DEPARTMENT OF PUBLIC SAFETY AND CORRECTIONS

Public Safety Services

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GOVERNOR

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STATE FIRE MARSHAL

INTERPRETIVE MEMORANDUM 2002-11

To: Licensed Architects
Licensed Engineers
Licensed Sprinkler Contractors
Licensed Fire Alarm Contractors
Licensed Fire Suppression Contractors
Felicia Cooper, Deputy State Fire Marshal Administrator
Stephen Gogreve, Manager of Inspections/Arson
Pat Day, Supervisor of Health Care Inspections
Marc Reech, Executive Staff Officer
Plan Review Staff

From: Jean Carter, Architect Supervisor
Fidel Fremin, Architect Supervisor
Henry Reed, Architect Supervisor
Cindy Obier, Architect Supervisor
Don Zeringue, Chief Architect

Approved by: Mark Gates, 2.10.03
Deputy Assistant Secretary

Date: July 1, 2002 Revision Date: February 6, 2003 (all italicized items)

Re: Utilization of the Central Model EC-25 Extended Coverage Area/Density Sprinkler, manufactured by Tyco Fire Products

Big box" stores, including but not limited to Home Depot, Lowes, Wal Mart & Super WalMart, Sam's Club & Sam's Club Supercenter, Comp USA, Conns, Best Buy, Cost Plus, Kirshmans, Hobby Lobby, Michaels, Office Depot, Office Max, etc., are ever increasing in number. "Big box" stores present several new and unique types of commodities and storage arrangements not provided in previous large mercantile occupancies. Although NFPA 13 has made great strides in addressing the unique needs of water fire suppression for commodity types and storage arrangements associated with large retail and "big box" stores, NFPA 13:1-2, 1999 edition, states the following:

Nothing in this standard is intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by the standard is not lowered.

This interpretive memorandum presents sprinkler test criteria regarding utilization of a new sprinkler head manufactured by Tyco Fire Products, Landsdale, Pennsylvania: Central Model EC-25 Extended Coverage Area/Density Sprinkler. An attachment is provided, titled "EC-25 Sprinkler Appeal" and comprises the EC-25 test criteria as synopsized by Mr. Bob Morgan, Fire Protection Engineer, TVA Fire & Life Safety, Inc.

The NFPA 101 Life Safety Code and adopted national fire codes require fire protection features that will provide a minimum acceptable level of safety. The features required by these codes may be altered, substituted, or omitted, if alternative features are proposed that will provide a level of safety equivalent to that provided by compliance with specific requirements of these codes.

Based on a review of the documentation described above and the "EC-25 Sprinkler Appeal" attachment, this office hereby accepts and allows the use of the Central Model EC-25 Extended Coverage Area/Density Sprinkler for mercantile occupancies, including "big box" stores and storage occupancies subject to the following stipulations:

1. EC-25 sprinklers shall be hydraulically designed in accordance with their listing criteria, including a 25.2 K-factor and 7 p.s.i. minimum discharge.

2. NFPA 13, most current promulgated edition, shall be utilized, as applicable to the occupancy, hazard class, and commodity type(s) protected.

Currently the 1999 edition of NFPA 13 is promulgated by this office. An addition occurs in the 2002 edition, specifically relating to sprinkler designs utilizing EC-25 sprinklers. These special designs are based fire heat release calorimeter tests and 10 full-scale tests conducted by the Retail Fire Research coalition, at Underwriters Laboratories in 2000. It is a determination of this office that NFPA 13:12.7.2, 2002 edition, titled "Sprinkler Design Criteria for Storage and Display of Class I through Class IV Commodities, Cartoned Non-Expanded Group A Plastics, and Non-Expanded Exposed Group A Plastics in Retail Stores" may be utilized for sprinkler system design subject to the following stipulations:

1. *Six (6) specific density/demand/rack arrangement requirements are provided at Sections 12.7.2.1 through 12.7.2.6. Designer shall indicate the specific section utilized in design and provide submittal documentation indicating compliance with all requirements listed in the section chosen. The protection area of each sprinkler shall be in accordance with Section 8.8.2.1.3, which allows the S x L method in lieu of square protection areas. This section also limits the maximum spacing of EC-25 heads to 14 feet x 14 feet with a maximum area of 196 square feet. These requirements are consistent with the EC-25 listing criteria.*

2. *All other aspects of the sprinkler system shall comply with NFPA 13, 1999 edition.*

JCC/jcc

EC-25 Sprinkler Appeal

This report presents an engineering analysis of various fire protection requirements for automatic sprinkler design and how it relates to the use of the Central EC-25 sprinkler in lieu of the K-11 ELO sprinklers referenced in the standards and codes. This report will specifically evaluate the requirements of the following nationally recognized fire protection standards:

NFPA 13, Standard for the Installation of Sprinkler Systems, 1999 Edition
NFPA 30B, Code for the Manufacture and Storage of Aerosol Products, 1998 Edition
NFPA 30, Flammable and Combustible Liquids Code, 2000 Edition
Factory Mutual Data Sheet 8-9, dated May 2000 (for expanded, exposed plastics only)

The purpose of this analysis is to show compliance with the requirements of these standards by demonstrating the equivalency of using the Central EC-25 sprinkler in lieu of the K-11 ELO sprinklers referenced in the specific standards. Compliance will be shown through a variety of methods, including how the nationally recognized fire protection organizations compare the two sprinklers, and an engineering analysis of the performance of the two sprinkler types in similar full-scale fire tests. These comparisons will demonstrate how the use of the EC-25 sprinkler in the application of the NFPA and FM sprinkler designs would be permitted based on 1999 NFPA 13, Section 1-2, which states that "… Nothing in this standard is intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by the standard is not lowered".

The issue at hand is that all of the above referenced standards specifically refer to the K-11 ELO ($^5/_8$-in.) sprinkler in its design criteria and not the EC-25 sprinkler. It is the intent of this engineering analysis to demonstrate equivalency in the use of the Central EC-25 sprinkler in lieu of the K-11 ELO sprinklers referenced in the standards. This equivalency maintains the level of safety prescribed by the standards; therefore, the use of the Central EC-25 sprinkler with the standard sprinkler design criteria is an acceptable design practice.

- National Recognized Comparisons of the Two Sprinkler Types

The following demonstrates how the two sprinkler types are compared by the various nationally recognized organizations:

NFPA:

The NFPA standards define both the K-11 and the EC-25 sprinklers as standard spray sprinklers. This definition is "a type of sprinkler listed for its capability to provide fire control for a wide range of fire hazards". Spray sprinklers are the types used when applying the "density/area" curves of 1999 NFPA 13. The EC-25 is further defined as an extended coverage spray sprinkler.

Additionally, the provisions of NFPA 13, Section 1-2 provides that "nothing in this standard is intended to restrict the use of new technologies or alternate arrangements provided the level of safety prescribed by this standard are not lowered."

Factory Mutual:

TYCO Fire Products has received authorization from Factory Mutual Research to distribute the Central EC-25 sprinkler as Factory Mutual Research Approved. The approval applies to the sprinkler as an upright extended coverage control mode (density/area) automatic sprinkler with a nominal discharge coefficient of 25.2. The approval of the EC-25 sprinkler allows for use of all current area/density applications recognized by Factory Mutual Global Loss Prevention Data Sheets, including any specific area/density designs previously recognized only for 11.2 K-Factor sprinklers. The following additional criteria are mandated:

Maximum Coverage Area:	196 ft^2
Minimum Coverage Area:	100 ft^2
Maximum Spacing:	14ft
Minimum Spacing:	10 ft*
Minimum Operating Pressure:	7 psi

*** See Manufacturer's Data Sheet for Specific Exception**

- Full-Scale Fire Tests Using Each Sprinkler Type

The specific design parameters provided in the various NFPA Standards and Factory Mutual Data Sheets are the result of large-scale fire tests. One of these such test programs, performed by the Factory Mutual Research Corporation, are the fire tests documented in their Technical Report dated November 1994, "Large-Scale Fire Tests of Rack Stored Group A Plastics in Retail Operation Scenarios Protected by Extra Large Orifice (ELO) Sprinklers." These tests were very successful and resulted in some specific design criteria that is found in the 1999 NFPA 13, Section 7-4.1.7.1 Exception for solid and slatted shelves.

Recently, TYCO Fire Products submitted their new EC-25 sprinkler to evaluate its fire protection performance. Three groupings of large-scale fire tests were performed with conditions duplicating that of previous large-scale fire tests that used other control mode sprinklers (i.e. Large Orifice, Extra Large Orifice and K17 models) to compare results. This is a comparative method has been employed by Factory Mutual Research Corporation in previous test programs with results leading to the development of new FM-Approval criteria.

- A summary of the test results for the EC-25 sprinkler verses the previous test results of other standard spray sprinklers is as follows:

Table 1 – Test Series SP18

	Test Series SP 18		
Sprinkler	K8	K11	EC-25
Test Date	11/29/73	12/6/93	6/16/00
Commodity	Plastic	Plastic	Plastic
Arrangement	Palletized	Palletized	Palletized
Ceiling Height	25 ft	25 ft	25 ft
Storage Height	15 ft	15 ft	15 ft
Ignition Location	Between 4	Between 4	Between 4
Pressure	36 psi	19 psi	22 psi
Gas Peak Temp	2004°F	1509°F	506°F
Gas 1 Minute Peak	1818°F	1377°F	282°F
Steel Peak Temp	NM	203°F	133°F
Steel 1 Minute Peak	NM	196°F	132°F
# Open Sprinklers	24	16	2
Density	0.6 gpm/ft²	0.6 gpm/ft²	0.6 gpm/ft²
Pallets Consumed	20	2	6

Table 2 – Test Series #74

	Test Series #74		
Sprinkler	K5.6	K11	EC-25
Test Date	11/13/69	11/29/93	4/25/00
Commodity	Class II	Class II	Class II
Arrangement	Rack	Rack	Rack
Ceiling Height	30 ft	30 ft	30 ft
Storage Height	20 ft	20 ft	20 ft
Ignition Location	Between 4	Between 4	Between 4
Pressure	43 psi	11 psi	8.4 psi
Gas Peak Temp	829°F	934°F	882°F
Gas 1 Minute Peak	765°F	570°F	462°F
Steel Peak Temp	NM	308°F	138°F
Steel 1 Minute Peak	NM	306°F	137°F

# Open Sprinklers	18	9	4
Density	0.37 gpm/ft²	0.37 gpm/ft²	0.37 gpm/ft²
Pallets Consumed	41	5	1

Table 3 – Test Series RSP-7

	Test Series RSP-7				
Sprinkler	K8	K11	K17	EC-25	EC-25
Test Date	10/22/75	3/25/92	9/22/97	6/3/00	6/3/00
Commodity	Plastic	Plastic	Plastic	Plastic	Plastic
Arrangement	Rack	Rack	Rack	Rack	Rack
Ceiling Height	25 ft	25 ft	25 ft	25 ft	25 ft
Storage Height	15 ft	15 ft	15 ft	15 ft	15 ft
Ignition Location	Between 4	Between 4	Under 1	Under 1	Under 1
Pressure	55 psi	29 psi	12.5 psi	22 psi	7 psi
Gas Peak Temp	1957°F	817°F	537°F	294°F	264°F
Gas 1 Minute Peak	1877°F	612°F	312°F	152°F	189°F
Steel Peak Temp	NM	163°F	135°F	89°F	132°F
Steel 1 Minute Peak	NM	159°F	134°F	88°F	131°F
# Open Sprinklers	29	4	7	1	3
Density	0.6 gpm/ft²	0.6 gpm/ft²	0.6 gpm/ft²	0.6 gpm/ft²	0.6+ gpm/ft²
Pallets Consumed	26	2	4	1	4

Reviewing these results demonstrates that the EC-25 sprinkler performed better than the standard sprinkler ($^{17}/_{32}$-in), with a significantly lower number of sprinklers operating and less pallet loads consumed by the fire. The EC-25 was also found to perform better than or comparable to that of the ELO and K17 models with a low number of sprinklers operating and a low number of pallet loads consumed by the fire. The criteria that the Factory Mutual Research Corporation used to determine that the results of the K17-231 fire tests were acceptable are the following:

Sprinkler system water demands were low (at most about 600 gpm).

Ceiling-level gas and steel temperatures remained well below levels that would have endangered exposed structural steel.

Fuel consumption and the extent of the fire damage to the test arrays were kept well within desired limits.

Based on their criteria for acceptable results, the Factory Mutual Research Corporation found that the test results of the EC-25 sprinkler were acceptable in

regards to fire control, magnitude and duration of high ceiling level temperatures and the extent of fire damage.

- Sprinkler Performance in Regards to Droplet Size and Heat Absorption

The SFPE Handbook of Fire Protection Engineering (Second Edition), page 4-68 provides information regarding droplet size and motion for a sprinkler spray. The basic comparison is that for geometrically similar sprinklers, the median droplet diameter in the sprinkler spray has been found to be inversely proportional to the $^1/_3$ power of the water pressure and directly proportional to the $^2/_3$ power of the sprinkler orifice diameter.

The handbook goes on to say that one of the factors that the heat absorption rate of a sprinkler spray depends on is the total surface area of the water droplets, which is proportional to the total water discharge rate divided by the median droplet diameter.

It is not economical or feasible to test a sprinkler head at every possibly spacing, so maximum head spacing and minimum operating pressure limitations are placed on specific sprinklers in order to ensure a proper discharge pattern with adequate droplet sizes to provide the necessary heat absorption rates. Successful completion of full scale testing for both the ELO and EC-25 sprinklers have demonstrated sufficient droplet mass and momentum to overcome the aggressive fire plume associated with a Group A Plastic fire.

- Individual Protection Standard Requirements

The following nationally recognized fire protection standards all specifically identify the $^5/_8$-in. (K-11 ELO) sprinklers in there design criteria. This is the result of the fact that when these standards were developed, the EC-25 sprinkler did not exist.

1999 NFPA 13 Requirements – Rack Storage of Group A Plastics

NFPA 13, Section 7-4.1.7.1 (Exception) (1999 Edition) provides specific design criteria necessary to protect rack storage with slatted shelves without being considered racks with solid shelves. One of the criteria is that "sprinklers shall be K11.2 orifice spray sprinklers with a temperature rating of ordinary, intermediate, or high and shall be listed for protection of storage occupancies". Appendix C, Section C-7-4.1.7.1 of the standard, further states that the results of full-scale fire testing performed at the Factory Mutual Research Corporation "clearly demonstrate the acceptable performance of sprinkler systems protecting storage configurations that involve the use of slatted shelves as described in 7-4.1.7.1".

NFPA 13, Figure 7-4.4.2.3(e) Note 5 (1999 Edition) provides for protection of Group A plastics stored to a height of 20 ft under a 27 ft ceiling with $^5/_8$-in. orifice

spray listed for protection of storage occupancies to utilize a design criteria of 0.60 gpm/ft² over 2,000 ft² without in-rack sprinkler protection. Appendix C, Section C-7-4.4.2.3 of the standard, further states that the results of full-scale fire testing performed at the Factory Mutual Research Corporation "clearly demonstrate the acceptable performance of sprinkler systems protecting storage configurations that involving storage of Group A Plastics up
to 20 ft in height under a 27 ft ceiling where using ELO sprinklers to deliver a design density of 0.6 gpm/ft²."

The utilization of the EC-25 sprinkler was specifically tested under the above specified conditions as part of the Retail Fire Research Coalition including an increase in the storage height from 20 ft to 22 ft and an increase in the ceiling height from 27ft to 30 ft. The test results verify successful protection utilizing a design criteria of 0.60 gpm/ft² over 2,000 ft².

- 1998 NFPA 30B Requirements – Rack Storage of Aerosol Products

NFPA 30B, Table 4-3(e) (1998 Edition) provides specific design criteria necessary to protect rack storage of Level 2 and Level 3 aerosols with in-rack sprinklers. The specific criteria proposed is for Level 3 aerosol storage with a clearance between 5 and 10 feet. This protection criteria requires a ceiling design of 0.60 gpm/ft^2 over 2,000 ft^2 based on a 10 ft. clearance. One of the criteria is that ceiling sprinkler type and arrangement shall be standard spray, high temperature, $^{17}/_{32}$-in. or $^{5}/_{8}$-in. orifice standard response sprinklers with 100 ft^2 maximum spacing.

Appendix B, Section B-1 and Tables B-1(a) through (g) discuss fire test data conducted in the 1970s and 1980s on aerosol storage arrangements. It should be noted that none of these tests utilized the $^{5}/_{8}$-in. ELO sprinkler head, yet the code permits this type of sprinkler head in its design criteria. The most logical reason for this would be that the performance of the K-11 ELO sprinkler in fire tests for Group A Plastic commodities was so successful that the code committee permitted the inclusion of the ELO sprinkler head as a standard spray sprinkler meeting the standard sprinkler spacing and pressure requirements specified. Similar application for the EC-25 sprinkler can be justified based on the enhanced performance demonstrated in comparative full scale tests.

The utilization of the EC-25 sprinkler requires the extension of the operating area per sprinkler beyond the coverage area per sprinkler limit of 100 ft² and acceptance of an orifice diameter greater than 5/8 in. The comparative full scale tests demonstrate the successful performance of the EC-25 sprinkler (1 in. orifice diameter) at areas of coverage up to 196 ft² with fewer operating sprinklers, reduced levels of damage, lower ceiling and steel temperatures, etc. for a wide range of high challenge fires. Similar expectations can be applied to flammable and combustible liquids.

The maximum available temperature rating for the EC-25 is 214°F. This requires acceptance of an intermediate temperature rating in lieu of the specified high temperature sprinkler. The response times for initial sprinkler operation at the maximum sprinkler spacing for the EC-25 with a 165°F rating are comparable to response times for 165°F ELO sprinklers installed at an 8 ft x 10 ft spacing. (1:29 to 1:47 sec compared to 2:03 sec)

- 2000 NFPA 30 Requirements – Rack Storage of Flammable and Combustible Liquids

NFPA 30, Table 4.8.2(a) (2000 Edition) provides specific design criteria necessary to protect rack storage of Class IB, IC, II and III liquids. The Table distinguishes between Non-Relieving and Relieving style containers. The specific criteria proposed has been selected based on its ability to protect both non-relieving containers (≤ 1 gal.) and relieving style containers (≤ 5 gal.) with the same design criteria. This criteria is for a ceiling density of 0.60 gpm/ft^2 over a 2,000 ft^2 design area with two levels of in-racks (Note 7 is utilized to obtain the ceiling density for relieving style containers). The two levels of in-rack sprinklers are based on 16-ft. high racks. One of the criteria in this Table is that ceiling sprinkler type be Large Orifice or Extra Large Orifice. Additionally, Note b Table 4.8.2(a) provides that the ceiling sprinklers are high temperature and Section 4.8.2.2 provides a maximum sprinkler spacing of 100 ft^2.

Appendix D, Section D.1 discusses the development of suppression-oriented protection criteria for liquids in containers and states that this criteria "relies almost exclusively on the evaluation of large-scale fire test data". It goes on to state that "Reliance on actual test data for all situations and scenarios is not, however, practical from a cost standpoint. Development of NFPA 30 protection criteria, therefore, relies heavily on data from representative test scenarios". Alternative materials and scenarios are then evaluated in terms of the specific test data, historical test data, and engineering experience with the hazards. Pending the complete development of engineering tools to evaluate hazards, this approach represents the best method to meet the NFPA policy that codes and standards be scientifically based". This information specifically demonstrates that not all storage situations can be specifically tested and that specific design criteria in this code is based on extrapolation and interpolation of actual test data.

The utilization of the EC-25 sprinkler requires the extension of the operating area per sprinkler beyond the coverage area per sprinkler limit of 100 ft^2 and acceptance of an orifice diameter greater than 5/8 in. The comparative full scale tests demonstrate the successful performance of the EC-25 sprinkler (1 in. orifice diameter) at areas of coverage up to 196 ft^2 with fewer operating sprinklers, reduced levels of damage, lower ceiling and steel temperatures, etc. for a wide range of high challenge fires. Similar expectations can be applied to flammable and combustible liquids.

The maximum available temperature rating for the EC-25 is 214°F. This requires acceptance of an intermediate temperature rating in lieu of the specified high temperature sprinkler. A review of the Report of the National Wholesale/Retail Occupancy Fire Research Project on the Protection of Flammable Liquids, prepared in November 1992 by Underwriter's Laboratories for the National Fire Protection Research Foundation, shows evidence that the use of 214^{0}F sprinklers would not have an adverse effect on the successful results of Fire Test Nos. 10 & 11 from this report, which best mirror the storage arrangements at The Home Depot store.

The parameters for Test Nos. 10 & 11 include the following:

Fire Test No. 10:

- Commodity – Heptane (Class IB Flammable Liquid)
- Ceiling Height – 27 ft.
- Storage Height – 16 ft.
- Ceiling Sprinkler Density – 0.60 gpm/ft^2
- Ceiling Sprinkler Type – 286^{0}F ELO
- In-Rack Sprinklers – 2 levels at 73 and 138 inches above floor
- In Rack Sprinkler Type - 155^{0}F Quick Response, Large Orifice
- Shelf Type – Open 2 by 2 inch Wire Mesh
- Aisle Spacing – 7.5 ft.

Fire Test No. 11:

- Commodity – Heptane (Class IB Flammable Liquid)
- Ceiling Height – 27 ft.
- Storage Height – 19 ft.-8 in.
- Ceiling Sprinkler Density – 0.60 gpm/ft^2
- Ceiling Sprinkler Type – 286^{0}F ELO
- In-Rack Sprinklers – 2 levels at 73 and 138 inches above floor
- In Rack Sprinkler Type - 155^{0}F Quick Response, Large Orifice
- Shelf Type – 2 by 6 inch Wood Slats and Open 2 by 2 Wire Mesh on Top Shelf Only
- Aisle Spacing – 7.5 ft.

The results for Test Nos. 10 & 11 include the following:

Fire Test No 10:

This test was successful with no ruptures of containers and the fire was suppressed within 5 minutes. No ceiling level sprinklers operated and a total of three in-rack sprinklers operated. In reviewing the attached Illustrations B-73 through B-76 of the report, none of the thermocouples measuring ceiling

temperatures within the test area showed a temperature above 214^{0}F, which explains why no ceiling sprinklers activated.

Fire Test No 11:

This test was successful with no ruptures of containers and the fire was suppressed within 2 minutes 30 seconds. No ceiling level sprinklers operated and a total of three in-rack sprinklers operated. In reviewing the attached Illustrations B-81 through B-84 of the report, none of the thermocouples measuring ceiling temperatures within the test area showed a temperature above 214^{0}F, which explains why no ceiling sprinklers activated.

In reviewing the results of Fire Test Nos. 10 & 11, it is clear that the use of 214^{0}F ceiling sprinklers would not have an adverse effect on the successful results of Fire Test Nos. 10 & 11. In both of the tests reviewed, no thermocouple measured a ceiling temperature above 214^{0}F.

- FM Data Sheet 8-9 – Rack Storage of Uncartoned Expanded Group A Plastics

The May 2000 FM Data Sheet 8-9, Table 3.3.7.2(p) provides specific design criteria necessary to protect rack storage of uncartoned expanded Group A Plastics. This design criteria is being utilized because NFPA does not address rack storage of uncartoned expanded plastics. One of the criteria is that the ceiling sprinklers shall be ELO or standard type.

The Factory Mutual Approval allows for use of the EC-25 with all current area/density applications recognized by Factory Mutual Global Loss Prevention Data Sheets, including any specific area/density designs previously recognized only for 11.2 K-Factor sprinklers.

- Conclusion

The main question that needs to be answered by this analysis is whether the use of the EC-25 sprinkler in lieu of the K-11 ELO sprinkler as specified in the NFPA and FM standards would lower the level of safety prescribed by the standard. The above cited information supports that it would not. This conclusion is based on the following facts:

The fire tests conducted by Factory Mutual Research Corporation using the EC-25 sprinkler found that they "will provide protection that is equivalent to or in some cases better than that provided by FM-Approved Standard spray, ½-in. and $^{17}/_{32}$-in. orifice, sprinklers, and Extra Large Orifice, .64-in. orifice, sprinklers" assuming they are installed under the following conditions:

- Protection guidelines are governed according to the "Density/Area" method of design. The minimum allowable discharge pressure employed is 7 psi."

These tests for the EC-25 sprinkler were conducted using rack storage of Group A Plastics and included a ceiling design density of 0.60 gpm/ft^2, which is equivalent to the ceiling design density required for the other protection scenarios involving rack storage of aerosols, flammable and combustible liquids, and uncartoned expanded Group A Plastics, with the exception that these other commodities also required in-rack sprinkler protection.

Both the ELO and EC-25 sprinkler need to be installed in accordance with the standard sprinkler placement requirements and therefore based on the area of coverage per sprinkler, would have different flow rates and discharge pressures. As discussed regarding droplet sizes, the full-scale fire tests were not performed with every possible sprinkler coverage area, and therefore not every possible droplet size, surface area and heat absorption rate. The difference in these critical criteria between the K-11 ELO and the EC-25 sprinklers were not found to be an issue since they both performed successfully in identical full-scale fire tests on Group A Plastics.

The Factory Mutual Approval allows for use of the EC-25 with all current area/density applications recognized by Factory Mutual Global Loss Prevention Data Sheets, including any specific area/density designs previously recognized only for 11.2 K-Factor sprinklers.

Finally, the use of NFPA 13, Section 1-2 (1999 Edition) allows for use of new technology such as that employed in the development of the EC-25 provided the level of safety prescribed by the standard is not lowered.

Submitted by:

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