

COMMODITY CLASSIFICATION

**Table of Contents**

	Page
<b>1.0 SCOPE</b> .....	3
1.1 Hazards .....	3
1.2 Changes .....	3
<b>2.0 LOSS PREVENTION RECOMMENDATIONS</b> .....	3
2.1 General .....	3
2.2 Commodity Classification .....	3
2.2.1 Noncombustible .....	4
2.2.2 Class 1 .....	4
2.2.3 Class 2 .....	4
2.2.4 Class 3 .....	5
2.2.5 Class 4/Unexpanded Plastic (UP) .....	5
2.2.6 Expanded Plastic (EP) .....	5
2.2.7 Classifying Commodities Containing Plastics .....	5
2.2.8 External Packaging .....	6
2.2.9 Pallets Supporting Commodities .....	8
2.3 Examples of Commodities .....	9
2.4 Protection .....	16
2.4.1 General .....	16
2.4.2 Empty Plastic Intermediate Bulk Containers (IBCs) .....	16
<b>3.0 SUPPORT FOR RECOMMENDATIONS</b> .....	16
3.1 Burning Characteristics and Testing to Assist in Determining Commodity Classification .....	16
3.1.1 Burning Characteristics .....	16
3.1.2 Bench-Scale Laboratory Tests .....	17
3.1.3 Fire Products Collector (FPC) Commodity Classification Tests .....	18
3.2 Factors Affecting Commodity Classification .....	20
3.2.1 Mixed Commodities .....	20
3.2.2 Configuration .....	20
<b>4.0 REFERENCES</b> .....	20
4.1 FM .....	20
4.2 Other .....	20
<b>APPENDIX A GLOSSARY OF TERMS</b> .....	20
<b>APPENDIX B DOCUMENT REVISION HISTORY</b> .....	22

**List of Figures**

Fig. 2.1. Commodity components .....	4
Fig. 2.2.5.1. Volume of EP that envelops the material .....	5
Fig. 2.2.7. Classify cartoned commodities containing plastic .....	6
Fig. 2.2.8.3-1. Examples of gridded plastic containers (i.e., plastic containers that are significantly open on the sides and/or bottoms) .....	7
Fig. 2.2.8.3-2. Examples of solid plastic containers (i.e., plastic containers that do not have openings on the sides and/or bottoms) .....	7

**List of Tables**

Table 2.2.8.3. Products Stored in Plastic Containers .....	8
Table 2.3. Examples of Material Classification .....	10



Table 2.3. Examples of Material Classification (continued) ..... 13  
Table 2.3. Examples of Material Classification (continued) ..... 14  
Table 2.3. Examples of Material Classification (continued) ..... 15  
Table 2.4.2.1. Protection of Empty Intermediate Bulk Containers (IBCs) ..... 16  
Table 3.1.3. FM Standard Commodities ..... 19

## 1.0 SCOPE

This data sheet provides guidance on classifying stored commodities. Examples of Class 1, 2, 3, unexpanded plastic, and expanded plastic storage commodities are also provided in this data sheet.

Recommendations for protection of these commodities can be found in Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*.

### 1.1 Hazards

Refer to the applicable occupancy-specific data sheet (see Appendix A for definition) for loss prevention recommendations related to the following subjects, which are not covered in this data sheet:

- Storage of special hazards such as ignitable liquids (DS 7-29), aerosol products (DS 7-31), compressed gasses (DS 7-50)
- Storage of commodities such as rubber tires (DS 8-3), baled fiber (DS 8-7), hanging garments (DS 8-18), roll paper (DS 8-21), baled waste paper (DS 8-22), rolled non-woven fabrics (DS 8-23), pallets (DS 8-24), and carpets (DS 8-30)
- Storage arrangements, such as carousel storage (DS 8-33) or automatic storage and retrieval systems (DS 8-34), that contain high-value equipment

### 1.2 Changes

**October 2024.** Interim revision. The following changes were made:

- A. Removed guidance for li-ion batteries, Section 2.4.2, as it has been relocated to FM Loss Prevention Data Sheet 7-112, *Li-Ion Battery Manufacturing and Storage*.
- B. Updated Table 2.3, ID 7 section reference to see Data Sheet 7-112.
- C. Added FM reference to Data Sheet 7-112 in Section 4.1.
- D. Removed li-ion battery related definitions from Appendix A.

## 2.0 LOSS PREVENTION RECOMMENDATIONS

### 2.1 General

A commodity includes stored materials, internal packaging, external packaging (e.g., cardboard containers), and material handling products (e.g., pallets). (See Figure 2.1.) When evaluating commodities to determine their classification, all these components need to be included. Section 2.2 provides guidance on evaluating these individual components of the commodity. Table 2.3 of Section 2.3 includes a list of example materials and their classifications.

FM's standard commodities are ranked from the lowest hazard (noncombustible) to the highest hazard (uncartoned expanded plastic), as follows:

- Noncombustible
- Class 1
- Class 2
- Class 3
- Class 4/Cartoned unexpanded plastic (CUP)
- Cartoned expanded plastic (CEP)
- Uncartoned unexpanded plastic (UUP)
- Uncartoned expanded plastic (UEP)

### 2.2 Commodity Classification

Follow these three steps to determine the commodity classification:

**First Step:** Evaluate the material and internal packaging. To do so, use Sections 2.2.1 through 2.2.6.

When there is a combination of materials (i.e. noncombustible, ordinary combustibles, unexpanded, and expanded plastic), use Figure 2.2.7 (Section 2.2.7). Include only the material and internal packaging when determining the percent of plastic. The density of expanded plastic may be assumed to be 2 lb/ft<sup>3</sup> (32 kg/m<sup>3</sup>).

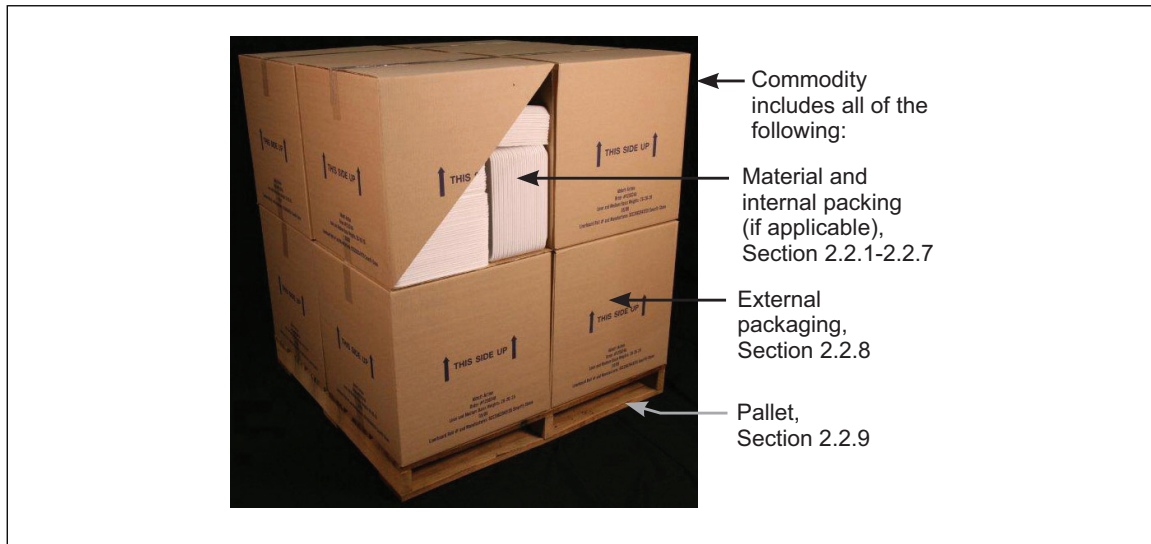


Fig. 2.1. Commodity components

**Second Step:** Evaluate the effect of external packaging. Use Section 2.2.8.

**Third Step:** Evaluate the effect of pallets. Use Section 2.2.9.

Additionally, Section 2.3, Table 2.3 may be used as a tool to aid in the commodity classification. The “materials” listed in Table 2.3 may describe one, or a combination, of the commodity’s components. For example, “materials” may describe the following:

- Stored materials
- Stored materials and internal packaging
- The material, the internal packaging, and external packaging

Depending on the information provided in Table 2.3, consider the three steps above to determine the overall commodity classification.

### 2.2.1 Noncombustible

2.2.1.1 Classify materials that do not burn as noncombustible. Noncombustible commodities do not require, by themselves, sprinkler protection.

**Note:** Sprinkler protection is required for facilities that have combustibles in the construction, the occupancy, or material-handling processes. If the current occupancy and construction is noncombustible, sprinkler protection should be considered to accommodate future changes to storage, occupancy, or construction.

### 2.2.2 Class 1

2.2.2.1 Classify stored materials that meet the following as Class 1 commodities:

- A. Noncombustible materials on wood or FM Approved pallets
- B. Noncombustible materials packaged in single-layer corrugated cardboard cartons with or without single thickness dividers, or in ordinary paper wrappings on wood or FM Approved pallets

Class 1 commodities may contain a negligible amount of plastic trim such as knobs or handles.

### 2.2.3 Class 2

2.2.3.1 Classify stored materials that meet the following as Class 2 commodities:

Noncombustible or Class 1 commodities stored in multiple-thickness corrugated cardboard cartons, slatted wooden containers, solid wooden boxes, or equivalent combustible packaging material on wood or FM Approved pallets.

### 2.2.4 Class 3

2.2.4.1 Classify stored materials that meet the following criteria as Class 3 commodities:

- A. Cellulosic materials, such as wood, paper, or natural textiles, on wood or FM Approved pallets. Products may or may not be stored in corrugated cardboard cartons.
- B. Classes 1, 2, and 3 materials containing no more than 5% plastic (unexpanded, expanded, or a combination of the two) by either weight or volume.

### 2.2.5 Class 4/Unexpanded Plastic (UP)

2.2.5.1 Treat stored materials that meet the following criteria as unexpanded plastic:

- A. Total weight or volume of unexpanded plastic is more than 5% for a single pallet load.
- B. Total volume of expanded plastic (foam plastic) is from 5% to 40% for a single pallet load.
- C. Total volume of expanded plastic is greater than 5% and up to 20% when exposed or located on the outer portion of the material (i.e., protects or envelops the material). See Figure 2.2.5.1

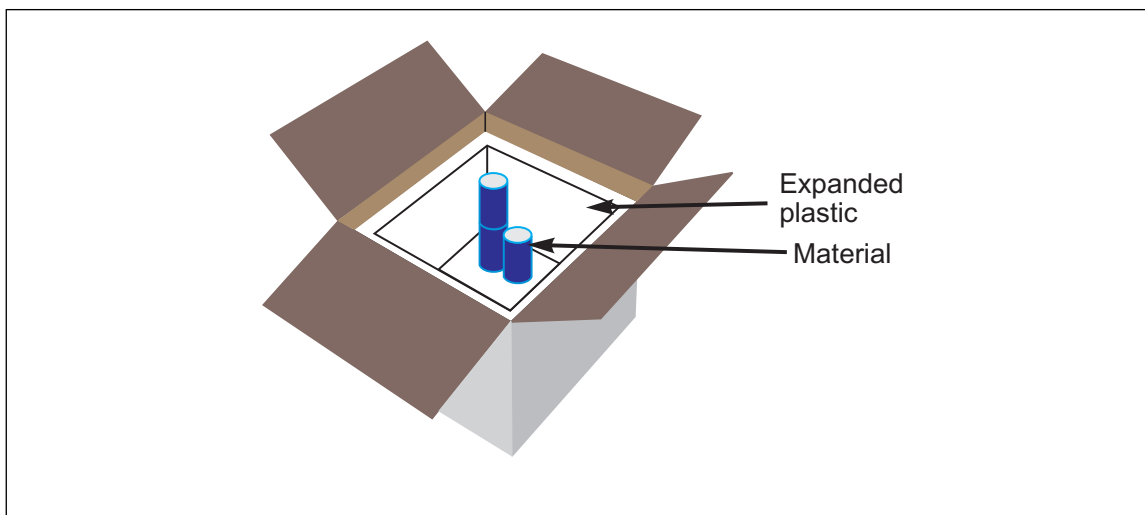


Fig. 2.2.5.1. Volume of EP that envelops the material

2.2.5.2 If the material is considered unexpanded plastic and is stored in corrugated cardboard cartons, treat the commodity as cartoned unexpanded plastic (CUP)/Class 4. Otherwise, treat it as uncartoned unexpanded plastic (UUP). Some exceptions apply and are listed in Table 2.3 (Section 2.3).

### 2.2.6 Expanded Plastic (EP)

2.2.6.1 Treat stored materials that meet the following criteria as expanded plastic:

- A. Total volume of expanded plastic (foam plastic) is greater than 40%.
- B. Total volume of expanded plastic is greater than 20% and is exposed or located on the outer portion of the material (i.e., protects or envelops the material). See Figure 2.2.5.1.
- C. Empty plastic containers that hold more than 32 oz (1 L) and are not nested.

2.2.6.2 If the material is considered EP and is stored in corrugated cardboard cartons, treat the commodity as cartoned expanded plastic (CEP). Otherwise, treat it as uncartoned expanded plastic (UEP). Some exceptions apply and are listed in Table 2.3 of Section 2.3.

### 2.2.7 Classifying Commodities Containing Plastics

Apply Figure 2.2.7 to materials and the internal packaging that contain expanded plastic and/or unexpanded plastic materials.

If the material/internal packaging is stored in a corrugated cardboard box, take this into account. For example, if it is determined the material/internal packaging is unexpanded plastic but stored in cartons, the commodity classification should be cartoned unexpanded plastic (CUP).

If the material is stored in plastic containers, classify the material/internal packaging based on Figure 2.2.7 and refer to Section 2.2.8 and/or Table 2.3 for guidance on how to classify the entire commodity (i.e., including the plastic container).

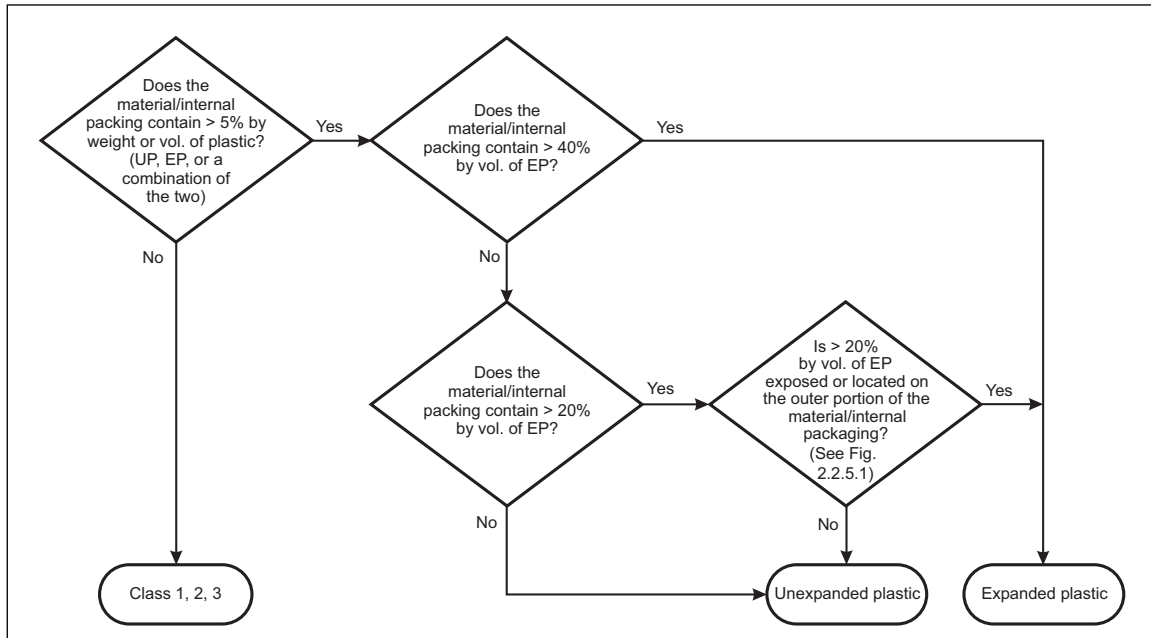


Fig. 2.2.7. Classify cartoned commodities containing plastic

## 2.2.8 External Packaging

The external packaging of a material will determine the early stages of fire growth. If the external packaging is a higher or lower hazard than the material inside the package, adjust the commodity classification accordingly. The commodity classification may be raised or lowered based on the external packaging. The following containers and adjustments are typically used for external packaging.

**2.2.8.1 Corrugated cardboard cartons:** Corrugated cardboard cartons absorb sprinkler water, which can help by wetting the commodity and reducing fire spread. On the other hand, cartons burn easily, allowing fire to spread up a storage array quickly and operate sprinklers faster. A lack of cardboard packaging allows a fire to grow low in a storage array, leading to a larger fire when the first sprinkler operates. A commodity that consists of plastic materials stored in a corrugated cardboard carton is treated as a cartoned plastic commodity (CUP or CEP). Noncombustible solids in corrugated cardboard cartons are protected as Class 1 commodities.

**2.2.8.1.1 Partial packaging:** Partial packaging using corrugated cardboard cartons can be considered as fully cartoned for commodity classification purposes when either of the following criteria are met:

- A. Only one of the carton's sides has been removed.
- B. More than one side has been removed, but cardboard covers at least the bottom, top, and 75% of the total area of the four vertical sides.

If the top is completely removed and sprinkler water can be collected, see open-top container protection guidance in Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*.

**2.2.8.2 Solid metal containers:** Solid metal containers will decrease the hazard. A commodity that consists of plastic materials stored in a five-sided, open top, solid metal container is treated as a Class 3 commodity. A commodity that consists of plastic materials stored in a solid metal container with a solid metal top is treated as a Class 1 commodity.

2.2.8.3 Solid and gridded unexpanded plastic storage containers (see Figures 2.2.8.3-1 and 2.2.8.3-2): In general, plastic storage containers drive the fire protection. Treat the commodity in accordance with Table 2.2.8.3.



Fig. 2.2.8.3-1. Examples of gridded plastic containers (i.e., plastic containers that are significantly open on the sides and/or bottoms)



Fig. 2.2.8.3-2. Examples of solid plastic containers (i.e., plastic containers that do not have openings on the sides and/or bottoms)

Table 2.2.8.3. Products Stored in Plastic Containers

General Contents	Container Sides and/or Bottoms	Wall Thickness in. (mm)	Volume of the Plastic Container gal (L)	Description of Contents	Commodity Classification	
Solid	Solids or gridded	Any	> 1 (4)	Noncombustible	UUP	
			≤ 1 (4)	Noncombustible	CUP	
			Any	Combustible UUP or a lesser hazard	UUP	
			Any	UEP commodities	UEP	
Liquid or Semi-Liquids	Gridded	Any	Any	Bottles or jars of any material (glass, plastic, metal, laminated paper/carton) containing nonignitable liquids/semi-liquids	Class 1	
				Solid	Any	Any
	≤ 5 (19)	Nonignitable liquids/semi-liquids	Class 1			
	≥ 1/4 (6)	> 5 (19)	Nonignitable liquids/semi-liquids			
	< 1/4 (6)	> 5 (19)	Nonignitable liquids/semi-liquids	Class 2		

2.2.8.4 Wood Crate: Solid wooden crates at least 0.25 in. (6.3 mm) thick, will decrease the hazard. A commodity that consists of plastic materials stored in a five-sided, closed-top, solid wooden crate is treated as a Class 3 commodity except when the commodity is li-ion batteries.

2.2.8.5 Encapsulated Commodity: Encapsulation does not significantly impact the commodity classification of a product. However, the encapsulation will impact the pre-wetting capabilities of the commodity; and therefore, needs to be accounted for in the sprinkler system design. The protection design guidelines provided in Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*, already account for the presence of encapsulation.

2.2.8.6 Flexible Intermediate Bulk Containers (Supersacks): Flexible intermediate bulk containers are usually combustible bags that store free-flowing material. Once the bag burns through, the free-flowing material inside will flow or spill out of the bag, reducing the fire intensity. Combustible flexible intermediate bulk containers storing inert free-flowing material are protected as Class 1 commodities. Combustible flexible intermediate bulk containers storing free-flowing unexpanded plastic material are protected as CUP commodities.

### 2.2.9 Pallets Supporting Commodities

2.2.9.1 Wood or FM Approved pallets: There is no increase in commodity classification. Except when noncombustible materials are stored, treat as Class 1.

2.2.9.1.1 Treat cardboard pallets as wood pallets for commodity classification purposes.

2.2.9.1.2 Do not use cardboard pallets for ignitable liquid handling.

2.2.9.1.3 Only use FM Approved pallets with ignitable liquid storage where allowed by Data Sheet 7-29.

2.2.9.2 Unexpanded plastic pallets (not FM Approved): There is no increase in commodity classification if the material itself is considered a plastic (CUP, CEP, UUP, or UEP) and is supported by unexpanded plastic pallets.

Increase the classification of the commodity by one level when non-FM Approved plastic pallets are used to support stored commodities. Increase the classification of the commodity as follows:

Class 1 → Class 2

Class 2 → Class 3

Class 3 → Cartoned unexpanded plastic (CUP)

2.2.9.3 Expanded plastic pallet (not FM Approved): There is no increase in commodity classification if the material itself is considered an expanded plastic. If it is not an expanded plastic, take into consideration the volume of the pallet to determine the commodity classification. For example, if the pallet consists of 15% by volume of the overall pallet load, the commodity is considered expanded plastic.



2.2.9.4 The following assumptions may be used if the weight or volume of the material is not provided:

- A. Density of expanded plastic: 2 lb/ft<sup>3</sup> (32 kg/m<sup>3</sup>)
- B. Weight of a plastic pallet (high-density polyethylene): 55 lb (25 kg)
- C. Weight of a hard-wood pallet: 38 lb (17 kg)
- D. Pallet dimensions: 40 in. x 48 in. x 6 in. (1 m x 1.2 m x 152 mm)
- E. Volume of solid-piled commodity: 60 ft<sup>3</sup> (1.7 m<sup>3</sup>) on a pallet

### 2.3 Examples of Commodities

Table 2.3 includes a list of example materials.

Classifications listed in Table 2.3 are only examples and are based on what is described as the “material.” The materials do not necessarily take into account packaging, storage configuration, use of pallet, etc. Furthermore, products vary depending on the manufacturer.

Use the recommendations provided in this data sheet in conjunction with Table 2.3 to classify a commodity. If packaging is not included in the description of the “material,” take this into account before applying the classification recommendation. For example:

- A. Metal parts are listed as noncombustible; however, if stored in single-layer corrugated cartons, the commodity is classified as Class 1 (see Section 2.2.2).
- B. If a material is listed as unexpanded plastic (UP) or expanded plastic (EP) but is stored in cartons, classify the commodity as cartoned unexpanded plastic (CUP) or cartoned expanded plastic (CEP), respectively.
- C. If a material is listed as unexpanded plastic or expanded plastic and is not stored in cartons, classify the commodity as uncartoned unexpanded plastic (UUP) or uncartoned expanded plastic (UEP), respectively.
- D. If a material is listed as CUP or CEP, it is assumed that cartons are used in the packaging of the commodity. Some exceptions apply and are listed in Table 2.3. For example: “Finished lightweight paper products (i.e., tissue paper), uncartoned, wrapped or not wrapped in plastic sheeting” are classified as CUP, although they are not cartoned. Cartoned finished lightweight paper products are considered a Class 3 commodity.
- E. If a material is listed as UUP or UEP, it is assumed that cartons are not used for external packaging. Some exceptions apply and are listed in Table 2.3. For example: “Mineral spirit-impregnated charcoal, cartoned or uncartoned” is classified as UUP whether the charcoal is cartoned or not.

Table 2.3. Examples of Material Classification

Item	Material	Class
<b>Batteries</b>		
1	Dry cell (Excluding lithium metal and lithium-ion batteries). Uncartoned.	Class 1
2	Wet cell (non-ignitable electrolyte) (e.g. automobile, boats). Uncartoned.	Class 1
3	Dry cell (Excluding lithium metal and lithium-ion batteries). Cartoned.	Class 2
4	Wet cell (non-ignitable electrolyte) (e.g. automobile, boats). Cartoned.	Class 2
5	Batteries with plastic casing, empty	UP
6	Wet-cell (non-ignitable electrolyte) large vehicles (e.g. truck)	UP
7	Li-ion cells, modules, and products with li-ion batteries.	See Data Sheet 7-112.
<b>Beer and Wine</b>		
8	Volume of alcohol is 20% or less. Considered non-ignitable liquid. Stored in a plastic container that is 5 gal (19 l) or less	Class 1
9	Volume of alcohol is 20% or less alcohol. Considered non-ignitable liquid. Stored in wood barrels.	Class 1
10	Volume of alcohol is 20% or less Considered non-ignitable liquid. Stored in a plastic container greater than 5 gal (19 L) and have a wall thickness less than ¼ in (6 mm). Generally, 55 gal (208 L) drums meet this criterion.	Class 2
11	Molded polyurethane/stainless steel beer kegs, empty	EP
<b>Construction Materials/Appliances</b>		
12	Electrical heating coils	Non-combustible
13	Metal appliances that do not include combustible parts (stoves, washer, dryers)	Non-combustible
14	Metal pots and pans	Non-combustible
15	Mirrors	Non-combustible
16	Paint, water-based (latex). Stored in metal cans.	Class 1
17	Polyurethane (not exposed) filled metal door panels	Class 1
18	Fiberglass insulation: paper-backed rolls, bagged or unbagged	Class 2
19	Appliances with plastic interiors (e.g. refrigerators)	Class 3
20	Fiberglass matting (e.g. roofing material)	Class 3
21	Melamine sheets (cellulosic and resin materials)	Class 3
22	Roof insulation boards (phenolic foam)	Class 3
<b>Construction Materials/Appliances</b>		
23	Roofing shingles, fiberglass	Class 3
24	Roofing shingles, asphalt.	Class 3
25	Roofing, felt	Class 3
26	Metal panels or doors insulated with polyurethane. Polyurethane is exposed or the thickness of the metal is less than 24 gauge.	CUP
27	Polyisocyanurate board, Class 1 roofing material. Cartoned or uncartoned.	UUP
28	Water-barrier for building construction, manufactured with nonwoven HDPE fiber	UP
29	Polyethylene foam pipe insulation	EP
30	Sealants and electrical insulation (paraffin wax based)	EP
<b>Electronics</b>		
31	Cartoned computer software packages. Includes owner's manual and compact disc in an envelope. No plastic in packaging.	Class 2
32	Circuit board, copper clad	Class 3
33	Circuit boards, FRP backed	Class 3
34	Glass light bulbs, cartoned.	Class 3
35	E-cigarettes (excludes large quantities of e-cig fluid)	CUP
36	Personal computer printers	UP
37	Plastic computer terminal housing	UP

Table 2.3. Examples of Material Classification (continued)

Item	Material	Class
<b>Empty Containers</b>		
38	Glass bottles or jars, empty	Non-combustible
39	Metal cans, empty. Packaged on corrugated cardboard trays, in cartons, or slipsheets. No plastic (except plastic sheet wrap or banding).	Class 1
40	Polyethylene Terephthalate (PET) bottles, empty, uncartoned or cartoned	CUP
41	Cardboard drink boxes (plastic-coated, wax-coated, and/or aluminum-lined), empty, cartoned or uncartoned	CUP
42	Collapsed wood containers, treat as UUP unless protection requirements are provided in Data Sheet 8-24 for wood pallets	UUP
43	Plastic containers, empty, including cups, bottles, or jars (not PET), up to 32 oz (1 L)	UP
44	Plastic containers, gridded or solid, collapsed.	UUP
45	Plastic containers, gridded or solid, nested with sides sliding together in a tight-fitting arrangement producing limited air spaces.	UUP
46	Plastic containers, empty, not collapsed, gridded or solid, greater than 32 oz (1 L).	EP
47	Plastic bottles (including PET), empty, stored in plastic containers, gridded or solid, any volume	UEP
48	Empty composite intermediate bulk containers (IBC) with plastic, wood, or steel pallets	See Section 2.4.2.
<b>Food Products - Frozen</b>		
49	Solid foods (e.g., prepared frozen meals on thin plastic trays and cartoned)	Class 2
50	Meat on plastic trays, cartoned or uncartoned	Class 2
<b>Food Products - Not Frozen</b>		
51	Fresh fruit and vegetables	Non-combustible
52	Meat, bulk, uncartoned	Class 1
53	Dry pet food in plastic-laminated paper bags	Class 2
54	Meat, fresh, cartoned, no plastic	Class 2
55	Butter stored in plastic containers, cartoned or uncartoned	Class 3
56	Margarine stored in plastic containers, cartoned or uncartoned	Class 3
57	Cereal or combustible food products stored in cartons	Class 3
58	Cheese, wheels, wax-coated, cartoned or uncartoned	Class 3
59	Cookies, cartoned or uncartoned	Class 3
60	Chocolate, cartoned or uncartoned	Class 3
61	Dry pet food in cartons	Class 3
62	Meat, fresh, on plastic trays, cartoned or uncartoned	Class 3
63	Candy, stored in plastic trays and packaged in cardboard boxes	Class 3
64	Produce, fresh, bulk, stored in any volume gridded plastic containers, if the container is 100% full	Class 3
65	Chewing gum, cartoned or uncartoned	Class 3
66	Produce, fresh, bulk, stored in solid plastic containers 5 gal (19 L) or less	Class 3
67	Eggs stored in expanded polystyrene (PS) containers, cartoned	CUP
68	Snack foods (e.g., potato chips) in plasticized aluminum bags, cartoned	CUP
69	Produce, fresh, bulk, stored in solid plastic containers that hold more than 5 gal (19 L).	UUP
70	Polystyrene foam plates, cups, etc.	EP

Table 2.3. Examples of Material Classification (continued)

Item	Material	Class
<b>Furniture and Bedding</b>		
71	Metal cabinets	Non-combustible
72	Metal desks with plastic tops and trim	Class 1
73	Wood furniture (e.g. doors, frames, windows, window frames, cabinets, chairs, tables, etc.)	Class 3
74	Comforters, quilts or duvets. Natural or synthetic	EP
75	Mattress, foam	EP
76	Polyisocyanurate foam cushions	EP
77	Upholstered furniture, containing expanded foam.	EP
<b>Ignitable Liquids</b>		
78	Plastic containers of alcohol based hand sanitizing wipes	UP
79	Mineral spirit impregnated charcoal, cartoned or uncartoned.	UUP
<b>Miscellaneous</b>		
80	Charcoal, cartoned or uncartoned	Class 3
81	Fiberglass basketball backboard	Class 3
82	Tobacco products in paperboard cartons	Class 3
83	Polystyrene finished toy products	UP
84	Stuffed toys	EP
<b>Non-Ignitable Liquids</b>		
85	Glass bottles or jars, filled with non-ignitable liquids	Non-combustible
86	Cardboard drink boxes (plastic-coated, wax-coated, and/or aluminum-lined) filled with non-ignitable liquid. Uncartoned or on corrugated carton trays.	Class 1
87	Metal cans, filled with non-ignitable liquids or semi-solids. Stored on cardboard trays, in cartons, or on slipsheets (i.e. dividers). No plastic components (except plastic sheet wrap or banding).	Class 1
88	Non-ignitable liquids in plastic containers that are 5 gal (19 l) or less	Class 1
89	Semi-liquids (non-ignitable). Including: crushed fruits and vegetables. Stored in solid plastic containers that are 5 gal (19 l) or less	Class 1
90	Glass bottles or jars filled with non-ignitable liquids. Stored in gridded plastic containers	Class 1
91	Plastic bottles (<5 gal/19 l), filled with non-ignitable liquid. Stored in gridded plastic containers	Class 1
92	Polyethylene Terephthalate (PET) bottles, filled with non-ignitable liquids. Stored in gridded plastic containers.	Class 1
93	Cardboard drink boxes (plastic-coated, wax-coated, and/or aluminum-lined) filled with non-ignitable liquid. Cartoned.	Class 2
94	Metal cans, filled with non-ignitable liquids or semi-solids. On plastic slipsheets (i.e. dividers)	Class 2
95	Non-ignitable liquids or semi-liquids stored in solid plastic containers that are greater than 5 gallons (19 l) and have a wall thickness less than ¼ in (6 mm). Generally, 55 gal (208 L) drums meet this criterion.	Class 2
96	Glass bottles or jars that are empty or filled with non-ignitable liquids, stored in solid plastic containers	UUP
97	Non-ignitable liquids or semi-liquids stored in solid plastic containers that are greater than 5 gallons (19 l) and have a wall thickness ¼ in (6 mm) or greater.	UUP
98	Plastic bottles, filled with non-ignitable liquid. Stored in solid plastic containers.	UUP
<b>Nonwoven</b>		
99	Nonwoven finished products. Refer to Data Sheet 8-23 Rolled Nonwoven Fabric Storage for unfinished products.	UP
100	Shrink-wrapped diapers, uncartoned.	UP

Table 2.3. Examples of Material Classification (continued)

Item	Material	Class
<b>Packaging Material</b>		
101	Cornstarch packaging material	Class 3
102	Bubble wrap	UP
103	Polyethylene foam packaging material	EP
104	Polypropylene foam packaging material	EP
105	Polystyrene foam packaging material	EP
106	Phase change material	See Data Sheet 7-29, Section 2.1.3.9
<b>Paper Products</b>		
107	Book signatures. Cartoned or uncartoned.	Class 2
108	Aluminum foil laminate paper (no plastic component)	Class 3
109	Fiberboard (cellulosic material)	Class 3
110	Paper products: books, magazines, stationary, newspaper, paper or cardboard games. Cartoned or Uncartoned.	Class 3
111	Paper Matches, cartoned or uncartoned.	Class 3
112	Latex-laminated Kraft paper, sheets	Class 3
113	Wallpaper, rolls (finished products).	Class 3
114	Cellulosic products. Stored in cartons (e.g. paper plates, cups, towels).	Class 3
115	Finished light weight paper products, cartoned (e.g., tissue paper). Product within carton may or may not be wrapped in plastic sheeting)	Class 3
116	Aluminum foil laminate paper with plastic components.	CUP
117	Polyethylene-laminated Kraft paper, sheets	CUP
118	Finished light weight paper products (i.e., tissue paper) - uncartoned, wrapped or not wrapped in plastic sheeting. See Data Sheet 8-21 for storage of unfinished rolled paper.	CUP
<b>Pharmaceutical</b>		
119	Noncombustible creams/gels in plastic containers that are 4–8 oz (0.12–0.24 l), stored in cartons.	Class 3
120	Medicine tablets or capsules in glass jars, stored in cardboard and/or cartons.	Class 3
121	Hypodermic needles (stainless steel) stored individually in plastic containers. Cartoned	CUP
122	Medicine tablets or capsules in plastic containers. Cartoned	CUP
123	Medicine tablets or capsules in plastic-faced foil packs. Cartoned	CUP
<b>Plastic Containers</b>		
124	Corrugated plastic boxes filled with cardboard box flats	Class 3
125	Plastic containers, solid, storing noncombustible solids, 1 gal (4 L) or less	CUP
126	Phenolic Resin powder in 55 gal (210 l) Plastic Drums	UUP
127	Plastic containers, solid or gridded. Storing combustible solids (that would be considered Class 1, 2, 3, or unexpanded plastics). All volumes. Completely full.	UUP
128	Plastic containers, solid. Storing noncombustible solids. > 1 gal (4 l) in volume.	UUP
129	Plastic containers, solid or gridded. Storing commodities considered expanded plastic. All volumes	UEP

Table 2.3. Examples of Material Classification (continued)

Item	Material	Class
<b>Plastics</b>		
130	Phenolic plastic	Class 3
131	Regenerated cellulosic (cellophane)	Class 3
132	Solid silicones	Class 3
133	Rigid polyvinyl chloride (PVC) finished products (e.g., pipes, ducts, building panels, siding)	Class 3
134	PVC finished products, with plasticizer contents up to 20%	Class 3
135	Polyethylene Terephthalate (PET) plastic (other than cups and bottles)	UP
136	Acrylic/epoxy traffic lane dividers	UP
137	Acrylics	UP
138	Nylons	UP
139	Plastic "flip-flop" sandals	UP
140	Plastic drip trays	UP
141	Plastic light reflectors	UP
142	Polycarbonate products	UP
143	Polyester products	UP
144	Polyisobutylene tubing	UP
145	Polypropylene decorative ribbon or bows	UP
146	Shoes with vinyl sides, crepe soles	UP
147	Vinyl boots	UP
148	Vinyl tablecloth	UP
149	Plastic pallets, idle. (Not FM Approved). See Data Sheet 8-24 for more information.	UUP
150	Acrylonitrile-butadiene-styrene (ABS)	EP
151	Corrugated plastic	EP
152	Polyurethane foam	EP
153	Polystyrene, expanded (e.g.: egg crates, packing peanuts/chips)	EP
154	ABS	UP
155	Film, PVC Christmas garlands ("tinsel")	UP
156	PVC finished products, with plasticizer greater than 20%	UP
157	Polyvinyl chloride (PVC) insulated cable, on plastic reels. Uncartoned.	UUP
158	Pre-cured tire tread	UP
159	Rubber products (aprons, pants, gloves, boots, tire retread, ear plugs, stoppers, etc.)	UP
160	Rubber, baled crude	UP
161	Running shoes with nylon cover, rubber soles	UP
162	Running shoes with vinyl cover, rubber soles	UP
163	Santoprene (synthetic rubber)	UP
<b>Powders/Granulars</b>		
164	Free-flowing inert materials stored in combustible bags in racks (e.g., cement, calcium chloride, clay, iron oxide, sodium chloride, sodium silicate).	Class 1
165	Polyester/epoxy coating powder stored in cartons.	Class 3
166	Free-flowing combustible dust (e.g., sugar or starch) stored in combustible bags or cartons.	Class 3
167	Granular/free-flowing unexpanded plastics (e.g. polystyrene bottle caps) stored in bags or cartons.	CUP
168	Toner powder (polymer/carbon black mix) in plastic bottles.	UP
169	Free-flowing combustible metal material stored in sealed metal containers.	See Data Sheet 7-76

Table 2.3. Examples of Material Classification (continued)

Item	Material	Class
<b>Solid Metal Containers</b>		
170	Closed metal containers containing plastic materials	Class 1
171	Plastics stored in open-top metal containers	Class 3
172	Plastic materials stored in 5-sided solid metal container	Class 3
<b>Textiles</b>		
173	Clothing and textiles, natural fiber (e.g. wool, cotton) and viscose. Not hanging. See Data Sheet 8-18 for hanging garments.	Class 3
174	Leather, finished products (e.g. shoes, jackets, gloves, bags, luggage, belts, etc.). Cartoned and uncartoned.	Class 3
175	Yarn and thread, natural fiber and viscose (100% cellulose based)	Class 3
176	Fibers, natural. Baled and stored in cartons	Class 3
177	Clothing and textiles, synthetic. Not hanging. See Data Sheet 8-18 for hanging garments. Cartoned and uncartoned.	CUP
178	Spandex elastic thread	UP
179	Fabric softener sheets, wax-coated	EP
180	Synthetic yarns and fibers such as polypropylene, polyethylene, and nylon	See Data Sheet 7-1
<b>Tools and Parts</b>		
181	Metal parts	Non-combustible
182	Motors, electric. Metal housing.	Non-combustible
183	Metal parts stored in cartons	Class 1
184	Polyester/fiberglass fishing rod	CUP
185	Plastic screwdriver handles	UP
186	Automobile bumpers	EP
<b>Wax Products</b>		
187	Wax, dental. Finished product (in plastic container)	UP
188	Candles - see Wax, paraffin	EP
189	Natural "beeswax"	EP
190	Wax crayons	EP
191	Wax, dental. Raw material	EP
192	Wax, paraffin	EP
193	Wax-coated, polyester/nylon stripping pads	EP
<b>Wire/Cable/Spool</b>		
194	Polyvinyl chloride (PVC) insulated cable, on metal reels	Class 1
195	Polyvinyl chloride (PVC) insulated cables, on wood, or paper reels.	Class 3
196	Wood spools (empty)	Class 3
197	Rubber hose (exterior), woven metal (interior)	CUP
198	Plastic (other than PVC) insulated conductor and power cable on wood or metal reels or in cartons.	CUP
199	Film, rolled polyester on any type of reel	UP
200	Film, rolled polyethylene on any type of reel	UP
201	Wire, bare on plastic spools. Uncartoned.	UUP
202	Film, rolled polypropylene on any type of reel	UP
<b>Wood Products</b>		
203	Noncombustible commodities stored on wood pallets.	Class 1
204	Green wood products (e.g., plywood, bundled or stacked lumber, particleboard with moisture content greater than or equal to 20%)	Class 1
205	Empty wood barrels (with moisture content above 8%)	Class 1
206	Wood products (e.g., plywood, bundled or stacked lumber, particleboard, empty barrels with moisture content below 8%)	Class 3
207	Matches, wooden matches, cartoned or uncartoned.	CUP
208	Fireplace logs, impregnated with ignitable liquids or wax. Cartoned or uncartoned.	UEP
209	Wax-covered wood chips, cartoned or uncartoned.	UEP

## 2.4 Protection

### 2.4.1 General

2.4.1.1 Classify stored commodities based on the guidance provided in this data sheet. Protect stored commodities based on the guidance provided in Data Sheet 8-9, Storage of Class 1, 2, 3, 4, and Plastic Commodities. Base protection on the highest hazard commodity at the facility.

2.4.1.2 As an alternative to protecting the entire facility to the highest hazard commodity, segregate the highest hazard commodity from the rest of the facility and protect accordingly. Note: Keeping the highest hazard commodity properly segregated can be very difficult in normal warehouse operations.

### 2.4.2 Empty Plastic Intermediate Bulk Containers (IBCs)

2.4.2.1 Protect palletized storage of empty plastic IBCs and “recon” (reconditioning of used) empty plastic IBCs per the guidance in Table 2.4.2.1.

Table 2.4.2.1. Protection of Empty Intermediate Bulk Containers (IBCs)

Ceiling Height	Storage Height	Pallet Material	Wet Pipe Systems			Dry Pipe Systems with 20 s water delivery time
			QR, Pendent, 160°F (70°C)			SR, 286°F (140°C)
			K14.0 (K200) <sup>Note 1</sup>	K22.4 (K320)	K25.2 (K360)	K25.2 (K360)
30 ft (9.0 m)	15 ft (4.5 m), maximum 3 IBCs high	Wood or Steel	12 @ 18 psi (1.2 bar)	NA	NA	12 @ 15 psi (1.0 bar)
		Plastic	12 @ 32 psi (2.2 bar)			30 @ 15 psi (1.0 bar)
40 ft (12 m)	30 ft (9 m), maximum 6 IBCs high	Wood or Steel	NA	NA	12 @ 40 psi (2.8 bar)	NA
		Plastic		12 @ 60 psi (4.1 bar)	12 @ 60 psi (4.1 bar)	
45 ft (13.5 m)	30 ft (9 m), maximum 6 IBCs high	Wood or Steel	NA	NA	12 @ 40 psi (2.8 bar)	12 @ 40 psi (2.8 bar)
		Plastic			12 @ 60 psi (4.1 bar)	20 @ 60 psi (4.1 bar)
48 ft (14.5 m)	30 ft (9 m), maximum 6 IBCs high	Wood or Steel	NA	NA	12 @ 75 psi (5.2 bar)	NA
		Plastic				

Note 1. These protection options are for pendent sprinklers only.

2.4.2.2 Provide a water supply capable of meeting the design sprinkler discharge flow rate plus a 250 gal./min. (946 L/min.) hose stream demand for at least 60 minutes.

## 3.0 SUPPORT FOR RECOMMENDATIONS

### 3.1 Burning Characteristics and Testing to Assist in Determining Commodity Classification

#### 3.1.1 Burning Characteristics

3.1.1.1 Heat of Combustion Heat of combustion is the maximum amount of energy (i.e., heat) released per unit weight of material burned. The overall hazard of a commodity is a function of its heat release rate (Btu/min or kW), which is the product of its heat of combustion (Btu/lb or kJ/kg) and burning rate (lb/min or kg/s). As the heat release rate increases, so does the hazard.

The heat of combustion of ordinary combustibles generally ranges between 6,000 and 8,000 Btu/lb (13,960 and 18,600 kJ/kg). The heat of combustion for plastics generally ranges between 12,000 and 20,000 Btu/lb (27,910 and 46,520 kJ/kg). The burning rate of a commodity is dependent on many things, but plastic materials generally exhibit higher maximum burning rates than similarly arranged ordinary combustibles. This difference can be two to three times higher for many plastic materials.



The heat of combustion of a material sample can be determined using bench-scale testing, including the oxygen bomb calorimeter or flammability propagation apparatus (FPA). The oxygen bomb calorimeter will provide the gross heat of combustion (complete combustion), while the FPA will provide the effective heat of combustion (incomplete combustion).

### 3.1.1.2 Percentage of Inert Material

Inert additives are noncombustible. They are inorganic compounds that may be incorporated into resins as fillers to improve the properties of plastics. They are added to plastics during the manufacturing stage. Additives include glass, calcium carbonate, metal flakes, metallic oxides or powders, and other inorganic compounds. Inert additives in large amounts may increase the fire resistance of plastics by increasing their heat capacity and reducing their heat of combustion. The percentage of inert material is determined by burning a sample of the material in a 1500°F (815°C) furnace to complete combustion in the oxygen bomb calorimeter. Inert material corresponds to the remaining material after complete combustion (percentage of ash). The remaining material is weighed and compared to the original weight.

The heat content measured as described above is directly related to the amount of inert material present. To make a more meaningful comparison of heat contents, it is necessary to factor out the percentage of inert material from the heat of combustion measured in the bomb calorimeter. For example, if a sample had a heat of combustion of 9,000 Btu/lb (20,700 kJ/kg) and 40% inert, the actual heat content of the combustible part of the sample is:

$$(9,000 \text{ Btu/lb}) / (1.0 - 0.4) = 15,000 \text{ Btu/lb or}$$

$$(20,700 \text{ kJ/kg}) / (1.0 - 0.4) = 34,890 \text{ kJ/kg}$$

The heat content of the combustible portion of the sample is 15,000 Btu/lb (34,890 kJ/kg), which falls into the plastics range.

Intermediate-scale fire tests demonstrate that for plastic containing high percentages of inert material, the overall hazard of the plastic was not affected. The tested commodity consisted of 52% inert and 48% polyester/polystyrene, the measured heat content was in the ordinary combustible range, but fire testing demonstrated that the commodity created a hazard well above that of ordinary combustibles. The measured heat of combustion was approximately 7,000 Btu/lb (16,100 kJ/kg); typical of ordinary combustibles. After factoring out the inert percentage, the heat of combustion of the combustible material was approximately 14,500 Btu/lb (33,350 kJ/kg), typical of many plastics.

### 3.1.2 Bench-Scale Laboratory Tests

Bench-scale laboratory tests aid in determining commodity classification. However, these tests only provide limited information and cannot simulate the large-scale burning behavior of the tested commodity.

Results of bench-scale testing provide a simple basis for comparison between the material in question and known commodities. The results from bench-scale tests are not conclusive; therefore, results of bench-scale tests must be evaluated very conservatively. FM has tested materials that were difficult to burn or burned relatively slowly under bench-scale test conditions, but burned severely under large-scale conditions.

Generally, a material will burn more severely under large-scale conditions than under bench-scale conditions. If a material exhibits burning characteristics similar to a plastic commodity under bench-scale conditions, then it is likely that under large-scale conditions the material would also burn like a plastic and therefore be protected as a plastic commodity. This is an example where bench tests can eliminate the need for much more expensive large-scale tests or intermediate-scale testing under the fire products collector.

Although bench tests provide an inexpensive way of proving high combustibility, they usually are not appropriate for proving low combustibility. For example, a plastic material that has a high percentage of inert material and/or has some fire retardants added will probably burn very slowly in a bench test. It may even be difficult to get the material to burn at all. However, this does not prove the plastic material will burn very slowly under actual storage conditions. In these cases, good judgment or a larger scale test is needed to determine the commodity classification.

#### 3.1.2.1 Oxygen Bomb Calorimeter

Bench-scale testing may be conducted in the oxygen bomb calorimeter. Characteristics, including the gross heat of combustion and the percentage of inert material, can be determined (see information on each of

these characteristics above). These characteristics will help determine if the material will burn similarly to ordinary combustibles or plastics. However, these properties will not help to determine if a plastic will burn similarly to an expanded plastic or an unexpanded plastic.

A sample of the material, approximately 0.04 oz (1 g) in weight is burned in an oxygen bomb calorimeter. The bomb is a small, closed vessel filled with compressed oxygen and submerged in a specific amount of water. Ignition of the sample is made electrically via a wire. The heat released during the combustion is represented as the temperature rise in the water bath, and the heat content in Btu/lb (kJ/kg) can be determined. The heat of combustion does not take into account the storage configuration. If the material has a heat content much higher than 8,000 Btu/lb (18,400 kJ/kg), then the material is generally classified as a plastic. However, the storage arrangement will also contribute to the commodity classification.

### 3.1.2.2 Fire Propagation Apparatus (FPA)

Bench-scale testing may be conducted using the FPA. These tests only provide limited information and cannot simulate large-scale burning behavior of the material being tested.

The FPA can measure the following burning characteristics: effective heat of combustion, heat release rate, and critical heat flux (how much energy is needed for ignition). The FPA may also be used as a screening test and can eliminate the need for much more expensive large-scale tests or intermediate-scale testing under the fire products collector. If the results of FPA testing demonstrate that a material sample is a higher hazard than a known commodity, further testing may be avoided. However, if the results indicate a relatively low hazard when compared to a known commodity, it is likely that additional testing will be favorable.

See Data Sheet 1-4, *Fire Tests*, for a more information.

### 3.1.3 Fire Products Collector (FPC) Commodity Classification Tests

Although bench-scale tests are quick and relatively inexpensive, in many cases they do not provide enough information to conclusively determine the commodity classification. The FPC commodity classification tests provide a conclusive way to determine the commodity classification of most materials.







Commodity classification tests may be performed as part of risk service testing. For the Intermediate and Large-Scale Risk Service Test Protocol, see Section 3 of the Risk Service Testing Field Guide.

The FPC is a calorimeter that can measure convective heat release rates up to approximately 1,100,000 Btu/min (20 MW). The FPC measures convective and total heat release rates, generation rates of carbon monoxide and carbon dioxide, and depletion rate of oxygen. Radiative heat release and burning rates also can be determined.

The material in question is arranged on a double-row rack segment. A specially designed water applicator is installed directly above the array. The water applicator uses water nozzles designed to deliver a very uniformly distributed, predetermined amount of water (gpm/ft<sup>2</sup> or mm/min) to the top surface of the array. Water is delivered from the water applicator to the top surface array at the same time a standard response 286°F (141°C) sprinkler on a 10 x 10 ft (3 x 3 m) spacing, located 10 ft (3 m) above the array and 7 in. (178 mm) below the ceiling would actuate. The water density application does not correspond to the design density of an installed automatic sprinkler system.

Usually three tests are conducted, with the water application rate being varied between the three tests. The results are then compared to FM's standard commodities, which are used as benchmarks to determine the commodity classification of the tested material. All benchmark commodities are stored on wood pallets. See Table 3.1.3 for a list of FM's standard commodities. Most of the protection guidelines in Data Sheet 8-9 are based on large-scale fire tests using these standard commodities.

Table 3.1.3. FM Standard Commodities

Class	Commodity	Figure
Class 2	Metal-lined double tri-wall cartons	
Class 3	Paper cups in compartmented cartons	
Cartoned Unexpanded Plastic	Unexpanded polystyrene cups in compartmented cartons	
Cartoned Expanded Plastics	Expanded polystyrene foam plates stored in corrugated cartons	
Uncartoned Unexpanded Plastic	Plastic pallets	
Uncartoned Expanded Plastic	Exposed foam plates	

## 3.2 Factors Affecting Commodity Classification

### 3.2.1 Mixed Commodities

3.2.2.1 Generally, facilities store a variety of commodities. Protect the facility for the highest hazard commodity. Do not base protection on an average of the commodities. There are a number of reasons for providing protection for the highest hazard commodity:

- A. Fire tests showed that replacing one tier of a four-tier-high rack array with a higher hazard commodity produced a hazard much higher than that of a rack filled 100% with the lower hazard commodity.
- B. Fire tests where sprinkler protection is adequate for a specific commodity will typically burn 200-300 ft<sup>2</sup> (19-28 m<sup>2</sup>) area of the commodity tested. Only a small amount of material has to burn to create relatively large sprinkler operating area (1500-2500 ft<sup>2</sup> [140-230 m<sup>2</sup>]). Increasing the hazard by introducing a more hazardous commodity may increase the burning area and potentially overtax the sprinkler system, which was designed for a lower hazard commodity.
- C. "Averaging the commodities" requires continual monitoring of the facility to ensure the concentrations of higher hazard commodities are not exceeded. In normal warehouse environments, adequate monitoring is very difficult and generally not feasible.

### 3.2.2 Configuration

The classification of a commodity is a function of both the material and its configuration. For example, a solid block of wood is relatively difficult to ignite and slow to burn. If, however, the wood is in a configuration that maximizes surface area and has parallel surfaces to encourage re-radiation and convection, it burns much more rapidly (e.g., idle wood pallets). The large amount of heat released under such configurations can result in a hazard beyond that normally associated with the primary material.

Furthermore, for mixed materials, the percentage of different combustibles should be considered together with packaging and configuration of different materials. If a higher or lower hazard material protects or envelops other materials, the overall classification should be adjusted accordingly.

## 4.0 REFERENCES

### 4.1 FM

Data Sheet 1-4, *Fire Tests*  
Data Sheet 7-29, *Storage of Ignitable Liquids*  
Data Sheet 7-31, *Storage of Aerosol Products*  
Data Sheet 7-50, *Compressed Gases in Portable Cylinders and Bulk Storage*  
[Data Sheet 7-112, \*Li-Ion Battery Manufacturing and Storage\*](#)  
Data Sheet 8-3, *Rubber Tire Storage*  
Data Sheet 8-7, *Baled Fiber Storage*  
Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*  
Data Sheet 8-18, *Storage of Hanging Garments*  
Data Sheet 8-21, *Roll Paper Storage*  
Data Sheet 8-22, *Storage of Baled Waste Paper*  
Data Sheet 8-23, *Rolled Nonwoven Fabric Storage*  
Data Sheet 8-24, *Idle Pallet Storage*  
Data Sheet 8-30, *Storage of Carpets*  
Data Sheet 8-33, *Carousel Storage and Retrieval Systems*  
Data Sheet 8-34, *Protection for Automatic Storage and Retrieval Systems*

### 4.2 Other

International Plastics Selector. *Elastomeric Materials*. 1977.

## APPENDIX A GLOSSARY OF TERMS

**Cell:** The smallest electrochemical component that can store energy.

**CEP:** Cartoned expanded plastic.

**Commodity:** Combination of material, external packaging (e.g., container), and material handling aids (e.g., pallets). The purpose of assigning a commodity classification is to determine the proper level of fire protection. A commodity classification is dependent on how the commodity burns and how the burning commodity responds to the application of sprinkler discharge.

**Container:** Used for storing, handling, and transporting materials. May be constructed of wood, cardboard, or plastic. Containers may be referred to as “totes,” “crates,” “KLT”(Kleinladungstraeger), or “GLT” (Großladungstraeger).

**CUP:** Cartoned unexpanded plastic.

**Encapsulation:** A method of packaging consisting of a plastic sheet completely enclosing the sides and top of a pallet load containing a combustible commodity, or a group of combustible commodities or combustible packages. Totally noncombustible commodities on wood pallets enclosed only by a plastic sheet as described above are not considered encapsulated. The term “encapsulation” also applies to individual cartons that are enclosed on the top and sides in plastic, and to cartons waterproofed by coatings on the exterior surfaces.

The term “encapsulation” does not apply to individual plastic enclosed items inside a larger non-plastic enclosed or waterproofed container. If holes or voids in the plastic or waterproof cover on the top of the carton exceed more than half the area of the top, the term “encapsulation” does not apply.

**FM Approved:** Products and services that have satisfied the criteria for FM Approval. See the *Approval Guide*, an online resource of FM Approvals, for a complete listing of products and services that are FM Approved.

**Module:** A combination of series and parallel connected cells.

**Nonignitable liquid:** Any liquid or liquid mixture that will not burn. If a liquid or liquid mixture does not have a fire point, it is considered nonignitable. Ignitable liquids include flammable liquids, combustible liquids, inflammable liquids, or any other term for a liquid that will burn.

**Occupancy-specific data sheet:** An FM property loss prevention data sheet that addresses a specific occupancy hazard. Individual data sheets belong to the following data sheet series:

Series Number	Data Sheet Subject
1	Construction
2	Sprinklers
3	Water Supply
4	Extinguishment Equipment
5	Electrical
6	Boilers and Industrial Heating Equipment
7	Hazards
8	Storage
9	Miscellaneous
10	Human Factor
11	Systems Instrumentation and Control
12	Pressure Vessels
13	Mechanical
15	Welding
17	Boiler and Machinery Miscellaneous

**Palletized:** A storage arrangement that consists of materials stored on pallets. In this data sheet, when a commodity is “palletized,” wood pallets are implied unless noted otherwise.

**Thermoplastic:** Type of plastic material that become soft when sufficiently heated and then hardens when cooled, no matter how often the process is repeated. Generally, thermoplastics burn more readily than thermoset plastics.

**Thermoset plastics:** Type of plastic material that sets into permanent shape from the heat and pressure applied to them during manufacturing. Reheating will not soften these materials. Generally, thermoset plastics burn less readily than thermoplastics.

**UEP:** Uncartoned expanded plastic.

**UUP:** Uncartoned unexpanded plastic.

#### APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

**October 2024.** Interim revision. The following changes were made:

A. Removed guidance for li-ion batteries, Section 2.4.2, as it has been relocated to FM Loss Prevention Data Sheet 7-112, *Li-Ion Battery Manufacturing and Storage*.

B. Updated Table 2.3, ID 7 section reference to see Data Sheet 7-112.

C. Added FM reference to Data Sheet 7-112 in Section 4.1.

D. Removed li-ion battery related definitions from Appendix A.

**January 2023.** Interim revision. The following changes were made:

A. Changed the upper limit of 10% expanded plastic allowed on outer portion of product to 20% in Section 2.2.5.1C.

B. Updated Figure 2.2.7 references and percentage of expanded plastic.

C. Added guidance on how to treat partial packaging in Section 2.2.8.1.2.

D. Added guidance on how to treat wooden crates for external packaging in Section 2.2.8.4.

E. Added guidance for encapsulated product in Section 2.2.8.5.

F. Added guidance for flexible intermediate bulk containers (i.e., bulk bags or supersacks) in Section 2.2.8.6.

G. Clarified treatment of cardboard pallets for commodity classification in Section 2.2.9.

H. Clarified and expanded lithium-ion battery storage guidance in Section 2.4.2.

I. Updated empty intermediate bulk container guidance in Section 2.4.3 including Table 2.4.3.1.

J. Updated following items in Table 2.3:

1. Changed formatting to remove category column and added sub-heading rows.
2. Added item 21 for melamine sheets.
3. Clarified item 45 intent of 'no air spaces'.
4. Removed reference to Data Sheet 7-29 in item 48, as information is now in 8-1.
5. Clarified item 64 intent to be 100% full of produce.
6. Added item 80 for charcoal.
7. Added item 106 for phase change material guidance to reference Data Sheet 7-29.
8. Added item 116 for aluminum foil laminate paper with plastic components.
9. Updated item 165, polyester/epoxy coating powder, to Class 3 from CUP.
10. Added item 166 for combustible dust stored in cartons or plastic bags for bulk storage.
11. Added item 169 for metal powders in sealed metal containers/cans to reference Data Sheet 7-76.
12. Added item 204 for green wood products.

K. Revised figure and table numbers to align with current formatting standards.

**April 2021.** Interim revision. Made editorial change to commodity classification of butter and margarine in Table 2 to align with Data Sheet 7-29, *Flammable Liquid Storage in Portable Containers*.

**April 2020.** Interim revision. The following changes were made:

- A. Added guidance on Lithium-Ion batteries to Section 2.4.2.
- B. Added guidance on empty intermediate bulk containers (IBCs) to Section 2.4.3 (moved from OS 7-29 and updated).
- C. Reorganized Section 2.0 for improved clarity.
- D. Added commodity classification for electronic cigarettes.
- E. Added information to Table 2 on batteries, empty IBCs, PVC-containing materials, synthetic yarns, and empty wood barrels. As a result, the numbering has changed.

April 2015. Interim revision. Table 1, *Products Stored in Plastic Containers*, was modified to be consistent with Table 2, *Examples of Material Classification*.

October 2014. Interim revision. Minor editorial changes and clarifications were made.

April 2014. The following changes were made:

- A. Added Table 1, Examples of Material Classification (Section 2.4).
- B. Reformatted the data sheet. Section 2.0 is limited to commodity classifications, recommendations, and Table 1. Section 3.0 includes descriptions of commodity classification tests procedures.
- C. Removed references to Group A, B, and C plastics. Plastics are now classified as unexpanded or expanded.
- D. Removed Commodity Class 4. Class 4 commodities are treated and protected as cartoned unexpanded plastic (CUP).
- E. Changed the classification of certain materials. This is due to changes in commodity classification (e.g., Class 4 to CUP), as well as recent testing conducted at FM.
- F. Changed the classification of some materials that were treated as noncombustible. Noncombustible materials only apply to materials that do not burn. The following are no longer considered noncombustible: wooden barrels with beer or wine; free-flowing materials stored in combustible bags on wood or FM Approved pallets; free-flowing materials that are not inert.
- G. Removed guidance for oil-based liquids. Refer to Data Sheet 7-29 for recommendations on the storage of all ignitable liquids.
- H. Revised recommendations throughout the document to make it clear that wood pallets and FM Approved pallets should be treated the same.

October 2013. Minor editorial changes were made.

May 2004. A clarification regarding the classification of beer and wine in wooden barrels has been incorporated into recommendations in Section 2.2.1.

May 2001. A clarification regarding the classification of beer and wine has been incorporated into section 2.2.3.2. The clarification was done so that the definitions of nonflammable liquids (Group 5 water miscible liquids) would correspond with definitions found in Data Sheet 7-29, *Flammable Liquid Storage in Portable Containers*.

May 2000. This revision of this document has been reorganized to provide a consistent format.