

# NFPA 231D

## Storage of Rubber Tires

### 1989 Edition



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The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

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 231D**  
**Standard for**  
**Storage of Rubber Tires**  
**1989 Edition**

This edition of NFPA 231D, *Standard for Storage of Rubber Tires*, was prepared by the Technical Committee on Storage of Rubber Tires, released by the Correlating Committee on Storage, and acted on by the National Fire Protection Association, Inc. at its Annual Meeting held May 15-18, 1989 in Washington, D.C. It was issued by the Standards Council on July 14, 1989, with an effective date of August 7, 1989, and supersedes all previous editions.

The 1989 edition of this document has been approved by the American National Standards Institute.

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.

**Origin and Development of NFPA 231D**

A tentative standard on the storage of rubber tires was developed by a Subcommittee of the Committee on General Storage and adopted by the National Fire Protection Association, Inc. at the 1974 Annual Meeting in Miami Beach, Florida.

The first official edition of NFPA 231D was prepared by the Committee on General Storage. It included revisions made to the tentative standard, and was adopted by the Association at the 1975 Fall Meeting in Pittsburgh, Pennsylvania. The 1980 edition was a partial revision of the 1975 edition and the 1986 edition was a partial revision of the 1980 edition. The 1989 edition contains guidelines for outdoor storage of scrap tires in the Appendix.

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## NFPA 231D

## Standard for

## Storage of Rubber Tires

1989 Edition

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

A dagger (†) following the number designating a paragraph or section in the text indicates additional suggestions with regard to that paragraph or section in Appendix B.

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

## Chapter 1 Introduction

## 1-1 Scope.

**1-1.1** This standard applies to the storage of rubber tires when stored indoors.

**1-1.2** The provisions contained in this standard apply to new facilities for tire storage and when converting existing buildings to tire storage occupancy. It may be used as a basis for evaluating existing storage facilities.

**1-1.3** This standard is not intended to apply to small scale storage as defined in Section 1-2.

## 1-2\* Definitions.

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

NOTE: The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

**Authority Having Jurisdiction.** The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes,

an insurance inspection department, rating bureau, or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

**Available Height for Storage.** The maximum height at which tires can be stored above the floor and still maintain adequate clearance from structural members and the required clearance below sprinklers.

**Bundled Tires.** A storage method in which a number of tires are strapped together. (See Figure 1-3.8.)

**Conventional Pallet.** A material handling aid designated to support a unit of load with stringers to provide support for material handling devices.

**Horizontal Channel.** Any uninterrupted space in excess of 5 ft (1.5 m) in length between horizontal layers of stored tires. Such channels may be formed by pallets, shelving, racks, or other storage arrangements.

**Labeled.** Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**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.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

**On-side Storage.** Tires stored horizontally or flat. (See Figure 1-3.6.)

**On-tread Storage.** Tires stored vertically or on their treads. (See Figure 1-3.7.)

**Palletized.** Storage on portable racks of various types utilizing a conventional pallet as a base.

**Pyramid Storage.** On-floor storage in which tires are pyramided to provide pile stability.

**Rack.** Any combination of vertical, horizontal, and diagonal members which support stored materials. Racks may be fixed or portable. A fixed rack is a supporting framework which remains in a fixed position within the warehouse during normal usage and into which the placement and retrieval of storage is through the handling of tires individually or in pallets loads. (See Figures 1-3.1 to 1-3.8.)

**Rubber Tires.** Pneumatic tires for passenger automobiles, aircraft, light and heavy trucks, trailers, farm equipment, construction equipment (off-the-road), and buses.

**Shall.** Indicates a mandatory requirement.

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

**Small Scale Storage.** Storage of less than 10,000 units.

**Storage Aids.** Commodity storage devices such as shelves, pallets, dunnage, separators, and skids.

**Units (equivalent passenger).\*** One average size passenger tire weighing approximately 25 lb (11 kg).

**1-3 Illustrations.** The following illustrations do not necessarily cover all possible storage configurations.

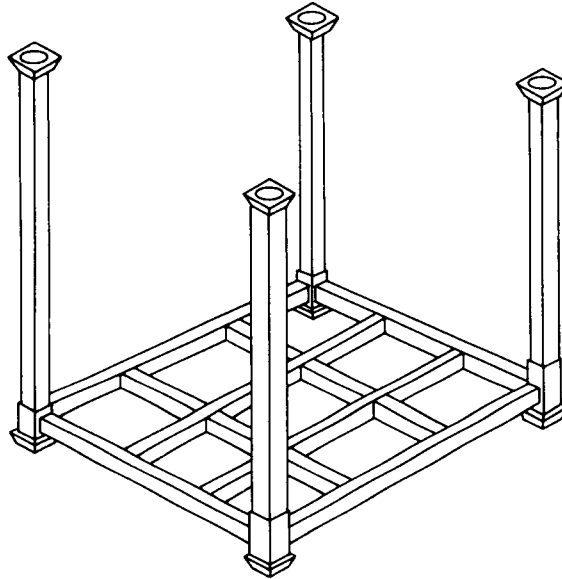


Figure 1-3.1 Typical Open Portable Rack Unit.

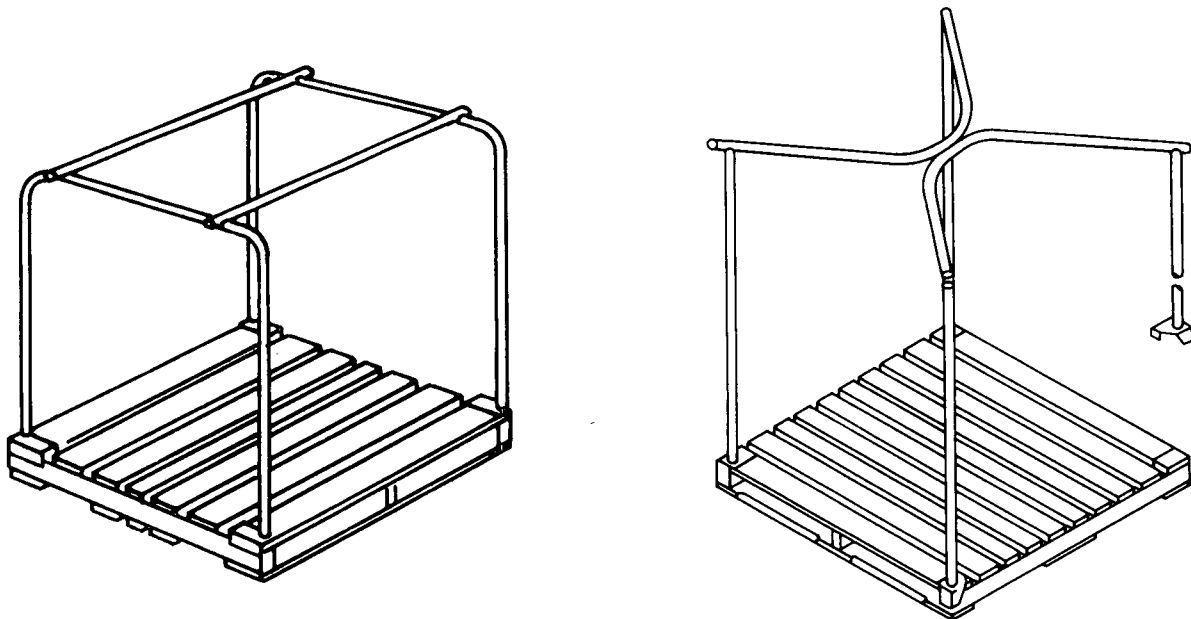


Figure 1-3.2 Typical Palletized Portable Rack Units.



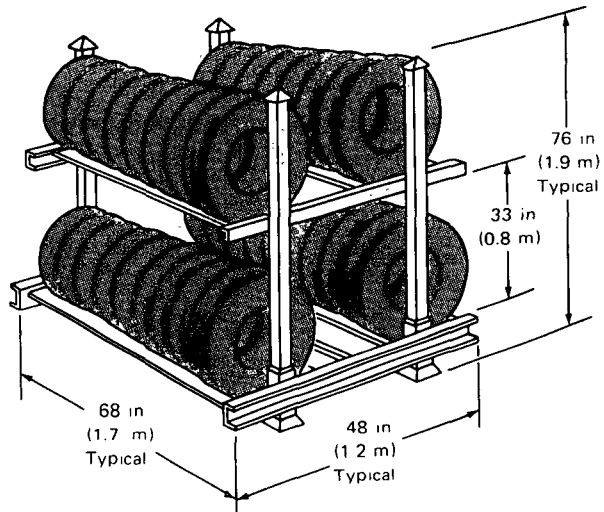
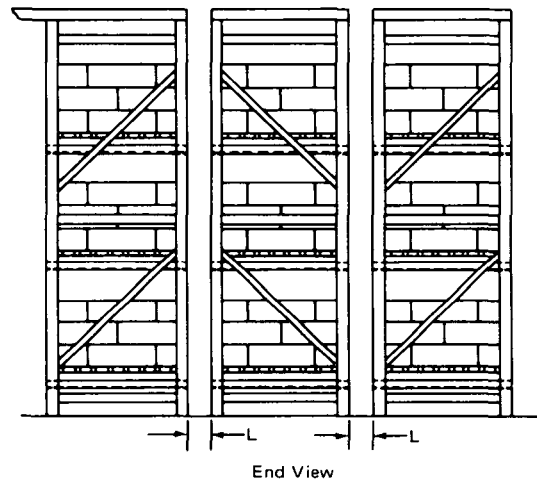
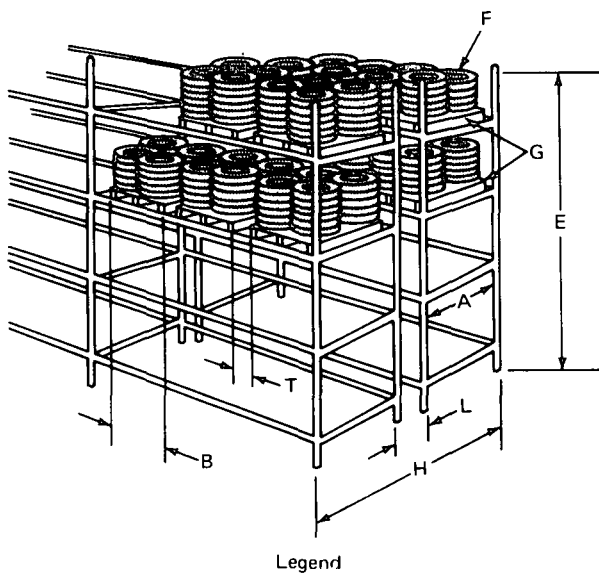


Figure 1-3.3 Open Portable Rack.



L—Longitudinal Flue Space      T—Transverse Flue Space

Figure 1-3.5 Multiple Row Fixed Rack.



Legend

A—Load Depth      E—Storage Height  
 B—Load Width      F—Commodity  
 T—Transverse Flue Space      G—Pallet  
 L—Longitudinal Flue Space      H—Rack Depth

Figure 1-3.4 Double Row Fixed Rack Storage.

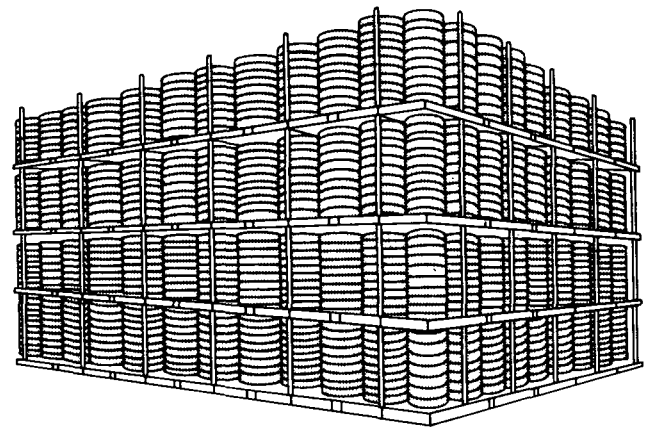


Figure 1-3.6 Palletized Portable Rack On-Side Storage Arrangement (Bundled or Unbundled).

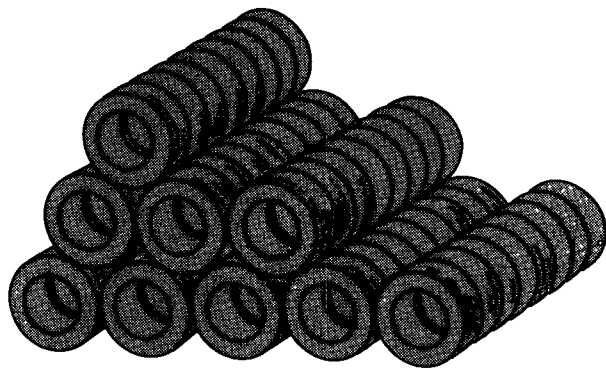


Figure 1-3.7 On Floor Storage. On-tread, normally bundled. Distance along tire hole not to exceed 25 ft (7.7 m).

## Chapter 2 Building Arrangement

### 2-1\* Construction.

**2-1.1\*** Buildings used for the storage of tires which are protected according to this standard may be of any of the types described in NFPA 220, *Standard on Types of Building Construction*.

**2-1.2** Steel columns shall be protected according to the following:

(a) Storage exceeding 15 ft (4.6 m) through 20 ft (6 m) in height.

One hour fireproofing or one sidewall sprinkler head directed to one side of the column at 15 ft (4.6 m) level.

(b) Storage exceeding 20 ft (6 m) in height.

Two hour fireproofing for the entire length of the column, and including connections with other structural members; or two sidewall sprinkler heads, one at the top of the column and the other at the 15-ft (4.6-m) level, both directed to the side of the column.

*Exception:* The above protection is not required where storage in fixed racks is protected by in-rack sprinklers.

### 2-2 Fire Walls.

**2-2.1** Where protection in accordance with Section 4-1 is provided, stored tires shall be segregated from other combustible storage by aisles at least 8 ft (2.4 m) wide. Where not so protected, stored tires shall be cut off by fire walls.

**2-2.2** When tires are stored up to 15 ft (4.6 m) high, walls between adjacent warehouse areas and between manufacturing and warehouse areas shall have not less than a 4-hour fire rating. When tires are stored over 15 ft (4.6 m) high, walls between manufacturing and warehouse areas shall have a fire rating of not less than 6 hours.

## Chapter 3 Storage Arrangement

### 3-1 Piling Procedures.

**3-1.1** Piles shall not be more than 50 ft (15 m) in width.

Piles along a wall shall not be more than 25 ft (7.6 m) in width from the wall.

Where tires are stored on tread the dimension of the pile in the direction of the wheel hole shall not exceed 50 ft (15 m).

Tires piled on floor on tread shall not exceed 25 ft (7.6 m) in the direction of wheel holes.

**3-1.2** The width of main aisles between piles shall be not less than 8 ft (2.4 m).

### 3-2 Clearances.

**3-2.1** The clearance from the top of storage to sprinkler deflectors shall be not less than 3 ft (0.9 m).

**3-2.2** Storage clearance in all directions from roof structures shall be not less than 3 ft (0.9 m).

**3-2.3** Storage clearance from ducts shall be maintained in accordance with NFPA 91, *Blower and Exhaust Systems*.

**3-2.4** Storage clearance from 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.

**3-2.5\*** Clearance shall be maintained to lights or light fixtures to prevent possible ignition.

**3-2.6** Not less than 24 in. (0.6 m) clearance shall be maintained around the path of fire door travel unless a barricade is provided.

## Chapter 4 Fire Protection

### 4-1 Automatic Sprinkler Systems.

**4-1.1** Automatic sprinklers, where provided, shall be installed in accordance with NFPA 13, *Standard for Installation of Sprinkler Systems*, except as modified in this chapter.

**4-1.2\*** Sprinkler discharge densities and areas of application shall be in accordance with Table 4-1.2.

#### 4-1.3 System Requirements.

**4-1.3.1** For the purpose of selecting sprinkler spacings in hydraulically designed sprinkler systems, to obtain a stipulated density, 60 lb (4 atmospheres) per square in. (414 kPa) shall be the maximum discharge pressure used at the calculation starting point.

**4-1.3.2** In buildings which are occupied in part for tire storage, where only a portion of the sprinkler system is hydraulically designed, the design area shall extend not less than 15 ft (4.6 m) beyond the area occupied by the tires.

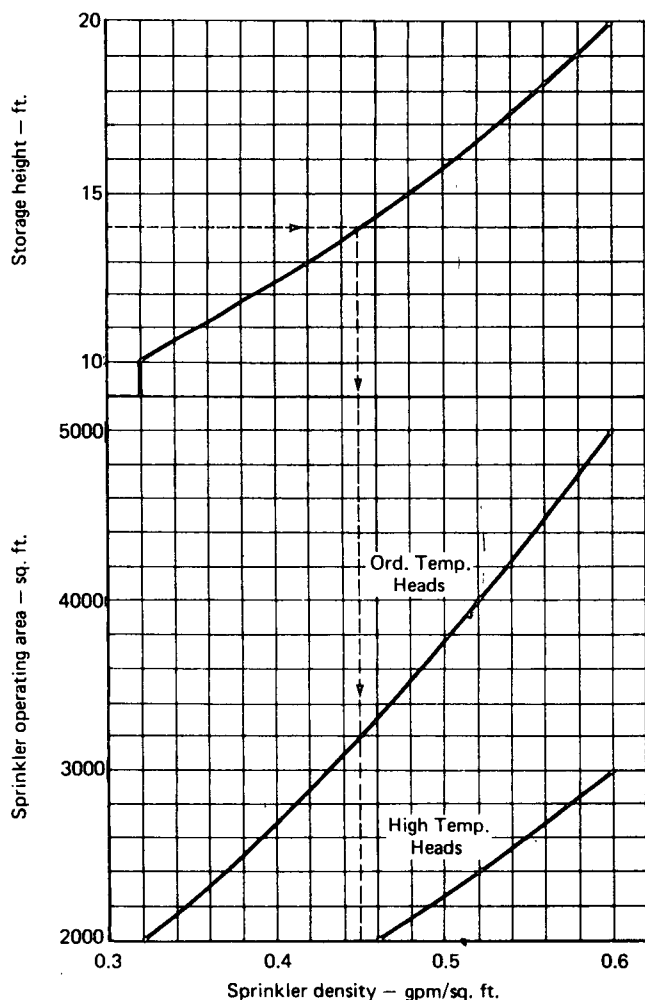


Figure 4-1.2 Sprinkler System Design Curves for Palletized Portable Rack Storage and Fixed Rack Storage with Pallets.

To use curves, enter at storage height (example 14 ft (4.3 m)); read density (0.45) then down to sprinkler operating area; 3200 sq ft (297 m<sup>2</sup>) for ordinary heads, 2000 sq ft (186 m<sup>2</sup>) for high temperature heads.

#### 4-1.4 In-Rack Sprinkler System Requirements.

4-1.4.1 In-rack sprinklers, where provided, shall be installed in accordance with NFPA 231C, *Standard for Rack Storage of Materials*, except as modified in this section.

4-1.4.2 In-rack sprinkler deflectors shall be located at the same level as the bottom of the pallet support to maintain an unobstructed clear space of at least 4 in. (102 mm). In-rack sprinklers shall be located at least 2 ft (0.6 m) from rack uprights.

4-1.4.3 Maximum horizontal spacing of sprinklers in racks shall be 8 ft (2.4 m).

4-1.4.4 Sprinklers in racks shall discharge at not less than 30 psi (207 kPa).

4-1.4.5 Water demand for sprinklers installed in racks shall be based on simultaneous operation of the most hydraulically remote 12 sprinklers when only one level is installed in racks.

#### 4-2 High Expansion Foam Systems.

4-2.1\* High expansion foam systems installed in accordance with NFPA 11A, *Standard for Medium and High Expansion Foam Systems*, as modified herein, may be installed in addition to automatic sprinklers. When so installed, a reduction in sprinkler discharge density to one half the density specified in Table 4-1.2 or 0.24 gal per min per sq ft [(9.78 L/min)/m<sup>2</sup>], whichever is higher, will be allowed.

4-2.2 High expansion foam systems shall be automatic in operation.

4-2.3 Detectors shall be listed and shall be installed at the ceiling at one half listed spacing in accordance with NFPA 72E, *Standard on Automatic Fire Detectors*.

4-2.4 Detection systems, concentrate pumps, generators, and other system components essential to the operation of the system shall have an approved standby power source.

#### 4-3 Water Supplies.

4-3.1 The rate of water supply shall be sufficient to provide the required sprinkler discharge density over the required area of application plus provision for generation of high expansion foam and in-rack sprinklers when used.

4-3.2 Total water supplies shall include provision for not less than 750 gal/min (2835 L/min) for hose streams, in addition to that required for automatic sprinklers and foam systems. Water supplies shall be capable of supplying the demand for sprinkler systems and hose streams for not less than 3 hours.

4-3.3\* Where dry pipe systems are used, the area of sprinkler application shall be increased by not less than 30 percent.

#### 4-4 Manual Inside Protection.

4-4.1 Where automatic sprinkler protection is provided, small hose [1½ in. (38 mm)] shall be provided to reach any portion of the storage area. Small hose may be supplied from

- (a) Hydrants, or
- (b) A separate piping system for small hose stations, or
- (c) Valved hose connections on sprinkler risers where such connections are made upstream of sprinkler control valves, or
- (d) Adjacent sprinkler systems.

4-4.2\* In locations where small hose is provided, portable fire extinguishers for Class A fires may be omitted in storage areas.

4-5 Hydrants. At locations without public hydrants, or where hydrants are not within 250 ft (76 m), private hydrants shall be installed in accordance with NFPA 24, *Stan-*

Table 4-1.2

Piling Method	Piling Height ft	Sprinkler Discharge Density gpm/ft <sup>2</sup> (See Notes 1 and 2)	Areas of Application ft <sup>2</sup> (See Note 1)	
			Ord. Temp. Heads	High Temp. Heads
<b>1. On Floor Storage</b>				
a. Pyramid piles				
b. Other arrangements such that no horizontal channels are formed	Up to 5	See NFPA 13, <i>Standard for Installation of Sprinkler Systems</i>		
	5 + to 7	0.24	2,000	2,000
	7 + to 8	0.26	2,000	2,000
c. Tires piled on floor on tread (See Note 3)	8 + to 10	0.28	2,000	2,000
d. Off the road tires	10 + to 12	0.32	2,000	2,000
<b>2. Palletized Portable Rack Storage</b>				
On side or tread	9 to 20	See Figure 4-1.2		
	20 + to 30	0.3 plus high expansion foam	3,000	3,000
<b>3. Open Portable Rack Storage</b>				
On side or tread	Up to 12	0.6	5,000	3,000
	12 + 20	{ 0.6 0.9 or 0.3 plus high expansion foam	(See Note 4) (See Note 4) 3,000	5,000 3,000 3,000
<b>4. Double &amp; Multi-row Fixed Rack Storage on Pallets</b>				
On side or tread	9 to 20	See Fig. 4-1.2	—	—
	20	0.4 plus 1 level in-rack sprinklers or 0.3 plus high expansion foam	3,000 3,000	3,000 3,000
	20 + to 30	0.3 plus high expansion foam	Not Recommended	3,000
<b>5. Double &amp; Multi-row Fixed Rack Storage Without Pallets or Shelves</b>				
On side or tread	Up to 12	0.6	5,000	3,000
	12 + 20	{ 0.6 0.9 or 0.3 plus high expansion foam or 0.4 plus 1 level in-rack sprinklers	(See Note 4) (See Note 4) 3,000 3,000	5,000 3,000 3,000
	20 + to 30	0.3 plus high expansion foam	Not Recommended	3,000

**Notes:**

1. Sprinkler discharge densities and areas of application are based on a maximum clearance of 10 ft (3.1 m) between sprinkler deflectors and the maximum available height of storage.
2. The densities and areas provided in the table are based on fire tests using standard response, standard orifice (½ in.), and large orifice (17/32 in.) sprinklers. In buildings where "old style" sprinkler heads exist, discharge densities shall be increased by 25%. For use of other types of sprinklers consult the authority having jurisdiction.
3. Piles not to exceed 25 ft (7.6 m) in direction of wheel holes.
4. Water supply shall fulfill both requirements.

ward for the Installation of Private Fire Service Mains and Their Appurtenances.

#### 4-6 Alarm Service.

**4-6.1** Automatic sprinkler systems and foam systems where provided shall have approved central station, auxiliary, remote station, or proprietary waterflow alarm service.

*Exception: Local waterflow alarm service may be provided where recorded guard service is also provided. (See NFPA 601, Standard for Guard Service in Fire Loss Prevention.)*

**4-6.2** Alarm service shall comply with one of the following: NFPA 71, *Standard for the Installation, Maintenance, and Use of Signaling Systems for Central Station Service*; NFPA 72A, *Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm and Supervisory Service*; NFPA 72B, *Standard for the Installation, Maintenance and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*; NFPA 72C, *Standard for the Installation, Maintenance and Use of Remote Station Protective Signaling Systems*; or NFPA 72D, *Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems*.

#### 4-7\*† Fire Emergency Organization.

**4-7.1** Arrangements shall be made to permit rapid entry into the premises by the municipal fire department, police department, or other authorized personnel in case of fire or other emergency.

**4-7.2** Plant emergency organizations where provided shall be instructed and trained in the following procedures:

- (a) Maintaining the security of the premises.
- (b) Means of summoning outside aid immediately in an emergency.
- (c) Use of portable extinguishers and small hose lines or small fires and mop-up operations.
- (d) Operation of the sprinkler system and water supply equipment.
- (e) Use of material handling equipment while sprinklers are still operating to effect final extinguishment.
- (f) Supervision of sprinkler valves after the system is turned off so that the system can be reactivated if rekindling occurs.

**4-7.3** A fire watch shall be maintained when the sprinkler system is not in service.

### Chapter 5 Building Equipment, Maintenance, and Operations

#### 5-1 Mechanical Handling Equipment.

**5-1.1 Industrial Trucks.** Power-operated industrial trucks shall comply with NFPA 505, *Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Maintenance and Operation*.

**5-2 Storage of Empty Wood Pallets.** Wood pallets shall be stored in accordance with the requirements of NFPA 231, *Standard for General Storage*, Section 4-4.

#### 5-3 Cutting and Welding Operations.

**5-3.1** When welding or cutting operations are necessary, the precautions contained in NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*, shall be followed. When possible, work shall be removed to a safe area.

**5-3.2** Welding, soldering, brazing, and cutting may be performed on rack or building components which cannot be removed, provided no storage is located below and within 25 ft (7.6 m) of the working area, and flameproof tarpaulins enclose this section. During any of these operations the sprinkler system shall be in service. Extinguishers suitable for Class A fires with a minimum rating of 2A and charged inside hose lines where provided shall be located in the working area. A fire watch shall be maintained during these operations and for not less than 30 minutes following completion of open flame operation.

**5-4 Waste Disposal.** Rubbish, trash, and other waste material shall be disposed of at regular intervals. (See NFPA 82, *Standard on Incinerators, Waste and Linen Handling Systems and Equipment*.)

**5-5 Smoking.** Smoking shall be strictly prohibited, except in locations prominently designated as smoking areas. "No Smoking" signs shall be posted in prohibited areas.

#### 5-6 Maintenance and Inspection.

**5-6.1** Fire walls, fire doors, and floors shall be maintained in good repair at all times.

**5-6.2\*** The sprinkler system and the water supplies shall be maintained and serviced.

### Chapter 6 Referenced Publications

**6-1** The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**6-1.1 NFPA Publications.** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 11A-1988, *Standard for Medium and High Expansion Foam Systems*

NFPA 13-1989, *Standard for the Installation of Sprinkler Systems*

NFPA 24-1987, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*

NFPA 51B-1989, *Standard for Fire Protection in the Use of Cutting and Welding Processes*

NFPA 71-1989, *Standard for the Installation, Maintenance and Use of Signaling Systems for Central Station Service*

NFPA 72A-1987, *Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm and Supervisory Service*

NFPA 72B-1986, *Standard for the Installation, Maintenance and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*

NFPA 72C-1986, *Standard for the Installation, Maintenance and Use of Remote Station Protective Signaling Systems*

NFPA 72D-1986, *Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems*

NFPA 72E-1987, *Standard on Automatic Fire Detectors*

NFPA 82-1983, *Standard on Incinerators, Waste and Linen Handling Systems and Equipment*

NFPA 91-1983, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying*

NFPA 220-1985, *Standard on Types of Building Construction*

NFPA 231-1987, *Standard for General Storage*

NFPA 231C-1986, *Standard for Rack Storage of Materials*

NFPA 505-1987, *Firesafety Standard for Powered Industrial Trucks Including Type Designations, Area of Use, Maintenance and Operation*

NFPA 601-1987, *Standard for Guard Service in Fire Loss Prevention*.

## Appendix A

*This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.*

**A-1-2 Units.** One H78-14 passenger tire weighs about 25 lb (11 kg). One heavy service (truck) tire, size 10.00-20 weighs above 100 lb (45 kg) and is equivalent to four passenger units. Light heavy service tires vary in size and weight from passenger size to heavy service size—on the average being about 2½ equivalent passenger units. Other types of tires are found in a broad range of sizes. Except in large warehouses they are not likely to be encountered in significant quantities.

**A-2-1** Smoke removal is important to manual fire fighting and overhaul. Since most fire tests were conducted without smoke and heat venting, protection specified in Section 4-1 was developed without the use of such venting. However, venting through eave/line windows, doors, monitors, gravity, or mechanical exhaust systems is essential to smoke removal after control of the fire is achieved.

**A-2-1.1** Building codes and insurance requirements may affect the type of construction selected.

**A-3-2.5** Incandescent light fixtures should have shades or guards to prevent ignition of commodity from hot bulbs where possibility of contact with storage exists.

**A-4-1.2** Density and areas of application in Table 4-1.2 have been developed from fire test data. Protection requirements for other storage methods are beyond the scope of the standard at the present time. From recent fire testing

with densities (0.45 gpm/sq ft and higher) [(18.3 L/min)/m²] there have been indications that large orifice sprinklers at greater than 50 sq ft (4.6 m²) spacing produce better results than the ½-in. (12.7-mm) orifice sprinklers at 50 sq ft (4.6 m²) spacing.

Table 4-1.2 is based on operation of standard sprinklers. Use of "quick response" or other special sprinklers should be based on appropriate tests as approved by the authority having jurisdiction.

**A-4-2.1** In existing buildings to be used for tire storage, high expansion foam might be used to augment an existing sprinkler system whose calculated density was below that required for the proposed storage height. For example, an existing system calculated to provide 0.25 gpm/sq ft [(10.2 L/min)/m²] could be used for storages requiring up to 0.50 gpm/sq ft [(20.3 L/min)/m²] with the addition of a high expansion foam system. An alternative may be to reinforce or redesign the sprinkler system.

**A-4-3.3** Wet systems are recommended for tire storage occupancies. Dry systems are acceptable only where it is impracticable to provide heat.

**A-4-4.2** Extinguishers should be provided for adjacent areas such as offices, shops, boiler rooms, electrical switch rooms, truck service areas, etc. If cutting or welding is contemplated, extinguishers will also be needed. Size, spacing, and type of extinguisher should be in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

**A-4-7** (See also Appendix B.) Information on emergency organization is given in NFPA 600, *Recommendations for Organization, Training and Equipment of Private Fire Brigades*.

**A-5-6.2** See NFPA 13A, *Inspection, Testing, and Maintenance of Sprinkler Systems*, for guidance.

## Appendix B

*This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.*

### B-4-7 Suggestions for Fighting Rubber Tire Fires in Sprinklered Buildings.

**Introduction.** Observations at tire fire tests have indicated that while automatic sprinklers with adequate discharge densities can control a fire, extinguishment by sprinklers alone is not to be expected. It is essential that the behavior of this type of fire be understood if control is not to be lost in the overhaul stage.

**Incipient Stage.** If caught in the incipient stage control can often be effected. Dry chemical type extinguishers have been found effective since the powder will pass into the mass of tires and knock down flame temporarily. It is necessary to back up extinguishers with small hose, and to remove affected tires from the pile. Tires thus removed should be taken out of doors, thoroughly soaked, and left where they do not expose other combustibles. The area in which the fire occurred should be constantly attended for several hours to watch for rekindling.

Automatic sprinklers can be expected to operate within 2 to 5 minutes of ignition. At this point, the fire has generally progressed beyond the stage where extinguishers are effective and within a few minutes, smoke will make the area untenable and vision will be completely obscured.

**Active Stage.** At this point, the building is untenable and obscured vision makes the use of hose streams questionable. It is best to allow the sprinklers to take control of the fire. Most sprinklers will have operated within 15 to 20 minutes of ignition if control is to be effected. Sprinklers should be allowed to operate at least 60 and preferably 90 minutes. During the period the building is best left unventilated. As control of the fire is gained, smoke will tend to change from black to gray and diminish in intensity. During this period at least six charged 1½-in. (38-mm) hose lines should be laid out preparatory to entering the building. Portable floodlights should be secured as well as raincoats, boots, helmets, breathing apparatus, etc., for the overhaul crew.

**Critical Stage.** After 60 to 90 minutes and when smoke intensity has diminished, the building should be ventilated around the periphery of the suspected fire location. During this period close observation should be made of smoke conditions. If smoke generation increases, cease ventilating and close up building if possible.

**Overhaul.** As soon as smoke clears to the extent that the building can be entered, entry should be made with small hose streams which should be directed into burning tires. Sprinklers should remain in operation unless the fire chief is certain that hose can control the fire.

Fork trucks and other means should be employed to remove tires from the fire area. It will usually be necessary to keep sprinklers and/or hose streams in operation during this procedure at least until all evidence of flame is gone. Patrols should be made in affected area for 24 hours following the fire.

In the event that control of the fire is lost as evidenced by increasing smoke generation, loss of pressure at fire pump discharge (indicating massive sprinkler operation), collapsing roof, etc., efforts should be directed towards preventing the spread of the fire beyond the area bounded by the fire walls. At this point, consideration should be given to shutting off sprinklers in the fire area to provide water for protecting the exposures.

**Use of High Expansion Foam.** If a high expansion foam system is used in connection with automatic sprinklers, sprinklers may be shut off 1 hour after ignition and an additional 1-hour soaking time for foam allowed before the building is opened up and overhaul begun. Limited tests with high expansion foam indicate that fire extinguishment is largely complete after a period of soaking in foam. As a precautionary measure, charged hose streams should be available when foam is drained away.

After the initial fill, foam generators should be operated periodically during the soaking period to maintain the foam level. This is necessary since sprinklers and products of combustion will cause partial foam breakdown.

## Appendix C Guidelines for Outdoor Storage of Scrap Tires

**C-1 General.** The intent of these recommendations is to provide fire protection guidance to minimize the fire hazard in areas for outside scrap tire storage. Each individual property will have its own special conditions of tire handling, exposure, and topography. For this reason, only basic fire protection principles are being considered herein which are intended to be applied with due consideration of the local factors involved. The authority having jurisdiction should be consulted in all cases.

Rubber has a heat combustion of about 15,000 BTU's per pound, or roughly twice that of ordinary combustibles (that is, paper and wood). Once ignited, fire development is rapid and high temperatures can be expected, due to the large exposed surface area of tires. Burning is likely to persist for hours. In cases where the fire is controlled, rekindling is a possibility.

These recommendations are not intended to apply to storage of shredded tires (chips, granules, etc.)

**C-2 Definitions.** Unless expressly stated elsewhere, the following terms will for the purpose of these recommendations have the meanings indicated below:

**Aisle.** An accessible clear space between storage piles or groups of piles suitable for housekeeping operations, visual inspection of piling areas, and initial fire fighting operations.

**Clear Space.** Any area free of combustible materials. This does not preclude the storage of noncombustible materials that will not transmit an exposure fire.

**Fire Lane.** A clear space suitable for fire fighting access and operations by motorized fire apparatus.

**Yard.** The outdoor areas where scrap tires are stored.

**Units (equivalent passenger).** One average size passenger tire weighing approximately 25 lb (11 kg).

**Scrap Tire.** A tire that is no longer suitable for vehicular use.

### C-3 Fire Experience.

**C-3.1** Fire experience in outdoor storage of scrap tires reveals a number of concerns, including: the generation of large amounts of black smoke; the fact that the storage is often too close to buildings on the same or adjacent premises, causing fires in these exposed buildings; the generation of oil during the fire where the oil contributes to the fire or where the run-off will contaminate the surrounding area; delay in reporting the fire; and the lack of fire fighting capabilities. The fire hazards inherent in scrap rubber tire storage are best controlled by a positive fire prevention program which would include the intent that a fire would be contained to the pile of origin and limiting the exposures to other piles or associated structures.

### C-3.2 Fire Prevention.

**C-3.2.1** The fire hazard potential inherent in scrap rub-

ber tire storage operations can best be controlled by a positive fire prevention program. The method of stacking should be solid piles in an orderly manner and should include:

- (a) Fire lanes to separate piles and provide access for effective fire fighting operations.
- (b) Separation of yard storage from buildings and other exposures.
- (c) An effective fire prevention maintenance program including control of weeds, grass, and other combustible materials within the storage area.
- (d) The topography should be considered since in fire conditions, oil accumulations or run-off can be expected. Scrap tire storage should preferably be on a level area.

**C-3.2.2** Appropriate steps should be taken to limit access to the tire storage area. Acceptable access should be provided for fire fighting equipment.

#### C-4 Exposure Protection.

**C-4.1** For 500 units or less a minimum separation between scrap rubber tires and structures should be 25 ft (7.6 m) minimum or as reduced by Chapter 3, "Means of Protection," and Chapter 4, "Application of Means of Protection," of NFPA 80A, *Recommended Practice for Protection of Buildings from Fire Exposures*.

#### C-4.2 For More than 500 Units.

**C-4.2.1** The minimum distance between outside scrap rubber tire storage and buildings should be determined in accordance with the intent and provisions of NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*. Since it is based on exposure from a burning building, restrictions are needed for application to an outside storage configuration.

(a) The height of exposing fire from burning trees should be taken as 1.5 times the height of the tire pile since flames extending above the burning tires contribute to the size of the radiation surface area. The height of the exposing fire, per NFPA 80A, is the building height. Height of combustibles stored within the building is not mentioned; it would be inherent in the selection of the severity of the exposure fire. A comparative building height would have to exceed height of piling by several feet at least, and could be substantially higher. Furthermore, the height (and width) of flames above a fire-penetrated roof would be substantially influenced by the debris of the fire-damaged or collapsed roof, whereas flame height above yard storage would have no such restraint.

(b) The width of the exposing fire should be taken as the accumulative width of piles facing the exposed building, with disregard for the nominal separation between piles provided by narrow access aisles and roadways. In order for storage piles to be considered isolated piles, the minimum separation distance between piles should be in accordance with Table C-4.2.3. This distance can be reduced to that necessary to provide a dirt berm at least  $1\frac{1}{2}$  times the height of the pile.

(c) Percent of opening in exposing wall area should be considered to be 100 percent.

(d) Severity of exposing fire should be considered as severe.

**C-4.2.2** Means of protecting the building exposed by burning tire storage may be selected from NFPA 80A, Chapter 3, and separation adjustments may be based on building construction and protective measures as given in NFPA 80A, Chapter 4, except that the separation should never be reduced below that necessary for fire fighting access. (See Section C-4.3.)

**C-4.2.3** Table C-4.2.3 gives representative separations between exposed building and piles or between isolated piles.

Table C-4.2.3 Representative Exposure Separation Distances

Exposed Face Dimensions	Tire Storage Pile Height						
	8	10	12	14	16	18	20
25	56	62	67	73	77	82	85
50	75	84	93	100	107	113	118
100	100	116	128	137	146	155	164
150	117	135	149	164	178	189	198
200	130	149	167	183	198	212	226
250	140	162	181	198	216	231	245

NOTE: Separation distances are based on NFPA 80A, Chapter 2, using a factor of 1.5 in accordance with C-4.2.1(a).

**C-4.2.4** Because of the extensive fire expected in scrap tire storage some form of exposure protection for adjoining properties should be considered. If the clear space as recommended in Table C-4.2.3 cannot be provided, provide a dirt berm  $1\frac{1}{2}$  times the height of the tire storage.

**C-4.2.5** The distance between storage and grass, weeds, and brush should be 50 ft (15 m).

#### C-4.3 Fire Fighting Access.

**C-4.3.1** Maximum pile height should be 20 ft (6 m). Pile width and length should not exceed 250 ft (76.2 m) without a separation according to Table C-4.2.3. Dirt berms may be used in lieu of cross aisles in accordance with C-4.2.1(b). (See Figure C-4.3.1.)

**C-4.3.2** The fire department should be consulted for advice on provision of all-weather roadways to and within the storage area. Depending on storage area configuration and size, access obstruction (river, railroad yards), prevailing wind direction, alternative tactics, etc., fire fighting strategy may require one or more aisles to be wider than those described in C-4.3.1.

**C-4.3.3** Pre-emergency planning should be made with the local fire protection agency so that fire emergencies can be properly handled in the tire storage facility.

#### C-5 General Fire Protection.

##### C-5.1 General.

**C-5.1.1** Weeds, grass, and similar vegetation should be eliminated throughout the entire yard. Combustibles should be removed as they accumulate.

**C-5.1.2** Smoking should be prohibited within the tire storage area. Other types of potential ignition sources such as cutting and welding, heating devices, open fires, etc., should be prohibited.



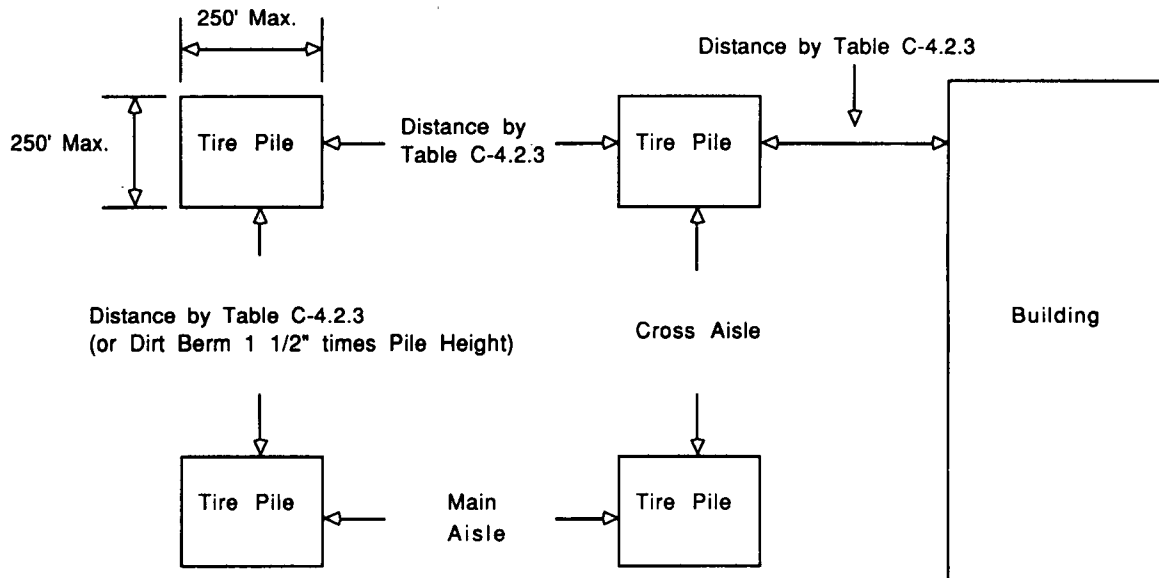


Figure C-4.3.1 Tire Pile Arrangement.

**C-5.1.3** Suitable safeguards should be provided to minimize the hazard of sparks from such equipment as refuse burners, boiler stacks, vehicle exhaust, etc.

#### C-5.2 Water Supplies.

**C-5.2.1** Either a public or private fire main and hydrant system should be provided. A water system should be provided to supply a minimum of 1000 gpm (3780 L/min) for less than 10,000 units storage, or 2000 gpm (7560 L/min) for 10,000 units or greater for a duration of 3 hours.

**C-5.2.2** If there is access to a lake, stream, pond, or other body of water in the vicinity of the storage area a fire department suction connection should be provided.

**C-5.2.3** If fire hoses are not immediately available from responding public fire departments, on-site storage of 1000 ft (304.8 m) of 2½-in. (63-mm) hose and sufficient nozzles should be provided. In addition to water hose streams, high expansion foam may be used to control or extinguish scrap tire fires.

**C-5.2.4** Bulldozers, front-end loaders and similar equipment can be used to move tires not yet involved in the fire, to create breaks in the tire pile or to cover burning tires with soil.

#### Appendix D Referenced Publications

**D-1** The following documents or portions thereof are referenced within this standard for informational purposes only and thus should not be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**D-1.1 NFPA Publications.** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 10-1988, *Standard for Portable Fire Extinguishers*

NFPA 13A-1987, *Recommended Practice for the Inspection, Testing and Maintenance of Sprinkler Systems*

NFPA 600-1986, *Recommendations for Organization, Training and Equipment of Private Fire Brigades*

NFPA 80A-1987, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*.

## Index

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**Please use the forms which follow for submitting proposed amendments.  
Use a separate form for each proposal.**

1. For each document on which you are proposing amendment indicate:
  - (a) The number and title of the document
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2. Check the box indicating whether or not this proposal recommends new text, revised text, or to delete text.
3. In the space identified as "Proposal" include the wording you propose as new or revised text, or indicate if you wish to delete text.
4. In the space titled "Statement of Problem and Substantiation for Proposal" state the problem which will be resolved by your recommendation and give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If a statement is more than 200 words in length, the technical committee is authorized to abstract it for the Technical Committee Report.
5. Check the box indicating whether or not this proposal is original material, and if it is not, indicate source.
6. If supplementary material (photographs, diagrams, reports, etc.) is included, you may be required to submit sufficient copies for all members and alternates of the technical committee.

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- (a) identification of the submitter and his affiliation (Committee, organization, company) where appropriate, and
- (b) identification of the document, paragraph of the document to which the proposal is directed, and
- (c) a statement of the problem and substantiation for the proposal, and
- (d) proposed text of proposal, including the wording to be added, revised (and how revised), or deleted.

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Date 5/18/85 Name John B. Smith Tel. No. 617-555-1212

Address 9 Seattle St., Seattle, WA 02255

Representing (Please indicate organization, company or self) Fire Marshals Assn. of North America

1. a) Document Title: Protective Signaling Systems NFPA No. & Year NFPA 72D

b) Section/Paragraph: 2-7.1 (Exception)

2. Proposal recommends: (Check one) ☐ new text  
☐ revised text  
☒ deleted text.

3. Proposal (include proposed new or revised wording, or identification of wording to be deleted):

Delete exception.

4. Statement of Problem and Substantiation for Proposal:

A properly installed and maintained system should be free of ground faults. The occurrence of one or more ground faults should be required to cause a "trouble" signal because it indicates a condition that could contribute to future malfunction of the system. Ground fault protection has been widely available on these systems for years and its cost is negligible. Requiring it on all systems will promote better installations, maintenance and reliability.

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