, Sweden
> John M. Cholin, P.E., FSFPE, J.M. Cholin Consultants, Inc., USA

Engineering Technology Conference Registration Fees:

Advance Registration Fees
Two-Day Option
> $345 U.S. Dollars for SFPE Members and $495 U.S. Dollars for Non-Members

One-Day Option
> $195 U.S. Dollars for SFPE Members and $295 U.S. Dollars for Non-Members

Late Registration Fees
Two-Day Option
> $475 U.S. Dollars for SFPE Members and $625 U.S. Dollars for Non-Members

One-Day Option
> $275 U.S. Dollars for SFPE Members and $395 U.S. Dollars for Non-Members

Professional Development Week Seminars
Earn Valuable CEUs while giving your company a competitive edge by attending a series of seminar being taught by the profession’s leaders. Plan a week of training at the SFPE Professional Development Week being held October 16 - 19, 2012 to stay a step ahead. Seminars scheduled to be held are:

> New! Emergency Communications Systems: Planning, Design and Use
> New! Intelligibility: Planning, Design and Testing
> New! Flammable and Combustible Liquids
> Revised! Dust Explosion
> Principles of Fire Protection Engineering
> Sprinkler Design for the Engineer
> Protection of Storage Occupancies
> Introduction to Fire Dynamics Simulator and Smokeview
> Use of Quantitative Tools for Analysis of Fire Dynamics
> Application of Fire Risk Assessment
> Introduction to Industrial Fire Protection Engineering

For more information, go to:
http://www.sfpe.org/SharpenYourExpertise/Education/2012SFPEAnnualMeeting.aspx
or contact Julie Gordon at SFPE Headquarters at 301-915-9724.
The International Conference on Performance-Based Codes and Fire Safety Design Methods has established a reputation within the fire protection engineering community as the paramount event for keeping abreast of advancements in performance-based fire protection design.

Performance-based fire protection design continues to grow in use and acceptance. However, fire protection engineering has not reached the state of other engineering disciplines, where performance-based design is the norm. Because it is an advancing field, major new developments occur at a rapid pace.

Starting in 1996, the Society of Fire Protection Engineers, along with several partner organizations, has held a biennial conference to showcase the state of the art in performance-based code approaches and engineering design methods. In 2012, this conference will be held in Hong Kong.

Papers will be presented on newly emerging technologies, as well as perspectives on approaches that have worked well, and approaches that have not worked as well as originally desired.

Share your expertise, showcase your knowledge, and help shape the future of fire protection engineering by participating in this biennial conference.

**Registration Fees:**

**Advance Registration Fees (Must be received by April 30, 2012)**
- $800 U.S. Dollars for SFPE Members
- $950 U.S. Dollars for Non-Members

**Late Registration Fees (Received after April 30, 2012)**
- $925 U.S. Dollars for SFPE Members
- $1,075 U.S. Dollars for Non-Members

For more information or to register, visit [www.sfpe.org](http://www.sfpe.org).
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Problem

A woman is walking toward a mountain. When she looks at the top of the mountain, she measures the angle of elevation as 15 degrees. She walks one kilometer closer to the mountain, and when she looks at the top of the mountain again, she measures the angle of elevation as 20 degrees. How tall is the mountain?

Solution to Last Issue’s Brainteaser

Someone walks south for one kilometer, turns and walks west for one kilometer, then turns again and walks north for one kilometer. The person ends at the same point from which it started. If the person is not standing on the north pole, where is he or she standing?

The person must be standing 1.16 km (1 + 1/2π) from the south pole. If the person were to walk one km south from this point and then turn and walk one km west, they would trace a complete circle around the south pole. After they turn and walk north for one km, they would return to the point from which they started.
With an international standing that has attracted more than 4,500 members and 65 chapters around the world, the Society of Fire Protection Engineers (SFPE) advances the science and practice of fire protection engineering worldwide. Our strength and the future of the industry rely on the innovative thinking and active participation of professional fire protection engineers just like you. And, our members realize benefits they can’t get anywhere else...

- Gain the credibility you need to advance your career.
- Build life-long alliances and share ideas and solutions with more than 4,500 industry peers and 65 local chapters through SFPE’s many networking opportunities throughout the year.
- Stay up to date on new developments (and new opportunities) through SFPE’s monthly e-newsletter, web site postings, blog, and job board.
- Sharpen your expertise on technical topics through the quarterly peer reviewed Journal of Fire Protection Engineering, Fire Protection Engineering Magazine, design guides, and other publications—as well as continuing education programs, symposia, and distance learning.
- Access smart opportunities and enjoy discounts on publications, educational events, and professional liability and group insurance programs.
- Shape the future of fire protection engineering by contributing your time and expertise as a volunteer.

Join the Society of Fire Protection Engineers

MAIL to SFPE at 7315 Wisconsin Avenue, Suite 620E, Bethesda, MD 20814 or FAX to (301) 718-2242 or email Sean Kelleher at skelleher@sfpe.org

SFPE Membership Application

☑ Yes! I would like to advance my career and help shape the future of fire protection engineering. Sign me up for a year of SFPE member benefits. I understand that the $215 annual membership fee entitles me to all of the benefits described above.

☑ I am not an engineer, but I would like to build alliances with the industry. Enroll me in the SFPE Allied Professional Group. Annual dues are $107.50. Complimentary memberships are available to engineering students and recent graduates. Visit www.sfpe.org/membership/join for application details.

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Integrated Voice Messaging

Fike’s Integrated Voice Messaging system is listed to the new UL2572 Mass Notification Systems standard, making it an ideal foundation for mass notification or emergency communication systems. Features include an optional Local Operating Console (LOC) or remote microphone. The LOC enables the user to remotely page and/or initiate pre-recorded messages from a remote location. It can also be used with Fike’s CyberCat® line of Fire Alarm products to provide voice capabilities within smaller applications.

www.fike.com
—Fike

Fire-Resistant Ductwork

Firespray’s Flamebar BW11 lab exhaust ductwork serves as a space-saving alternative to horizontal shaft-wall construction. Fully compliant with the International Mechanical Code (IMC) and Uniform Mechanical Code (UMC), the Flamebar BW11 system can eliminate the need for a drywall shaft. In one recent lab application, the Firespray system reduced the complete assembly’s footprint by more than a foot horizontally and vertically – gaining much-needed space above the ceilings.

www.firesprayusa.com
—Firespray International

Steel Piping Systems

Conbraco Industries, Inc., introduces the most recent addition to its Apollo® brand: Apollo® Fire Protection System Solutions’ XPress galvanized and stainless steel piping systems. The XPress fittings are a labor-saving addition to traditional threaded pipe and fittings. These press systems are ideal for both new construction and retrofit projects such as hospitals, hotels, schools, food and beverage facilities, or any other buildings with complex fire sprinkler layouts.

www.conbraco.com
—Apollo Fire Protection System Solutions

Dual-Strobe Functionality

SpectrAlert® Advance Dual Strobe and Dual Strobe with Speaker Expander Plates combine the functions of two to three devices on a single mounting plate and back box. The expander plates include a UL 1638-Listed (Visual Signaling Appliances) amber lens strobe for Private Mode General Utility Signaling that meets DOD specification requirements. They can be used in 12- or 24-V systems and can be paired with a fire-rated SpectrAlert Advance Strobe or Speaker Strobe.

www.systemsensor.com/ecs
—System Sensor

Gamewell-FCI Expands Line

Gamewell-FCI has expanded its portfolio of emergency communications systems (ECS) to encompass technologies for in-building, between-building and distributed recipient mass notification. The E3 Series® fire alarm and ECS provides advanced fire protection and autonomous control of in-building and between-buildings emergency communications. The system is capable of creating and sending distributed recipient notifications via email, SMS text alerts, computer pop-ups, cable TV systems and more.

www.gamewell-fci.com
—Gamewell-FCI

Potter’s New Fire Panels

Potter has introduced two higher capacity addressable fire alarm control panels: the PFC-6200 and the PFC-6800. The PFC-6200 is a 127-point panel expandable up to 254 points, whereas the Potter PFC-6800 is a 127-point panel expandable up to 1,016 points. Both utilize the Potter/Nohmi device protocol that has a complete line of initiating and control devices, and the same features as the rest of the PFC Series line including system-wide synchronization, Ethernet connection and e-mail communication capability.

www.pottersignal.com
—Potter Electric Signal Co.
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www.notifier.com
—NOTIFIER

Intelligent Fire Systems

Siemens Building Technologies Div. introduces its new Cerberus™ PRO and Desigo™ Fire Safety portfolios — advanced fire system panels and smoke detectors for small- to mid-size applications, featuring Advanced Signal Analysis technology. All components have been engineered for interoperability, and the flexibility and scalability of system components allow them to be easily adapted to meet new conditions such as a growing business or changes in building use.

www.usa.siemens.com/fire
—Siemens Building Technologies Div.

Mass Notification System

The Farenhyt ECS mass notification system delivers real-time, intelligible communications over a completely supervised system that meets the latest NFPA 72, UL 2572 and Department of Defense (DoD) standards. Farenhyt ECS control panels include customizable switches for as many as 15 pre-recorded messages and a microphone for live paging. As many as seven ECS remote command units can tie into a facility’s Farenhyt ECS.

www.farenhyt.com
—Silent Knight

Clean Agent Systems

Viking has extended its portfolio to include waterless suppression technology. The VK-1230 clean agent system, which is cULus Listed and FM Approved as Standard Response. It uses the same threaded cover plate as the G4A. With a K Factor of 5.6, the G5-56 has a full 3/4-in. adjustment — 1/4-in. more than the G4A. The sprinkler comes with a factory-installed protective cap with protective lip and secure threaded fit.

www.reliablesprinkler.com
—Reliable Automatic Sprinkler Co.

Third Edition of Hydraulics

The third edition of Fire Protection Hydraulics and Water Supply Analysis is a resource for those working in the in the areas of water supply or sprinkler analysis and design. It explains how to determine friction loss within water systems, test water supply systems, and prepare hydraulics calculations. Hydraulics also gives methods for testing, inspecting, and maintaining fire pump installations. References to fire protection water supply demands have been updated to the latest codes and standards. Item 36876. $90.

www.shop.ifsta.org
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