

Chapter 3

High-Piled Storage Area Requirements

Introduction

After the commodities are classified and the storage height and high-piled storage area have been determined and identified, the amount and type of protection required for the facility must be determined. These requirements are set forth in IFC Table 2306.2, which contains the general fire protection and life safety requirements for high-piled combustible storage. This table serves as an index to the requirements in Sections 2306.2 through 2306.10, which address the following requirements:

- Section 2306.2: Extent and type of protection
- Section 2306.3: Separation of high-piled storage areas
- Section 2306.4: Automatic sprinklers
- Section 2306.5: Fire detection
- Section 2306.6: Building access
- Section 2306.7: Smoke and heat removal
- Section 2306.8: Fire department hose connections
- Section 2306.9: Aisles
- Section 2306.10: Portable fire extinguishers

Application of Table 2306.2

The requirements in Table 2306.2 are based on five variables, which are the basis for the application of the requirements in Chapter 23 and NFPA 13. The variables are:

- commodity classification;
- size of high-piled storage area;
- requirements for all storage areas;
- solid-pile storage, shelf storage and palletized storage volume;
- and height limits.

A basic review of this table reveals that all the requirements are dependent on the classification of the commodity and the size of the high-piled storage area. The table is divided into two basic commodity categories: Classes I through IV and High hazard. For Class I through IV commodities, there are no real differences in the requirements; once the goods, materials and packaging are assigned to one of the four commodity classes, the requirements of Table 2306.2 are primarily based on the size of the high-piled storage area.



Definitions

AUTOMATIC SPRINKLER SYSTEM. An automatic sprinkler system, for fire protection purposes, is an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The system includes a suitable water supply. The portion of the system above the ground is a network of specially sized or hydraulically designed piping installed in a structure or area, generally overhead, and to which automatic sprinklers are connected in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the fire area.

FIRE ALARM SYSTEM. A system or portion of a combination system consisting of components and circuits arranged to monitor and announce the status of fire alarm or supervisory signal-initiating devices and to initiate the appropriate response to those signals.

MANUAL STOCKING METHODS. Stocking methods utilizing ladders or other nonmechanical equipment to move stock.

MECHANICAL STOCKING METHODS. Stocking methods utilizing motorized vehicles or hydraulic jacks to move stock.

Key Concept

Table 2306.2 serves as an index for the requirements for the protection of high-piled combustible storage based on the building occupancy, the area of storage, the commodity classification and the type of storage.

In high-piled storage areas that contain a mix of commodity classes, Section 2306.2 specifies the minimum requirements for extent and type of required protection. It states:

**TABLE 2306.2
GENERAL FIRE PROTECTION AND LIFE SAFETY REQUIREMENTS**

COMMODITY CLASS	SIZE OF HIGH-PILED STORAGE AREA ^a (square feet) (see Sections 2306.2 and 2306.4)	ALL STORAGE AREAS (See Sections 2306, 2307 and 2308) ^b					SOLID-PILED STORAGE, SHELF STORAGE AND PALLETIZED STORAGE (see Section 2307.3)		
		Automatic fire-extinguishing system (see Section 2306.4)	Fire detection system (see Section 2306.5)	Building access (see Section 2306.6)	Smoke and heat removal (see Section 2306.7)	Draft curtains (see Section 2306.7)	Maximum pile dimension ^c (feet)	Maximum permissible storage height ^d (feet)	Maximum pile volume (cubic feet)
I-IV	0-500	Not Required ^e	Not Required	Not Required ^e	Not Required	Not Required	Not Required	Not Required	Not Required
	501-2,500	Not Required ^e	Yes ⁱ	Not Required ^e	Not Required	Not Required	100	40	100,000
	2,501-12,000 Public accessible	Yes	Not Required	Not Required ^e	Not Required	Not Required	100	40	400,000
	2,501-12,000 Nonpublic accessible (Option 1)	Yes	Not Required	Not Required ^e	Not Required	Not Required	100	40	400,000
	2,501-12,000 Nonpublic accessible (Option 2)	Not Required ^e	Yes	Yes	Yes ^j	Yes ^j	100	30 ^f	200,000
	12,001-20,000	Yes	Not Required	Yes	Yes ^j	Not Required	100	40	400,000
	20,001-500,000	Yes	Not Required	Yes	Yes ^j	Not Required	100	40	400,000
	Greater than 500,000 ^g	Yes	Not Required	Yes	Yes ^j	Not Required	100	40	400,000
High hazard	0-500	Not Required ^e	Not Required	Not Required ^e	Not Required	Not Required	50	Not Required	Not Required
	501-2,500 Public accessible	Yes	Not Required	Not Required ^e	Not Required	Not Required	50	30	75,000
	501-2,500 Nonpublic accessible (Option 1)	Yes	Not Required	Not Required ^e	Not Required	Not Required	50	30	75,000
	501-2,500 Nonpublic accessible (Option 2)	Not Required ^e	Yes	Yes	Yes ^j	Yes ^j	50	20	50,000
	2,501-300,000	Yes	Not Required	Yes	Yes ^j	Not Required	50	30	75,000
	300,001-500,000 ^{g,h}	Yes	Not Required	Yes	Yes ^j	Not Required	50	30	75,000

For SI: 1 foot = 304.8 mm, 1 cubic foot = 0.02832 m³, 1 square foot = 0.0929 m².

- When automatic sprinklers are required for reasons other than those in Chapter 23, the portion of the sprinkler system protecting the high-piled storage area shall be designed and installed in accordance with Sections 2307 and 2308.
- For aisles, see Section 2306.9.
- Piles shall be separated by aisles complying with Section 2306.9.
- For storage in excess of the height indicated, special fire protection shall be provided in accordance with Note g when required by the fire code official. See also Chapters 28 and 34 for special limitations for aerosols and flammable and combustible liquids, respectively.
- Section 503 shall apply for fire apparatus access.
- For storage exceeding 30 feet in height, Option 1 shall be used.
- Special fire protection provisions including, but not limited to, fire protection of exposed steel columns; increased sprinkler density; additional in-rack sprinklers, without associated reductions in ceiling sprinkler density; or additional fire department hose connections shall be provided when required by the fire code official.
- High-piled storage areas shall not exceed 500,000 square feet. A 2-hour fire wall constructed in accordance with the *International Building Code* shall be used to divide high-piled storage exceeding 500,000 square feet in area.
- Not required when an automatic fire-extinguishing system is designed and installed to protect the high-piled storage area in accordance with Sections 2307 and 2308.
- Not required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with NFPA 13.

Extent and type of protection. Where required by Table 2306.2, fire detection systems, smoke and heat removal, draft curtains and automatic sprinkler design densities shall extend the lesser of 15 feet (4572 mm) beyond the high-piled storage area or to a permanent partition. Where portions of high-piled storage areas have different fire protection requirements because of commodity, method of storage or storage height, the fire protection features

required by Table 2306.2 within this area shall be based on the most restrictive design requirements.

Table 2306.2 requires automatic sprinkler protection for high-piled combustible storage areas over 12,000 square feet housing Class I through IV commodities or storing High-hazard commodities in an area greater than 2,500 square feet. For instances where a particular storage area is designed for a lower hazard commodity and a higher hazard commodity is introduced, Section 2306.2 can be used to require improvements to the fire protection systems so the higher-hazard commodity can be safely stored.

For buildings containing high-piled combustible storage that is accessible to the public, such as Mercantile (Group M) occupancies, the area thresholds for requiring automatic sprinkler protection are far less than the base values prescribed in the IFC and IBC Section 903.2.7. The requirement for the installation of an automatic sprinkler system is applicable in public accessible buildings storing Class I through IV commodities with a high-piled storage area over 2,500 square feet and public accessible high-piled storage areas over 500 square feet housing High-hazard commodities. By comparison, IFC and IBC Section 903.2.7 require automatic sprinkler protection when the fire area of a Group M occupancy exceeds 12,000 square feet. The intent of this provision is to protect the building occupants. Group M occupancies can have large occupant loads and fuel packages. Fires involving high-piled combustible storage can have fast burning rates and high heat-release rates. Accordingly, when the Group M occupancy contains high-piled combustible storage, the IFC lowers the area threshold to ensure that design of the automatic sprinkler system can control or suppress a fire.

Consider the example in Figure 3-1. The illustration is a partial view of a Group S-1 occupancy that contains high-piled combustible storage. The automatic sprinkler system for the building is designed for the protection of nonencapsulated Class III commodities. A nonencapsulated Class IV commodity has been introduced. To comply with Section 2306.2, the automatic sprinkler system in the area storing the Class IV commodities must be extended a minimum of 15 feet beyond the high-piled storage area or to a permanent partition. Figure 3-1 illustrates the storage boundary for the Class IV commodities and the added 15-foot perimeter in which the fire protection system must be designed to accommodate this commodity.

In cases where mixed commodities are stored and are not separated, fire code officials should also apply the requirements for Section 2304.2. This requires an engineering analysis of the automatic sprinkler system protecting the commodity that has an increased heat-release rate. Such an analysis will confirm if the automatic sprinkler system can adequately protect the stored commodity.

Separation of High-Piled Storage Areas

In high-piled combustible storage areas that can contain multiple classes of commodities, the commodities can be separated using minimum 1-hour fire barriers to isolate the higher hazard commodities from the less challenging commodities. Separating high hazard commodities, such as expanded or unexpanded Group A

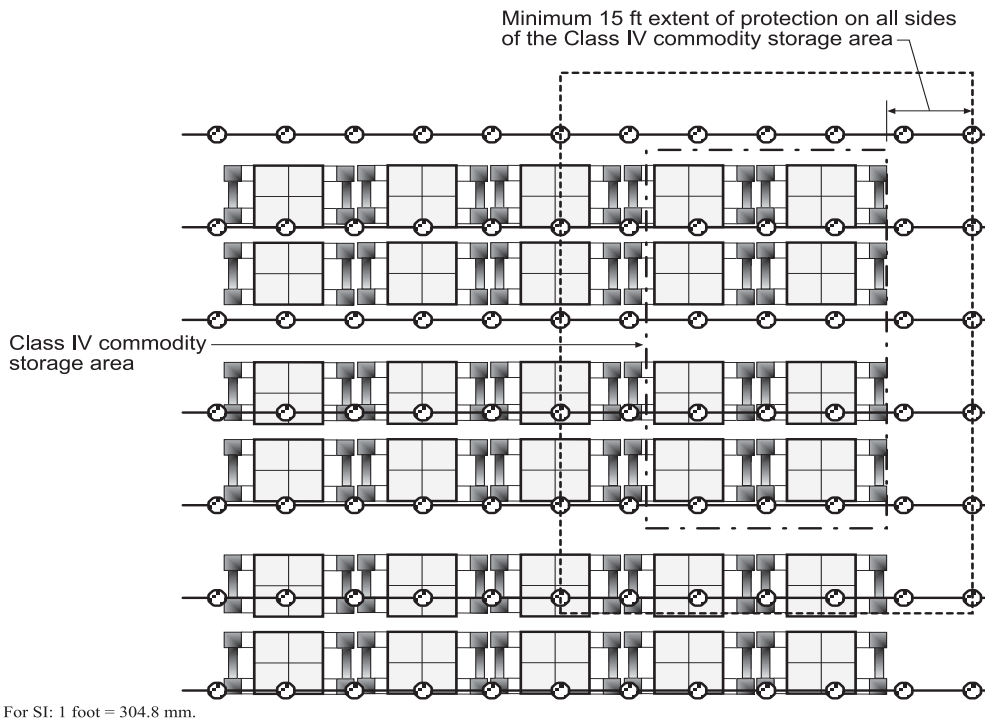


Figure 3-1:
Extent of Protection

high-piled storage areas from other occupancies including mixed occupancies inside a building and separation of two or more high-piled combustible storage areas within the same building.

Regarding separation of a high-piled storage area from other occupancies within the building, a high-piled storage area generally is limited to one of the following occupancy classifications:

- Groups S-1 or S-2
- Group M
- Group H-2, H-3, H-4, or a combination of these hazardous occupancies

While the high-piled storage area may be classified as one of these occupancies, one or more other occupancies may occur within the building. For example, it is not uncommon for a Group S-1 occupancy containing high-piled combustible storage to be located in the same building with an office area classified as Group B. IFC Section 2306.3.1 defers the requirements for the separation of any occupancies containing high-piled combustible storage areas in mixed occupancy buildings to the *International Building Code*.

IBC Section 508.4 contains the separation requirements in mixed occupancy buildings including separation based on the method being utilized. The section establishes four methods of dealing with mixed occupancies: accessory occupancies, incidental accessory occupancies, nonseparated occupancies and separated occupancies. Only the separated occupancies method requires some degree of fire-resistance-rated separation between occupancies, and even then such separations are not required for all occupancy pairings. The method used for regulating mixed occupancies is determined by the design professional and is approved by the code official.

plastics or rubber tires, allows the area of the sprinkler system designed to protect these commodities to be limited when the automatic sprinkler system is designed in accordance with either Section 2306.2 or Section 2304.2.

Section 2306.3 sets forth the requirements for the separation of high-piled storage areas. This section addresses separation of

Key Concept

IBC Section 508 establishes the requirements for separation of mixed uses and occupancies.

The separated-occupancy provisions of IBC Section 508.4 reference IBC Table 508.4 for the minimum fire-resistance-rated separation required between different occupancies. In reviewing a Group B/F-1/S-1 mixed-occupancy condition, building owners have great flexibility for activities in such a building. In buildings where products are manufactured and the materials are stored using high-piled combustible storage methods, the storage area can be anywhere in the building because the Group F-1 and S-1 uses are not required to be separated. As a result, it is important that fire code officials identify where the finished commodities will be stored in the building and ensure that the automatic sprinkler protection is adequate for the area containing high-piled combustible storage. Fire departments should consider developing an administrative policy that addresses the design of automatic sprinkler systems in buildings that are speculative in nature and are designed to accommodate mixed occupancies where no fire-resistance-rated separations are required.

**TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)**

OCCUPANCY	A ^d , E		I-1, I-3, I-4		I-2		R		F-2, S-2 ^b , U		B, F-1, M, S-1		H-1		H-2		H-3, H-4, H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A ^d , E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3 ^a
I-1, I-3, I-4	—	—	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP
I-2	—	—	—	—	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP
R	—	—	—	—	—	—	N	N	1 ^c	2 ^c	1	2	NP	NP	3	NP	2	NP
F-2, S-2 ^b , U	—	—	—	—	—	—	—	—	N	N	1	2	NP	NP	3	4	2	3 ^a
B, F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	N	N	NP	NP	2	3	1	2 ^a
H-1	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP
H-3, H-4, H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1 ^{e, f}	NP

For SI: 1 square foot = 0.0929 m².

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

NS = Buildings not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

N = No separation requirement.

NP = Not permitted.

a. For Group H-5 occupancies, see Section 903.2.5.2.

b. The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but to not less than 1 hour.

c. See Section 406.1.4.

d. Commercial kitchens need not be separated from the restaurant seating areas that they serve.

e. Separation is not required between occupancies of the same classification.

f. For H-5 occupancies, see Section 415.8.2.2.

In accordance with IFC Section 2306.3.2, 1-hour fire barriers can be used to create separate high-piled storage areas. Provided the high-piled combustible storage area is less than 12,000 square feet for Class I through IV commodities or less than 2,500 square feet for High-hazard commodities, automatic sprinkler protection is not required by IFC Table 2306.2. When a building contains a Group S-1 fire area exceeding 12,000 square feet, the fire area must be sprinklered. An aggregate of Group S-1 fire areas that exceed 24,000 square feet also require automatic sprinkler protection per IFC Section 903.2.8 unless the Group S-1 occupancy is divided