

# NFPA 231F

## Standard for the Storage of Roll Paper

### 1996 Edition



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An International Standards-Making Organization



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There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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**NFPA 231F**

**Standard for the**

**Storage of Roll Paper**

**1996 Edition**

This edition of NFPA 231F, *Standard for the Storage of Roll Paper*, was prepared by the Technical Committee on General Storage and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 13-15, 1995, in Chicago, IL. It was issued by the Standards Council on January 12, 1996, with an effective date of February 2, 1996, and supersedes all previous editions.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

This edition of NFPA 231F was approved as an American National Standard on February 2, 1996.

**Origin and Development of NFPA 231F**

The need for a standard for storage of roll paper was brought to the attention of the Association after the occurrence of several disastrous fires in warehouses containing roll paper. The lack of a national standard had made designing, building, and using a facility for the storage of roll paper an expensive undertaking, sometimes resulting in sub-standard fire protection. Because of the unique characteristics of roll paper, the Standards Council was petitioned and agreed to have the Technical Committee on General Storage develop NFPA 231F, *Standard for the Storage of Roll Paper*. The first edition was adopted in 1984. A subsequent edition was adopted in 1987.

The 1996 edition of NFPA 231F was revised to incorporate advances in sprinkler technology. Further revisions address miscellaneous storage, retroactivity, and changes to the scope of the document. A number of editorial changes were also incorporated to improve the user friendliness of the document.

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**Committee Scope:** This Committee shall have primary responsibility for documents on safeguarding general warehousing and commodities stored indoors or outdoors against fire. This Committee does not cover storage specifically covered by other NFPA standards.

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**NFPA 231F**  
**Standard for the**  
**Storage of Roll Paper**  
**1996 Edition**

NOTICE: An asterisk (\*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Information on referenced publications can be found in Chapter 6 and Appendix C.

## Chapter 1 Introduction

### 1-1 Scope.

**1-1.1** This standard shall apply to the storage of roll paper in buildings or structures.

**1-1.2\*** This standard shall apply to new facilities or where converting existing buildings to a roll paper storage occupancy. It can be used as a basis for evaluating existing storage facilities.

**1-1.3** This standard shall not apply to:

- (a) Storage in unsprinklered buildings and structures.
- (b) Storage on racks, which shall be in accordance with NFPA 231C, *Standard for Rack Storage of Materials*.
- (c) Miscellaneous storage, which shall be in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.
- (d) Storage of waxed paper, synthetic paper, and palletized roll storage other than on a single floor pallet or raised floor platform.

**1-2 Purpose.** The purpose of this standard is to provide a reasonable degree of protection for the storage of roll paper where stored in buildings or structures by means of installation requirements based upon sound engineering principles, test data, and field experience. Nothing in this standard is intended to restrict new technologies or alternate arrangements, provided that the level of protection prescribed by the standard is not lowered.

**1-3 Retroactivity Clause.** The provisions of this document shall be considered necessary to provide a substantial level of protection from fire. They reflect situations and the state of the art at the time the standard was issued.

Unless otherwise noted, it is not intended that the provisions of this document be applied to facilities, equipment, structures, or installations that were existing or approved for construction or installation prior to the effective date of this document.

*Exception: In those cases where it is determined by the authority having jurisdiction that the existing situation involves a distinct hazard to life or property, this standard shall apply.*

### 1-4 Definitions.

**Approved.\*** Acceptable to the authority having jurisdiction.

### Array.

**Closed Array.** A vertical storage arrangement in which the distances between columns in both directions are short [not more than 2 in. (50 mm) in one direction and 1 in. (25 mm) in the other].

**Open Array.** A vertical storage arrangement in which the distance between columns in both directions is lengthy (all vertical arrays other than closed or standard).

**Standard Array.\*** A vertical storage arrangement in which the distance between columns in one direction is short [1 in. (25 mm) or less], and is in excess of 2 in. (50 mm) in the other direction.

**Authority Having Jurisdiction.\*** The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

**Banded Storage.** Rolls provided with a circumferential steel strap [ $\frac{3}{8}$  in. (9.5 mm) or wider] at each end of the roll.

**Clearance.** The distance from the top of storage to ceiling sprinkler deflectors.

**Column.** A single vertical stack of rolls.

**Core.** The central tube around which paper is wound to form a roll.

**Early Suppression Fast Response (ESFR) Sprinkler.** See NFPA 13, *Standard for the Installation of Sprinkler Systems*.

**Encapsulated.** A method of packaging consisting of a plastic sheet completely enclosing the sides and top of roll paper.

**Extra Large Orifice (ELO) Sprinkler.** See NFPA 13, *Standard for the Installation of Sprinkler Systems*.

**Large Drop Sprinkler.** See NFPA 13, *Standard for the Installation of Sprinkler Systems*.

**Listed.\*** Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

**Paper (general term).** The term for all kinds of felted sheets made from natural fibrous materials, usually vegetable but sometimes mineral or animal, and formed on a fine wire screen from water suspension.

**Rack Storage.** Any combination of vertical, horizontal, or diagonal members that can support roll paper storage. Racks can be fixed or portable.

**Shall.** Indicates a mandatory requirement.

**Should.** Indicates a recommendation or that which is advised but not required.

**Spray Sprinkler.** See NFPA 13, *Standard for the Installation of Sprinkler Systems*.

## Sprinkler Temperature Rating.

*Ordinary Temperature Rated Sprinklers.* Includes temperature ratings of 135°F to 170°F (57°C to 77°C).

*Intermediate Temperature Rated Sprinklers.* Includes temperature ratings of 170°F to 250°F (77°C to 121°C).

*High Temperature Rated Sprinklers.* Includes temperature ratings of 250°F to 300°F (121°C to 149°C).

## Storage.

*Horizontal Storage.* Rolls stored with the cores in the horizontal plane (on-side storage).

*Miscellaneous Storage.* See NFPA 13, *Standard for the Installation of Sprinkler Systems*.

*Storage Height.\** The maximum vertical distance above the floor at which roll paper is normally stored.

*Vertical Storage.* Rolls stored with the cores in the vertical plane (on-end storage).

*Wrapped Storage.\** Rolls provided with a complete heavy kraft covering around both sides and ends.

**Weight of Paper.\*** See A-2.

**1-5\* Units.** Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). The liter unit, which is not part of but is recognized by SI, is commonly used in international fire protection.

**1-5.1** If a value for measurement as given in this standard is followed by an equivalent value in other units, the first value shall be considered to be the requirement. The equivalent value might be approximate.

**1-5.2** SI units have been converted by multiplying the quantity by the conversion factor and then rounding the result to the appropriate number of significant digits.

## Chapter 2\* Classification of Roll Paper

**2-1 General.** For the purposes of this standard, the following classifications of paper shall apply. These classifications shall be used to determine the sprinkler system design criteria.

**2-1.1 Heavyweight Class.** Includes paperboard and paper stock having a basis weight [weight per 1000 ft<sup>2</sup> (92.9 m<sup>2</sup>)] of 20 lb (9.1 kg) or greater.

**2-1.2 Mediumweight Class.** Includes the broad range of papers having a basis weight [weight per 1000 ft<sup>2</sup> (92.9 m<sup>2</sup>)] of 10 lb to 20 lb (4.5 kg to 9.1 kg).

**2-1.3 Lightweight Class.** Includes all papers having a basis weight [weight per 1000 ft<sup>2</sup> (92.9 m<sup>2</sup>)] less than 10 lb (4.5 kg).

**2-1.4 Tissue.** Includes the broad range of papers of characteristic gauzy texture, which in some cases are fairly transparent. For the purposes of this standard, tissue is defined as the soft, absorbent type, regardless of basis weight; specifically, crepe wadding and the sanitary class including facial tissue, paper napkins, bathroom tissue, and toweling.

## Chapter 3 Building Construction

### 3-1 Construction.

**3-1.1\*** Buildings used for storage of materials that are stored and protected in accordance with this standard shall be permitted to be of any of the types described in NFPA 220, *Standard on Types of Building Construction*.

**3-1.2** Adequate access shall be provided to all portions of the premises for fire-fighting purposes.

**3-2\* Emergency Smoke and Heat Venting.** The protection outlined in this standard shall apply to buildings with or without roof vents and draft curtains.

**3-3\* Structural Steel Protection.** The protection outlined in this standard shall apply to buildings with or without fireproofing or other modes of steel protection.

*Exception: Where modified by 4-2.2.*

## Chapter 4 Storage Arrangement

**4-1 Piling Procedures and Precautions.** The floor load design shall take into account the added weight of water that could be absorbed during fire-fighting operations by certain commodities such as newsprint, corrugating medium, and tissue.

### 4-2 Commodity Clearance.

**4-2.1** The clearance between the top of storage and sprinkler deflectors shall be in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

*Exception: Where modified by this standard.*

**4-2.2** If the commodity is stored above the lower chord of roof trusses, at least 1 ft (0.3 m) of clear space shall be maintained to allow wetting of the truss unless the truss is protected with 1-hour fireproofing.

**4-2.3** Storage clearances from ducts shall be maintained in accordance with NFPA 90B, *Standard for the Installation of Warm Air Heating and Air Conditioning Systems*, and NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*.

**4-2.4** The clearance between stored materials and unit heaters, radiant space heaters, duct furnaces, and flues shall not be less than 3 ft (0.9 m) in all directions or shall be in accordance with the clearance shown on the approval agency label.

**4-2.5\*** Clearance to lights or light fixtures shall be maintained to prevent possible ignition.

**4-2.6** Sufficient clearance around the path of fire door travel and around fire extinguishing and protection equipment shall be maintained to ensure accessibility for inspection and operational use.

### 4-3 Aisles.

**4-3.1** Wall aisles shall be at least 24 in. (600 mm) wide to minimize possible structural damage from roll paper that expands with the absorption of water.

**4-3.2\*** Aisles shall be maintained to retard transfer of fire from one pile to another and to allow convenient access for fire fighting, salvage, and removal of storage.

## Chapter 5 Fire Protection

### 5-1 Automatic Sprinkler Systems.

**5-1.1** Sprinkler systems installed in buildings or structures used for the storage of roll paper shall be in accordance with NFPA 13, *Standard for Installation of Sprinkler Systems*.

*Exception: Where modified by this chapter.*

**5-1.1.1** Where buildings are occupied in part for vertical roll paper storage and only a portion of the sprinkler system is hydraulically designed, the design area shall extend not less than 20 ft (6.1 m) beyond the area occupied by the roll paper storage.

**5-1.1.2** Wet-pipe systems shall be used in tissue storage areas.

**5-1.1.3** Horizontal storage of heavyweight or mediumweight paper shall be protected as a closed array.

**5-1.1.4** Mediumweight paper shall be permitted to be protected as heavyweight paper where wrapped completely on the sides and both ends, or where wrapped on the sides only with steel bands.

Wrapping material shall be either a single layer of heavyweight paper with a basis weight of 40 lb (18.1 kg), or two layers of heavyweight paper with a basis weight of less than 40 lb (18.1 kg).

**5-1.1.5** Lightweight paper or tissue paper shall be permitted to be protected as mediumweight paper where wrapped completely on the sides and both ends, or where wrapped on the sides only with steel bands.

Wrapping material shall be either a single layer of heavyweight paper with a basis weight of 40 lb (18.1 kg), or two layers of heavyweight paper with a basis weight of less than 40 lb (18.1 kg).

**5-1.1.6** For purposes of sprinkler system design criteria, lightweight class paper shall be protected as tissue.

### 5-1.2 Storage Less than 10 ft (3.1 m) in Height.

**5-1.2.1** Storage of heavyweight or mediumweight classes of rolled paper up to 10 ft (3.1 m) in height shall be protected by sprinklers designed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, for Ordinary Hazard, Group 2 densities.

**5-1.2.2** Storage of tissue and lightweight classes of paper up to 10 ft (3.1 m) in height shall be protected by sprinklers in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, for Extra Hazard, Group 1 densities.

### 5-1.3 Spray Sprinklers.

**5-1.3.1** Sprinkler design criteria for storage of roll paper 10 ft (3.1 m) high and higher in buildings or structures with roof or ceilings up to 30 ft (9.1 m) shall be in accordance with Tables 5-1.3.1(a) and (b). For definition of storage height, see Section 1-4.

**5-1.3.2** Large orifice sprinklers shall be used for new sprinkler system installations.

*Exception: The use of extra large orifice sprinklers shall be permitted where listed for such use and where installed at a minimum operating pressure of 10 psi (69 kPa).*

**5-1.3.3\*** Where dry-pipe systems are used in Heavyweight Class or Mediumweight Class storage areas, the areas of operation indicated by Tables 5-1.3.1(a) and (b) shall be increased by 30 percent.

**5-1.3.4** The minimum discharge pressure from any sprinkler in the design area shall not be less than 15 psi (105 kPa).

**5-1.3.5\*** High temperature sprinklers shall be used for installations protecting roll paper stored 15 ft (4.6 m) or higher.

**5-1.3.6** The protection area per sprinkler shall not exceed 100 ft<sup>2</sup> (9.3 m<sup>2</sup>) or be less than 70 ft<sup>2</sup> (6.5 m<sup>2</sup>).

**5-1.4 Large Drop Sprinklers.** Where automatic sprinkler system protection utilizes large drop sprinklers, hydraulic design criteria shall be as specified in Table 5-1.4. Design discharge pressure shall be 50 psi (350 kPa) in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. The number of sprinklers to be calculated is indicated based on storage height, clearance, and system type.

**5-1.5 ESFR Sprinklers.** Where automatic sprinkler system protection utilizes ESFR sprinklers, hydraulic design criteria shall be as specified in Table 5-1.5. Design discharge pressure shall be applied to 12 operating sprinklers in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

### 5-2 High-Expansion Foam.

**5-2.1** Where high-expansion foam systems are installed in addition to automatic sprinklers, they shall be installed in accordance with NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*.

*Exception: Where modified by this chapter.*

**5-2.2** Where high-expansion foam systems are installed in Heavyweight Class and Mediumweight Class storage areas, sprinkler discharge design densities can be reduced to not less than 0.24 gpm/ft<sup>2</sup> [(10 lpm)/m<sup>2</sup>] with a minimum operating area of 2000 ft<sup>2</sup> (186 m<sup>2</sup>).

**5-2.3** Where high-expansion foam systems are installed in tissue storage areas, sprinkler discharge densities and areas of application shall not be reduced below those provided in Tables 5-1.3.1(a) and (b).

**5-2.4** High-expansion foam systems shall be automatic in operation.

### 5-3 Water Supplies.

**5-3.1** The water supply system for automatic fire protection systems shall be designed for a minimum duration of 2 hours.

*Exception: For ESFR sprinklers, the water supply duration shall be 1 hour.*

**5-3.2** At least 500 gpm (1893 lpm) shall be added to the sprinkler demand for large and small hose stream demand.

*Exception: For ESFR sprinklers, the hose stream allowance shall be for 250 gpm (947 lpm).*