HIGH-PILED COMBUSTIBLE STORAGE
INFORMATION PACKET #1

General Information about The Requirements Of Chapter 32 of the 2012 International Fire Code

Des Moines Fire Department
Fire Prevention Bureau

September 2014
HIGH PILED COMBUSTIBLE STORAGE DOCUMENT SUMMARIES

Document 1  General Information on the Requirements of Chapter 32 of the 2012 International Fire Code. This document contains general information about high-piled combustible storage and the requirements of Chapter 32 of the 2012 International Fire Code. This document is recommended for first time customers trying to obtain as much practical information as possible prior to plan submittal. This document also contains samples of our questionnaires for both stocking of general commodities as well as plastics. See Table of Contents for copies of these forms.

Document 2  Commodity Classifications. This document contains numerous examples of products and their associated commodity classifications. Use this document to aid in correctly determining the commodity class for a given product or products.

Document 3  High Piled Storage of Combustibles in Existing Buildings with Existing Tenants. This document is the primary resource for those existing facilities obtaining an annual high piled storage permit. All required forms and instructions on how to fill out the forms and what to submit are provided.
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PURPOSE

This document will provide the user a basic understanding of high piled storage requirements as found within Chapter 32 of the 2012 International Fire Code, as amended. The document will also describe high piled storage plan submission requirements, and discuss some examples and problem areas concerning high piled storage.

SCOPE

This document applies to all newly constructed facilities engaging in high piled storage activities or existing facilities where the high piled storage practices have been modified in any manner. High piled storage activities include all occupancies where combustible commodities, classification of 1 through 4 are stored over 12 feet high and high hazard commodity classification are stored over 6 feet high. This document also includes facilities with the capacity for high-piled storage regardless of whether they are currently doing so.

In addition to the requirements of Chapter 32, the following Chapters including material-specific requirements shall apply:

1. Aerosols shall be in accordance with Chapter 51.
2. Flammable and combustible liquids shall be in accordance with Chapter 57.
3. Hazardous materials shall be in accordance with Chapter 50.
4. Storage of combustible paper records shall be in accordance with NFPA 13.
5. Storage of combustible fibers shall be in accordance with Chapter 52.
6. General storage of combustible material shall be in accordance with Chapter 3.

Storage of hazardous materials over 12 feet is outside the scope of this document.
DEFINITIONS

AEROSOL A product which is dispensed from a pressurized aerosol container by the use of a propellant. (IFC)

AREA CAPABLE OF ACCOMMODATING HIGH PILED STORAGE Buildings containing an area capable of accommodating high piled storage, but which is not being utilized as such. (IFC)

ARRAY The configuration of storage. Characteristics considered in defining an array include the type of packaging, flue spaces, height of storage and compactness of storage. (IFC)

ARRAY, CLOSED A storage arrangement having a 6-inch or smaller width vertical flue space that restricts air movement through the stored commodity. (IFC, NFPA 13)

ARRAY, OPEN A storage arrangement where air movement through the piled is enhanced because of vertical flues larger than 6-inches. (NFPA 13)

AUTOMATED STORAGE AND RETRIEVAL SYSTEM An Automatic Storage and Retrieval System is an automated, robotic system for sorting, storing and retrieving items in a warehouse. (About.com)

BIN BOX A five-sided container with an open side facing an aisle. Bin boxes are self-supporting or are supported by a structure designed so that little or no horizontal or vertical space exists around the boxes. (IFC)

CARTONED A method of storage consisting of corrugated cardboard or paperboard containers fully enclosing the commodity. (NFPA 13)

COMBUSTIBLE A material that, in the form in which it is used and under the conditions anticipated, will ignite and burn. A material that does not meet the definition of non-combustible. (NFPA 101)

COMBUSTIBLE, NON A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion or release flammable vapors when subjected to heat. (NFPA 13)

COMBUSTIBLE, ORDINARY Commodities consisting of wood, paper, natural fibers, etc.

COMMODITIES The combinations of product, packing material and container upon which commodity classifications are based. (IFC)

CURTAIN BOARDS or DRAFT CURTAINS Structures arranged to limit the spread of smoke and heat along the underside of the ceiling or roof. (IFC)

EARLY SUPPRESSION FAST RESPONSE SPRINKLERS (ESFR) A type of fast response sprinkler that meet the criteria of having a thermal element with an RTI of 80 (meter-seconds)¹⁄₂ or more, and is listed for its capability to provide fire suppression of specific high-challenge fire hazards. (NFPA 13)

ENCAPSULATED A method of packaging consisting of a plastic sheet completely enclosing the sides and top of a pallet load containing a combustible commodity, a combustible package, a group of combustible commodities or combustible packages. Totally noncombustible commodities on wood pallets enclosed only by a plastic sheet, as described, are not covered under this definition. Banding (i.e. stretch-wrapping around the sides only of a pallet load) is not considered to be encapsulated. Where there are holes or voids in the plastic or waterproof cover on the top of the carton that exceed more than half of the area of the cover, the term encapsulated does not apply. The term encapsulated does not apply to plastic-enclosed products or packages inside a large, non-plastic, enclosed container. (NFPA 13)

EXTRA HIGH-RACK COMBUSTIBLE STORAGE Storage on racks of Class I, II, III, or IV commodities which exceed 40-ft in height and storage on racks of high-hazard commodities which exceed 30-ft in height. (IFC)

FLUE SPACE, LONGITUDINAL The space between rows of storage perpendicular to the direction of loading. (NFPA 13)

FLUE SPACE, TRANSVERSE The space between rows of storage parallel to the direction of loading. (NFPA 13)
HIGH PILED COMBUSTIBLE STORAGE Storage of combustible materials in closely packed piles or combustible materials on pallets, in racks, or on shelves where the top of storage is greater than 12 feet in height. When required by the fire code official, high-piled combustible storage also includes certain high-hazard commodities, such as rubber tires, Group A plastics, flammable liquids, idle pallets, rail-road ties and similar commodities, where the top of storage is greater than 6 feet in height. (IFC)

HIGH PILED STORAGE AREA An area within a building which is designated, intended, proposed or actually used for high piled combustible storage. This definition is intended to include the actual floor space of racks or piles, and associated aisles, when required. (IFC)

PALLETS Material-handling aids, constructed of wood or plastic, designed to support unit loads, with openings to provide access for material handling devices. (NFPA 13)

PALLET, SLAVE A specifically designed pallet to be used with a computerized material handling system. (NFPA 13)

PILE, STABLE Those arrays where collapse, spillage of contents, or leaning of stacks across flue spaces is not likely to occur soon after initial fire development. (NFPA 13)

PILE, UNSTABLE Those arrays where collapse, spillage of contents, or leaning of stacks across flue spaces occurs soon after initial fire development. (NFPA 13)

PLASTICS, GROUP A Group A plastics are plastic materials having a heat of combustion that is much higher than that of ordinary combustibles, and a burning rate higher than that of Group B plastics. (IFC)

PLASTICS, GROUP B Group B plastics are plastic materials having a heat of combustion and a burning rate higher than that of ordinary combustibles, but not as high as those of Group A plastics. (IFC)

PLASTICS, GROUP C Group C plastics are plastic materials having a heat of combustion and a burning rate similar to those of ordinary combustibles. (IFC)

PLASTICS, FREE-FLOWING Those plastics that, in their original state of flakes, powder, pellets, or random-packed small plastic objects (ex: razor blade dispensers), will fall out of their containers during a fire, fill the flue spaces, and create a smothering effect on a fire. (NFPA 13)

PLASTICS, EXPANDED (FOAMED OR CELLULAR) Those plastics, the density of which is reduced by the presence of numerous small cavities (cells), interconnecting or not, dispersed throughout their mass. (IFC, NFPA 13)

PLASTICS, NON EXPANDED Those plastics with high densities, solid, or not otherwise categorized as expanded, such as polyethylene film, polystyrene toys, polyester and polystyrene plastic tote bins, polyethylene 55-gallon drums or smaller containers, etc.

RACK Any combination of vertical, horizontal, and diagonal members which supports stored materials. Some rack structures use solid shelving. Racks can be fixed, portable, or moveable. Loading can be either manual, using lift trucks, stacker cranes, hand placement or automatic, using machine controlled storage and retrieval systems. (NFPA 13)

RACK, SINGLE ROW Racks with no longitudinal flue space, and having a width up to 6 feet, with aisles at least 3½ feet from other storage. (NFPA 13)

RACK, DOUBLE ROW Two single row racks placed back to back, creating a flue space, having a combined width up to 12 feet, with aisles at least 3½ feet on each side. (NFPA 13)

RACKS, MULTIPLE-ROW Racks greater than 12 feet wide or single- or double-row racks separated by aisles less than 3½ feet wide, having an overall width greater than 12 feet. (NFPA 13)

RACKS, PORTABLE Racks that are not fixed in place. They can be arranged in any number of configurations. (NFPA 13)

RACKS, MOVEABLE Racks on fixed rails or guides. They can be moved back and forth only in a horizontal two-dimensional plane. A moving aisle is created as abutting racks are loaded or unloaded, then moved across the aisle to abut other racks. Rack arrangements generally result in the same protection needs as for multi-row racks. (NFPA 13)
SOLID SHELVING Fixed-in-place solid, slatted or other types of shelves, located within the racks, and which obstructs sprinkler discharge down into the racks. The area of a solid shelf is defined by perimeter aisle or flue space on all four sides. Solid shelves having an area equal or less than 20 square feet shall be defined as open racks. Shelves of wire mesh, slates or other materials more than 50 percent open, and where the flue spaces are maintained, shall be defined as open racks. (IFC, NFPA 13)

STORAGE, BIN BOX Storage in five-sided wood, metal or cardboard boxes with open face on the aisles. Boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes. (NFPA 13)

STORAGE, HEIGHT The measurement between the finished floor and top of the stored commodity. This is not to mean the measurement taken to the top of the highest shelf on the rack or other storage systems. (FM 8-9)

STORAGE, PALLETIZED Storage of commodities on pallets or other storage aids that form horizontal spaces between tiers of storage. (NFPA 13)

STORAGE, RACK Storage in racks that use combinations of vertical, horizontal and diagonal members, with or without solid shelves, to support stored material. Racks may be fixed in place or portable. Loading may be done either manually by using lift trucks, stacker cranes, or hand placement, or automatically by using machine-controlled storage and retrieval systems. (FM 8-9)

STORAGE, SHELF Storage on a structure where shelves are less than 30 inches deep with the distance between shelves usually 2 feet apart and not exceeding 3 feet vertically, and separated by approximately 30 inches. (IFC, NFPA 13)

STORAGE, SOLID PILED This is on-floor storage, without pallets or other material handling devices. Unit loads are placed on top of each other, leaving no horizontal spaces between unit loads. (FM 8-9)

GUIDELINES

PLANS, FEES, INSPECTIONS AND PERMITTING

Plans. High piled storage plans are required for all new high piled storage buildings/facilities, or new high piled storage arrangements within existing buildings meeting either of the following:

- 2501 square feet or greater of Class I-IV commodity storage.
- 501 square feet or greater of High Hazard commodity storage.

*The total of all storage areas, regardless of separation, is added together and if the total area meets either of the above criteria, plans must be submitted for review.

For example, a building has four 700 square foot areas of high piled Class IV commodities. The total square footage of high-piled storage is 2800 square feet. Therefore, high piled storage plans are required to be submitted. (The submission requirements for these plans are discussed later in this document.)

Plan submittal requirements

Plans must include the following information about the project:

- Project name and address shown on plans
- Appropriate storage questionnaire attached to plans
- Floor plan of the building showing locations and dimensions of all high-piled storage areas
- Location of required fire department access doors
- Type of fire suppression and detection equipment
- Location of valves controlling the water supply of ceiling and in-rack sprinklers
- Type, location and specifications of smoke removal and curtain board systems
- All vents are provided with labeling in a logical manner
- Additional information regarding required design features, commodities, storage arrangement and fire protection features within the high-piled storage area
Plans must include the following information for each high-piled storage area:

- Maximum usable storage height for each storage area
- Indicate whether each storage area contains rack and/or piled storage
- Location and classification of commodities for all storage areas
- Maximum pile volume for each storage array
- Dimension and location of transverse and longitudinal flue spaces
- Aisle dimensions between each storage array
- Usable storage height for each storage area
- Number of tiers within each rack
- Location of commodities which are banded or encapsulated
- Commodity clearance between top of storage and the sprinkler deflector for each storage arrangement

If the high piled storage is part of a new building one set of high piled storage plans must be submitted along with each construction set that is submitted to the City of Des Moines Permit and Development Center and one additional set is required for the Fire Prevention Bureau. If the storage plans are a result from new storage practices in an existing building two sets of plans are required. One will be retained and the other will be returned for the facility’s records.

**Inspections.** The cost of all inspections is included in the permit fees, but when re-inspections are necessary a re-inspection fee will be imposed. Prior to scheduling the high-piled inspection with the DMFD’s New Construction Inspector the following requirements must be met:

- Permit fees have been paid
- Plans have been submitted and approved
- Coordinate with other trade inspections with the Permit Development Center
- Obtain a temporary Certificate of Occupancy
- Move the stock into the high-piled storage areas

Contact the Fire Prevention Bureau with any inspection scheduling concerns or questions. The DMFD Fire Prevention Bureau may be reached by calling 515-283-4240.

**Permits.** After the high-piled storage inspection is completed the permanent Certificate of Occupancy (CO) and an annual operational permit will be issued. The operational permit is good for one year from the date of issue e.g. if the permit were issued on April 12, 2009, then the permit is valid (assuming storage is the same) until April 11, 2010. At that time a new operational permit is required. This new permit drives an annual inspection to ensure the approved storage practices are still approved. If the annual inspection discovers different storage practices or arrangements in use, one of two things must happen:

1. The facility reverts to the approved storage methods or
2. The facility submits new plans and complies with any new requirements per the current fire code, as amended.

**GENERAL REQUIREMENTS**

**Commodity Classification**

Commodity Classification is the method by which the commodities, the combination of products, packing material, and container, is assigned class for the sake of storage and fire protection requirements. Commodities shall be classified as Class I, II, III, IV or high hazard in accordance with section 3203 of the IFC. All high piled storage requirements, as well as fire sprinkler design parameters, rely upon the commodity classifications of the products stored. *Des Moines Fire Department’s High Piled Combustible Storage Document 2 - Commodity Classifications*, provides a list of the most common commodities and
their classifications. Refer to this document for assistance determining commodity classifications. For any specific questions regarding commodity classification, please contact the Des Moines Fire Prevention Bureau.

Materials listed within each commodity classification are assumed to be unmodified with respect to flammability or combustibility characteristics. Use of flame-retarding modifiers or the physical form of the material could change the classification. See Section 3203.7 of the IFC for classification of Group A, B and C plastics.

**Limited quantities of Group A plastics**

To classify a commodity containing any amount of Group A plastic it is necessary to know how much plastic is in the commodity, including packaging, packing, container, and product. The amount of plastic is calculated either by weight or volume depending upon the type of plastic, expanded or unexpanded, in the commodity. If the commodity contains expanded or foamed plastic such as polyurethane foam cushions the commodity and plastic limits are measured by volume. If the commodity contains unexpanded or solid plastic the commodity and plastic limits are measured by weight. The fire code allows a limited amount of Group A plastics within the definitions of Class I-IV commodities. IFC Figure 3203.7.4, reproduced below, shows the allowable amounts of Group A plastics for each commodity class.

**FIGURE 1 - A REPRODUCTION OF IFC FIGURE 3203.7.4 MIXED COMMODITIES**

Figure 1 is intended to determine the commodity classification of a mixed commodity in a package, carton or on a pallet where plastics are involved.

The following formulas are used to determine the amounts of plastics within a commodity.
c. Percent by volume = \[ \frac{\text{Volume of plastic in pallet load}}{\text{Total volume of pallet load, including pallet}} \]

d. Percent by weight = \[ \frac{\text{Weight of plastic in pallet load}}{\text{Total weight of pallet load, including pallet}} \]

The formulas are based on an individual pallet or carton load. This means that the entire pallet or carton must be considered in determining the amount of plastics. The following examples help explain this further.

Below are two examples of how to utilize Figure 1 to classify commodities.

**Example #1**

**Given:**
A commodity contains 7 percent by weight of unexpanded Group A plastic and 8 percent by volume of expanded plastic. What is the commodity classification?

**Solution:**
- Find percent by weight of unexpanded plastic on chart (#1 in Figure 2)
- Find where 7 percent would fall along this axis and draw an imaginary line vertically (#2 in Figure 2)
- Find percent by volume of expanded plastic on the chart (#3 in Figure 2)
- Find where 8 percent would fall along this axis and draw an imaginary line horizontally (#4 in Figure 2)
- Where the lines intersect correlate with a commodity classification

**Answer:** Since the intersection point is within the shaded area identified as Class IV commodity, the commodity shall be classified as such.

**Example #2**

**Given:**
A pallet load of 20 scanners has the following dimensions and weights:
- Dimension of pallet load is 4 feet by 4 feet
- Each scanner has 0.5 cubic feet of polystyrene foam packaging
- Entire pallet load weighs 400 pounds
- Each scanner has 2.5 pounds of Group A nonexpanded plastic (rubber rollers, ABS cover, etc.) with remainder of weight load being other than Group A plastics
What is the commodity classification?

**Solution:**
- 0.5 cubic feet of foam packaging per scanner multiplied by 20 scanners = 10 cubic feet
- 4 feet x 4 feet x 4 feet - 64 cubic feet for the entire pallet load
- THEREFORE, 10 cubic feet divided by 64 cubic feet multiplied by 100 percent equals 15.6% by volume of expanded plastic ((10cf / 64cf) x 100% = 15.6%)
- 2.5 pounds of unexpanded Group A plastic per scanner multiplied by 20 scanners equals 50 pounds of unexpanded Group A plastic. (2.5lbs x 20 = 50lbs.)
- THEREFORE, 50 pounds divided by 400 pounds multiplied by 100 percent equals 12.5% by weight of unexpanded Group A plastics. ((50lbs/400lbs) x 100% = 12.5%)

**Answer:**
Using the same steps in Example 2, the commodity classification, based on the amount of Group A plastics is High Hazard. See Figure 3.

*Separation of high piled storage areas.* When required, high piled combustible storage areas must be separated from other portions of the building. Some examples of this include separation between uses, multiple storage areas and storage areas with varying commodity classifications. Each will be discussed.

*Separation from other uses.* Section 508 of the International Building Code discusses mixed-use occupancies and occupancy separation for mixed occupancies. Storage areas and their associated occupancy classifications are adequately separated per Section 508 and Table 508.4.

*Aggregate areas.* For the purposes of determining requirements when multiple storage areas are proposed, the total area for all storage areas must be added together unless the storage areas are adequately separated. See Figure 4. If each storage area may be considered individually, as shown in Figure 5. Plans are required when high piled combustible storage totals more than 500 square feet regardless of whether the storage areas are separated. Assuming the storage areas are identical occupancy (not commodity) classifications, the IFC requires the separation to consist of a 1-hour rated fire barrier wall and any/all openings to be protected with 1-hour rated assemblies without exception.
IFC 3206.3.2.1
The aggregate of all high-piled storage areas within a building shall be used for the application of Table 3206.2 unless such areas are separated from each other by 1-hour fire barriers constructed in accordance with Section 707 the International Building Code. Penetrations in such fire barriers shall be protected with an assembly having a 1-hour fire protection rating.

Multi-class storage areas. When a facility utilizing more than one storage area has at least one of those storage areas consisting of high hazard commodities, with the remainder of the storage areas Class IV or lower commodities, those storage areas must be separated. Otherwise, all storage areas must be designed per High Hazard requirements, regardless of the storage areas’ proximity to each other. The required separation is the minimum 1-hour fire barrier and 1-hour fire rated assemblies.

IFC 3206.3.2.2
High-piled storage areas classified as Class I through IV not separated from high-piled storage areas classified as high hazard shall utilize the aggregate of all high-piled storage areas as high hazard for the purposes of the application of Table 3206.2. To be considered as separated, 1-hour fire barriers shall be constructed in accordance with Section 707 of the International Building Code. Openings in such fire barriers shall be protected by opening protectives having a 1-hour fire protection rating.

General Fire Protection and Life Safety Requirements. Based on the commodity classifications of the products stored and the square footage(s) of the storage areas, certain provisions are required as per Table 3206.2, General Fire Protection and Life Safety Requirements. Table 3206.2 is provided below for reference. Note that this table has been amended from its original version. The most noteworthy amendment with this table is the elimination of the differences in Public and Non-public accessible spaces. Essentially, the provisions for a Fire Detection System have been eliminated. The only system required (when required) is a fire sprinkler system. Each requirement within this table will be discussed.
### Table 3206.2 General Fire Protection and Life Safety Requirements

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<th>Fire Detection System (see Section 3206.5)</th>
<th>Building Access (see Section 3206.6)</th>
<th>Smoke and Heat Removal (see Section 3206.7)</th>
<th>Draft Curtains (see Section 3206.7)</th>
<th>Maximum Pile Dimension (feet)</th>
<th>Maximum Permissible Storage Heights (feet)</th>
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<td>20,001-500,000</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes</td>
<td>Yes&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>100</td>
<td>40</td>
<td>400,000</td>
</tr>
<tr>
<td></td>
<td>Greater than 500,000&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>100</td>
<td>40</td>
<td>400,000</td>
</tr>
<tr>
<td>High hazard</td>
<td>0-500</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>501-2,500</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50</td>
<td>30</td>
<td>75,000</td>
</tr>
<tr>
<td></td>
<td>2,501-2,500 Nonpublic accessible (Option 1)</td>
<td>Yes</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50</td>
<td>30</td>
<td>75,000</td>
</tr>
<tr>
<td></td>
<td>2,501-2,500 Nonpublic accessible (Option 2)</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes</td>
<td>Yes&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Yes&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Yes&lt;sup&gt;b&lt;/sup&gt;</td>
<td>50</td>
<td>20</td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td>2,501-300,000</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes</td>
<td>Yes&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50</td>
<td>30</td>
<td>75,000</td>
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<tr>
<td></td>
<td>300,001-500,000&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Required&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50</td>
<td>30</td>
<td>75,000</td>
</tr>
</tbody>
</table>

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

- **a.** 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.
- **b.** For aisles, see Section 2306.9.
- **c.** Piles shall be separated by aisles complying with Section 2306.9.
- **d.** 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.
- **e.** Section 503 shall apply for fire apparatus access.
- **f.** For storage exceeding 30 feet in height, Option 1 shall be used.
- **g.** 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.
- **h.** 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.
- **i.** 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.
- **j.** Not required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with NFPA 13.

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1. Foot = 304.8 mm, 1 cubic foot = 0.02832 m³, 1 square foot = 0.0929 m².
2. 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.
3. For aisles, see Section 2306.9.
4. Piles shall be separated by aisles complying with Section 2306.9.
5. 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.
6. Section 503 shall apply for fire apparatus access.
7. For storage exceeding 30 feet in height, Option 1 shall be used.
8. 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.
9. 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.
10. 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.
11. Not required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with NFPA 13.
**Automatic fire extinguishing systems.** Chapter 32 only states when a fire sprinkler system is required. Chapter 32 does not state which type of fire sprinkler system is required. It is beyond the scope of Chapter 32 and this document to discuss fire sprinkler systems and high piled storage, other than to note in the table above when a fire sprinkler system is required.

IFC 3206.4

*Automatic sprinkler systems* shall be provided in accordance with Sections 3207, 3208 and 3209.

**Fire detection systems.** Another important amendment is the elimination of any requirement for fire detection systems. Previously, fire detection systems were permitted in lieu of fire sprinkler systems and other provisions when specific-sized storage areas were considered non-accessible to the public. As with fire sprinkler systems, it is beyond the scope of Chapter 32 and this document to discuss fire alarm systems, other than what has been previously discussed.

Where fire detection is required by Table 3206.2, an *approved* automatic fire detection system shall be installed throughout the *high-piled storage area*. The system shall be monitored and be in accordance with Section 907.

**Building access.** When required, access doors that lead directly into the high piled storage areas are to be installed. These doors must be keyed for fire department use, which means that all doors must be keyed such that one key may open any of the doors, and that key must be provided in the building's Knox™ lock box. These keys must also be labeled for their use. The access doors shall not be less than 3 feet in width and 6 feet, 8 inches in height. The use of a ladder to access the doors is prohibited, and utilizing roll-up doors as the access doors are not permitted.

Access doors are required for each 100 lineal feet, or fraction thereof, of storage area exterior walls that front fire apparatus access roads. This means that if an office and warehouse with high piled storage fronts a fire apparatus access road, and the total length of the warehouse portion fronting the access road is 250-feet, a total of 3 access doors are required. Again, one door is required for each 100 lineal feet or fraction thereof. There are two 100-foot segments, plus one, fraction of a 100-foot segment; hence, 3 access doors. These access doors may be located at any point along each 100-foot linear section. This means that the doors could be as close as a few feet apart, to as many as 200-feet apart. As long as at least one door is provided for each 100-ft linear section of an exterior wall of a high piled storage area that fronts a fire department access road, the intent of the code is met. See Figure 6 for an illustration of this. If fire apparatus access roads are provided along either side and/or back of this example, additional doors would then be required.
**Smoke and heat vents.** Smoke and heat vents are required as dictated by Table 3206.2. The Des Moines Fire Prevention Bureau is well aware of studies performed that suggest smoke/heat vents interfere with the designed operation of fire sprinklers. Despite these studies, smoke/heat vents are still required. However, when vents are provided in buildings that utilize fire sprinklers, the fusible element of the vent must be at least 100º F above the operating temperature of the sprinklers within immediate vicinity of the vent. Therefore, if the temperature rating of the sprinklers is 286º F, the fusible element of the vents must be at least 386º F. This is to help ensure that the sprinklers operate as designed and are minimally affected by vent operation. Additionally, the Des Moines Fire Department does not utilize the vents as an automatic fire protection feature of a building. Although the vents will operate automatically, the intent with the vent use is to allow ease in manual venting and to reduce the chance of firefighters having to cut a hole in a roof to vent it. Firefighters would be able to open vents strategically to evacuate smoke and heat. Due to this, all smoke and heat vents must open automatically as well as have approved means of manual opening from the roof. All vents must be labeled, both inside and out, in a logical manner. The labeling scheme must be indicated on the plans.

**Smoke vent calculation.** To determine the number of required smoke/heat vents, Table 910.3 of the IFC is utilized.

**TABLE 1 - TABLE 910.3 OF THE 2012 IFC AS AMENDED**

<table>
<thead>
<tr>
<th>OCCUPANCY CLASSIFICATION</th>
<th>DESIGNATED STORAGE HEIGHT (FEET)</th>
<th>MINIMUM DRAFT CURTAIN DEPTH (FEET)</th>
<th>MAXIMUM AREA FORMED BY DRAFT CURTAIN (SQUARE FEET)</th>
<th>VENT AREA TO FLOOR AREA RATIO</th>
<th>MAXIMUM SPACING OF VENT CENTERS (FEET)</th>
<th>MAXIMUM DISTANCE TO VENTS FROM WALL OR DRAFT CURTAIN (FEET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP F-1</td>
<td>...</td>
<td>0.2 X H but ≥1</td>
<td>50,000</td>
<td>1:100</td>
<td>120</td>
<td>60</td>
</tr>
<tr>
<td>GROUP S-1 (OPTION 1)</td>
<td>≤ 20</td>
<td>6</td>
<td>10,000</td>
<td>1:100</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>&gt;20 ≤ 40</td>
<td>6</td>
<td>8,000</td>
<td>1:75</td>
<td>100</td>
<td>55</td>
</tr>
<tr>
<td>GROUP S-1 (OPTION 2)</td>
<td>≤ 20</td>
<td>4</td>
<td>3,000</td>
<td>1:75</td>
<td>100</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>&gt;20 ≤ 40</td>
<td>4</td>
<td>3,000</td>
<td>1:50</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>GROUP S-1 HIGH HAZARD (OPTION 1)</td>
<td>≤ 20</td>
<td>6</td>
<td>6,000</td>
<td>1:50</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>&gt;20 ≤ 30</td>
<td>6</td>
<td>6,000</td>
<td>1:40</td>
<td>90</td>
<td>45</td>
</tr>
<tr>
<td>GROUP S-1 HIGH HAZARD (OPTION 2)</td>
<td>≤ 20</td>
<td>4</td>
<td>4,000</td>
<td>1:50</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>&gt;20 ≤ 30</td>
<td>4</td>
<td>2,000</td>
<td>1:30</td>
<td>75</td>
<td>40</td>
</tr>
</tbody>
</table>

1 Requirements for rack storage heights in excess of those indicated shall be in accordance with Chapter 23. For solid-piled storage heights in excess of those indicated, an approved engineered design shall be used.

The table provides a vent area to floor area ratio based on the commodity classification and height of storage. Therefore, four things are needed to calculate the number of vents required. 1- Commodity classification; 2- Height of storage; 3- Total square footage of storage area; 4- Proper vent ratio. Since draft curtains are not permitted in sprinkled buildings and smoke vents are required when sprinklers are required, Options 1 and 2 for any commodity classification noted in the table above may be ignored. This means that if a specific storage arrangement has two choices for vent ratio, and the only difference is based on the draft curtain area, the less restrictive vent ratio may be chosen.
With the above information, two different vent ratios may be chosen. Either 1:75 or 1:50 may be used to determine the total vent space required. Again, since the square footage of area created by draft curtains is not applicable, either ratio may be used. Typically, the ratio that allows the smallest total vent space is chosen. In this example the smallest vent ratio is 1:75 (the larger the number, the smaller the total vent space required). With this vent ratio, the total vent square footage may be calculated. The formula to figure the total vent space is as follows:

\[
\text{Storage square footage divided by the vent ratio} = \text{total vent square footage}
\]

Therefore, \(\frac{63500 \text{ (storage SF)}}{75 \text{ (vent ratio)}} = 846.7\text{sf of vents required.}\) Now that the total vent space is known, the number of vents required may be calculated. Note that the number of vents is based on the individual size of the vents being installed. The typical vent size is \(4' \times 8'\) (32sf total) and will be used in this example. Therefore, to determine the total number of vents, divide 846.7 by 32. This results in 26.4 vents required. When the number of vents calculated includes a fraction (number right of decimal) the number must be rounded up to the next whole number. For this example, the total number of vents required is 27 vents.

**Draft curtains.** As stated previously, draft curtains are not permitted within sprinklered buildings. Additionally, draft curtain requirements in high piled storage facilities have been amended out of the adopted fire code. Therefore, for the purposes of this document, no further information regarding draft curtains will be provided.

**Solid pile storage.** There are three typical methods of storage that include solid pile, shelf and rack storage. A significant difference between the solid piles and shelf/rack storage is that the shelves/racks are typically secured to the floor. Solid piles of combustibles are not secured to the floor and the areas they occupy may be expanded, contracted or moved at any time. Because of this, all storage pile areas are required to indicate the boundaries for the piled storage. This may be done with paint, tape or other approved striping on the warehouse floor. There are no requirements as to the color or width of the striping, other than it must be present. However, yellow tape and/or paint has typically been used to delineate these areas.

**Shelf storage.** Shelf storage and storage in solid piles, solid piles on pallets and bin box storage in bin boxes not exceeding 5 feet (1524 mm) in any dimension, shall be in accordance with IFC Section 3206. Shelf storage greater than 12 feet (3658 mm) but less than 15 feet (4572 mm) in height shall be in accordance with the fire protection requirements set forth in NFPA 13. Shelf storage 15 feet (4572 mm) or more in height shall be protected in an approved manner with special fire protection, such as in-rack sprinklers.

**Rack Storage.** Shall be in accordance with IFC Section 3206. Bin boxes exceeding 5 feet (1524 mm) in any dimension shall be regulated as rack storage. Automatic sprinklers are required for rack storage an approved automatic sprinkler system shall be installed throughout the building or to 1-hour fire barriers constructed in accordance with Section 707 of the International Building Code. Openings in such fire barriers shall be protected by opening protectives having a 1-hour fire protection rating.

**Plastic pallets and shelves.** Storage on plastic pallets or plastic shelves shall be protected by approved specially engineered fire protection systems. Except when listed plastic pallets are used. Plastic pallets listed and labeled in accordance with UL 2335 shall be treated as wood pallets for determining required sprinkler protection.

**Racks with solid shelving.**
Racks with solid shelving having an area greater than 32 square feet (3 m²), measured between approved flue spaces at all four edges of the shelf have different requirements unless they meet the following exceptions, but must be protected per NFPA 13.

1. Racks with mesh, grated, slatted or similar shelves having uniform openings not more than 6 inches (152 mm) apart, comprised of at least 50 percent of the overall shelf area, and with approved flue spaces are allowed to be treated as racks without solid shelves.
2. Racks used for the storage of combustible paper records, with solid shelving, shall be in accordance with NFPA 13.

**Flue spaces.** Flue spaces shall be provided in accordance with the table below. Required flue spaces shall be maintained. Where required the necessary flue spaces shall be equipped with approved devices to protect the required flue spaces.

**Column protection.** Steel building columns shall be protected in accordance with NFPA 13.

**Extra-high-rack storage systems.** Approval of the fire code official shall be obtained prior to installing extra-high-rack combustible storage. Buildings with extra-high-rack combustible storage shall be protected with a specially engineered automatic sprinkler system. Extra-high-rack combustible storage shall be provided with additional special fire protection, such as separation from other buildings and additional built-in fire protection features and fire department access.

### REQUIREMENTS FOR FLUE SPACES FOR RACK STORAGE

<table>
<thead>
<tr>
<th>RACK CONFIGURATION</th>
<th>AUTOMATIC SPRINKLER PROTECTION</th>
<th>SPRINKLER AT THE CEILING WITH OR WITHOUT MINIMUM IN-RACK SPRINKLERS</th>
<th>IN-RACK SPRINKLERS AT EVERY TIER</th>
<th>NONSPRINKLERED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Storage height</td>
<td>Option 1 Option 2</td>
<td>&gt; 25 feet Any height</td>
<td>Any height</td>
</tr>
<tr>
<td>Single-row rack</td>
<td>Transverse flue space</td>
<td>3 inches Vertically aligned Not Required</td>
<td>Not Required Not Required</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Longitudinal flue space</td>
<td>Not Required Not Required</td>
<td>Yes Not Applicable Not Required</td>
<td></td>
</tr>
<tr>
<td>Double-row rack</td>
<td>Transverse flue space</td>
<td>6 inches Vertically aligned Not Required</td>
<td>Not Required Not Required</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Longitudinal flue space</td>
<td>Not Required Not Required</td>
<td>Yes Not Applicable Not Required</td>
<td></td>
</tr>
<tr>
<td>Multi-row rack</td>
<td>Transverse flue space</td>
<td>6 inches Vertically aligned Not Required</td>
<td>Not Required Not Required</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Longitudinal flue space</td>
<td>Not Required Not Required</td>
<td>Yes Not Applicable Not Required</td>
<td></td>
</tr>
</tbody>
</table>

**Hazardous materials storage.** The storage of hazardous materials must be in compliance with all applicable fire code and national standards. Refer to applicable codes and national standards for additional information. For specific questions regarding hazardous materials storage, contact the Des Moines Fire Prevention Bureau.

**PUTTING IT ALL TOGETHER - HIGH PILED STORAGE EXAMPLES**

**Single storage area, Class I through IV commodities.** For a single storage area, there are no differences in requirements between Classes I through IV commodities. Therefore, as an example, if sprinklers are required for a Class II commodity, based on a given amount of storage space, sprinklers will also be required for Class I, III or IV for that same amount of storage space. However, it may be possible to separate the storage by approved methods such that the smaller storage area sizes fall below sizes for requirements. These types of storage areas are the easiest to design. The differences in commodity classifications would play a role in the sprinkler system design, if applicable.

**Multiple storage areas, Class I through IV commodities.** There may be instances in which a facility wishes to store a specific commodity classification in a specific area. The code allows this practice. Additionally, if the individual storage areas are adequately separated, as previously mentioned, each storage area, not the aggregate of the areas, is required to meet high piled storage requirements. This means that if designed properly, each storage area may not require sprinklers, smoke/heat vents and access provisions. See Figure 7 for an illustration of this.
Now that the storage areas are separated per Chapter 32 requirements, each storage area is then evaluated against code requirements rather than all areas combined. These three storage areas being separated per fire code requirements would only require fire sprinklers. FD access and smoke/heat vents are no longer required.

**Multiple storage areas, Class I through IV and high hazard commodities.** High hazard commodities present unique concerns with high piled storage design. This is due to the fact that high hazard commodities burn more intensely than Class I-IV commodities. Therefore are defined as combustibles stored greater than 6 feet (Class I-IV is combustibles over 12 feet), and requirements for fire sprinklers, smoke/heat vents and FD access begin at smaller sizes of storage areas. See Table 2306.2. So the principles of aggregation and separation play a particular role. A facility may have 1,000SF of high hazard commodities with the rest of a 100,000SF being Class IV commodities or less. However, if the high hazard commodities are not separated per code, the entire facility is considered a high hazard commodity.

As an example, a facility currently has one storage area with a total of 17,500SF of mixed commodity storage (12,000SF of Class I-IV and 2,500SF of high hazard) to 19 feet in height. The facility is bound by a fire apparatus access road on three sides. Being a single storage area, the entire area must meet the requirements of the greatest hazard. In this instance it is high hazard commodities. Therefore 17,500SF of high hazard storage requires 11 smoke/heat vents, 4 FD access doors and fire sprinkler system designed for the high hazard commodity. See Figure 8 below.
The total cost of the sprinkler system, access doors and vents could be significant in the budget for this project. However, if the storage was rearranged such that the high hazard commodities were separated, per fire code requirements, from the remaining commodities, the requirements in Chapter 32 are reduced. The only requirement for high piled storage facilities with 2500SF of high hazard and 12,000SF of Class I-IV commodities that are separated per fire code requirements is a sprinkler system. Therefore, the costs for the vents and access doors are eliminated for the cost of a 1-hour fire barrier and 1-hour opening protection. See Figure 9.

![FIGURE 8 - MULTI-COMMODITY SEPARATED STORAGE WITH APPLICABLE REQUIREMENTS](image)

**Facilities Capable of High Piled Storage But Not Practicing High Piled Storage**

From time to time, a building is designed such that ceiling heights are tall enough to allow storage meeting the definition of high piled combustible storage. However, the facility does not employ such storage practices. These are considered facilities that are capable of, but not practicing, high piled storage. When a facility falls into this category, a high piled storage waiver is required to be signed and placed on file within the Des Moines Fire Prevention Bureau. This waiver is a declaration signed by the owner of the building that high piled storage of combustible materials will not be practiced in the building. The declaration also states that if such practices are found, during an inspection or at any other time, the facility must revert back to non high piled practices, or the building or facility must come into full compliance with the current fire code.

Approved signage is required throughout all areas within a building capable of, but not practicing, high piled storage. Spaces such as atriums, with vaulted ceilings (as in churches), auditoriums and other similar spaces are not applicable to this requirement. See the section on Signage Construction and Design Requirements for the required signage in these locations. If there is any uncertainty if signage is required in such a space, contact the Des Moines Fire Prevention Bureau for clarification.

**SIGNAGE CONSTRUCTION AND DESIGN REQUIREMENTS**

*All high piled storage facilities.* All signage shall be a minimum of 1 foot by 3 feet and shall be constructed of durable materials such as metal or plastic. Signs constructed of paper, cardboard or similar materials are not acceptable. Each sign shall be provided with "NO STACKING ABOVE THIS LINE" and "BY ORDER OF THE DES MOINES FIRE DEPARTMENT" wording in 2 inch black letters with at least a 1/2 inch stroke on a white background. Additionally, each sign shall be provided with a 3 inch wide red stripe the full width of the sign. Within this red stripe, the maximum height permitted and highest commodity classification (if applicable) shall be stated in 2 inch white letters with at least a 1/2 inch stoke. All graphics shall be printed on the sign, or otherwise permanently affixed to the sign. See Figure 10 for signage specifications.
FIGURE 9 - SIGNAGE SPECIFICATIONS

The layout or arrangement of the required signage features is flexible. See Figure 11 for examples of acceptable arrangements.

FIGURE 10 - OTHER ACCEPTABLE SIGNAGE ARRANGEMENTS

Facilities capable of, but not utilizing high piled storage. Signage used in areas capable of, but not practicing high piled storage shall be the same dimensions, color scheme and wording with one exception. The red stripe does not contain any wording and is left as a solid red stripe. This allows the signs to be used when the area is used for high pile storage by affixing the proper wording to the red stripe. Signs shall also be constructed of durable materials such as metal or plastic. Signs constructed of paper, cardboard or similar materials are not acceptable. All graphics shall be printed on the sign, or otherwise permanently affixed to the sign. See Figure 12 for an acceptable example.

Striping. An acceptable alternative to signage is striping. The striping shall consist of a 3 inch solid red stripe running the entire perimeter of the area. The red stripe shall have 2 inch white wording having at least an 1/2 inch stroke. Figure 13 depicts an illustration of the striping design; however, does not show the acceptable required wording.

FIGURE 11 - STRIPING DESIGN EXAMPLE

For areas with high piled storage, required wording shall state "NO STACKING ABOVE THIS LINE BY ORDER OF THE DES MOINES FIRE DEPARTMENT". The greatest commodity classification and maximum storage height permitted shall also be provided. All wording shall be oriented as shown in Figure 14. Wording shall be spaced at 50-feet intervals as measured from end of wording to start of wording as depicted in Figure 15.
For areas capable of, but not practicing high piled storage, the only acceptable form of stacking limit identification is the approved signage mentioned above. Striping is not permitted.

**Signage and Striping Installation Requirements**

All high piled combustible storage areas and those areas capable of, but not practicing high piled storage, are required to install applicable signage at the maximum permitted height of the storage. The signage is designed to provide a visual indicator that storage must not exceed a certain height. If storage exceeds permitted heights, a resulting fire could very easily and quickly overtake a sprinkler system (if present) because along with other variables, the sprinkler system is specifically designed for a given height of storage. Storage exceeding permitted heights in unsprinklered buildings presents a significant hazard for firefighters as the height of the storage affects the penetrability of fire hose streams. Therefore, it is extremely important for the designed storage height permitted within a storage area to remain at that height. Storage heights not in compliance may be the difference between a single pallet fire and a complete building loss.

All signage and striping must be installed to provide maximum visibility. The top of the red stripe, whether on signage or striping alone, shall be installed at the maximum storage height permitted as measured from the floor. See Figure 16.

**FIGURE 14 - SIGNAGE AND STRIPING VERTICAL INSTALLATION EXAMPLE**

Signs shall be placed a maximum of 25 feet from all corners within a storage area, and shall be spaced a maximum of 50 feet between signs along perimeter walls of the storage area. Signage may be adjusted to provide enhanced visibility while not exceeding the maximum distances. For example, depending on the layout of aisles, signage may be adjusted so that the sign is centered on the aisle. See Figures 17-19.

Internal portions of the storage area shall be signed or striped, as well. If columns are available, signs may be mounted to the columns in such a way as to provide maximum visibility. This may include providing signs on more than one side of the column. Striping shall encompass all applicable columns. When columns are not present, the signage may be hung from the roof supports. These signs would be provided at the required spacing.
If the spacing of the columns is greater than 50 feet, signs or striping shall be provided for all applicable internal columns. When column spacing is less than 50 feet, signs or striping shall be provided on all applicable columns not to exceed 50 feet spacing. See Figure 18 for an illustration.

FIGURE 15 - ISOMETRIC CORNER EXAMPLE FOR MARKING INSTALLATION
The first sign is a maximum of 25 feet from the corner or wall. To provide the highest visibility, signs should be placed so they are clearly visible when looking down the aisle. The sign may be shifted from the 25 feet distances to accommodate this, but no more than 25 feet from the corner or wall.

When signs are not able to be affixed to a wall, the sign spacing is permitted to be adjusted to reflect the spacing of columns. If no columns are available, the signs may be hung from the roof/ceiling structure and spaced at required intervals.

FIGURE 16 - SIGNAGE PLACEMENT AND SPACING EXAMPLE

FIGURE 17 - END OF AISLE VIEW OF SIGNAGE AND STRIPING PLACEMENT EXAMPLE
COMPLETING THE STORAGE QUESTIONNAIRES FOR NEW BUILDINGS OR TENANTS

*QUESTIONNAIRES ARE LOCATED IN PACKET #3*

General Storage (Class I-IV Commodities)

Completely and accurately fill out the High Piled Combustible Storage Questionnaire. The questionnaire should be completed and signed by a person qualified to answer these questions correctly. The following is a breakdown of each section of the questionnaire and commentary explaining the information being sought.

**Business Name.** Please provide the name of the tenant/business which will be occupying the space intended for stocking of high piled combustible materials.

**Business Address.** The correct and complete address must be provided to insure the correct information is in our database and on the high piled combustible storage permit.

**Business Telephone.** Provide at least one daytime phone number for the business that can be used as a contact for any questions or concerns. If possible, include a fax number and a secondary number.

**Item 1.** **Commodity Classifications.** Identifying commodity classifications is the first step in determining applicable fire code requirements. Fire protection measures, such as fire sprinkler designs, are also based on commodity classifications. If a commodity is misclassified and fire sprinkler systems are designed for the incorrect classification, a resulting fire may easily overtax the sprinkler system causing the sprinkler system to be ineffective. Therefore accurately classifying commodities is imperative. It is understood that difficulties may arise in trying to determine appropriate classifications. Document 3 provides a comprehensive listing of various commodities, with their classifications. If difficulties are still being experienced, please contact the Des Moines Fire Prevention Bureau for assistance.

**Item 2.** **Description of Storage.** Provide an accurate and detailed description of all current storage practices in the facility. If commodity classifications are known, provide descriptions of where and how each classification is being stored. For example, Class I commodities being stored throughout the facility; Class IV commodities being stored on racks 1-5 to heights of 22 feet. and Class III commodities being stored on racks 5-10 to heights of 15 feet.

*Note: If plastics are being stored, identify this in the description, and also complete the Plastics Questionnaire."

**Item 3.** **Maximum Storage Height.** Provide the maximum height(s), in feet, of the storage within the facility. This measurement is taken from the floor to the top of the stored commodity, not to the highest shelf or rack.

**Item 4.** **Clear Ceiling Height.** This is the measurement, in feet, from the floor of the high piled storage areas to the bottom of the roof deck.

**Item 5.** **Clear Height.** The measurement, in feet, from the floor of the high piled storage areas to the bottom of the structural supports of the roof deck. This may be the bottom of the roof joists, twin “T’s”, rafters, etc.

**Item 6.** **Method of Storage.** Indicate all methods in which commodities are currently being stored. Photographs, specification sheets and other information may be submitted to provide a better understanding of how commodities are being stored.

**Item 7.** **Rack Storage Information.** Provide as detailed and accurate information as possible.

*Type of Racks.** Single row racks are those racks in which commodities may be reached from either side of the rack. No flue space is located in the middle of single row racks. Double row racks allow access from a single side of the individual rack, with a flue space in between the racks. See Figure 20. Multiple row racks are similar to double row racks, but incorporate more than two racks. Multiple row racks will be more than two pallets deep.
**Height of Racks.** Indicate if racks are "x" ft high in one area and "y" ft high in other areas or a constant height throughout. This measurement is from the floor level to the highest possible level or shelf the racks. Rack specification sheets may be submitted, as well.

**Depth of Racks.** This measurement is from the front of the rack or aisle, to the back of the rack either aisle (for single row racks) or flue space (for double and multiple row racks). If different width racks are present, indicate all widths of all racks. For double or multiple row racks, indicate the total widths (depths) of each double or multiple rows.

**Width of Racks.** This is the side-to-side measurement of the racks. Provide the total width of the racks for each row. The width measurement is measured parallel to the aisles.

**Aisle Widths Between Racks.** Typically the aisle widths will be either 4 or 8 feet wide. However, other aisle widths are definitely possible. Indicate the smallest dimension on the questionnaire, but be sure to show all aisle widths on the drawings. See Figure 21.

**Longitudinal and Transverse Flue Spaces.** Indicate both of these flue spaces in inches for the current storage practices in the facility. See Figure 20.

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**FIGURE 18 - TYPICAL DOUBLE ROW RACK WITH FLUES**  
**FIGURE 19 - ILLUSTRATION OF AISLE WIDTH**

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**Item 8.** **Mechanical Smoke Removal Systems.** "Mechanical" refers to smoke that is forcibly removed out of the facility, or air forcibly pushed into the facility, to pressurize the facility. These systems may include fans either positioned on the roof or towards the tops of exterior walls. Mechanical smoke removal systems are not smoke vents.

**Item 9.** **Smoke Vents.** Based on the requirements of Chapter 32 in the 2012 IFC, determine if smoke vents are required.

- **Vent to Ceiling Area Ratio.** Once smoke vents are required, the applicable vent to ceiling ratio must be determined. Table 910.3 (below) taken from the 2012 IFC provides the available ratios based on the situation.

- **Number of Vents Required.** Provide the total number of vents that are required based on the vent to ceiling area ratio chosen.

**Item 10.** **Draft/Curtain Boards.** Indicate if draft or curtain boards are being proposed. Keep in mind that these devices are only permitted in non-sprinklered buildings.

**Item 11.** **Gross Square Footage of Entire Structure.** Provide the gross square footage of the entire facility. This figure includes all portions of the structure, as well as each individual floor, mezzanines, etc.
Item 12. **Square Footage of High Piled Storage Areas Only.** Provide the square footage for all areas used for the high piled storage of combustibles. If more than one area is present and the areas are separated in some fashion (either by distance or barrier) indicate the sizes for each area. If more than one area is present and not separated in some manner, sum all areas into one area. For those areas that are separated, indicate this with a number in the check box next to the appropriate size for each area. Otherwise, check the appropriate box. The areas used in this measurement are all floor spaces being used by racks and/or piles, plus the required aisles for each area. A general rule of thumb for numerous rows of racks or piles is to include all aisles between the racks and piles, as well as any applicable required aisles elsewhere throughout the storage.

Item 13. **Fire Sprinklers Throughout/Partial.** Indicate if the facility will be sprinklered throughout all areas or partial areas. Some requirements for high piled combustible storage dictate the presence of fire sprinkler systems.

- **Partial - Storage Areas.** Indicate whether the partial fire sprinkler protection will include all high piled storage areas or not.

- **ESFR System.** For those high piled storage areas that will utilize fire sprinkler protection, indicate if the sprinkler system protection being provided will be an ESFR system. See definitions section for a definition of ESFR. If the entire facility will be an ESFR system throughout, check "Throughout" then, "Yes" for ESFR.

Item 14. **Fire Alarm System.** Indicate whether a fire alarm system is present in the facility or not. A security and/or burglar system that may incorporate a few smoke detectors does not count. The fire alarm system will incorporate smoke detection, heat detection, manual fire alarm pull stations, horns, strobes, etc.

Item 15. **Piled Storage Information.** Provide as detailed and accurate information as possible. This section only refers to commodities being stored on the floor (with or without the use of pallets) and stacked atop each other. No racks or shelves are used for pile storage.

- **Cubic Feet Per Pile.** Provide the cubic feet for each high piled of combustible storage.

- **Maximum Pile Dimension.** This measurement represents the longest side of a pile.

- **Maximum Pile Height.** As measured from the floor to the top of storage in feet. If multiple piles with different heights are present, provide information for all piles.

- **Aisle Widths Between Piles.** Typically the aisle widths will be either 4 or 8 feet wide. However other aisle widths are definitely possible. Indicate the smallest dimension on the questionnaire but ensure to show all aisle widths on the drawings. See Figure 21.

Item 16. **Access Doors Provided.** - Access doors providing access from the exterior roadways and/or driveways directly into the high piled storage areas is what may be required. An exterior door that provides direct access into the high piled storage areas from a sidewalk does not meet this criterion. An access door from a roadway into an office which is adjacent to the high piled storage area also does not meet this criterion.

Item 17. **Access Doors Keyed for Fire Department Use.** All access doors specifically into the high pile storage areas must have a method for gaining entry from the exterior of the facility. In the very least, a key lock must be present with the master key(s) located in the facilities’ Knox™ box.

**Lock Box Note.** All warehouse facilities with fire detection/alarm and suppression systems installed require a Lock Box system installed in a fire department approved location. The Lock Box system is a safe and secure on site key box for fire department’s use only. The Des Moines Fire Department has sole access to the Lock box. Master keys, card keys, and any other special access keys (to any fire protection system) are required in the Lock box. This permits safe entry and helps to minimize damage to your facility in the event of an emergency. Each exterior door should have a Lock Box label installed to assist the fire department in recognizing that the building is equipped with this system.
Names and Titles of Persons Responsible for Information Contained Within Questionnaire. Provide the names of the individuals who completed these forms, along with all applicable phone/fax numbers, in order to contact them for additional information, or to answer questions that may arise.

Storage Questionnaire - Plastic Storage (High Hazard Commodities)

Completely and accurately fill out the Plastics Storage Questionnaire. The questionnaire should be completed and signed by a person qualified to answer these questions correctly. The following is a breakdown of each section of the questionnaire and commentary explaining the information being sought.

Business Name. Please provide the name of the tenant/business which will be occupying the space intended for stocking of high piled combustible materials.

Business Address. The correct and complete address must be provided to insure the correct information is in our database and on the high piled combustible storage permit.

Business Telephone. Provide at least one daytime phone number for the business that can be used as a contact for any questions or concerns. If possible, include a fax number and a secondary number.

Item 1. Plastic Group Type. Much like the importance of correctly classifying commodities, plastics require correct grouping. A few sections taken from the 2012 International Fire Code depicting the various groups of plastics and examples are provided for assistance.

Group A plastics. Group A plastics are plastic materials having a heat of combustion that is much higher than that of ordinary combustibles, and a burning rate higher than that of Group B plastics. Examples of Group A plastics include, but are not limited to, the following:

- ABS (acrylonitrile-butadiene-styrene copolymer)
- Acetal (polyformaldehyde)
- Acrylic (polymethyl methacrylate)
- Butyl rubber EPDM (ethylene propylene rubber)
- FRP (fiberglass-reinforced polyester)
- Natural rubber (expanded)
- Nitrile rubber (acrylonitrile butadiene rubber)
- PET or PETE (polyethylene terephthalate)
- Polybutadiene
- Polycarbonate
- Polyester elastomer
- Polyethylene
- Polypropylene
- Polystyrene (expanded and unexpanded)
- Polyurethane (expanded and unexpanded)
- PVC (polyvinyl chloride greater than 15 percent plasticized, e.g., coated fabric unsupported film)
- SAN (styrene acrylonitrile)
- SBR (styrene butadiene rubber)

Group B plastics. Group B plastics are plastic materials having a heat of combustion and a burning rate higher than that of ordinary combustibles, but not as high as those of Group A plastics. Examples of Group B plastics include, but are not limited to, the following:

- Cellulosics (cellulose acetate, cellulose acetate butyrate, ethyl cellulose)
- Chloroprene rubber
- Fluorooplastics (ECTFE, ethylene-chlorotrifluoroethyl-ene copolymer; ETFE, ethylene-tetrafluoroethylene copolymer; FEP, fluorinated ethylene-propylene copolymer)
- Natural rubber (nonexpanded)
- Nylon (Nylon 6, Nylon 6/6)
- PVC (polyvinyl chloride greater than 5-percent, but not exceeding 15-percent plasticized)
- Silicone rubber

**Group C plastics.** Group C plastics are plastic materials having a heat of combustion and a burning rate similar to those of ordinary combustibles. Examples of Group C plastics include, but are not limited to, the following:

- Fluoroplastics (PCTFE, polychlorotrifluoroethylene; PTFE, polytetrafluoroethylene)
- Melamine (melamine formaldehyde) henol VC (polyvinyl chloride, rigid or plasticized less than 5 percent, e.g., pipe, pipe fittings)
- PVDC (polyvinylidene chloride)
- PVDF (polyvinylidene fluoride)
- PVF (polyvinyl fluoride)
- Urea (urea formaldehyde)

This list should facilitate the identification in grouping plastic commodities into an A, B, or C group type. If difficulties still arise, contact the product manufacturer for the necessary information required to properly group the type of plastic the facility stores. Submit this information to the Des Moines Fire Prevention Bureau for record.

**Item 2. Percentage of Plastic in Storage.** The percentage of plastics is a significant factor. The difference between percentages may be the difference in fire sprinklers within the facility. Therefore, an estimated percentage of plastic materials within the facility is required. Please note that this percentage of plastics is based on individual pallet loads/cartons or packages, and is a function of the volume or weight of the packaging method. For example, in a pallet load of bicycles, the amount of plastics (pedals, reflector, tires, handle bar grips, etc.) is actually very limited as compared to the metal (non-combustible) portions of the bicycle. The percentage of plastics in the pallet load of bicycles may be 25% or ¼ of the total weight or volume of the pallet. In another example of storing computers, the percentage of plastics may be as high as 75%, due to computers being mostly plastic, with some exceptions. Contact the Des Moines Fire Prevention Bureau with any questions.

**Item 3. Plastic Group Type A Conditions.** If it has been determined that the plastics being stored are Group A plastics, then the following questions are required to be answered.

- **Expanded, Non-Expanded and Free Flowing.** Check all variations that apply and refer to the definitions section within this document for explanations of each variation. Plastics will be one of these variations.

- **Packaging of Plastic.** Check all variations present within the facility. Refer to the definitions section for assistance.

- **Plastic in Piles.** Again, check all variations present within the facility. Refer to the definitions section for assistance. If the plastics are stored on racks, this subsection need not be answered.

Contact the Des Moines Fire Prevention Bureau with any questions.

**Names and Titles of Persons Responsible for Information Contained Within Questionnaire.** Provide the names of the individuals who completed these forms, along with all applicable phone/fax numbers, in order to contact them for additional information, or to answer questions that may arise.