

FIRE PROTECTION DESIGN REVISIONS		
Revision Date	Section	Summary of Change
2/16/11	All	Replaced all occurrences of "Occupational" with "Environmental"
2/16/11	General Information	Added Insurance Office contact name
2/16/11	General Information	Added FM Global to list of agencies who will receive copies of designs
2/16/11	Specifications	Revised Design Information; attached FM Global Property Loss Prevention Data Sheets

FIRE PROTECTION DESIGN

UNIVERSITY CONTACT:

Environmental Health & Safety
(302) 831-8475

GENERAL INFORMATION:

1. The sprinkler to be designed as per code requirements and approved by local jurisdiction. Per Factory Mutual Global Standards the following requirements must be met beyond the applicable code. These requirements will be reviewed case by case per each project and instruct the Consultant as required by Facilities Planning and Construction.
2. All fire protection equipment should be U.L. listed and approved by Factory Mutual Research Corporation. Exceptions to be submitted for review to Occupational Health & Safety.
3. The Sprinkler design to be reviewed by Factory Mutual Engineer (Craig Kissell) and UD Fire Marshall (Kevin McSweeney) at preliminary and final design stages.
4. A minimum of one (2) copy of sprinkler shop drawings, associated hydraulic calculations, and equipment cut sheets should be submitted a minimum of 2 weeks in advance of the start of any work to Facilities Planning and Construction, with copy of transmittal memo to the University Insurance Office (Gary Stokes).

Facilities Planning and Construction will disseminate the copies to:

Environmental Health & Safety University of Delaware 222 S. Chapel Street (General Services Building) Newark, DE 19716 (302) 831-8475	FM Global Attn: Steven Poole 130 Wheaton Lane Churchville, MD 21028 (443) 794-1988	Factory Mutual Engineering Attn: Craig Kissell 64 Twin Brooks Drive Willow Grove, PA 19090 (215) 657-5301
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5. The University of Delaware Electric Shop must be notified at (302) 831-2621 to coordinate **ALL** sprinkler valve closures a minimum of 24 hours in advance for proper approval. This advance notice is required for the Electrical shop to survey the job and implement the use of the Factory Mutual Red Tag Permit System.
6. All sprinkler system designs should include a 10 psi safety factor.
7. A 2 color plastic engraved identification card showing the hydraulic design

information should be provided for each system. The placard should be secured to the riser.

8. The installation of the sprinkler system shall conform to National Fire Protection Association (NFPA) and should conform to Factory Mutual Global Corporation (FMGC) recommended good practices.
9. All steel pipe used shall be no less than Schedule 40.

APPROVED MANUFACTURERS: N/A

SPECIFICATIONS

PART 1 GENERAL

1.01 DESIGN INFORMATION

- A. See attached FM Global Property Loss Prevention Data Sheets, 3-26, March 2010.
- B. All other occupancies not specifically listed above will be handled on a case by case basis. The department of Facilities Planning & Construction should be contacted to obtain design information.
- C. Fire Pumps
 1. The power supply for electric fire pumps shall be connected before the building's main electrical disconnect. Power supply protection devices (fuses or circuit breakers) shall not be installed in the power supply circuits ahead of the fire pump feeder circuits. The power supply to the controller shall be run in such a way as to ensure that it would not be exposed to fire in the building.
 2. A fire pump room shall be provided and shall be constructed of noncombustible materials having a fire rating of at least 1 hour. The fire pump room should be accessible to the outdoors.

1.02 REFERENCE STANDARDS

- A. Underwriters' Laboratories, Inc. (UL) listing.
- B. National Fire Protection Association (NFPA) standards.

DO'S AND DON'TS: N/A

-- END OF SECTION --

FM Global
Property Loss Prevention Data Sheets

3-26

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FIRE PROTECTION WATER DEMAND FOR NONSTORAGE SPRINKLERED PROPERTIES

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1.0 SCOPE

This data sheet provides water demand recommendations for automatic sprinklers and hoses in nonstorage occupancies.

Refer to the applicable occupancy-specific data sheet for detailed sprinkler protection guidelines. See the definition of "occupancy-specific data sheet" in Appendix A for a list of data sheets organized by subject matter.

1.1 Changes

March 2010. This document has been completely rewritten. The following is a list of major changes:

- Added a table of hazard categories based on occupancy.
- Added a table of sprinkler design demands based on ceiling height and type of sprinkler system for each hazard category.
- Added design information on extended-coverage sprinklers for light- and ordinary-hazard occupancies.
- Added sprinkler protection design criteria for nonstorage and nonmanufacturing facilities with ceilings higher than 60 ft (18 m) and up to 100 ft (30 m).
- Added sprinkler protection design criteria for manufacturing facilities with ceilings up to 60 ft (18 m) high.
- Revised loss history.
- Updated Appendix A, Glossary of Terms.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Protection

Automatic sprinkler protection is the best defense against a fire. Sprinklers have proven to be the most practical and reliable means of controlling a fire in business and industry. Sprinkler protection minimizes not only fire damage, but also nonthermal damage, and allows for quick resumption of normal operations. Sprinklers are needed wherever the building construction or occupancy is combustible. Refer to the applicable occupancy-specific data sheet for detailed sprinkler protection guidelines. See the definition of "occupancy-specific data sheet" in Appendix A for a list of data sheets organized by subject matter.

2.1.1 Automatic Sprinkler Systems

2.1.1.1 For new installations of wet-pipe sprinkler systems, use FM Approved upright or pendent, standard or quick-response, standard-coverage or extended-coverage, nonstorage automatic sprinklers with a temperature rating of 160°F (70°C). Sprinklers with a temperature rating of 212°F (100°C) may be used in locations where the ambient temperature is in excess of 110°F (43°C). For locations prone to extremely cold and freezing conditions, use dry-pipe sprinkler systems with upright, standard response, standard-coverage sprinklers with a temperature rating of 280°F (140°C).

2.1.1.2 To determine the complete sprinkler system design, do the following:

- A. Use Table 1 to identify the hazard category based on occupancy.
- B. Use Table 2 to find the sprinkler design demand required for that hazard category, based on the ceiling height and type of system.
- C. Use Table 3 to determine the hose demand and duration.
- D. See the ceiling-level sprinkler spacing guidelines for nonstorage occupancies in Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.
- E. Use Table 4 to determine the minimum sprinkler K-factor for the hazard category and ceiling height.

2.1.1.3 Protection recommendations in the tables of this data sheet are intended for new installations and are based on complete sprinkler protection where needed, with no serious occupancy or protection deficiencies. Correct major deficiencies in occupancy or protection that could increase sprinkler demand. Such deficiencies include poor housekeeping, accumulations of lint or other combustible dust, obstructed sprinklers, and dry-pipe systems in certain hazardous areas. A strong water supply is no substitute for correcting these deficiencies.

Table 1. Hazard Categories Based on Occupancy

Occupancy	Description of Occupancy	Exceptions	Hazard Category
<ul style="list-style-type: none"> - Apartments - Churches - Concealed spaces - Hospitals and hospital laboratories - Hotel rooms - Institutions - Kitchens - Libraries - Meeting rooms in convention centers and hotels - Museums - Nursing or convalescent homes - Offices - Restaurant seating areas - Unused attics 	<p>Lightly loaded nonstorage and nonmanufacturing areas with ordinary combustibles.</p> <p>Expect fires with relatively low rates of heat release in these occupancies.</p>	<p>Libraries with stack rooms larger in size than defined in Appendix A; facilities with storage of electronic and plastic media (see the applicable storage data sheet).</p> <p>Laboratories where exposed storage and processing of flammable liquids is considered excessive (see the applicable flammable liquids data sheet).</p>	HC-1
<ul style="list-style-type: none"> - Atriums - Auto parking garages - Back stage of theaters and auditoriums - Boat mfg. and assembly - Boiler buildings - Casinos - Clubs - Convention centers - Display halls - Electronic-electrical mfg. and assembly - Food processing - Gyms - Leather tanning and working - Mercantile areas - Metalworking - Mineral processing - Movie and TV Studios - Paper processing - Retail areas - Rubber processing - Schools and universities - Sports Arenas - Theater & auditoriums - Utility and equipment rooms 	<p>Lightly and moderately loaded nonstorage, nonmanufacturing, and manufacturing areas with ordinary combustibles.</p> <p>Occupancies with fire hazards equivalent to in-process Class 3 commodities no more than 8 ft (2.4 m) high, or lesser hazard (e.g., mostly wood, cardboard products and small amounts of plastic, including foam plastic found in the seat cushion of a chair or plastic trim in an exhibit display booth).</p>	<p>Operations involving hydraulic fluid or flammable liquid (see DS 7-32, DS 7-29, and DS 7-98); aluminum rolling mills (see DS 7-84/13-28); paper machine areas that involve inks with flashpoints below 110°F (42°C) (see DS 7-4 and DS 7-96); aircraft hangars (see DS 7-93N).</p> <p>Oil cookers and distilling operations (see the applicable flammable liquid data sheet).</p> <p>Bulk retailers where merchandise is displayed on racks typically found in warehouses (see DS 8-9 and DS 8-3).</p> <p>Telephone switchgear rooms and generator rooms (see DS 5-12, DS 5-14, or DS 5-23).</p>	HC-2
<ul style="list-style-type: none"> - Interior loading docks - Modular building subassembly - Plastics processing and molding - Vehicle repair garages and assembly operations where vehicles are repaired, tested, or assembled with fuel in tanks - Highway trailers, trucks, boxcars, some mobile homes or similar metal vehicles with combustible interiors with the potential for shielded fire - Convention Centers, Theaters and Auditoriums with moderate to heavily loaded areas 	<p>Moderately to heavily loaded areas with or without plastics.</p> <p>Manufacturing and nonmanufacturing facilities with higher concentrations of combustibles or shielding of combustibles where the fire hazard could approach the equivalent of 6 ft (1.8 m) high in-process storage of cartoned unexpanded plastic commodities.</p>	<p>Facilities that use hydraulic and flammable liquids (see DS 7-98).</p> <p>Electronic media storage (see DS 8-8).</p>	HC-3
- Nonstorage occupancies with heavily loaded areas with or without plastics	<p>Heavily loaded nonstorage occupancies</p> <p>Expect fires with relatively high rates of heat release in these occupancies.</p>	Facilities that use hydraulic and flammable liquids (see DS 7-98).	HC-4

Table 2. Sprinkler Design Demands for Hazard Categories

Hazard Category	Sprinkler Design Demand (gpm/ft ²)/ft ² (mm/min)/m ²					
	Ceilings up to 30 ft (9 m)		Ceilings from 30 to 60 ft (9 to 18 m)		Ceilings from 60 to 100 ft (18 to 30 m)	
	Wet	Dry	Wet	Dry	Wet	Dry
HC-1	0.1/1500 (4/140)	0.1/1500 (4/140)	0.2/2500 (8/230)	0.2/3500 (8/330)	See 2.1.1.5	Not an option
HC-2	0.2/2500 (8/230)	0.2/3500 (8/330)	0.2/2500 (8/230)	0.2/3500 (8/330)	See 2.1.1.5	Not an option
HC-3	0.3/3000 (12/280)	0.3/4000 (12/370)	0.5/3000 (20/280)	0.5/4000 (20/370)	Not an option	Not an option
HC-4	0.5/3000 (20/280)	0.5/4000 (20/370)	0.5/3000 (20/280)	0.5/4000 (20/370)	Not an option	Not an option

Table 3. Hose Demand and Duration

Hazard Category	Hose Demand, gpm (L/min)		Duration, min
	Ceilings Under 60 ft (18 m)	Ceilings Over 60 ft (18 m)	
HC-1	250 (960)	500 (1900)	60
HC-2	250 (960)	500 (1900)	90
HC-3	500 (1900)	Not an option	90
HC-4	500 (1900)	Not an option	90

Table 4. Minimum Sprinkler K-Factors for Hazard Categories

Hazard Category	Ceiling Height, ft (m)		
	Up to 30 ft (9 m)	30-60 ft (9-18 m)	Over 60 ft* (18 m)
HC-1	5.6 (80)	11.2 (160)	25.2 or 25.2EC (360 or 25.2EC)
HC-2	8.0 (115)	11.2 (160)	25.2 or 25.2EC (360 or 25.2EC)
HC-3	11.2 (160)	11.2 (160)	Not an option
HC-4	11.2 (160)	11.2 (160)	Not an option

* Protection options for ceiling heights over 60 ft (18 m) are available for wet systems only.

2.1.1.4 Use the applicable occupancy-specific storage data sheet to determine the water demand design requirements when an area of in-process storage at manufacturing facilities is 200 ft² (20 m²) or greater (defined by minimum 8 ft wide aisles, and a storage height of either 5 ft (1.5 m) or greater for materials containing plastic, or 10 ft (3.0 m) or greater for cellulose-type material).

2.1.1.5 Use K25.2 (K360) or K25.2EC (K360EC) pendent, quick-response (QR) automatic sprinklers for protection of lightly to moderately loaded nonstorage and nonmanufacturing areas that have a maximum ceiling height of 100 ft (30 m). For K25.2 (K360) sprinklers, design the wet system to provide 12 sprinklers at 7 psi (0.5 bar). For K25.2EC (K360EC) sprinklers, design the wet system to provide 6 sprinklers at 7 psi (0.5 bar).

2.1.1.6 Flammable liquids found in lift trucks do not affect the sprinkler system design criteria. See DS 7-32 for protection guidelines for occupancies where flammable liquids are used, and DS 7-29 for protection guidelines for occupancies where flammable liquids are stored.

2.1.1.7 Generally, if the demand area is equal to or less than 1500 ft² (140 m²), the water demand duration of 60 minutes is recommended because a medium-sized, controlled fire is expected. However, if the design area is larger, the size of the controlled fire is expected to be larger; thus, the 90 minute water demand

duration is recommended. Water demand duration and hose demand may be increased up to 50% based on local occupancy or construction conditions. Examples of such conditions include:

A. Increased Water Demand Duration

1. For areas relatively inaccessible for manual firefighting
2. For potentially persistent fires
3. For lack of drainage in low-flash-point flammable liquid occupancies

B. Increased Hose Demand for HC-1 and HC-2 Occupancies

1. For areas with shielded fire potential. Such areas include combustible, concealed spaces in walls, floors, or ceilings; ducts; and wide shelves or enclosures. In hollow joisted or wood-frame construction, increase hose demand by 250 gpm (950 L/min).

2.1.1.8 Quick-Response (QR) Sprinklers

2.1.1.8.1 Use quick-response (QR) nonstorage sprinklers in wet systems only.

2.1.1.8.2 Do not use QR sprinklers where rapidly spreading fire may occur or where there are accumulations of oil, dust, lint or other combustible residue on ceilings, structural members, sprinkler piping, large machines, or hoods.

2.1.1.9 Extended-Coverage (EC) Sprinklers

2.1.1.9.1 Extended-coverage (EC) nonstorage sprinklers may be used to protect Hazard Category 1 (HC-1) and Hazard Category 2 (HC-2) occupancies, in wet systems only, and with the following exceptions:

- Spray application of flammable liquids
- Hydraulic equipment using flammable hydraulic fluids
- Any other occupancy involving flammable or combustible liquids
- Storage other than that defined in Section 2.1.1.4
- Retail/wholesale warehouse stores
- Stock rooms in retail stores
- Vehicle assembly or repair areas where there is fuel in fuel tanks
- Mobile/modular/manufactured home assembly or other occupancies with large areas shielded from sprinkler discharge

2.1.1.9.2 Install EC sprinklers in accordance with the recommendations in DS 2-0, *Installation Guidelines for Automatic Sprinklers*.

2.1.1.9.3 Adhere to the following design criteria when using EC sprinklers in Hazard Category 1 (HC-1) occupancies:

A. Design Area

1. For pendent and upright EC sprinklers, design the sprinkler system to supply the hydraulically most remote 9 sprinklers (3 sprinklers on three branch lines), or all sprinklers in the protected area, whichever is less.
2. For sidewall EC sprinklers in rooms with a maximum compartmented area of 1600 ft² (150 m²), design the sprinkler system to supply all sprinklers within the compartment.
3. For all types of EC sprinklers in corridors that can be protected by one row of sprinklers, design the sprinkler system to supply all sprinklers in a 1500 ft² (140 m²) area, or a maximum of 5 sprinklers, whichever is less. For corridors smaller than 1500 ft² (140 m²) in area, use the actual area. Note that there are no limitations the size of corridor areas when EC sidewall sprinklers in this fashion.

B. Design Density/Pressure

1. Design pendant and upright EC sprinklers to provide a minimum density of 0.1 gal/min/ft² (4 mm/min) or 7 psi (0.5 bar) at the most remote sprinkler, whichever is greater. When the sprinklers are not on a square spacing, base the flow for the most hydraulically remote sprinkler on the density applied over the square area calculated for the largest dimension of the sprinkler spacing. This will ensure the water is properly distributed over the entire area of sprinkler coverage. For example, when sprinkler spacing is 20 by 15 ft (6 by 4.5 m), the required waterflow from that sprinkler should be 0.1 gal/min/ft² (4 mm/min) over a 20 by 20 ft (6 by 6 m) area, not over a 20 by 15 ft (6 by 4.5 m) area. This will result in a sprinkler flow of 40 gpm (145 L/min), rather than 30 gpm (110 L/min).
2. Design EC sidewall sprinklers for the minimum pressure indicated in Table 5 for the sprinkler spacing. Minimum design pressures for EC sidewall sprinklers are a function of both the distribution characteristics of the sprinkler and the spacing. Ensure spacing does not exceed that indicated in Table 5. The "width" dimension is measured along the wall on which the sprinkler is mounted. The minimum design pressure ensures the water will effectively reach the far end of the sprinkler coverage area. Interpolations of pressure for different length dimensions are allowable; however, if the sprinklers are spaced less than 16 ft (5 m) apart, use the minimum pressure for 16 ft (5 m).

Table 5. Minimum Design Pressures for EC Sidewall Sprinklers

K-Factor and Orifice Size, in. (mm)	Maximum Spacing, ft (m) Width x Length	Minimum Design Pressure, psi (bar)
K5.6 (K80) 1/2 (13)	16 x 16 (5 x 5)	22 (1.5)
	16 x 18 (5 x 5.5)	29 (2.0)
	16 x 20 (5 x 6)	35 (2.4)
K8.0 (K115) 17/32 (15)	16 x 16 (5 x 5)	16 (1.1)
	16 x 18 (5 x 5.5)	20 (1.4)
	16 x 20 (5 x 6)	25 (1.7)
	16 x 22 (5 x 7)	30 (2.1)
	16 x 24 (5 x 7)	36 (2.5)

C. Water Supply and Duration

1. Ensure the water supply is capable of supplying the maximum sprinkler system demand, plus 250 gpm (950 L/min) for the hose demand, for a duration of 60 minutes.
- 2.1.1.9.4 Adhere to the following additional design criteria when using EC sprinklers in Hazard Category 2 (HC-2) occupancies:
 - A. Regardless of the density/area specified, ensure the design area is not less than the hydraulically most remote 9 sprinklers (3 sprinklers on three branch lines).
 - B. Ensure the minimum design pressure at each EC sprinkler is not less than 12 psi (0.8 bar) for 0.64 in. (16 mm) orifice EC sprinklers, and not less than 18 psi (1.2 bar) for 0.70 in. (19 mm) orifice EC sprinklers.
- 2.1.1.9.5 Do not use EC nonstorage sprinklers to protect HC-3 or HC-4 occupancies.
- 2.1.1.10 Where anti-freeze systems are prohibited by the authority having jurisdiction (AHJ), provide a dry-pipe automatic sprinkler system using dry pendant, standard response, nonstorage sprinklers for small loading docks, covered platforms, ducts, or similar small, unheated areas. Sprinklers may also extend through the wall from wet sprinkler piping in an adjacent heated area using dry pendant or sidewall sprinklers.

Where possible, extend the dry pendant sprinkler down at a 45° angle as shown in Figure 1. Do not exceed the width of the area to be protected by more than 7.5 ft (2.3 m). Do not space sprinklers more than 12 ft (3.7 m) apart.

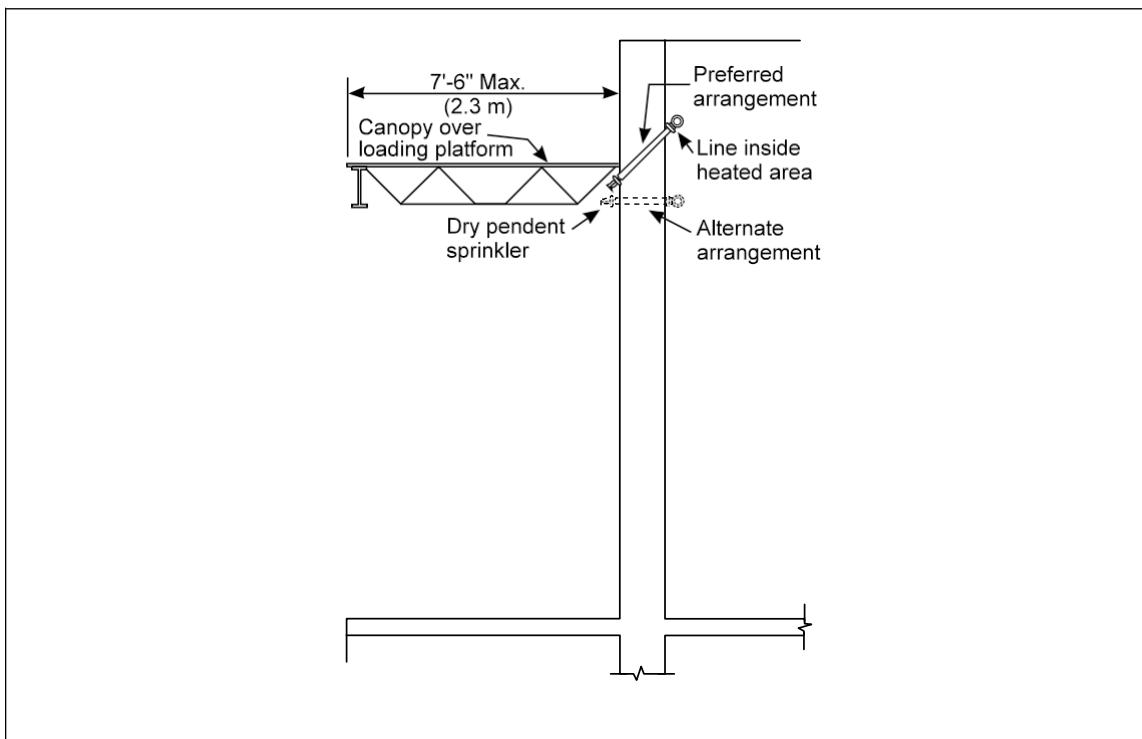


Fig. 1. Dry pendent sprinkler extended down at a 45° angle

3.0 SUPPORT FOR RECOMMENDATIONS

Hazard categories are based on occupancy, exposure, and combustible loading.

4.0 REFERENCES

4.1 FM Global

- Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*
- Data Sheet 5-12, *Electric AC Generators*
- Data Sheet 5-14, *Telecommunications*
- Data Sheet 5-23, *Emergency and Standby Power Systems*
- Data Sheet 7-4, *Paper Machines and Pulp Dryers*
- Data Sheet 7-29, *Flammable Liquid Storage in Portable Containers*
- Data Sheet 7-32, *Flammable Liquid Operations*
- Data Sheet 7-64/13-28, *Aluminum Industry*
- Data Sheet 7-93N, *Aircraft Hangars*
- Data Sheet 7-96, *Printing Plants*
- Data Sheet 7-98, *Hydraulic Fluids*
- Data Sheet 8-3, *Rubber Tire Storage*
- Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*
- Data Sheet 8-21, *Roll Paper Storage*

APPENDIX A GLOSSARY OF TERMS

Approval Guide: An online resource of FM Approvals that provides a guide to equipment, materials, and services that have been FM Approved for property conservation.

Combustible Occupancy: An occupancy that contains sufficient combustible materials to allow horizontal fire spread throughout a given area in the absence of sprinkler protection; or an occupancy that contains a sufficient concentration of combustibles that could cause significant damage to the building.

Demand Area: The expected area of sprinkler operation, based on the hazard being protected, used for hydraulic design purposes. In English units it is expressed in ft²; in metric units, m² (1 ft² = 0.093 m²).

Dry-Pipe Sprinkler System: A sprinkler system that is located downstream of a dry-pipe valve. It is filled with a pressurized gaseous medium (typically air or an inert gas such as nitrogen) for the purpose of maintaining the dry-pipe valve closed. Upon sprinkler actuation, the pressure within the sprinkler system begins to drop until the pressure becomes too low to keep the dry-pipe valve closed. At this time the dry-pipe valve opens (trips) allowing water to fill the sprinkler system and discharge through any sprinklers that have been actuated. A dry-pipe sprinkler system is typically used in areas where the presence of water within the sprinkler system is not suitable.

Density: The amount of water applied by sprinklers over a given area in a certain amount of time. In English units, it is expressed in gpm/ft²; in metric units, in mm/min (1 gpm/ft² = 40.74 mm/min).

Duration or System Duration: Water supply system duration is a defined time period between when a fire initially activates a sprinkler system and when the fire is extinguished. Fire extinguishment usually is accomplished by the manual firefighting efforts of public fire service personnel, facility fire service personnel, or facility emergency response team personnel. Duration takes into consideration the commodity hazard's expected fire size in the presence of the system's specific sprinklers and bases the design, as well as manual extinguishment by either one or two applied hose streams.

Extended-Coverage Sprinklers: The physical characteristics of extended-coverage (EC) sprinklers are similar to those of sprinklers for use with standard spacing. However, the deflector designs are enhanced to ensure proper uniformity and effectiveness of water distribution for the spacing and design pressures for which they are FM Approved.

FM Approved: A product that has been tested to and meets the requirements of an FM Approval Standard and has been listed in the Approval Guide.

Hose Demand: The water flow required for hoses (common sizes are 2-1/2 in. and 1-1/2 in.). In English units it is expressed in gpm; in metric units, L/min.

Library Stack Rooms: Rooms that house typical library bookshelves of approximately 8 ft (2.4 m) in height, containing books stored vertically on end, held in place in close association with each other, with aisles wider than 30 in. (762 mm).

Nonstorage Automatic Sprinkler: A sprinkler that has been categorized by FM Global as acceptable for protecting nonstorage occupancies and/or any other low to moderate heat-release rate fire as recommended in an applicable occupancy-specific data sheet.

Nonstorage Occupancy: An occupancy consisting of combustible or noncombustible materials that are not maintained in a storage arrangement.

Occupancy-Specific Data Sheet: An FM Global property loss prevention data sheet that addresses a specific occupancy hazard. Individual data sheets belong to a numbered "series" representing the following subjects:

Series Number	Data Sheet Subject
1	Construction
2	Sprinklers
3	Water supply
4	Extinguishing equipment
5	Electrical
6	Boilers and industrial heating equipment
7	Hazards
8	Storage
9	Miscellaneous
10	Human factor
11	Systems instrumentation and control
12	Pressure vessels
13	Mechanical
15	Welding
17	Boiler and machinery miscellaneous

Quick-Response (QR) Sprinklers: QR sprinklers are similar to standard sprinklers, except they use a fast-response, heat-actuated element.

Sprinkler Demand: The amount of water flow required for sprinkler protection. In English units it is expressed in gpm; in metric units, L/min (1 gpm = 3.79 L/min).

Waterflow Alarm: A device that is installed on a sprinkler system and arranged to provide an alarm when one or more sprinklers operate.

Total Water Demand: The water flow required for both sprinklers and hoses (i.e., total water demand is equal to sprinkler demand plus hose demand). Hose demand is not always provided by the sprinkler system. In English units it is expressed in gpm; in metric units, L/min.

APPENDIX B DOCUMENT REVISION HISTORY

March 2010. This document has been completely rewritten. The following is a list of major changes:

- Added a table of hazard categories based on occupancy.
- Added a table of sprinkler design demands based on ceiling height and type of sprinkler system for each hazard category.
- Added design information on extended-coverage sprinklers for light- and ordinary-hazard occupancies.
- Added sprinkler protection design criteria for nonstorage and nonmanufacturing facilities with ceilings higher than 60 ft (20 m) and up to 100 ft (30 m).
- Added sprinkler protection design criteria for manufacturing facilities with ceilings up to 60 ft (20 m) high.
- Revised loss history.
- Updated Appendix A, Glossary of Terms.

July 2008. References to FM Global Loss Prevention Data Sheet 7-96, *Printing Plants*, were added to Table 1.

May 2008. Clarifications were made to the recommendations 2.1.1.1 and 2.1.2.1.2.

January 2008. The following changes were made:

1. Combined Tables 2 through 10 to simplify the recommendations for sprinkler system water demand.
2. Replaced Table 1, which described temperature ratings for sprinklers, with a recommendation to use 160°F (70°C) and 280°F (140°C) temperature-rated sprinklers for wet and for dry systems respectively.
3. Added sprinkler system water demand information for assembly facilities manufacturing fiberglass boats.

January 2006. Clarification was made to the recommendation 2.1.2.3.1 and Table 11.

January 2005. Protection criteria has been provided for light, moderately and heavily loaded nonstorage areas with floor to ceiling clearances up to 60 ft (18.3 m). Storage type, storage and building height and corresponding protection criteria are provided in Table 11.

January 2001. The protection requirements for the spray application of flammable liquids, including catalytic spraying have been removed from this data sheet and are included in Data Sheet 7-27, *Spray Application of Flammable and Combustible Materials*.

The protection requirements for hydraulic equipment using hydraulic fluids have been removed from this data sheet. The protection requirements are in Data Sheet 7-98, *Hydraulic Fluids*.

September 2000. This revision of the document was reorganized to provide a consistent format.

October 1992. The following changes were made for this revision:

1. Flammable Liquids

Water demand criteria for flammable liquids in open and closed tanks are not contained in this revision of Data Sheet 3-26. In the previous revision of this data sheet, the occupancies were titled Flammable Liquids In Open Tanks and Containers and Flooding Systems and Flammable Liquids in Closed Containers, Except Drum Storage. Water demand criteria for these occupancies are incorporated with the flammable liquid data sheets.

2. Woodworking Occupancy

Water demand criteria for the general occupancy, Woodworking, are not in this revision of Data Sheet 3-26. Data Sheet 7-10, *Wood Processing and Woodworking Facilities*, has been revised (June 1991). Water demand information is now included in Data Sheet 7-10.

3. Textile Occupancy

Water demand criteria for the textile occupancy are not in this revision of Data Sheet 3-26. Data Sheet 7-1, *Fire Protection for Textile Mills*, has been revised. Water demand information is now included in Data Sheet 7-1.

4. Miscellaneous Occupancies

The section titled "Miscellaneous Occupancies" is included to provide guidelines for occupancies that are not found within the specific occupancies.

5. Miscellaneous Nonmanufacturing

The title "Miscellaneous Nonmanufacturing" is used in place of "Light Hazard Occupancy." The new title better defines the various occupancies involved.

6. Office Occupancies

Guidelines in Data Sheet 3-26 for office occupancy are in Table 2, within the section titled Miscellaneous Nonmanufacturing. Loss data (see Support for Recommendations) and fire test data indicate that a water supply capable of providing a density of 0.10 gpm/ft² (4 mm/min) over an area of 1500 ft² (140 m²) will provide adequate protection for an office occupancy.

7. Electronic-Electrical Manufacturing and Assembly

A separate occupancy category for electronic and electrical manufacturing and assembly occupancies has been added.

8. Plastics Processing

Recent fire tests indicate that ordinary, intermediate or high temperature rated sprinklers over 2500 ft² (230 m²) (dry system: 3500 ft²) will provide adequate protection over this occupancy.

9. Quick Response Automatic Sprinklers (QRAS)

This data sheet includes guidance on the use of QRAS. The recommendations are based on the results of fire tests comparing QRAS and conventional response automatic sprinklers.

10. Title Change

The title change to include "Nonstorage" better describes the occupancies included within this data sheet.

11. International and National Fire Protection Association Standards