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HIGH PILED STORAGE FIRE PROTECTION INFORMATION SHEET

This fact sheet will help you:

- Classify high-piled combustible storage
- Determine if sprinkler protection is required
- Determine if smoke and heat venting is necessary

SECTION 1 — INTRODUCTION

This fire safety information sheet is based on the 2007 Minnesota State Fire Code (MSFC) and the 2007 Minnesota State Building Code (MSBC). It contains a summary of the major rules relating to required fire protection systems that apply to high-piled combustible storage as defined in the 2007 MSFC:

High-Piled Combustible Storage is 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 chief, high-piled combustible storage also includes certain high-hazard commodities, such as rubber tires, Group A plastics, flammable liquids, idle pallets and similar commodities, where the top of storage is greater than 6 feet in height.

The 2007 MSFC is adopted statewide and applies throughout the entire state of Minnesota. It sets the minimum required level of safety and need not be adopted locally for it to be enforced. Local jurisdictions may, however, require a higher level of protection than stated in the MSFC through rules and ordinances.

Storage of high-piled combustible material and high-rack storage systems shall be in accordance with MSFC (07) Chapter 23. Factors such as method and height of stock piling, combustibility of materials, fuel load and rate of heat release, areas and size of piles, aisles, automatic fire-extinguishing systems, smoke-removal systems, fire protection and fire separations are considered. In the absence of specific provisions in MSFC (07) Chapter 23, NFPA 13 (2002 Edition), Chapter 12 shall apply.

A high-piled combustible storage building will be required to meet other requirements that are not listed in this publication. This information sheet provides an overview of the major code requirements that apply to fire protection systems in this type of occupancy and does not attempt to cover every situation. References to the applicable codes and standards are found throughout this document.

Both the MSFC (07) and MSBC (07) have additional requirements for issues such as egress, building construction, interior finish, building size, etc. The applicable documents should be consulted for complete requirements since these items are not covered here. More information is available from the Minnesota State Fire Marshal Division by sending an e-mail to firecode@state.mn.us or view our web page at www.fire.state.mn.us for the latest information on fire in Minnesota.

SECTION 2 — CLASSIFY THE COMMODITY

The first step in evaluating what fire protection systems are required for high-piled storage is to determine the commodity classification for the storage. In reviewing hundreds of sprinkler system plans a year, the State Fire Marshal Division finds that an incorrect or non-conservative commodity classification is one of the most frequent errors associated with sprinkler system design.

2.1 High-hazard commodities

Special fire protection problems are created by the storage of high-hazard commodities. From MSFC (07) Section 2303.6, some examples include:

- Aerosols, Level 3 (see Chapter 28)
- Alcoholic beverages, exceeding 80 percent alcohol, in bottles or cartons
- Commodities of any class in plastic containers in carousel storage
- Flammable solids (except solid combustible metals)
- Glycol in combustible containers (50% +)
- Lacquers, which dry by solvent evaporation, in metal cans or cartons
- Lubricating or hydraulic fluid in plastic containers
- Mattresses, foamed rubber or foamed plastics
- Pallets and flats which are idle combustible
- Paper, asphalt, rolled (vertical or horizontal)
- Paper and pulp, rolled, in vertical storage (unbanded or without approved wrap)
- Pillows, foamed rubber and foamed plastics
- Plastics, most group A (such as ABS, acetal, acrylic, butyl rubber, EPDM, FRP, natural rubber, nitrile rubber, PET or PETE, polybutadiene, polycarbonate, polyester elastomer, polyethylene, polypropylene, polystyrene, polyurethane and PVC, SAN and SBR).
- Pyroxylin
- Rubber Tires
- Vegetable oil and butter in plastic containers.

2.2 Other commodities

Most other commodities consisting of limited combustible materials, wood, paper, natural fibers, and some low flammability plastics are classified as Class I, II, III or IV commodities. For examples, see MSFC (07) Section 2303. NOTE: Some commodity classifications listed in the MSFC differ from those contained in National Fire Protection Association (NFPA) standards. See the attached commodity classification tables for more information.

- **Class I commodities** are essentially noncombustible products on wooden or non-expanded polyethylene solid deck pallets. Commodities can be in ordinary corrugated cartons with or without single thickness dividers or in ordinary paper wrappings with or without pallets.

- **Class II commodities** are Class I products (noncombustible) in slatted wooden crates, solid wooden boxes, or multiple-thickness paperboard cartons with or without pallets.

- **Class III commodities** are commodities of wood, paper, natural fiber cloth with or without pallets.

- **Class IV commodities** are Class I, II or III products containing Group A plastics in ordinary corrugated cartons with or without pallets. It also includes Class I, II and III products with Group A plastic packaging in the range of 10-15% by weight or 10-25% by volume. To determine the exact classification, use MSFC (07) Figure 2303.7.4, reprinted on the next page.

- **Plastic commodities** are divided into three groups; Group A (highest hazard), Group B, and Group C (lowest hazard). If the hazard of the plastic is unknown, a Group A designation should be selected. Group A plastics are considered high hazard commodities as defined above in Section 2.1.

2.3 Mixed commodities

When different commodity classes are stored in the same area, the protection required for the storage must be based on the highest class of commodity stored [MSFC (07) Section 2304.1]. For limited storage of commodities with a higher classification than the remainder of the storage, MSFC (07) Section 2304.2 permits designation of the classification based on an engineering analysis. When using such an engineering analysis, the sprinkler protection is still required to be adequate to protect the higher hazard commodity, although over a smaller area of operation.

For commodities that are composed of different materials, one of which is plastic, MSFC (07) Section 2303.7.4 refers to Figure 2303.7.4 (reprinted on the next page).

Plastics are manufactured in two basic forms. Unexpanded plastics are high-density materials that may be blown into different shapes such as drums, containers, electronics housings, toys, tote bins etc. Expanded plastics are usually made from the same plastic resins, but during the manufacturing process, small bubbles are trapped in the plastic resulting in a much lower density. These expanded plastics are sometimes called foamed plastics and may include materials such as insulation board, packing beans, polystyrene foam coffee cups/plates, and pipe insulation. Because of their lower density, expanded plastics tend to have a higher heat release rate than expanded plastics.

To use MSFC (07) Figure 2303.7.4, both the percent by volume of expanded plastic and the percent by weight of unexpanded plastic in the commodity must be known. For example, a pallet load with 5% by volume expanded plastic and 10% by weight unexpanded plastic would be considered a class IV commodity. Should the quantity of expanded plastic be increased to 20%, the commodity would be classified as a high hazard (group A plastic). A pallet load with 25% by weight unexpanded plastic and no expanded plastics would also be a high hazard (group A plastic) commodity.

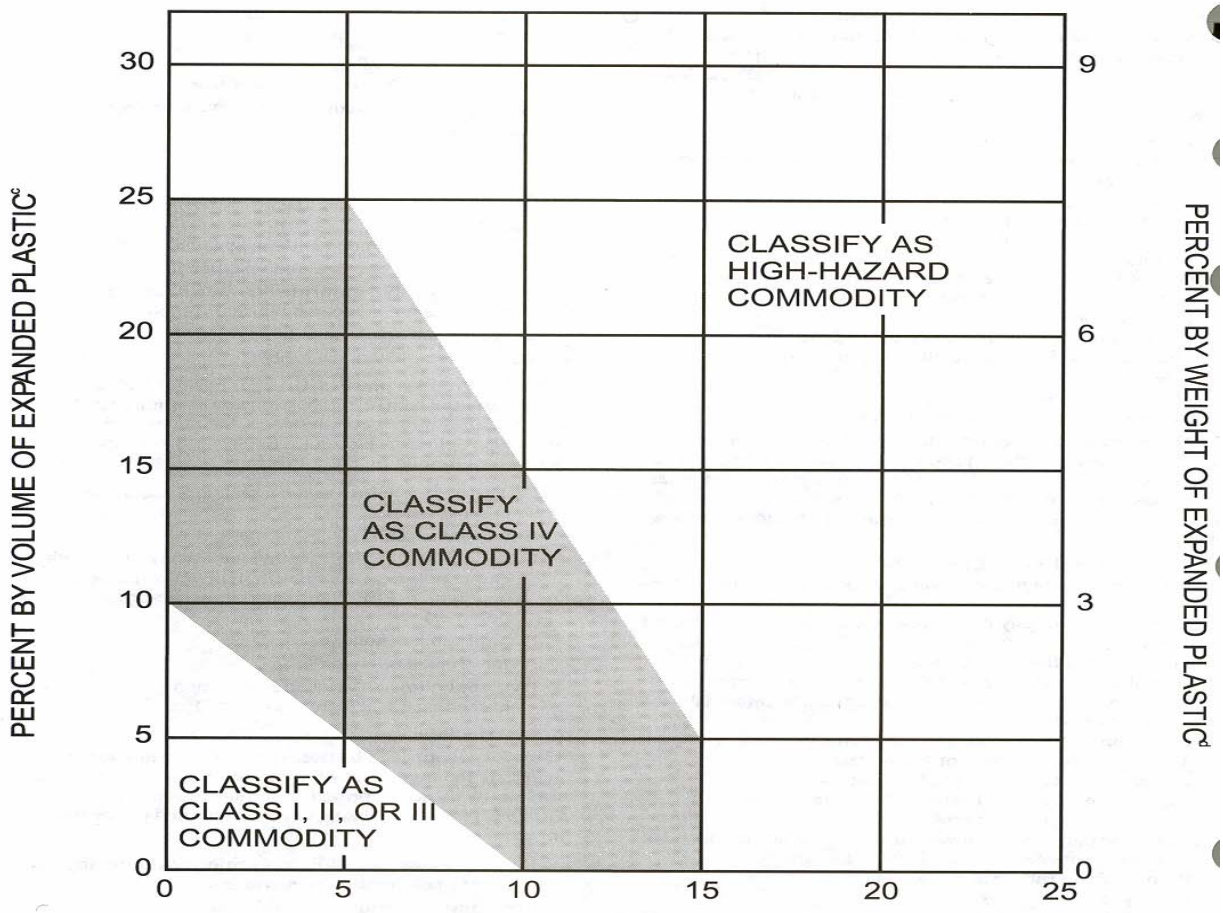


FIGURE 2303.7.4
MIXED COMMODITIES[a, b]

a. This table is intended to determine the commodity classification of a mixed commodity in a package, carton or on a pallet where plastics are involved.
b. The following is an example of how to apply the table: A package containing a Class III commodity has 12-percent Group A expanded plastic by volume. The weight of the unexpanded Group A plastic is 10 percent. This commodity is classified as a Class IV commodity. If the weight of the unexpanded plastic is increased to 14 percent, the classification changes to a high-hazard 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 = $\frac{\text{Weight of plastic in pallet load}}{\text{Total weight of pallet load, including pallet}}$

↓

Percent by volume = $\frac{\text{Volume of plastic in pallet load}}{\text{Total volume of pallet load, including pallet}}$

Percent by weight = $\frac{\text{Weight of plastic in pallet load}}{\text{Total weight of pallet load, including pallet}}$

It is not appropriate to convert percent by weight unexpanded and percent by volume expanded plastic for the purpose of reducing the hazard of a commodity to lower the required level of sprinkler protection.

For additional guidance on the storage of multiple classes of commodities, see NFPA 13 (2002 edition), Chapter 12.

2.4 Flammable and combustible liquids and aerosol containers

Flammable and combustible liquids in all types of containers, including aerosols require detailed review for proper protection. Any time these types of materials are stored in any quantity, and especially when mixed with other types of storage, expert advice should be obtained. Usually only very small quantities of flammable and combustible liquids are allowed to be stored before the MSFC (07) requires some type of fire suppression system.

SECTION 3 — FIRE PROTECTION REQUIREMENTS

Fire protection for high piled combustible storage is addressed in MSFC (07) Sections 2307.2, 2308.2 and 2309.2 and is summarized below in Table 1. Pay particular attention to the requirements for sprinkler protection. For class I-IV commodities, an automatic extinguishing system is required for over 2,500 square feet of storage; although there is one option for nonpublic accessible buildings that would allow up to 12,000 square feet of storage (an alarm system and smoke control are required). For high hazard commodities, an automatic extinguishing system is required for over 500 square feet of storage, although there is one option for nonpublic accessible buildings that would allow up to 2,500 square feet of storage (an alarm system and smoke control are required).

Table 1: Summary of Fire Protection and Life Safety Requirements

COM-MODITY CLASS	SIZE OF HIGH-PILED STORAGE AREA[1] (square feet)	ALL STORAGE AREAS (See Sections 2306, 2307, and 2308)				SOLID-PILED STORAGE, SHELF STORAGE AND PALLETIZED STORAGE (See Section 2307.3)		
		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)	Maximum Pile Dimen-sion[c] (feet)	Maximum Permissible Storage Height[d] (feet)	Maximum Pile Volume (cubic feet)
I-IV	0-500	NR[a]	NR	NR[e]	NR	NR	NR	NR
	501-2,500	NR[a]	Yes	NR[e]	NR	100	40	100,000
	2,501-12,000 Public accessible	Yes	NR	NR[e]	NR	100	40	400,000
	2,501-12,000 Nonpublic accessible (Option 1)	Yes	NR	NR[e]	NR	100	40	400,000
	2,501-12,000 Nonpublic accessible (Option 2)	NR[a]	Yes	Yes	Yes j	100	30[g]	200,000
	12,001-20,000	Yes	NR	Yes	Yes j	100	40	400,000
	20,001-500,000	Yes	NR	Yes	Yes j	100	40	400,000
	Greater than 500,000[h]	Yes	NR	Yes	Yes j	100	40	400,000
High Hazard	0-500	NR[a]	NR	NR[e]	NR	50	NR	NR
	501-2,500 Public accessible	Yes	NR	NR[e]	NR	50	30	75,000
	501-2,500 Nonpublic accessible (Option 1)	Yes	NR	NR[e]	NR	50	30	75,000

	501-2,500 Nonpublic accessible (Option 2)	NR[a]	Yes	Yes	Yes j	50	20	50,000
	2,501-300,000	Yes	NR	Yes	Yes j	50	30	75,000
	300,001-500,000[h, i]	Yes	NR	Yes	Yes j	50	30	75,000

NR = Not required.

For SI: 1 foot = 304.8 mm, 1 cubic foot = 0.02832m^3, 1 square foot = 0.0929m^2.

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.

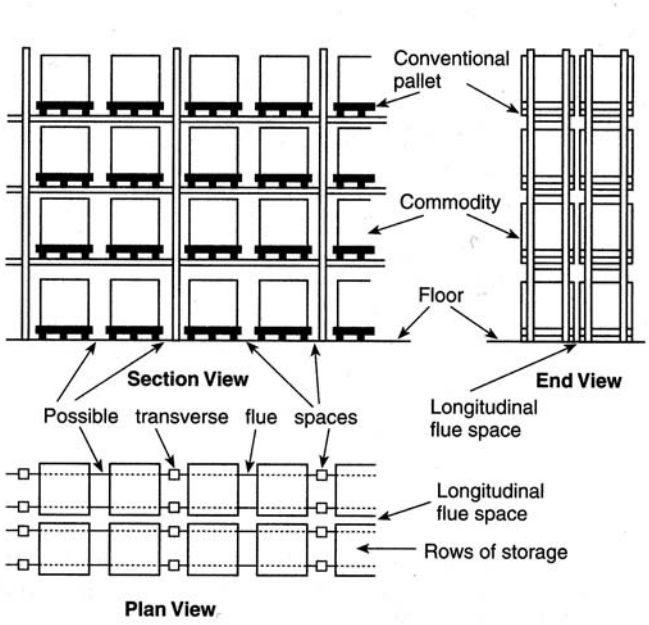
j. Not required when storage areas are protected by early suppression fast response (ESFR) sprinkler system installed in accordance with NFPA 13.

SECTION 4 — SPECIAL REQUIREMENTS FOR RACK STORAGE

4.1 Flue Spaces in Racks

When commodities are stored in racks, openings are created between pallet loads in each direction to facilitate material handling. These flue spaces typically run the full height of the storage and allow fire to rapidly spread throughout the rack. When sprinklers are provided at the ceiling, these same flue spaces allow water to travel into the storage array. Although the buoyant gases from the fire typically prevent the sprinkler water from reaching the seat of the fire, prewetting of commodity that is not yet burning slows the spread of fire to yet ignited fuel. One type of sprinklers, the Early Suppression-Fast Response (ESFR) sprinkler, actually provides sufficient downward momentum to the sprinkler spray that water drops can reach the seat of the fire, virtually suppressing it.

As shown in the figure below for a double row rack, transverse flue spaces run in the direction of pallet loading and occur at rack uprights or side to side between pallets. Longitudinal flue spaces run the length of the array and are perpendicular to the direction of pallet loading. The longitudinal flue space separates pallets front to back and can easily be blocked when pallet loads are loaded too far back into the storage array.



Developments in sprinkler design have allowed storage well above 20 feet to be protected with ceiling only sprinkler protection. For water to reach burning commodity located within the array, adequate sized flue spaces must be provided as required by MSFC (07) Section 2308.3. Table 2 (on the next page) details the minimum flue size for single, double and multi-row racks based on MSFC (07) Table 2308.3. When the minimum flue spaces are not provided, then installation of in-rack sprinklers at every tier is usually the only option as outlined in the last column of Table 2.

TABLE 2: REQUIRED FLUE SPACES FOR RACK STORAGE[1]

RACK CONFIGUR-ATION	FIRE SPINKLER PROTECTION		SPRINKLER AT THE CEILING WITH OR WITHOUT MINIMUM IN-RACK SPINKLERS			IN-RACK SPRINKLERS AT EVERY TIER	NON-SPRINKLERED
	STORAGE HEIGHT		≤25 FEET		>25 FEET	ANY HEIGHT	ANY HEIGHT
			OPTION 1	OPTION 2			
Single-Row Rack	Transverse Flue Space	Size[2]	3 inch	NA	3 inch	NR	NR
		Vertically Aligned	NR	NA	Yes	NA	NR
	Longitudinal Flue Space		NR	NA	NR	NR	NR
Double-Row Rack	Transverse Flue Space	Size[2]	6 inch[3]	3inch	3 inch	NR	NR
		Vertically Aligned	NR[3]	NR	Yes	NA	NR
	Longitudinal Flue Space		NR[3]	6 inch	6 inch	NR	NR
Multi-Row Rack	Transverse Flue Space	Size[2]	6 inch	NA	6 inch	NR	NR
		Vertically Aligned	NR	NA	Yes	NA	NR
	Longitudinal Flue Space		NR	NA	NR	NR	NR

that the configuration does not obstruct water penetration.
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
a. Three-inch transverse flue spaces shall be provided at least every 10 feet where ESFR sprinkler protection is provided.
b. Random variations are allowed, provided that the configuration does not obstruct water penetration.

When required, longitudinal flue spaces must be provided down the entire length of the array, High density racking may create situations where the backs of pallet loads but up against each other, blocking the longitudinal flue space. In this case, either in-rack sprinklers are necessary, or some type of permanent fixed stop must be installed on the racking to prevent pushing pallets together.

Transverse flue spaces are usually provided at the rack uprights, although this space can become blocked with structural elements used to support the rack. The required transverse flue space need not be provided in one continuous opening, but instead is measured as the sum total of the provided openings. For example, a 4" wide rack upright is provided that creates a transverse flue space, although this area also contains a 1" structural member that runs horizontally down the center. Since two 1 ½" openings are created, the total transverse flue space is considered to be 3" wide (sum total of all openings). When the space at the rack uprights is obstructed, the transverse flue could also be provided between pallet loads.

When vertically alignment of flue spaces is required, permanent pallet guides or stops are typically necessary to keep these spaces open.

4.2 Racks with Shelving That Can Restrict the Passage of Water

Additional support for pallet loads or cartoned commodities is often proved by including shelves or other forms of material handling surfaces such as slats, mesh, or grates. Unfortunately, shelves also restrict the flow of sprinkler water to burning fuel. When provided with approved flue spaces, shelves, slats or grates with openings not more than 6 inches apart comprising at least 50% of the overall shelf area are treated as racks without shelves.

Racks with solid shelving (and shelving not meeting the opening size requirements above) having an area greater than 32 square feet between flue spaces on all four sides shall have sprinkler protection installed as for solid shelves [MSFC (07) Section 2308.2.2]. Basically, this requires sprinklers at every tier within the array.

4.3 Steel Column Protection

Columns shall be protected according to NFPA 13 (2002 edition), Chapter 12. In some cases, structural steel reached temperatures that lead to failure based upon full scale testing of sprinkler protected rack storage. In these cases, NFPA 13 (2002 edition) requires additional sprinkler protection for structural steel members [NFPA 13 (2002 edition) Section 12.3.1.7].

SECTION 5 — SUMMARY

When reviewing the fire protection requirements for a storage facility, the following points should be considered:

- First classify the commodity. Use the information in Section 6 of this fact sheet as a guide, but if a commodity is not listed, do not guess. Contact the State Fire Marshal Division for assistance.
- Use Table 2306.2 from the MSFC (07) for fire protection requirements.
- For materials stored in racks, assure that adequate flue spaces are maintained to allow sprinkler water to penetrate the storage array.
- Watch for obstructions such as solid shelves or slats. Also watch for grates that allow products or cartons to obstruct flue spaces.

SECTION 6 — EXAMPLE COMMODITY CLASSIFICATIONS

Notes given in ( ) are found at the end

Aerosols (See MSFC (03) Chapter 28)	
Cartoned or uncartoned	
– Level 1	Class III
– Level 2	Class IV
– Level 3	High haz
Alcoholic Beverages	
Cartoned or uncartoned	
– Up to 20 percent alcohol in metal, glass or ceramic containers	Class I
– Up to 20 percent alcohol in wood containers	Class II
– Exceeding 20 percent alcohol but less than 80 percent alcohol, in cans or bottles in cartons	Class IV
– Exceeding 80 percent alcohol, in cans or bottles in cartons	High haz
Ammunition	
Small arms, shotgun	
– Packaged, cartoned	Class IV
Appliances, Major (e.g., stoves, refrigerators)	
– Not packaged, no appreciable plastic exterior trim	Class I
– Corrugated, cartoned, (no appreciable plastic trim)	Class II
Baked Goods	
Cookies, cakes, pies	
– Frozen, packaged in cartons (1)	Class II
– Packaged in cartons	Class III
Batteries	
Dry cells (nonlithium or similar exotic metals)	
– Packaged in cartons	Class I
– Blister-packed in cartons	Class II
Automobile	
– Filled (2)	Class I
Truck or larger	
– Empty or filled (2)	Group A
Beans Dried	
– Packaged, cartoned	Class III
Bottles, Jars	
Empty, cartoned	
– Glass	Class I
– Plastic PET (polyethylene terephthalate)	Class IV
Filled noncombustible powders	
– Plastic PET	Class II
– Glass, cartoned	Class I
– Plastic, cartoned [less than 1 gal (3.8 L)]	Class IV
– Plastic, uncartoned (other than PET), any size	Group A
– Plastic, cartoned or exposed [greater than 1 gal (3.8 L)]	Group A
– Plastic, solid plastic crates	Group A
– Plastic, open plastic crates	Group A
Filled noncombustible liquids	
– Glass, cartoned	Class I
– Plastic, cartoned [less than 5 gal (18.9 L)]	Class I
– Plastic, open or solid plastic crates (3)	Group A
– Plastic, PET	Class I
Boxes, Crates	
– Empty, wood, solid walls	Class II
– Empty, wood, slatted (4)	Outside of scope
Bread	
Wrapped, cartoned	Class III
Butter	
Whipped spread	Class III
In plastic containers	High haz
Candles	
Packaged, cartoned	
– Treat as expanded plastic	Group A
Candy	
Packaged, cartoned	Class III
Canned Foods	
In ordinary cartons	Class I
Cans	
Metal	
– Empty	Class I
Carpet Tiles	
Cartoned	Group A
Cartons	
Corrugated	
– Unassembled (neat piles)	Class III
– Partially assembled	Class IV
Wax coated, single walled	Group A
Cement	
Bagged	Class I
Ceramics (no plastic or foam packaging)	Class I
With plastic or foam packaging, see MUFC (98) Figure 8101.4-A	
Cereals	
Packaged, cartoned	Class III
Charcoal	
Bagged	
– Standard	Class III
Cheese	
– Packaged, cartoned	Class III
– Wheels, cartoned	Class III
Chewing Gum	
Packaged, cartoned	Class III
Chocolate	
Packaged, cartoned	Class III
Cloth	
Cartoned and not cartoned	
– Natural fiber, viscose	Class III
– Synthetic (5)	Class IV
Cocoa Products	
Packaged, cartoned	Class III

Coffee	
– Canned, cartoned	Class I
– Packaged, cartoned	Class III
Coffee Beans	
Bagged	Class III
Cork, baled	Class III
Cotton	
– Packaged, cartoned Diapers	Class III
– Cotton, linen	Class III
– Disposable with plastics and nonwoven fabric (in cartons)	Class IV
– Disposable with plastics and nonwoven fabric (uncartoned), plastic wrapped	Group A
Dairy products in nonwax-coated containers (excluding bottles)	Class I
Butter in plastic containers	High haz
Dried Foods	
Packaged, cartoned	Class III
Dry insecticides	Class I
Feed, bagged	Class III
Fertilizers	
Bagged	
– Phosphates	Class I
– Nitrates	Class II
Fiberboard, combustible	Class III
Fiberglass Insulation	
– Paper-backed rolls, bagged or unbagged	Class IV
File Cabinets	
Metal	
– Cardboard box or shroud	Class I
Fish or Fish Products	
Frozen	
– Nonwaxed, nonplastic packaging	Class I
– Waxed-paper containers, cartoned	Class II
– Boxed or barreled	Class II
– Plastic trays, cartoned	Class III
Canned	
– Cartoned	Class I
Foods	
Noncombustible containers	Class I
Combustible containers	Class II
Plastic containers	Class III
Frozen Foods	
Nonwaxed, nonplastic packaging	Class I
Waxed-paper containers, cartoned	Class II
Plastic trays	Class III
Fruit	
Fresh	
– Nonplastic trays or containers	Class I
– With wood spacers	Class I
Furniture	
Wood	
– No plastic coverings or foam plastic cushioning	Class III
– With plastic coverings	Class IV
– With foam plastic cushioning	Group A
Glass (no plastic or foam packaging)	Class I
With plastic or foam packaging, see MUFC (98) Figure 8101.4-A	
Glycol	
Metal cans	Class I
Combustible containers <25%	Class III
Combustible containers 25%-50%	Class IV
Combustible containers > 50%	High haz
Grains (Packaged in cartons)	
– Barley	Class III
– Rice	Class III
– Oats	Class III
Gypsum board	Class I
Ice Cream	Class I
Inert, noncombustible materials in noncombustible packaging	Class I
Insulation	
Noncombustible	Class I
Fiberglass Paper-backed rolls bagged or unbagged	Class IV
Leather Goods	Class III
Leather Hides	
Baled	Class II
Light bulbs	
Incandescent or fluorescent in cartons	Class II
Light Fixtures	
Nonplastic	
– Cartoned	Class II
Lighters	
Butane	
– Blister-packed, cartoned	Group A
– Loose in large containers (Level 3 aerosol)	Outside of scope
Linoleum products	Class IV
Liquids	
Noncombustible in plastic containers having less than a 5 gallon capacity	Class I
Noncombustible in plastic containers having a capacity of more than 5 gallons	Class III
Liquor	
100 proof or less; 1 gal (3.8L) or less, cartoned	
– Glass (palletized) (6)	Class IV
– Plastic bottles	Class IV
Lumber	Class III
Marble	
Artificial sinks, countertops	
– Cartoned, crated	Class II
Margarine	
– Up to 50 percent oil (in paper or plastic containers)	Class III
– Between 50 percent and 80 percent	Group A

oil (in any packaging)	
Matches	
Packaged, cartoned	
– Paper	Class IV
– Wood	Group A
Mattresses	
– Standard (box spring)	Class III
– Foam (in finished form)	Group A (high haz)
Meat, Meat Products	
– Bulk	Class I
– Canned, cartoned	Class I
– Frozen, nonwaxed, nonplastic containers	Class I
– Frozen, waxed-paper containers	Class II
– Frozen, expanded plastic trays	Class II
Metal Desks	
With plastic tops and trim	Class I
Milk	
– Nonwaxed-paper containers	Class I
– Waxed-paper containers	Class I
– Plastic containers	Class I
– Containers in plastic crates	Group A
Motors	
– Electric	Class I
Nail Polish	
– 1-oz to 2-oz (29.6-ml to 59.1-ml) glass, cartoned	Class IV
– 1-oz to 2-oz (29.6-ml to 59.1-ml) plastic bottles, cartoned	Group A
Nuts	
– Canned, cartoned	Class I
– Packaged, cartoned	Class III
– Bagged	Class III
Paints	
Friction-top cans, cartoned	
– Water-based (latex)	Class I
– Oil-based	Class IV
Pallets, idle combustible	High haz
Paper Products	
– Books, magazines, stationery, plastic-coated paper food containers, newspapers, cardboard games, or cartoned tissue products	Class III
– Tissue products, uncartoned and plastic wrapped plastics	Group A
Paper, Rolled	
Asphalt, rolled	High haz
In racks or on side	
– Medium or heavyweight	Class III
In racks	
– Lightweight	Class IV
Paper, rolled in vertical storage without approved wrap	High haz
Paper, Waste baled	Class III
Paper, Waxed	
Packaged in cartons	Class IV
Pharmaceuticals	
Pills, powders	
– Glass bottles, cartoned	Class II
– Plastic bottles, cartoned	Class IV
Nonflammable liquids	
– Glass bottles, cartoned	Class II
Photographic Film	
– Motion picture or bulk rolls in polycarbonate, polyethylene, or metal cans; polyethylene bagged in cardboard boxes	Class II
– 35-mm in metal film cartridges in polyethylene cans in cardboard boxes	Class III
– Paper, in sheets, bagged in polyethylene, in cardboard boxes	Class III
– Rolls in polycarbonate plastic cassettes, bulk wrapped in cardboard boxes	Class IV
Pillows	
Excluding foam rubber or plastic	Class III
Foam rubber or plastic	Group A (High haz)
Plastic Containers (except PET)	
– Carousel storage	High haz
– Noncombustible liquids or semi liquids in plastic containers of less than 5 gal (18.9 L) capacity	Class I
– Noncombustible liquids or semi liquids (such as ketchup) in plastic containers with nominal wall thickness of 1/4 in. (6.4 mm) or less and larger than 5 gal (18.9 L) capacity	Class II
– Noncombustible liquids or semi liquids (such as ketchup) in plastic containers with nominal wall thickness greater than 1/4 in. (6.4 mm) and larger than 5 gal (18.9 L) capacity	Group A
Plywood	Class III
Polyurethane	
Cartoned or uncartoned expanded	Group A
Poultry Products	
– Canned, cartoned	Class I
– Frozen, nonwaxed, nonplastic containers	Class I
– Frozen (on paper or expanded plastic trays)	Class II
Powders (ordinary combustibles — free flowing)	
In paper bags (e.g., flour, sugar)	Class II
Proxylin	High haz
PVA (polyvinyl alcohol) Resins	
Bagged	Class IV
PVC (polyvinyl chloride)	
– Flexible (e.g., cable jackets, plasticized sheets)	Class III
– Rigid (e.g., pipe, pipe fittings)	Class III

– Bagged resins	Class III
Rags	
Baled	
– Natural fibers	Class III
– Synthetic fibers	Class IV
Rubber	
– Natural, blocks in cartons	Class IV
– Synthetic	Group A
– Tires	High haz
Rugs, foamed back	Class IV
Salt	
– Bagged	Class I
– Packaged, cartoned	Class II
Shingles	
– Asphalt-coated fiberglass	Class IV
– Asphalt-impregnated felt	Class IV
Shock Absorbers	
– Metal dust covers	Class II
– Plastic dust covers	Class III
Signatures	
Books, magazines	
– Solid array on pallet	Class II
Skis	
– Wood	Class III
– Foam core	Class IV
Stuffed Toys	
Foam or synthetic	Group A
Sugar, bagged	Class III
Syrup	
– Drummed (metal containers)	Class I
– Barreled, wood	Class II
Textiles	
Natural fiber clothing or textile products	Class III
Synthetics (except rayon and nylon) 50/50 blend or less	
– Thread, yarn on wood or paper spools	Class III
– Fabrics	Class III
– Thread, yarn on plastic spools	Class IV
– Baled fiber	Group A
Synthetics (except rayon and nylon) greater than 50/50 blend	
– Thread, yarn on wood or paper spools	Class IV
– Fabrics	Class IV
– Baled fiber	Group A
– Thread, yarn on plastic spools	Group A
Rayon and nylon	
– Baled fiber	Class IV
– Thread, yarn on wood or paper spools	Class IV
– Fabrics	Class IV
– Thread, yarn on plastic spools	Group A
Tires, rubber	High haz
Tobacco Products	
In paperboard cartons	Class III
Transformers	
Dry and oil filled	Class I
Vegetables in noncombustible containers	Class I
Vegetable oil in plastic containers	High haz
Vinyl-Coated Fabric	
Cartoned	Group A
Vinyl Floor Coverings	
– Tiles in cartons	Class IV
– Rolled	Group A
Wax-Coated Paper	
Cups, plates	
– Boxed or packaged inside cartons (emphasis on packaging)	Class IV
– Loose inside large cartons	Group A
Wax	
Paraffin, blocks, cartoned	Group A
Wire	
– Bare wire on metal spools on wood skids	Class I
– Bare wire on wood or cardboard spools on wood skids	Class II
– Bare wire on metal, wood, or cardboard spools in cardboard boxes on wood skids	Class II
– Single- or multiple-layer PVC-covered wire on metal spools on wood skids	Class II
– Insulated (PVC) cable on large wood or metal spools on wood skids	Class II
– Bare wire on plastic spools in cardboard boxes on wood skids	Class IV
– Single- or multiple-layer PVC-covered wire on plastic spools in cardboard boxes on wood skids	Class IV
– Single, multiple, or power cables (PVC) on large plastic spools	Class IV
– Bulk storage of empty plastic spools	Group A
Wood Products	
– Baled	Class III
– Solid piles — lumber, plywood, particleboard, pressboard (smooth ends and edges)	Class II
– Spools (empty)	Class III
– Toothpicks, clothespins, hangers	Class III

in cartons	
– Doors, windows, wood cabinets, and furniture	Class III
– Patterns	Class IV
Yarn	
Natural fiber	Class III
Synthetic or nonviscose	Class IV

Notes:

(1) The product is presumed to be in a plastic-coated package in a corrugated carton. If packaged in a metal foil, it can be considered Class I.
(2) Most batteries have a polypropylene case and, if stored empty, should be treated as a Group A plastic. Truck batteries, even where filled, should be considered a Group A plastic because of their thicker walls.
(3) As the openings in plastic crates become larger, the product behaves more like a Class III commodity. Conversely, as the openings become smaller, the product behaves more like a plastic.
(4) These items should be treated as idle pallets.
(5) Tests clearly indicate that a synthetic or synthetic blend is considered greater than Class III.
(6) Where liquor is stored in glass containers in racks, it should be considered a Class III commodity; where it is palletized, it should be considered a Class IV commodity.