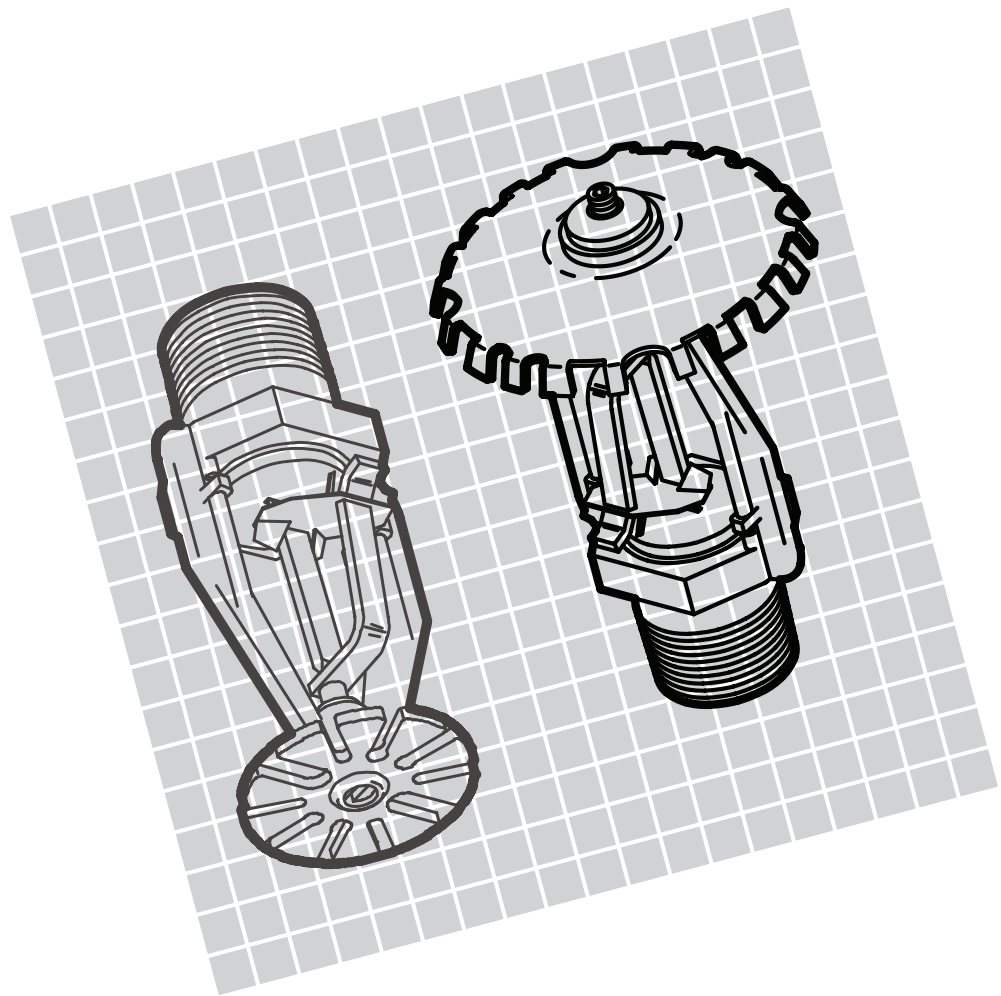


# Application of the Tyco Fire & Building Products Model ESFR-17 Pendent/Upright Sprinklers

## Sprinkler Identification Numbers (SIN) TY7226/TY126

Patent 5,829,532; 6,059,044  
Other Patents Pending



***tyco***

*Fire & Building  
Products*

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# APPLICATION OF THE TYCO FIRE & BUILDING PRODUCTS MODEL ESFR-17 PENDENT & UPRIGHT SPRINKLER

## SPRINKLER IDENTIFICATION NUMBER (SIN) TY7226 & TY126

### BACKGROUND

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As new technology for automatic fire sprinklers continues, we have demonstrated the overwhelming advantages and benefits of larger orifices being used in sprinklers for the protection of higher challenge occupancies. These occupancies typically include high storage of product. In most cases, "high storage" is considered storage over 12 feet (3,66 m). This storage may be in rack structures, or simply stored in solid piles, or on pallets from the floor. Among other factors, these larger orifice sprinklers provide large droplets, which have the ability to better penetrate a strong fire plume. It is not unusual at all, to see fire plume velocities in excess of 40 feet per second (12,2 m/sec.) when the first sprinkler operates. This is equivalent to a wind velocity of 27 miles per hour (43,4 Kph). It is this phenomenon that creates difficulties with the traditional orifice sprinklers' droplets to adequately penetrate the fire plume. The benefits of larger orifices in control-mode type sprinklers have become clear, and we can now utilize the same concept for "Suppression" sprinklers. The development of the new Tyco ESFR-17 pendent and upright sprinklers accomplishes this goal. Early Suppression Fast Response (ESFR) technology was first developed in the 1980's, with the first Approvals for ESFR sprinklers coming in 1988. The ESFR-17 pendent and upright takes Suppression sprinkler technology to another level.

### BENEFITS OF ESFR-17 Pendent/Upright

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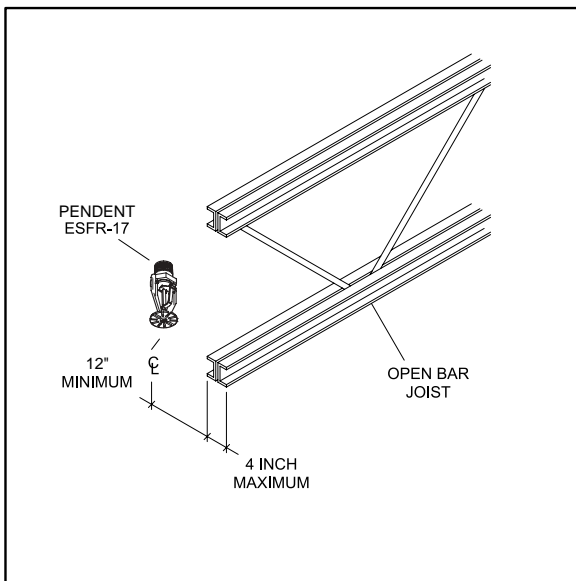
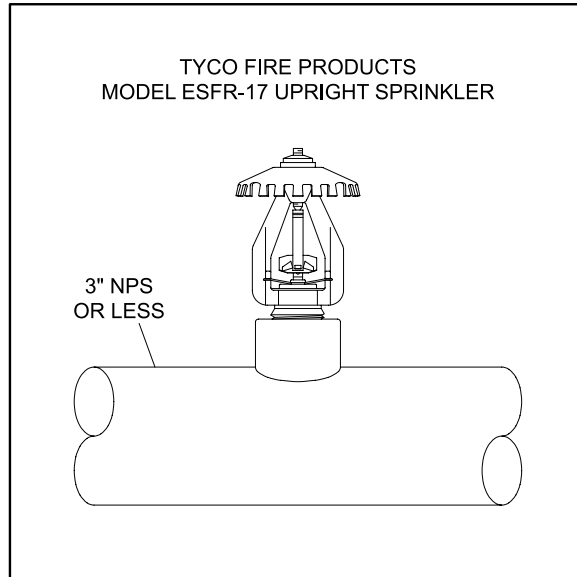
The most obvious benefit is the savings in required operating pressure of the ESFR-17 over that of a typical ESFR with a K-Factor of 14.0 GPM/psi<sup>1/2</sup> (201,6 LPM/bar<sup>1/2</sup>). The Tables herein show a comparison of required minimum pressures for both the K14 ESFR sprinkler and the ESFR-17 for various storage commodities and arrangements. What exactly would be the benefit of lower operating pressures? In many cases, lower minimum operating pressures result in pipe size savings. Whether this pipe size savings is due to 'downsizing' branch-lines or mains is dependent on various factors such as available water supply; pump size; system layout; and length of grid-lines. A second possible benefit could be the downsizing of the fire pump. Another benefit is one that does not result in any material cost savings, but rather the "comfort factor" if/when field modifications are made during installation. With an additional 15 to 23 psi (1,03 to 1,59 bar) of pressure afforded by this sprinkler, impacts of field changes can be more readily absorbed without the system supply being insufficient to compensate for the changes.



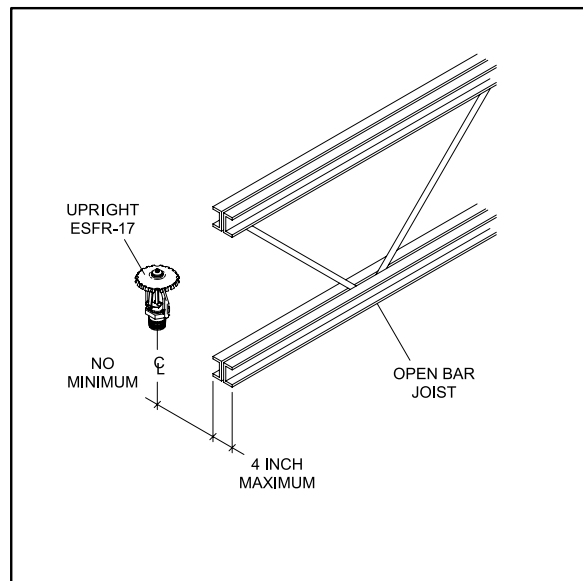
The upright ESFR-17 obstruction criteria is different from that of the ESFR-17 pendent. It may be installed on up to 3 inch nominal pipe without the requirement for sprigging up. Additionally, full scale testing at FM with upright ESFR sprinklers has shown that small obstructions located directly below the sprinklers have less impact on the performance of the upright than on pendent suppression mode sprinklers. Therefore, the obstruction requirements for the upright can be relaxed from that of pendent ESFR sprinklers. When Factory Mutual Research Approved upright suppression mode sprinklers are used, obstructions below sprinklers can be ignored if:

- They are open-web bar joists or trusses having chords no more than 4 in. (102 mm) wide, or
- They are bridging or wind bracing no more than 4 in. (102 mm) wide, or
- They are individual pipes and conduit 4 in. (102 mm) in diameter or less, or individual groups of smaller pipe or conduit having a total width of 4 in. (102 mm) or less.

It is important to note that these FM obstruction criteria is based on actual testing of upright ESFR sprinklers. NFPA guidelines historically have not differentiated between upright and pendent ESFR obstruction criteria, and currently require sprigging-up to an upright ESFR to raise the deflector above the branch-line piping. However, after actual testing at FM, these NFPA obstruction restrictions for FM Approved upright K-14 and K-17 ESFR sprinklers are not applicable. The 2002 edition of NFPA will now allow for deviation of their obstruction criteria when the upright ESFR is Listed as such



[12" minimum required for ESFR pendent]



[No minimum required for ESFR upright]

As with all new sprinkler technology, it is important to realize that different approving and listing agencies may have different design criteria or allowances. The design criteria should always be checked for the appropriate Listings/Approvals before proceeding. The following is an “snapshot” of the Approvals and Listings, and the allowances granted by the applicable agency..

**Technical Data**

- Model – ESFR-17 Pendent/ESFR-17 Upright
- Sprinkler Identification Number (SIN) – TY7226 Pendent/TY7126
- Listed and Approved Under "Tyco Fire & Building Products"
- Nominal K-Factor – 16.8 GPM/psi<sup>1/2</sup> (241,9 LPM/bar<sup>1/2</sup>)

**Approvals**

**PENDENT**

- FM Approved for the protection of the same types of commodities as allowed for K14 ESFR pendent sprinklers (excluding flammable liquids and aerosols) as required in the FM engineering data sheets.
- UL Listed as a "Specific Application" sprinkler for the protection of all commodities and storage arrangements as allowed for K14 ESFR pendent sprinklers in the NFPA Standards.

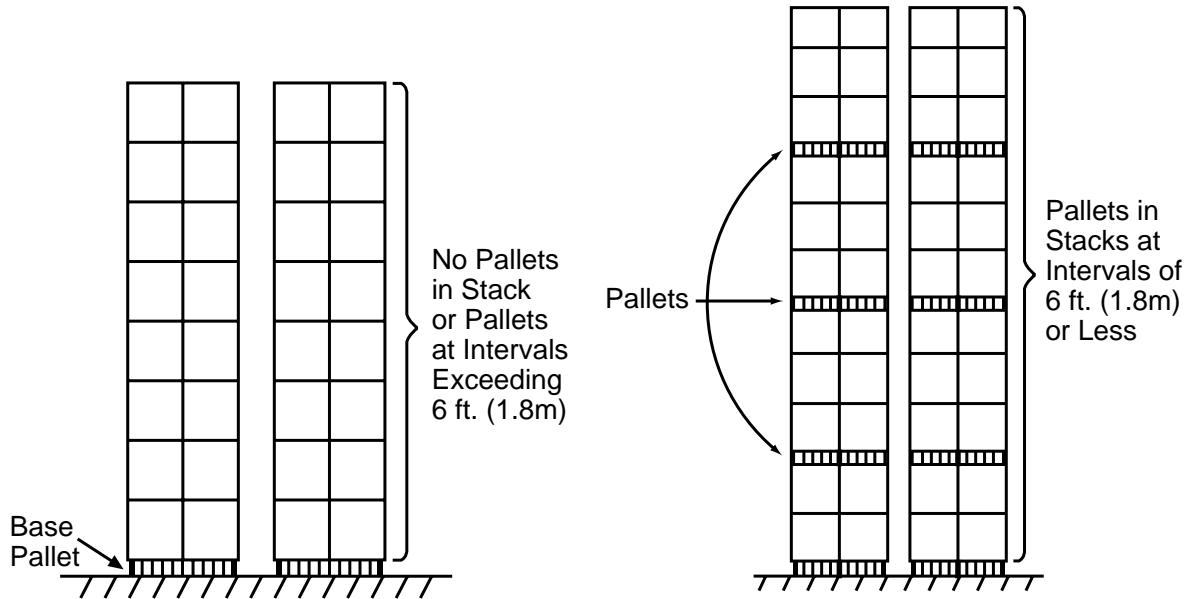
**UPRIGHT**

- FM Approved for storage arrangements and commodities as shown in Tables 1A, 2A, 3A, and 4A of this brochure

**Tables**

The tables contained within this paper, are broken down as follows:

- Palletized and Solid Piled Storage . . . . . Table 1 & 1A
- Rack Storage Without Solid Shelves . . . . . Table 2 & 2A
- Rubber Tire Storage . . . . . Table 3 & 3A
- Rolled Paper Storage . . . . . Table 4 & 4A
- Idle Wood and Plastic Storage . . . . . Table 5



[Table 1 – Palletized and Solid-Pile Storage-ESFR-17 PENDENT]

Type of Storage	Commodity	Max. Storage Height ft (m)	Max. Bldg. Height ft (m)	Min. Pressure		Appvls.
				K14 psi (bar)	ESFR-17 psi (bar)	
Palletized and solid-pile (no open top containers)	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned or Uncartoned unexpanded plastic; Cartoned expanded plastic; Idle wood or plastic pallets	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	UL/FM
	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned or Uncartoned unexpanded plastic; Cartoned expanded plastic	25 (7,6)	32 <sup>‡</sup> (9,8)	60 (4,1)	42 (2,9)	FM
	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned or Uncartoned unexpanded plastic; Idle wood or plastic pallets	35 (10,7)	40 (12,2)	75 (5,2)	52 (3,6)	UL/FM

<sup>‡</sup> See Fm Data Sheet 8-9, Table 3.3.7.2(m).

**[Table 1A – Palletized and Solid-Pile Storage-ESFR-17 UPRIGHT]**

Type of Storage	Commodity	Max. Storage Height ft (m)	Max. Bldg. Height ft (m)	Min. Pressure		Appvls
				K14 psi (bar)	ESFR-17 psi (bar)	
Palletized and solid-pile (no open top containers)	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned unexpanded plastic	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	FM
		25 (7,6)	32* (9,8)	60 (4,1)	42 (2,9)	FM
		30 (9,1)	35 (10,7)	75 (5,2)	52 (3,6)	FM
	Cartoned expanded plastic	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	FM
		25 (7,6)	32* (9,8)	60 (4,1)	42 (2,9)	FM

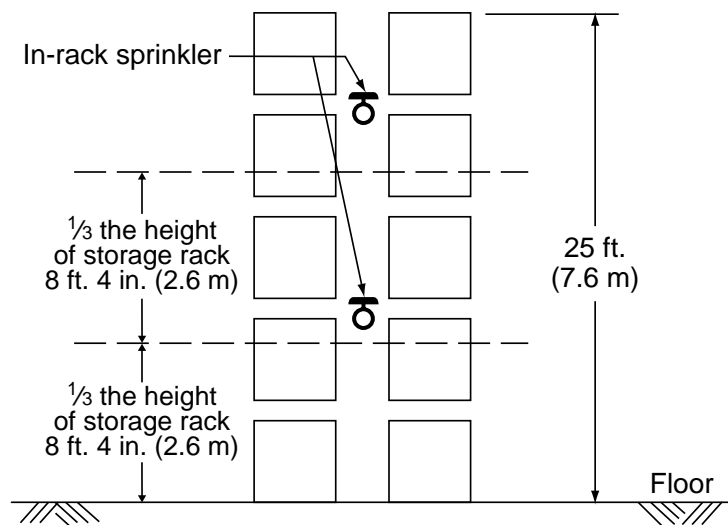
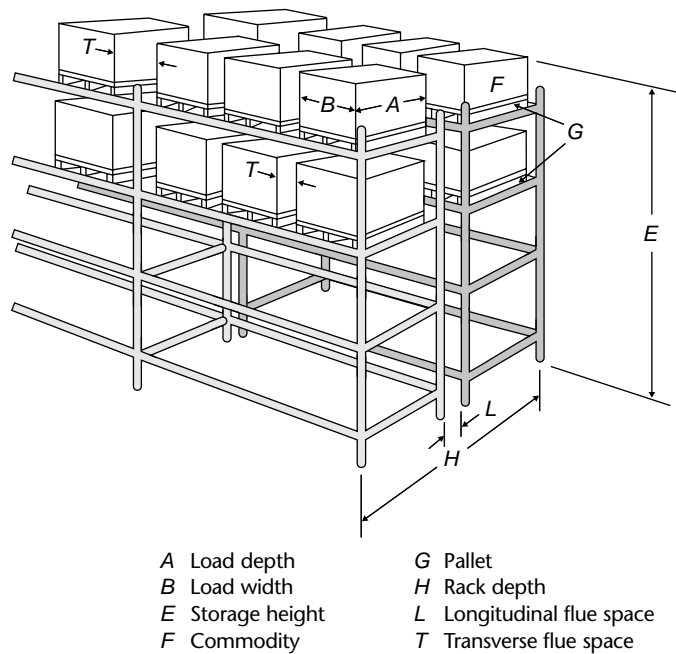
‡ See Fm Data Sheet 8-9, Table 3.3.7.2(m).

This example shows a racking arrangement that is typically used for the storage of product.

The figure on the right shows this racking arrangement that allows the use of commodity loads already on pallets to be placed into the racking. The pallets themselves rest on the horizontal rack framing members. The space labeled "L" in this figure (Longitudinal Flue Space) is where sprinklers and piping are typically run when sprinklers are required inside the racks. This is also illustrated below.

**The use of the ESFR-17 pendent or upright would eliminate the need for piping sprinklers inside the racking units**

when designed in accordance with its Approvals and Listings. The use of the ESFR-17 sprinklers also eliminates "storage to ceiling" maximum clearance restrictions of Group A plastic commodity that is found with "control-mode" sprinklers, as well as the aisle width restrictions and penalties for Class 1 through 4 commodities.



[Elevation View – Typical Double Row Rack Arrangement Without ESFR Sprinklers]

**[Table 2 – Rack Storage Without Solid Shelves]**

Type of Storage	Commodity	Max. Storage Height ft (m)	Max. Bldg. Height ft (m)	Min. Pressure K14 psi (bar)	ESFR-17 psi (bar)	Appvls.
Single row rack storage, double row rack storage, multiple row rack storage. (no open-top containers)	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned or Uncartoned unexpanded plastic; Cartoned expanded plastic; Idle wood or plastic pallets	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	UL/FM
	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned or Uncartoned unexpanded plastic; Cartoned expanded plastic	25 (7,6)	32 <sup>†</sup> (9,8)	60 (4,1)	42 (2,9)	FM
	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned or Uncartoned unexpanded plastic; Idle wood or plastic pallets	35 (10,7)	40 (12,2)	75 (5,2)	52 (3,6)	UL/FM
	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned or Uncartoned unexpanded plastic	40 (12,2)	45* (13,7)	90 (6,2)	63 (4,3)	FM

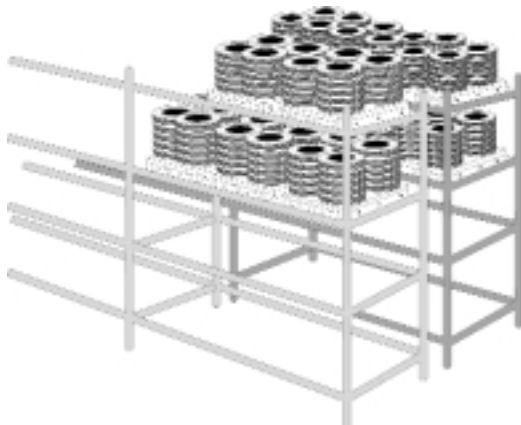
† See FM Data Sheet 8-9, Table 3.3.7.2(m).

\* Design 12 sprinklers plus one level of QR (K-8.0) large orifice, in-rack sprinklers located at the tier height closest to one-half the storage height. Location of in-rack sprinklers shall be at intersection of the longitudinal and transverse flue spaces, with spacing between sprinklers and lines of sprinklers not exceeding 5 ft.(1.5 m). In-rack sprinkler hydraulic design criteria is 8 sprinklers at 50 psi. (3.4 bar)

**[Table 2A – Rack Storage Without Solid Shelves-ESFR-17 UPRIGHT]**

Type of Storage	Commodity	Max. Storage Height ft (m)	Max. Bldg. Height ft (m)	Min. Pressure		Appvls
				K14 psi (bar)	ESFR-17 psi (bar)	
Single row rack storage, double row rack storage. (no open-top containers)	Class I, II, III, or IV, encapsulated or unencapsulated; Cartoned unexpanded plastic	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	FM
		25 (7,6)	32* (9,8)	60 (4,1)	42 (2,9)	FM
		30 (9,1)	35 (10,7)	75 (5,2)	52 (3,6)	FM
	Cartoned expanded plastic	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	FM
		25 (7,6)	32* (9,8)	60 (4,1)	42 (2,9)	FM

\*See Fm Data Sheet 8-9, Table 3.3.7.2(m).



[On-Side Storage Of Rubber Tires In Double Row Rack]



[On-Tread Storage Of Rubber Tires In Double Row Rack]

[Table 3 – Rubber Tire Storage-ESFR-17 Pendent]

Piling Method	Max. Storage Height ft (m)	Max. Bldg. Height ft (m)	Min. Pressure		Appvls.
			K14 psi (bar)	ESFR-17 psi (bar)	
On-side or on-tread, in palletized portable racks, open portable racks or fixed racks without solid shelves	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	UL/FM
On-side, in palletized portable racks, open portable racks or fixed racks without solid shelves	25 (7,6)	35 (10,7)	75 (5,2)	52 (3,6)	UL
Laced in open portable steel racks <sup>‡</sup>	25 (7,6)	30 (9,1)	75 <sup>‡</sup> (5,2)	63 <sup>‡</sup> (4,3)	UL

<sup>‡</sup>The design area shall consist of the most demanding 20 sprinklers, 5 sprinklers on each of 4 branch-lines.

**[Table 3A – Rubber Tire Storage-ESFR-17 Upright]**

Piling Method	Max. Storage Height ft (m)	Max. Bldg. Height ft (m)	Min. Pressure		Appvls.
			K14 psi (bar)	ESFR-17 psi (bar)	
On-side or on-tread, in palletized portable racks, open portable racks or fixed racks without solid shelves	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	UL/FM

‡The design area shall consist of the most demanding 20 sprinklers, 5 sprinklers on each of 4 branch-lines.

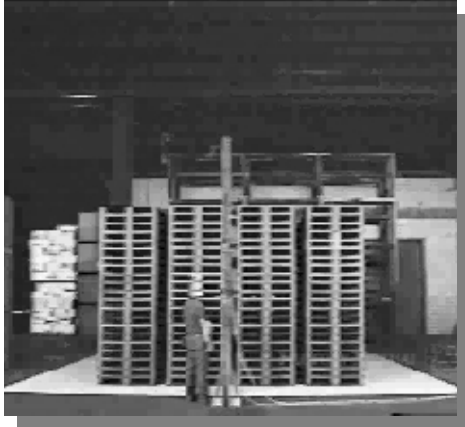


[Table 4 – Rolled Paper Storage-ESFR-17 Pendent]

	Max. Storage Height ft (m)	Max. Bldg. Height ft (m)	Min. Pressure		Appvls.
			K14 psi (bar)	ESFR-17 psi (bar)	
Mediumweight	20 (6,1)	30 (9,1)	50 (3,4)	35 (2,4)	FM
	20 (6,1)	35 (10,7)	75 (5,2)	52 (3,6)	FM
	20 (6,1)	40 (12,2)	75 (5,2)	52 (3,6)	FM
	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	UL
Heavyweight	25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)	UL/FM
	30 (9,1)	40 (12,2)	75 (5,2)	52 (3,6)	UL/FM
Plastic Coated Heavyweight	20 (6,1)	30 (9,1)	50 (3,4)	35 (2,4)	FM
	20 (6,1)	40 (12,2)	75 (5,2)	52 (3,6)	FM

**[Table 4A – Rolled Paper Storage-ESFR-17 Upright]**

	<b>Max. Storage Height ft (m)</b>	<b>Max. Bldg. Height ft (m)</b>	<b>Min. Pressure</b>		<b>Appvls.</b>
			<b>K14 psi (bar)</b>	<b>ESFR-17 psi (bar)</b>	
Mediumweight	20 (6,1)	30 (9,1)	50 (3,4)	<b>35</b> <b>(2,4)</b>	FM
	20 (6,1)	35 (10,7)	75 (5,2)	<b>52</b> <b>(3,6)</b>	FM
Heavyweight	25 (7,6)	30 (9,1)	50 (3,4)	<b>35</b> <b>(2,4)</b>	FM
	30 (9,1)	40 (12,2)	75 (5,2)	<b>52</b> <b>(3,6)</b>	FM
Plastic Coated Heavyweight	20 (6,1)	30 (9,1)	50 (3,4)	<b>35</b> <b>(2,4)</b>	FM
	20 (6,1)	40 (12,2)	75 (5,2)	<b>52</b> <b>(3,6)</b>	FM



**[Idle Plastic Pallets]**



**[Idle Wood Pallets]**



**[2-Way Wood Pallet]**



**[4-Way Wood Pallet]**

**[Table 5 – Idle Wood and Plastic Pallets-ESFR-17 Pendent]**

Max. Storage Height ft (m)	Max. Bldg. Height ft (m)	Min. Pressure	
		K14 psi (bar)	ESFR-17 psi (bar)
25 (7,6)	30 (9,1)	50 (3,4)	35 (2,4)
35 (10,7)	40 (12,2)	75 (5,2)	52 (3,6)

*The following pages illustrate actual fire sprinkler system layouts, and corresponding pipe sizes when using the ESFR-17 and also the K14 ESFR pendent sprinklers. Actual available water supply information has been used for each system, with the resulting data tabulated. Obviously, piping layouts and water supplies are infinitely variable. These layouts and supply pressures however, illustrate a reasonable cross section of typical field conditions. By simply checking both K-Factor sprinklers during the bid stage, a substantial material savings may be realized at job completion.*

## SYSTEM #1 ANALYSIS SUMMARY

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System #1, as with all of the systems shown, utilizes an actual water supply available at the base of the riser as provided to TFP. This system required a minimum pressure of 50 psi (3,4 bar) for K14 ESFR sprinklers. (35 psi (2,4 bar) for ESFR-17 sprinklers). The piping was all schedule 10. In this example, 3120 feet(951 m) of branch grid-lines could be reduced to 2 inch diameter(50 mm) from the 2 1/2 inch diameter (65 mm) required for the K14 ESFR sprinklers. The Primary and Secondary mains remained at 6 inch diameter (150 mm) for both type sprinklers. The Feed and Riser however, were reduced from 8 inch (200 mm) to 6 inch(150 mm) with the ESFR-17 sprinkler.

## SYSTEM #2 ANALYSIS SUMMARY

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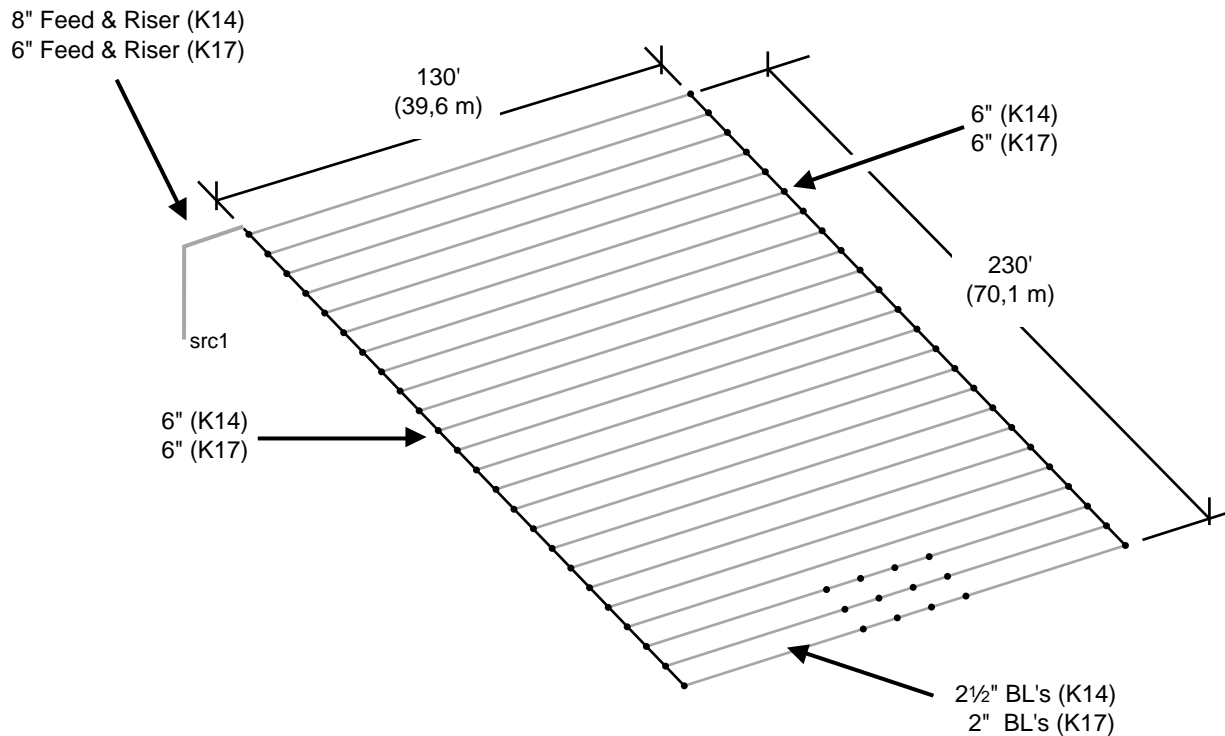
System #2, simulated the same piping arrangement as system #1: however, the water supply at the base of the riser was dramatically increased, simulating a pump being used. This system required a minimum pressure of 75 psi (5,2 bar) for K14 ESFR sprinklers. (52 psi (3,6 bar) for ESFR-17 sprinklers). Pipe type was schedule 10. The grid branch-lines for both the K14 ESFR and the ESFR-17 were 2 inch (50 mm). A pipe size savings was realized with the ESFR-17 in 230 feet (70 m) of primary main and approximately 20 feet (6 m) of Feed piping being reduced to 4 inch (100 mm) in lieu of 6 inch(150 mm) as required for the K14 ESFR sprinklers. While a substantial "Cushion" was available with the K14 ESFR, it was not enough to reduce the primary main to 4 inch.

## SYSTEM #3 ANALYSIS SUMMARY

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System #3, unlike the previous two systems, utilizes rather long (240 ft. (73 m)) grid branch-lines. Again, the water supply available at the base of the riser would suggest a fire pump being included in this example. This system required a minimum pressure of 75 psi (5,2 bar) for K14 ESFR sprinklers. (52 psi (3,6 bar) for ESFR-17 sprinklers). Pipe type was schedule 10. This layout allowed for the Secondary Main to be reduced to 4 inch (100 mm) from 6 inch (150 mm) for the K14 ESFR sprinklers. The Riser could also be reduced to 6 inch (150 mm) from 8 inch(200 mm) as required for the K14 ESFR sprinklers. With these reductions in pipe size, the pressure "cushion" still remaining when using the ESFR-17 sprinklers was 16.1 psi (1,1 bar) versus a "cushion" of 1.7 psi(.12 bar) with the K14 ESFR sprinklers.

# K14/K17 SYSTEM #1 ANALYSIS



## [Material – System #1]

*Pressure savings of the ESFR-17 allowed a reduction of branch-line pipe size as well as Feed and Riser pipe size.*

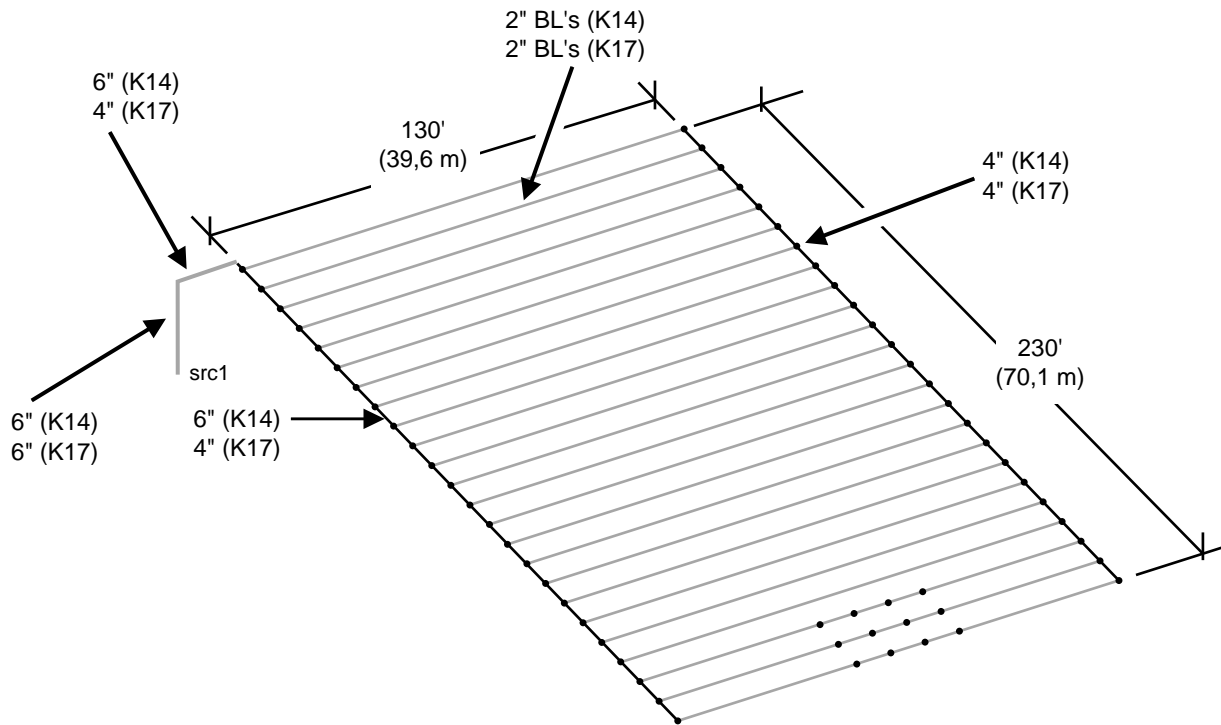
	Branch-Line Footage & Size	Primary Main Footage & Size	Secondary Main Footage & Size	Feed Main Footage & Size	Riser Footage & Size
K14 ESFR	3120' @ 2½" Dia.	230' @ 6" Dia.	230' @ 6" Dia.	20' @ 8" Dia.	30' @ 8" Dia.
ESFR-17	3120' @ 2" Dia.	230' @ 6" Dia.	230' @ 6" Dia.	20' @ 6" Dia.	30' @ 6" Dia.

## [Hydraulics]

Water Supply Info. @ Base Of Riser  
82 psi Static / 71 psi Residual / 2123 gpm Flowing

K14 ESFR System Requirements	ESFR-17 System Requirements
Required Pressure = 76.79 psi	Required Pressure = 76.01 psi
Required Flow = 1189.89 gpm	Required Flow = 1194.6 gpm
Available Pressure = 78.23 psi	Available Pressure = 78.2 psi
Cushion = 1.44 psi	Cushion = 2.19 psi

# K14/K17 SYSTEM #2 ANALYSIS



## [Material – System #2]

Pressure savings of the ESFR-17 allowed a reduction in Primary Main and Feed Main pipe size.

	Branch-Line Footage & Size	Primary Main Footage & Size	Secondary Main Footage & Size	Feed Main Footage & Size	Riser Footage & Size
K14 ESFR	3120' @ 2" Dia.	230' @ 6" Dia.	230' @ 4" Dia.	20' @ 6" Dia.	40' @ 6" Dia.
ESFR-17	3120' @ 2" Dia.	230' @ 4" Dia.	230' @ 4" Dia.	20' @ 4" Dia.	40' @ 6" Dia.

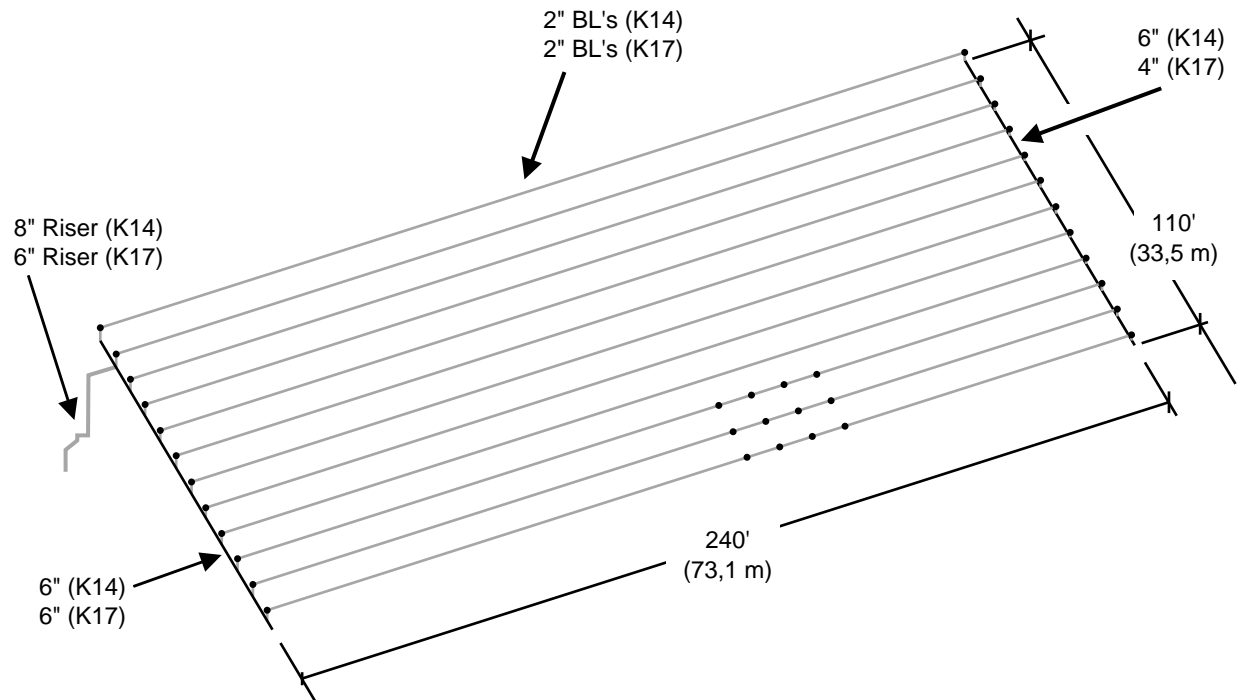
## [Hydraulics]

Water Supply Info. @ Base Of Riser  
 170 psi Static / 162 psi Residual / 1500 gpm Flowing

K14 ESFR System Requirements	ESFR-17 System Requirements
Required Pressure = 132.6 psi	Required Pressure = 154.8 psi
Required Flow = 1461.3 gpm	Required Flow = 1465 gpm
Available Pressure = 162.4 psi	Available Pressure = 162.3 psi
Cushion = 29.8 psi*	Cushion = 7.5 psi

\*Insufficient cushion to reduce Primary Main to 4"

# K14/K17 SYSTEM #3 ANALYSIS



## [Material – System #3]

*Pressure savings of the ESFR-17 allowed a reduction in Secondary Main and Riser size.*

	Branch-Line Footage & Size	Primary Main Footage & Size	Secondary Main Footage & Size	Feed Main Footage & Size	Riser Footage & Size
K14 ESFR	2900' @ 2" Dia.	110' @ 6" Dia.	110' @ 6" Dia.	N/A	40' @ 8" Dia.
ESFR-17	2900' @ 2" Dia.	110' @ 6" Dia.	110' @ 4" Dia.	N/A	40' @ 6" Dia.

## [Hydraulics]

Water Supply Info. @ Base Of Riser  
 163 psi Static / 162 psi Residual / 1650 gpm Flowing

K14 ESFR System Requirements	ESFR-17 System Requirements
Required Pressure = 160.5 psi	Required Pressure = 146.1 psi
Required Flow = 1459.8 gpm	Required Flow = 1461.7 gpm
Available Pressure = 162.2 psi	Available Pressure = 162.2 psi
Cushion = 1.7 psi	Cushion = 16.1 psi

## ESFR Pendent

- Areas of palletized or solid piled storage of Class 1 through Class 4 commodities, encapsulated or unencapsulated; cartoned or uncartoned unexpanded plastics; cartoned expanded plastics; or idle wood or plastic pallets shall be protected with ESFR sprinklers having a K-Factor of 16.8 GPM/psi<sup>1/2</sup> (241,9 LPM/bar<sup>1/2</sup>). The storage height shall not exceed 35 feet (10,7 m) with building height not exceeding 40 feet (12,2 m). The sprinkler shall be UL Listed and FM Approved under Tyco Fire Products. The minimum operating pressure shall be in accordance with the manufacturer's Listing for the appropriate storage height/building height.
- Areas of rack storage of Class 1 through Class 4 commodities, encapsulated or unencapsulated; cartoned or uncartoned unexpanded plastics; cartoned expanded plastics; or idle wood or plastic pallets shall be protected with ESFR sprinklers having a K-Factor of 16.8 GPM/psi<sup>1/2</sup> (241,9 LPM/bar<sup>1/2</sup>). The storage height shall not exceed 40 feet (12,2 m) with building height not exceeding 45 feet (13,7 m). The sprinkler shall be UL Listed and FM Approved under Tyco Fire Products. The minimum operating pressure shall be in accordance with the manufacturer's Listing for the appropriate storage height/building height.
- Areas where storage of rubber tires is kept on-side or on-tread and not exceeding 25 feet (7,6 m) in height in buildings not exceeding 35 feet (10,7 m) in height shall be protected with ESFR sprinklers having a K-Factor of 16.8 GPM/psi<sup>1/2</sup> (241,9 LPM/bar<sup>1/2</sup>). The sprinkler shall be UL Listed and FM Approved under Tyco Fire Products. The minimum operating pressure shall be in accordance with the manufacturer's Listing for the appropriate storage height/building height.
- Areas where roll paper of Mediumweight, Heavyweight, or Plastic Coated Heavyweight is stored shall be protected with ESFR sprinklers having a K-Factor of 16.8 GPM/psi<sup>1/2</sup> (241,9 LPM/bar<sup>1/2</sup>). The storage height shall not exceed 30 feet (9,1 m) with building height not exceeding 40 feet (12,2 m). The sprinkler shall be UL Listed and FM Approved under Tyco Fire Products. The minimum operating pressure shall be in accordance with the manufacturer's Listing for the appropriate storage height/building height.

## ESFR Upright

- Areas of single, double, and multiple row rack storage and palletized and solid piled storage (no open top containers or solid shelves) of Class 1 through Class 4 commodities, encapsulated or unencapsulated; cartoned unexpanded plastics; cartoned expanded plastics; shall be protected with Upright ESFR sprinklers with a nominal K-Factor of at least 16.8 GPM/psi<sup>1/2</sup> (241,9 LPM/bar<sup>1/2</sup>).

-The storage height shall not exceed 30 feet (9,1 m) with building height not exceeding 35 feet (10,7 m) for Class 1 through 4 and cartoned unexpanded plastics.

-The storage height shall not exceed 25 feet (7,6 m) with building height not exceeding 30 feet (9,1 m) for cartoned expanded plastics.

The sprinkler shall be FM Approved. The minimum operating pressure shall be in accordance with the manufacturers Listing for the appropriate storage height/building height.

- Areas where storage of rubber tires is kept on-side or on-tread and not exceeding 25 feet (7.6 m) in height in buildings not exceeding 30 feet (9,1 m) in height shall be protected with Upright ESFR sprinklers with a nominal K-Factor of at least 16.8 GPM/psi<sup>1/2</sup> (241,9 LPM/bar<sup>1/2</sup>). The sprinkler shall be FM Approved. The minimum operating pressure shall be in accordance with the manufacturers Listing for the appropriate storage height/building height.

- Areas where roll paper of Mediumweight, Heavyweight, or Plastic Coated Heavyweight is stored shall be protected with Upright ESFR sprinklers with a nominal K-Factor of at least 16.8 GPM/psi<sup>1/2</sup> (241,9 LPM/bar<sup>1/2</sup>).

- The storage height shall not exceed 20 feet (6,1 m) with building height not exceeding 35 feet (10,7 m) for mediumweight and 30 feet (9,1 m) for plastic coated heavyweight.

- The storage height shall not exceed 25 feet (7,6 m) with building height not exceeding 30 feet (9,1 m) for heavyweight.

The sprinkler shall be FM Approved. The minimum operating pressure shall be in accordance with the manufacturers Listing for the appropriate storage height/building height.



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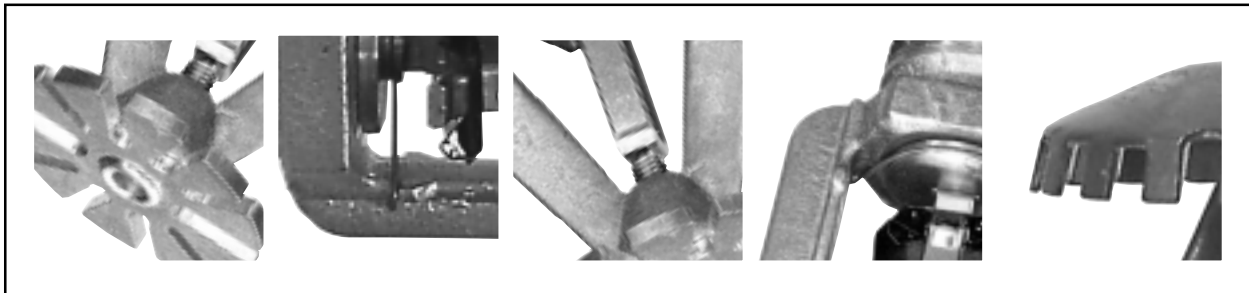


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**Tyco Fire & Building Products**

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***tyco***

*Fire & Building  
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