NFPA 231D
Standard for Storage of Rubber Tires

1998 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 231D

Standard for

Storage of Rubber Tires

1998 Edition

This edition of NFPA 231D, *Standard for Storage of Rubber Tires*, was prepared by the Technical Committee on Rubber Tires and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 18–21, 1998, in Cincinnati, OH. It was issued by the Standards Council on July 16, 1998, with an effective date of August 5, 1998, 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 231D was approved as an American National Standard on August 6, 1998.

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 its 1974 Annual Meeting in Miami Beach, FL.

The first official edition of NFPA 231D was prepared by the Committee on General Storage. It included revisions to the tentative standard and was adopted by the Association at its 1975 Fall Meeting in Pittsburgh, PA. 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 contained guidelines for outdoor storage of scrap tires in Appendix C.

The 1994 edition of the standard incorporated findings from recent full-scale fire tests. The concept of miscellaneous storage was introduced, and the suggestions for fighting rubber tire fires in sprinklered buildings were revised. Additional changes were incorporated to further enhance the document's user friendliness.

The 1998 edition introduces protection requirements for large-drop sprinklers and ESFR sprinklers. In addition, the fire wall requirements have been clarified.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the safeguards against fire in the storage of rubber tires.

Contents

NFPA 231D

Standard for

Storage of Rubber Tires

1998 Edition

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

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

Chapter 1 Introduction

1-1 Scope.

1-1.1 This standard shall apply to the indoor storage of rubber tires.

1-1.2 The provisions contained in this standard shall apply to new facilities for tire storage and the conversion of existing buildings to tire storage occupancy. This standard shall be permitted to be used as a basis for evaluating existing storage facilities.

1-1.3 Miscellaneous storage, as defined in this standard, shall be permitted to be protected in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

1-2 Definitions. Unless expressly stated otherwise, for the purposes of this standard, the following definitions shall apply:

Approved.* Acceptable to the authority having jurisdiction.

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

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

Banded Tires. A storage method in which a number of tires are strapped together.

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

Encapsulated.* A method of packing consisting of plastic sheet completely enclosing the sides and top of a combustible commodity or combustible package.

Horizontal Channel. Any uninterrupted space in excess of 5 ft (1.5 m) in length between horizontal layers of stored tires. Such channels are 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 that is 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.

Laced Storage. Tires stored where the sides of the tires overlap, creating a woven or laced appearance. *[See Figure 1-3(g).]*

Listed.* Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

Miscellaneous Storage.* Storage of rubber tires that is incidental to the main use of the building. Storage areas shall not exceed 2000 ft^2 (186 m^2). *(See Section 3-3.)*

On-Side Storage. Tires stored horizontally or flat.

On-Tread Storage. Tires stored vertically or on their treads.

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

Pyramid Storage. On-floor storage in which the tires are formed into a pyramid to provide pile stability.

Rack.* Any combination of vertical, horizontal, and diagonal members that supports stored materials. Racks are fixed or portable. A fixed rack is a supporting framework that remains in a fixed position within the warehouse during normal usage and into which the placement and retrieval of storage is by means of handling tires individually or in pallet loads.

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.

Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

Sprinkler Temperature Rating. Ordinary-temperature-rated sprinklers include temperature ratings between 135°F and 175°F (57°C and 80°C), and high-temperature-rated sprinklers include temperature ratings between 250°F and 300°F (121°C and 149°C).

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

1-3 Figures. Figures 1-3(a) through 1-3(g), which follow, do not necessarily illustrate all possible storage configurations.

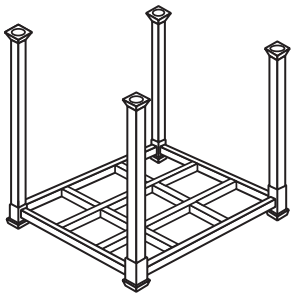


Figure 1-3(a) Typical open portable rack unit.

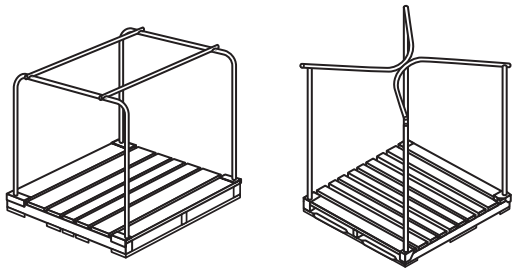
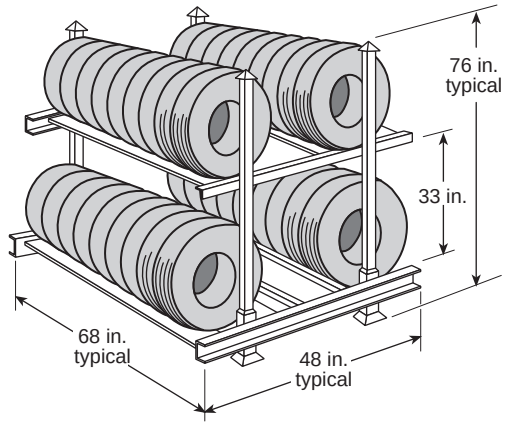


Figure 1-3(b) Typical palletized portable rack units.



For SI units, 1 in. = 0.348 m.

Figure 1-3(c) Open portable rack.

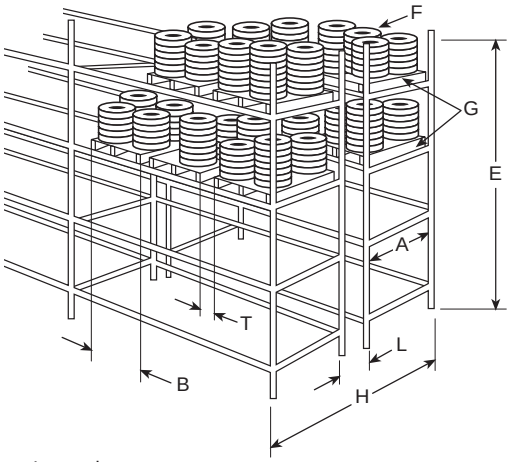
Chapter 2 Building Arrangement

2-1* Construction.

2-1.1* Buildings used for the storage of tires that are 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*.

2-1.2 The flow from a column sprinkler(s) shall be permitted to be omitted from the sprinkler system hydraulic calculations. Steel columns shall be protected as follows:

(a) *Storage Exceeding 15 ft through 20 ft (4.6 m through 6 m) in Height.* Columns shall have a 1-hour fire resistance rating for the entire length of the column, or one sidewall sprinkler shall be directed to one side of the column at a 15-ft (4.6-m) level.



Legend
A—Load depth
B—Load width
E—Storage height
F—Commodity
G—Pallet
H—Rack depth
L—Longitudinal flue space
T—Transverse flue space

Figure 1-3(d) Double-row fixed rack storage.

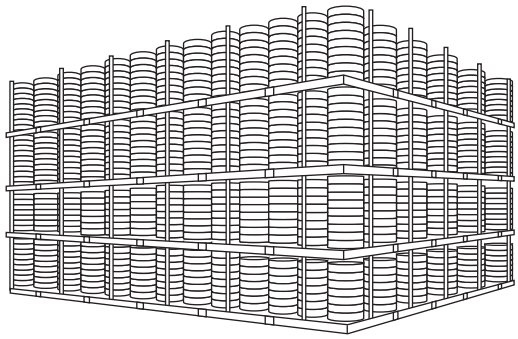


Figure 1-3(e) Palletized portable rack on-side storage arrangement (banded or unbanded).

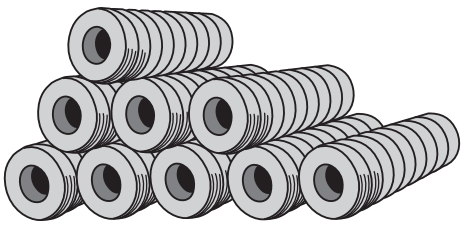


Figure 1-3(f) On-floor storage; on-tread, normally banded.

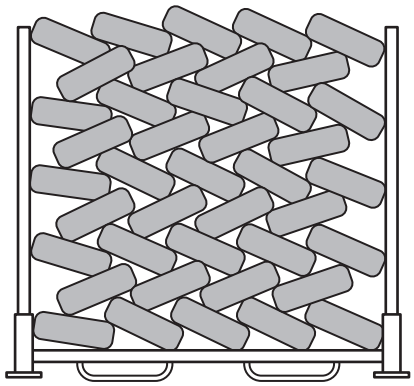


Figure 1-3(g) Typical laced storage.

(b) *Storage Exceeding 20 ft (6 m) in Height.* Columns shall have a 2-hour fire resistance rating for the entire length of the column, including connections with structural members; or two sidewall sprinklers, one at the top of the column and the other at a 15-ft (4.6-m) level, shall be directed to the side of the column.

Exception No. 1: The protection specified in 2-1.2(a) and (b) shall not be required where storage in fixed racks is protected by in-rack sprinklers.

Exception No. 2: The protection specified in 2-1.2(a) and (b) shall not be required where ESFR or large-drop sprinkler systems that are approved for rubber tire storage are installed.

2-2 Fire Walls. Four-hour fire walls shall be provided between the tire warehouse and tire manufacturing areas. Fire walls shall be designed in accordance with NFPA 221, *Standard for Fire Walls and Fire Barrier Walls.*

2-3* Travel Distance to Exits. Travel distance to exits in storage occupancies shall be in accordance with NFPA *101®, Life Safety Code.®*

Chapter 3 Storage Arrangement

3-1* Piling Procedures.

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

Exception No. 1: Where tires are stored on-tread, the dimension of the pile in the direction of the wheel hole shall be not more than 50 ft (15 m).

Exception No. 2: Tires stored adjacent to or along one wall shall not extend more than 25 ft (7.6 m) from that wall.

3-1.2 The width of the main aisles between piles shall not be 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 18 in.(0.45 m).

3-2.3 Storage clearance from ducts shall be maintained in accordance with NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials.*

3-2.4 Storage clearance from unit heaters, radiant space heaters, duct furnaces, and flues shall be not 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.

3-3 Miscellaneous Storage.

3-3.1 On-tread storage piles, regardless of storage method, shall not exceed 25 ft (7.6 m) in the direction of the wheel holes.

3-3.2 Acceptable storage arrangements shall include the following:

(a) On-floor, on-side storage up to 12 ft (3.7 m) high

(b) On-floor, on-tread storage up to 5 ft (1.5 m) high

(c) Double-row or multi-row fixed or portable rack storage on-side, or on-tread, up to 5 ft (1.5 m) high

(d) Single-row fixed or portable rack storage on-side, or on-tread, up to 12 ft (3.7 m) high

(e) Laced tires in racks up to 5 ft (1.5 m) high

3-3.3 Miscellaneous storage shall be protected in accordance with the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems.*

3-4 Mixed Storage. Where protection in accordance with this standard is provided, stored tires shall be segregated from other combustible storage by aisles at least 8 ft (2.4 m) wide.

Chapter 4 Fire Protection

4-1 Automatic Sprinkler Systems.

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

4-1.2* Sprinkler discharge and area of application shall be in accordance with Table 4-1.2(a) for $^{1}/_{2}$-in. (12.7-mm), $^{17}/_{32}$-in. (13.5-mm), $^{5}/_{8}$-in. (15.9-mm), and 0.70-in. (17.8-mm) sprinklers. For large-drop and ESFR sprinklers, refer to Tables 4-1.2(b) and (c), respectively.

4-1.3 System Requirements. For the purposes of this standard, the required sprinkler protection in buildings used in part for tire storage shall extend 15 ft (4.6 m) beyond the perimeter of the tire storage area.

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 by 4-1.4.2 through 4-1.4.4.

4-1.4.2 The maximum horizontal spacing of sprinklers in racks shall be 8 ft (2.4 m).

4-1.4.3 Sprinklers in racks shall discharge at not less than 30 psi (207 kPa).

4-1.4.4 Water demand for sprinklers that are installed in racks shall be based on the simultaneous operation of the most hydraulically remote 12 sprinklers where only one level is installed in racks.

Table 4-1.2(a) Spray Sprinklers — $^{1}/_{2}$-in. (12.7-mm), $^{17}/_{32}$-in. (13.5-mm), $^{5}/_{8}$-in. (15.9-mm), and 0.70-in. (17.8-mm) size orifices

Piling Method	Piling Height (ft)	Sprinkler Discharge Density *(See Note 2.)* (gpm/ft²)	Areas of Application (ft²) *(See Note 2.)* Ordinary Temp.	High Temp.
(1) On-floor storage	Up to 5	0.19	2000	2000
(a) Pyramid piles on-side	Over 5 to 12	0.30	2500	2500
(b) Other arrangements such that no horizontal channels are formed *(see Note 3)*	Over 12 to 18	0.60	Not allowed	2500
(c) Tires on-tread	Up to 5	0.19	2000	2000
	Over 5 to 12	0.30	2500	2500
(2) Palletized portable rack storage	Up to 5	0.19	2000	2000
(a) On-side or on-tread	Over 5 to 20	See Figure 4-1.2		
	Over 20 to 30	0.30 plus high-expansion foam	3000	3000
(b) On-side	20 to 25	0.60 and	Not allowed	5000
		0.90 *(see Note 4)*; or	Not allowed	3000
		0.75 with 1-hr fire-resistive rating of roof and ceiling assembly	Not allowed	4000
(3) Open portable rack storage, on-side or on-tread	Up to 5	0.19	2000	2000
	Over 5 to 12	0.60	5000	3000
	Over 12 to 20	0.60 and	Not allowed	5000
		0.90 *(see Note 4)*; or	Not allowed	3000
		0.30 plus high-expansion foam	3000	3000
(4) Single-, double-, and multi-row fixed rack storage on pallets, on-side or on-tread	Up to 5	0.19	2000	2000
	Over 5 to 20	See Figure 4-1.2; or		
		0.40 plus one level in-rack sprinklers; or	3000	3000
		0.30 plus high-expansion foam	3000	3000
	Over 20 to 30	0.30 plus high-expansion foam	Not allowed	3000
(5) Single-, double-, and multi-row fixed rack storage without pallets or shelves, on-side or on-tread	Up to 5	0.19	2000	2000
	Over 5 to 12	0.60	5000	3000
	Over 12 to 20	0.60 and	Not allowed	5000
		0.90 *see Note 4)*; or	Not allowed	3000
		0.40 plus one level in-rack sprinklers; or	3000	3000
		0.30 plus high-expansion foam	3000	3000
	Over 20 to 30	0.30 plus high-expansion foam	Not allowed	3000

Notes:
1. For SI units, 1 ft = 0.3048 m; 1 ft² = 0.0929 m²; 1 gpm/ft² = 40.746 (L/min)/m².
2. Sprinkler discharge densities and areas of application are based on a maximum clearance of 10 ft between sprinkler deflectors and the maximum available height of storage. The maximum clearance is noted from actual testing and is not a definitive measurement. The authority having jurisdiction shall use the appropriate judgment where this distance is modified.
3.* Laced tires on-floor, vertical stacking on-side (typical truck tires), and off-road tires.
4. Water supply shall fulfill both requirements.

Table 4-1.2(b) Large-Drop Sprinklers (*See Note 2.*)

Piling Method	Pile Height (ft)	Number of Sprinklers and Minimum Operating Pressures *(See Note 3.)*	Maximum Building Height (ft)	Duration (hr)	Hose Demand (gpm)
Rubber tire storage on-side or on-tread in palletized portable racks, or open portable racks, or fixed racks without solid shelves	Up to 25	15 sprinklers @ 75 psi *(See Note 4.)*	32	3	500

Notes:
1. For SI units, 1 ft = 0.3048 m; 1 ft^2 = 0.0929 m^2; 1 psi = 6.895 kPa; 1 gpm = 3.785 L/min.
2. Wet systems only.
3. Sprinkler operating pressures and number of sprinklers in the design are based on tests in which the clearance was 5 ft to 7 ft between the sprinkler deflector and the maximum height of storage. The authority having jurisdiction shall be consulted where clearances exceed 7 ft.
4. The design area shall consist of the most hydraulically demanding area of 15 sprinklers, consisting of 5 sprinklers on each of 3 branch lines. The design shall include a minimum operating area of 1200 ft^2, a maximum operating area of 1500 ft^2, and shall utilize a high-temperature-rated sprinkler.

Table 4-1.2(c) ESFR Sprinklers (*see Note 2*), Nominal *K* Factor 13.5–14.5

Piling Method	Pile Height (ft)	Maximum Building Height (ft)	Number of Sprinklers and Minimum Operating Pressures *(See Note 3.)*	Duration (hr)	Hose Demand (gpm)
Rubber tire storage on-side or on-tread in palletized portable racks, open portable racks, or fixed racks without solid shelves	Up to 25	30	12 sprinklers @ 50 psi *(See Note 4.)*	1	250
	Up to 25	35	12 sprinklers @ 75 psi *(See Note 4.)*	1	250
Laced tires in open portable steel racks *[See Figure 1-3(g).]*	Up to 25	30	20 sprinklers @ 75 psi *(See Notes 5 and 6.)*	3	500

Notes:
1. For SI units, 1 ft = 0.3048 m; 1 ft^2 = 0.0929 m^2; 1 psi = 6.895 kPa; 1 gpm = 3.785 L/min.
2. Wet systems only.
3. Sprinkler operating pressures and number of sprinklers in the design are based on tests in which the clearance was 5 ft to 7 ft between the sprinkler deflector and the maximum height of storage. The authority having jurisdiction shall be consulted where clearances exceed 7 ft.
4. The shape of the design area shall be in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems.*
5. Where used in this application, ESFR protection is expected to control rather than to suppress the fire.
6. The design area shall consist of the most hydraulically demanding area of 20 sprinklers, consisting of 5 sprinklers on each of 4 branch lines. The design shall include a minimum operating area of 1600 ft^2.

4-2 High-Expansion Foam Systems.

4-2.1* Where only automatic sprinkler protection is specified in Table 4-1.2(a), densities shall be permitted to be reduced to one-half the densities specified or to 0.24 gpm/ft^2 [(9.78 L/min)/m^2], whichever is higher, and a properly designed high-expansion foam system shall be installed in accordance with NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems.*

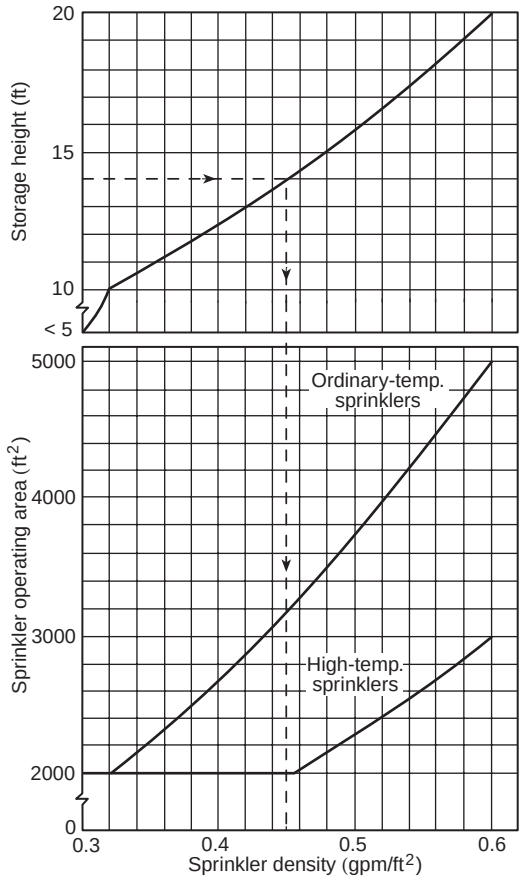
4-2.2 High-expansion foam systems shall be automatic in operation.

4-2.3 Detectors shall be listed and shall be installed at the ceiling at one-half the listed spacing in accordance with NFPA 72, *National Fire Alarm Code®.*

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 the generation of high-expansion foam and in-rack sprinklers where used.



For SI units, 1 ft = 0.3048 m; 1 ft^2 = 0.093 m^2; 1 gpm/ft^2 = 40.76 (L/min)/m^2.

Figure 4-1.2* Sprinkler system design curves for palletized portable rack storage and fixed rack storage with pallets over 5 ft to 20 ft (1.5 m to 6 m) in height.

4-3.2 Total water supplies shall include provision for not less than 750 gpm (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.

Exception No. 1: For on-floor storage up to and including 5 ft (1.5 m) in height, hose stream requirements shall be permitted to be 250 gpm (946 L/min), with a water supply duration of not less than 2 hours.

Exception No. 2: For ESFR and large-drop sprinkler systems approved for rubber tire storage, refer to Tables 4-1.2(b) and (c) for duration and hose demand.

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 [$1^1/_2$ in. (38 mm)] shall be provided to reach any portion of the storage area. Small hose shall be supplied from one of the following:

(a) Hydrants

(b) A separate piping system for small hose stations

(c) Valved hose connections on sprinkler risers where such connections are made upstream of sprinkler control valves

(d) Adjacent sprinkler systems

4-4.2 Portable Fire Extinguishers. Portable fire extinguishers shall be provided in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*. Up to one-half of the required complement of portable fire extinguishers for Class A fires shall be permitted to be omitted in storage areas where fixed, small hose lines [$1^1/_2$ in. (38 mm)] are available to reach all portions of the storage area.

4-5 Hydrants. At locations without public hydrants, or where hydrants are not located within 250 ft (76 m), private hydrants shall be installed in accordance with NFPA 24, *Standard 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 shall be permitted to be provided where recorded guard service also is provided.

4-6.2 Alarm service shall comply with NFPA 72, *National Fire Alarm Code*.

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) Maintenance of the security of the premises

(b) Means of summoning outside aid immediately in an emergency

(c) Use of portable extinguishers and small hose lines on 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 Industrial Trucks. Power-operated industrial trucks shall comply with NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operation*.

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

5-3 Cutting and Welding Operations.

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

5-3.2 Welding, soldering, brazing, and cutting shall be permitted to be performed on rack or building components that cannot be removed, provided no storage is located below and within 25 ft (7.6 m) of the working area and provided flameproof tarpaulins enclose this area. 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 shall be maintained 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.

5-5 Smoking. Smoking shall be strictly prohibited. Signs that read *no smoking* shall be posted in areas where smoking is prohibited.

Exception: Signs shall not be required to be posted in locations that are prominently designated as smoking 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 inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*

Chapter 6 Referenced Publications

6-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix D.

6-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1998 edition.

NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*, 1994 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1996 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 1995 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 1998 edition.

NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*, 1994 edition.

NFPA 72, *National Fire Alarm Code®*, 1996 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*, 1995 edition.

NFPA *101®*, *Life Safety Code®*, 1997 edition.

NFPA 220, *Standard on Types of Building Construction*, 1995 edition.

NFPA 221, *Standard for Fire Walls and Fire Barrier Walls*, 1997 edition.

NFPA 231, *Standard for General Storage*, 1998 edition.

NFPA 231C, *Standard for Rack Storage of Materials*, 1998 edition.

NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operation*, 1996 edition.

Appendix A Explanatory Material

Appendix A is not a part of the requirements of this NFPA document but is included for informational purposes only. This appendix contains explanatory material, numbered to correspond with the applicable text paragraphs.

A-1-2 Approved. 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, 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 that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-2 Authority Having Jurisdiction. 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, or 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 or her 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.

A-1-2 Encapsulated. Stretch-wrapping around the sides only should not be considered to be encapsulated.

A-1-2 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations 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.

A-1-2 Miscellaneous Storage. The limitations on the type and size of storage are intended to identify situations where the quantity tire storage is limited and where it is incidental to the main use of the building. Occupancies such as aircraft hangars, automobile dealers, repair garages, retail storage facilities, automotive and truck assembly plants, and mobile

home assembly plants are types of facilities where miscellaneous storage can be present. The fire protection sprinkler design densities specified by NFPA 13, *Standard for the Installation of Sprinkler Systems,* are adequate to provide protection for the storage heights indicated. Storage beyond these specified heights or areas presents hazards that are properly addressed by this standard and are outside the scope of NFPA 13.

A-1-2 Rack. For further information, see NFPA 231C, *Standard for Rack Storage of Materials.*

A-2-1 Smoke removal is important to manual fire fighting and overhaul. Since most fire tests were conducted without smoke and heat venting, the protection specified in Section 4-1 was developed without the use of such venting. However, venting through eaveline windows, doors, monitors, or 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 regulations affect the type of construction selected.

A-2-3 NFPA *101*, *Life Safety Code*, accurately reflects the travel distance requirements as follows:

(a) Tire storage is classified as ordinary hazard.
(b) Tire fires begin burning slowly. In combination with an acceptable automatic sprinkler system, this allows time for egress.
(c) Tire storage warehouses have a low occupant load.
(d) Large aisle widths [8-ft (2.4-m) minimum] required in 3-1.2 of this standard facilitate egress.

A-3-1 It is not the intent to limit the pile length. *(See Figure A-3-1.)*

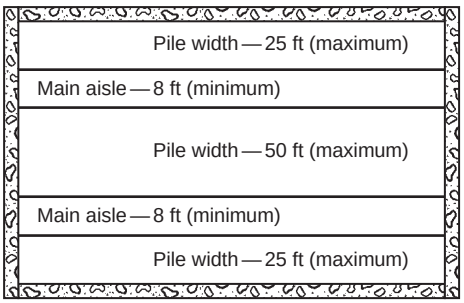


Figure A-3-1 Typical piling arrangement in accordance with Section 3-1.

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

A-4-1.2 Density and areas of application in Tables 4-1.2(a), (b), and (c) have been developed from fire test data. Protection requirements for other storage methods are beyond the scope of this standard at the present time. From recent fire testing with densities of 0.45 gpm/ft^2 [(18.3 L/min)/m^2] and higher, there have been indications that large-orifice sprinklers at greater than 50-ft^2 (4.6-m^2) spacing produce better results than the $^1/_2$-in. (12.7-mm) orifice sprinklers at 50-ft^2 (4.6-m^2) spacing.

Tables 4-1.2(a) and (b) are based on the operation of standard sprinklers. The use of quick-response or other special sprinklers should be based on appropriate tests as approved by the authority having jurisdiction.

Tables 4-1.2(a), (b), and (c) represent test results from rubber tire fire tests performed at the Factory Mutual Research Center. *(See FMRC J.I.OWIR3.RR, "Rubber Tires: Investigation of Common Protection for Three Types of Storage.")*

Storage heights and configurations, or both, [e.g., automated material-handling systems above 30 ft (9.1 m)] beyond those indicated in the table have not had sufficient test data developed to establish recommended criteria. Detailed engineering reviews of the protection should be conducted and approved by the authority having jurisdiction.

A-4-1.2 Figure 4-1.2. The graph in Figure 4-1.2 is used as follows:

(a) Note the example indicated by the broken line.
(b) Read across the graph to the storage height of 14 ft (4.3 m) until the storage height intersects the storage height curve at a sprinkler density of 0.45 gpm/ft^2 [(18.3 L/min)/m^2].
(c) Read down until the sprinkler density intersects the sprinkler operating area curves at 3200 ft^2 (297 m^2) for ordinary-temperature sprinklers and 2000 ft^2 (186 m^2) for high-temperature sprinklers.

A-4-1.2 Note 3 to Table 4-1.2(a). Laced tires are not stored to a significant height by this method due to the damage inflicted on the tire (i.e., bead).

A-4-2.1 In existing buildings used for tire storage, high-expansion foam can be used to augment an existing sprinkler system whose calculated density is below that required for the proposed storage height. For example, an existing system calculated to provide 0.25 gpm/ft^2 [(10.2 L/min)/m^2] can be used for storages requiring up to 0.50 gpm/ft^2 [(20.3 L/min)/m^2] where a high-expansion foam system is also used. Reinforcement or redesign of the sprinkler system is an alternative.

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

A-4-6.1 For further information, see NFPA 601, *Standard for Security Services in Fire Loss Prevention.*

A-4-7 Information on emergency organization is provided in NFPA 600, *Standard on Industrial Fire Brigades. (See also Appendix B.)*

A-5-4 For further information, see NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment.*

Appendix B Recommendations for Fighting Rubber Tire Fires in Sprinklered Buildings

This appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.

B-1 Introduction. It is essential that the steps necessary for fighting rubber tire fires be understood by both the building occupants and the fire service to prevent unnecessary injury or loss of life and to prevent loss of fire control during overhaul. Prevention of injury, loss of life, and loss of fire control necessitates emergency preplanning with the local fire department, building occupants, and others, as deemed necessary.

Fire tests of rubber tire storage indicate that smoke can quickly obstruct the visibility within a building and obscure the burning materials; plans for attacking and extinguishing a fire should be prepared in advance.

Because the products of combustion are harmful, all personnel assigned to perform interior functions should use breathing apparatus before obscuration occurs.

Ventilation efforts should be carefully controlled. Drafts from open doors and windows allow fresh air to reach the fire and make control of the fire difficult. Doors and windows should be closed as soon as possible to limit the air supply to the fire and to allow control by automatic systems to be established.

Fire brigades should be trained and equipped with the necessary tools and equipment to respond to a fire emergency; if possible, they should be trained to attack the fire prior to the arrival of the fire department.

Review of building and fire protection system plans should be part of the ongoing training of both the on-site personnel and the fire departments.

A tire fire can progress quickly through the stages described in Section B-2, and each stage presents a different set of conditions to responding emergency personnel. This appendix specifies items to be considered for inclusion in the emergency preplanning program.

Observations at tire fire tests and accounts of actual fires indicate that, while automatic sprinklers with adequate densities in approved configurations can control a fire, extinguishment by sprinklers alone normally does not occur. The four tests used also indicate that sprinkler protection can be overcome by the following:

(a) Storage that exceeds the heights specified in this standard
(b) Storage configurations that inhibit the movement of heat to the roof, slowing sprinkler operation
(c) Storage configurations that inhibit the waterflow to the seat of the fire, reducing sprinkler effectiveness

B-2 Fire Stages.

(a) *Incipient Stage.* This stage occurs within 2 minutes to 5 minutes of ignition.

1. **Important:** Drafts from open doors increase the intensity of fire and make control difficult. Doors should be closed as quickly as possible to isolate the fire area.
2. **Important:** Fire tests indicate that smoke obscuration occurs within 6 minutes to 9 minutes of ignition, even when the fire is sprinkler controlled. Breathing apparatus can be needed before obscuration occurs. If caught in the incipient stage, control of the fire can be achieved using interior hand hose and portable extinguishers. Quick reaction is essential, as the window of opportunity no longer exists within 2 minutes to 5 minutes of actual ignition, since the generation of heat and smoke make the area untenable. Dry chemical extinguishers have been found to be most effective but should be backed up with small hose, as the knock-down is only temporary.

   Tires in the affected area should be removed from storage. Tires removed from storage should be taken outdoors, thoroughly soaked, and left where they are not exposed to other combustibles. The fire area should be closely watched for several hours for signs of rekindling.

   While the first sprinkler can be expected to operate within the first 2 minutes to 5 minutes of ignition, the updraft from the fire can disrupt the sprinkler pattern to such an extent that the water can fail to reach the seat of the fire. After the first 4 minutes, the fire has generally progressed beyond the stage where portable extinguishers are effective and, within minutes, the smoke and carbon monoxide render the area untenable. Vision is obscured, and any personnel without breathing apparatus is at risk.

(b) *Active Stage.* The active stage of the fire follows the initial stage and is generally defined as the period where the sprinkler system is establishing control over the fire.

1. **Important:** Even though the fire is sprinkler controlled, roof temperatures that result from the tire fires can reach temperatures high enough to cause steel joists to deflect and possibly fail. In recent fire tests, gas temperatures at roof level ranged between 1110°F and 1450°F (593°C and 788°C) for 10 minutes. Roof steel exposed to such high gas temperatures can deflect or fail if subjected to additional loading. **DO NOT** station personnel on a roof to attempt ventilation.
2. **Important:** Local fire departments that attempt to draft from the sprinkler supply system decrease sprinkler effectiveness. If possible, separate municipal hydrants should be identified for fire department use.
3. **Important:** As the sprinklers gain control of the fire, the smoke turns from black to gray. A return to black smoke indicates that the sprinklers are not controlling the fire. Pump and system pressure also should be monitored. Loss of system pressure is an indication of additional sprinkler operation, pump failure, or loss of control.

   Responding local fire departments should be arriving by this time. Building personnel should advise arriving fire personnel of the location of all occupants of the building. At this point, there is little for the fire department to do except to connect to the municipal water supply and prepare to supplement the fire protection system through the fire department connection.

   Fire department personnel or maintenance personnel, or both, should respond to the fire pump room and work to maintain operation of the fire pump. System discharge pressure should be observed to determine that the pressure is stable. Unstable or decreasing discharge pressure indicates changes in the operating conditions of the fire protection system.

   During the active stage, the building is untenable, and obscured vision makes the advisability of using hose streams questionable. It should be noted that, in buildings with smoke vents, the use of fire hose for longer periods is possible but poses a degree of risk to personnel. The sprinklers should be allowed to take control of the fire. Most of the sprinklers begin to operate within 15 minutes to 20 minutes of ignition, if sprinkler control is effected. Sprinklers should be allowed to operate for at least 60 minutes to 90 minutes to gain control. Successful fire tests indicate that waterflow stabilizes within the first 20 minutes of the fire.

   The building should be left unventilated during this time. As control is gained, the smoke changes from black to gray and diminishes in intensity. During this period, at least six charged $1^1/_2$-in.

(38.1-mm) hose lines should be laid out before entering the building. Portable flood lights, turnout gear, breathing apparatus, and forklifts for the overhaul crew should be available.

(c) *Critical Stage.* The critical stage occurs between the final extinguishment and the ventilation of the building.

1. **Important:** Ventilation should be done slowly, and the sprinklers should be left in operation. A return to black smoke indicates that control of the fire is being lost. If black smoke appears, ventilation should cease, the building should be closed, and the sprinkler system should be allowed to regain control. It should be understood that, during the attempt to ventilate the building, the fire intensity can increase due to the addition of outside air. Additional sprinklers can be expected to operate during the ventilation effort. If control has been gained, extra sprinklers can fail to make a difference in overall performance. If control has not been gained or is marginal, the increase in the number of operating sprinklers could make regaining control more difficult due to the overall increase in sprinkler demand. Unless there is a system failure, the sprinklers should regain control. If there is any doubt that control of the fire has been gained, the sprinkler system should be allowed to soak the fire for longer than 90 minutes.
2. **Important:** The officer in charge should have a contingency plan if control of the fire is lost due to a system failure. If control of the fire is lost, as indicated by such factors as increasing smoke generation, loss of pressure at the fire pump discharge (indicating massive sprinkler operation), or collapsing roof, efforts should be directed toward preventing the spread of the fire beyond the area bounded by the fire walls. At this point, consideration should be given to shutting off the sprinklers in the fire area to provide water for protecting the exposures.

   After 60 minutes to 90 minutes, and when the smoke intensity has diminished, the periphery of the fire area should be ventilated. If control of the fire has been achieved, the roof temperature usually is sufficiently cool to allow the roof vents to be opened manually if they have not already opened automatically.

(d) *Overhaul.* Although visible fire is no longer present, overhaul of the fire area should be conducted to ensure complete extinguishment.

1. **Important:** Care should be taken that the hose streams do not lower the pressure or water supply to the sprinkler system. Sprinkler operation should cease only when the fire chief is certain that hose can control the fire.
2. **Important:** Caution should be used, as the tire piles will be unstable.

   As soon as the smoke clears to the extent that the building can be entered, entry should be made using small hose streams that should be directed into the burning tires. Sprinklers should be kept in operation during this period.

   Forklifts and other means should be used to remove the tires from the fire area to outside the building. It usually is necessary to keep the sprinklers in operation during this procedure at least until there is no evidence of flame. Patrols should be made of the affected area for at least 24 hours following the fire.

Following fire extinguishment, all fire protection systems should be restored to service as quickly as possible. These systems include, but are not limited to, the following:

(a) Sprinkler systems
(b) Alarm systems
(c) Pumps
(d) Water supplies

B-3 Use of High-Expansion Foam. If a high-expansion foam system is used in connection with automatic sprinklers, sprinklers should be permitted to be shut off 1 hour after ignition, and foam should be permitted to soak the fire for an additional 1 hour before the building is opened and overhaul is 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

This appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.

C-1 Scope. This appendix applies to the outdoor storage of scrap tires in whole, baled, or processed form, including incidental usage locations.

C-2 Purpose. This appendix has been developed for the purpose of aiding fire officials and authorities having jurisdiction in their effort to both prevent and properly manage fire incidents that occur in whole, baled, or processed scrap tire stockpiles. Each individual property has its own unique conditions of tire handling, exposure, and topography. Thus, in this appendix, basic fire protection principles are applied with due consideration of local factors.

Rubber has a heat combustion of about 15,000 Btu/lb, or roughly twice that of ordinary combustibles (e.g., paper and wood). Once ignited, fire development is rapid, and high temperatures can be expected due to the large exposed surface area of whole tires. In the case of baled or processed-tire fires, high temperatures can also be expected, although the fire behavior differs. Burning is likely to persist for extended periods. In all cases, there is a high probability of rekindling in the tire pile, even if the fire is controlled.

C-3 Definitions.

Burn-It. A fire-fighting strategy that allows for the free-burn of a tire fire.

Bury-It. A fire-fighting strategy in which a tire pile is buried with soil, sand, gravel, cement dust, or other cover material.

Concrete. A composite material that consists essentially of a binding medium within which particles or fragments of aggregate are embedded, in hydraulic cement concrete. The binder is formed from a mixture of hydraulic cement and water.

Forecasting. The ability to predict the fire progression location prior to the completion of the inventory fire break using heavy equipment.

Scrap Tire. A tire that can no longer be used for its original purpose due to wear or damage.

Shredded Tire. A size-reduced scrap tire. The reduction in size is accomplished by a mechanical processing device, commonly referred to a *shredder*.

Tactics. The method of securing the objectives laid out in the strategy through the use of personnel and equipment to as achieve optimum results.

Tire Chip. A classified scrap tire particle that has a basic geometrical shape, that is generally 2 in. (5.1 cm) or smaller, and that has most of the wire removed.

C-4 Fire Experience. Fire experience in outdoor storage of scrap tires reveals a number of concerns, including the following:

(a) Lack of fire codes for scrap tire storage
(b) Generation of large amounts of black smoke
(c) Storage is often too close to buildings on the same or adjacent premises, causing fires in the exposed buildings
(d) Generation of oil during a fire where oil contributes to fire or where runoff contaminates the surrounding area
(e) Delays in reporting fires
(f) Lack of fire-fighting capabilities

Fire hazards inherent in scrap rubber tire storage are best controlled by an aggressive fire prevention program that includes a pre-incident plan.

C-5 General. The fire hazard potential inherent in scrap rubber tire storage operations can best be controlled by an aggressive fire prevention program. The method of storage should be solid piles in an orderly manner and should include the following:

(a) Fire lanes to separate piles and to provide access for effective fire-fighting operations should be a minimum of 60 ft (18.3 m) in accordance with Table C-10.
(b) Separation of yard storage from buildings, vehicles, flammable materials, and other exposures should be a minimum of 200 ft (61 m).
(c) The area within 200 ft (61 m) of a pile should be totally void of trees, plants, or vegetation.
(d) Topography is a factor in determining the manner of tire fire tactics and environmental mediation.
(e) Tires should not be stored on wetlands, flood plains, ravines, canyons, or steeply graded surfaces. Scrap tire storage preferably should be on a level area. The preferred surface for the storage area is concrete or hard packed clay, not asphalt or grass.
(f) Smoking should be prohibited within the tire storage area. Other types of potential ignition sources such as cutting and welding, heating devices, and open fires should be prohibited. Suitable safeguards should be provided to minimize the hazard of sparks from such equipment as refuse burners, boiler stacks, and vehicle exhaust.
(g) Piles should not be permitted beneath power lines or structures.
(h) Lightning protection systems that conform to local and state codes should be located at the facility but away from the tire piles.
(i) Piles should be at least 50 ft (15.2 m) from the fences; lanes should be kept clear of debris or vegetation.

C-6 Fire Department Access to Site. Each tire storage yard should be provided with fire access routes as follows:

(a) Each tire storage yard or pile should be provided with emergency vehicle access routes, such that no portion of the pile is more than 150 ft (45.7 m) from an access road or fire break.
(b) All roads and accesses should be designed to support the loads imposed by fire-fighting equipment.
(c) All bridges and structures, including drainage structures on access roads, should be capable of carrying a minimum design load of HS-20 in accordance with AASHTO *Standard Specifications for Highway Bridges*. The design and as-built plans for all bridges should be certified by a licensed structural engineer; routes should be surfaced with material designed to allow accessibility under all climatic conditions.
(d) All emergency vehicle accesses should have an unobstructed vertical clearance of not less than $13^1/_2$ ft (4.1 m), or as is needed to allow for the passage of large fire-fighting equipment, with a minimum outside turning radius of 45 ft (13.7 m) provided for emergency vehicle access.
(e) All dead-end accesses in excess of 150 ft (45.7 m) should be provided with a turn-around area.
(f) Accesses should be well maintained and should remain accessible to the fire department at all times; the fire chief can allow the use of alternative materials or processes to provide equivalent fire protection.

C-7 Site Security. Appropriate steps should be taken to limit access to the tire storage area as follows:

(a) The facility should have a chain-link fence at least 10 ft (3 m) high with intruder controls on top (in accordance with local laws).
(b) Gates should protect each access point (a minimum of one on each side). Such gates should be capable of being locked when the facility is not open for business.
(c) All gates should have a 20-ft (6.1-m) open width and should remain unobstructed at all times.
(d) Gates should have rapid entry design that is compatible with local fire department requirements.
(e) Gates should have an optimum activation system or the equivalent and a compatible system approved by the local government. All electrically activated gates should have the capability to default to the unlocked position.
(f) A certified security attendant or site manager should be on site at all times when the facility is open.
(g) Clearly visible signs that indicate business hours and regulations should be posted near the facility entrance.

C-8 Pre-Incident Planning. Pre-incident plans are developed by fire departments to identify special features and hazards at a particular site or property and to specify the department operational plan. Pre-incident plans are specific to a location; analytical forecasting of the types of emergencies that can be encountered complement the readiness efforts that are generally employed to manage emergency incidents.

It is strongly recommended that the fire department adopt a model incident management system that is published, taught to all members, and regularly utilized. Neighboring (mutual aid) departments and outside agencies with whom the department interacts should be familiar with the department's model incident management system. Operational drills at the scrap tire facility that involve mutual aid companies and related agen-

cies are useful in evaluating shortfalls in the department's response capability and fire ground effectiveness.

A thorough survey of the area under the jurisdiction of the fire department should be undertaken to detect the existence of scrap tire piles. In many areas, piles are remotely and illegally dumped. Once the area has been surveyed and the existence of scrap tire piles has been identified, the magnitude of the problem should be assessed, and an appropriate fire prevention methodology should be developed.

Topographical maps and detailed area plot plans should be compiled, noting all features of the terrain and property, hydrants and water supply sources, accesses, interior lanes or passages, and fuel load configuration.

Ingress and egress plans should be developed for apparatus and equipment. The development of additional access points, pre-incident or post-incident, should be analyzed and planned, and the means of maintaining or expanding accesses should be provided.

Lists of emergency incident contact personnel (names, addresses, and telephone/pager numbers), appropriate agencies, contractors, mutual aid agreements, and so forth, should be obtained. Such lists should be updated on a semiannual basis.

A water supply use plan with the estimated gallons per minute (liters per minute) required should be developed.

C-9 Water Supplies. 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 20,000 units storage [50,000 ft^3 (1416 m^3)], or 2000 gpm (7560 L/min) for 20,000 units storage or more for a duration of 6 hours.

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-10 Pile Geometry and Spacing. Maximum pile height should be 20 ft (6 m), maximum pile width should be 50 ft (15 m), and maximum length should be 250 ft (76.2 m) without a separation in accordance with Table C-10. *(See Figure C-10.)*

The width limitation of 50 ft (15.2 m) means that, as the exposed face exceeds 100 ft (30.48 m), the pile takes on the appearance of a wind row, and there is little likelihood that the entire face would be burning all at once. Thus, in Table C-10, the minimum exposure separation distances are held constant for exposed face dimensions greater than 100 ft (30.48 m).

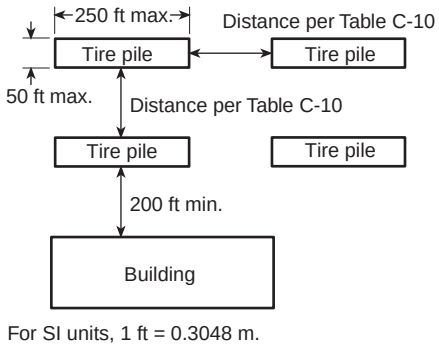


Figure C-10 Pile geometry and spacing.

500 Tires or Less. The minimum separation distance between scrap rubber tires and structures should be 25 ft (7.6 m) or as reduced by Chapter 3 and Chapter 4 of NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures.*

More than 500 Tires. In order for storage piles to be considered isolated piles, the minimum separation distance between piles should be in accordance with Table C-10.

The width of the exposing fire should be assumed to be the combined width of piles facing the exposed building, disregarding the nominal separation between piles provided by narrow access aisles and roadways.

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-10 cannot be provided, a dirt berm that is 1.5 times the height of the tire storage should be provided, or other protection that meets the requirements of the authority having jurisdiction should be provided.

The storage of baled tires should be vertical rather than horizontal. Under fire conditions, the bands release, allowing for sudden, drastic movement of burning tires.

C-11 Outdoor Tire Pile Fire-Fighting Tactics and Strategy. The guidelines contained in this appendix are based on the collective experience of fire service professionals who have managed major scrap tire fires. They are presented as an adjunct to the strategic and tactical practices of an incident command system.

Table C-10 Representative Minimum Exposure Separation Distances ***(See Note 2.)***

Exposed Face Dimensions (ft)	Tire Storage Pile Height (ft)						
	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	100	116	128	137	146	155	164
200	100	116	128	137	146	155	164
250	100	116	128	137	146	155	164

Notes:
1. For SI units, 1 ft = 0.3048 m.
2. Separation distances are based on the "Fire Safety Assessment of the Scrap Tire Storage Methods," by Robert Brady Williamson, PhD and Robert Allen Schroeder, MS.