

COMMODITY CLASSIFICATION

Table of Contents

	Page
1.0 SCOPE	3
1.1 Hazards	3
1.2 Changes	3
2.0 LOSS PREVENTION RECOMMENDATIONS	3
2.1 General	3
2.2 Commodity Classification	4
2.2.1 Noncombustible	4
2.2.2 Class 1	4
2.2.3 Class 2	5
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	6
2.2.8 External Packaging	6
2.2.9 Pallets Supporting Commodities	8
2.3 Examples of Commodities	8
2.4 Protection	15
2.4.1 General	15
2.4.2 Lithium-Ion (Li-ion) Batteries	16
2.4.3 Empty Plastic Intermediate Bulk Containers (IBCs)	16
3.0 SUPPORT FOR RECOMMENDATIONS	17
3.1 Burning Characteristics and Testing to Assist in Determining Commodity Classification	17
3.1.1 Burning Characteristics	17
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	21
3.2.1 Mixed Commodities	21
3.2.2 Configuration	21
4.0 REFERENCES	21
4.1 FM Global	21
4.2 Other	21
APPENDIX A GLOSSARY OF TERMS	21
APPENDIX B DOCUMENT REVISION HISTORY	22

List of Figures

Fig. 1. Commodity components	4
Fig. 2. Volume of EP that envelops the material	5
Fig. 3. Classify cartoned commodities containing plastic	6
Fig. 4. Examples of gridded plastic containers (i.e., plastic containers that are significantly open on the sides and/or bottoms)	7
Fig. 5. 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 1. Products Stored in Plastic Containers	8
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Table 2. Examples of Material Classification 9
Table 2. Examples of Material Classification (continued) 10
Table 2. Examples of Material Classification (continued) 13
Table 2. Examples of Material Classification (continued) 14
Table 3. Protection of Cartoned Lithium-Ion Batteries 16
Table 4. Protection of Empty Intermediate Bulk Containers (IBCs) 16
Table 5. FM Global Standard Commodities 20

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

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.

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 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 of Section 2.3 includes a list of example materials and their classifications.

FM Global'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)

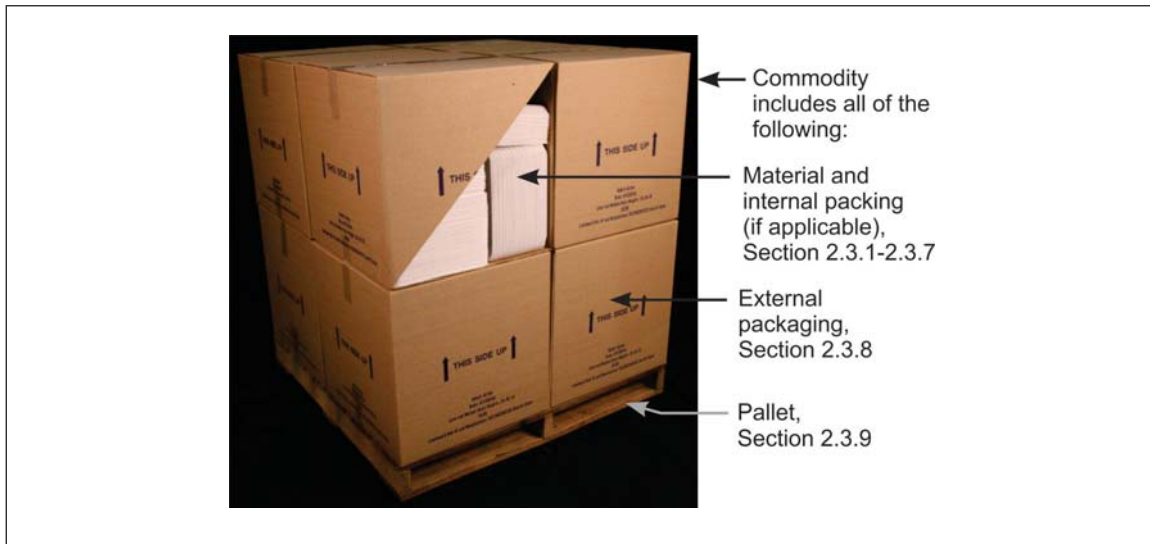


Fig. 1. Commodity components

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 3 (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/ft³ (32 kg/m³).

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 may be used as a tool to aid in the commodity classification. The “materials” listed in Table 2 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, 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:

- Noncombustible materials on wood or FM Approved pallets
- 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 10% when exposed or located on the outer portion of the material (i.e., protects or envelops the material). See Figure 2.

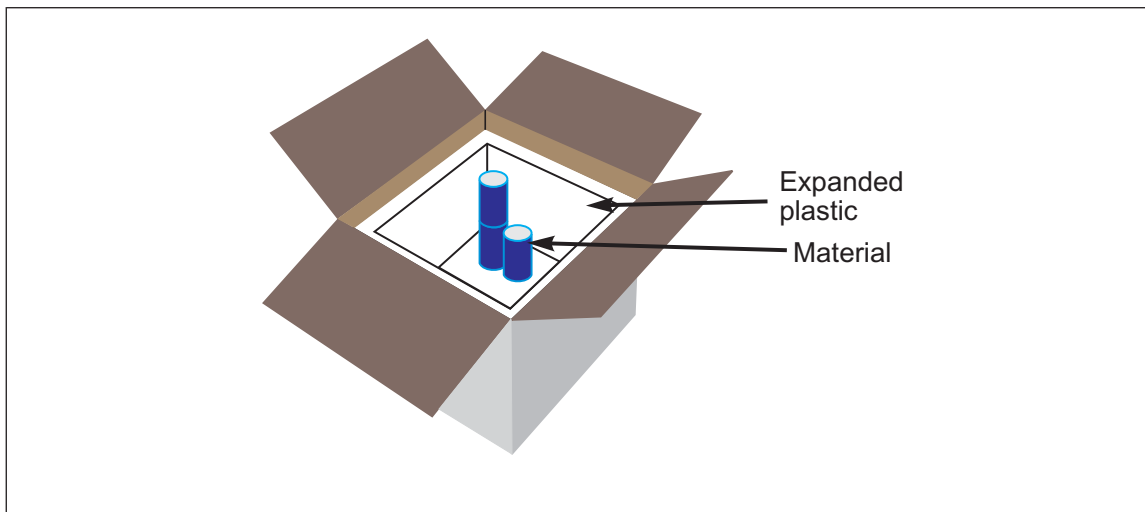


Fig. 2. Volume of EP that envelops the material

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 (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 10% and is exposed or located on the outer portion of the material (i.e., protects or envelops the material). See Figure 2.

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 of Section 2.3.

2.2.7 Classifying Commodities Containing Plastics

Apply Figure 3 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 3 and refer to Section 2.2.8 and/or Table 2 for guidance on how to classify the entire commodity (i.e., including the plastic container).

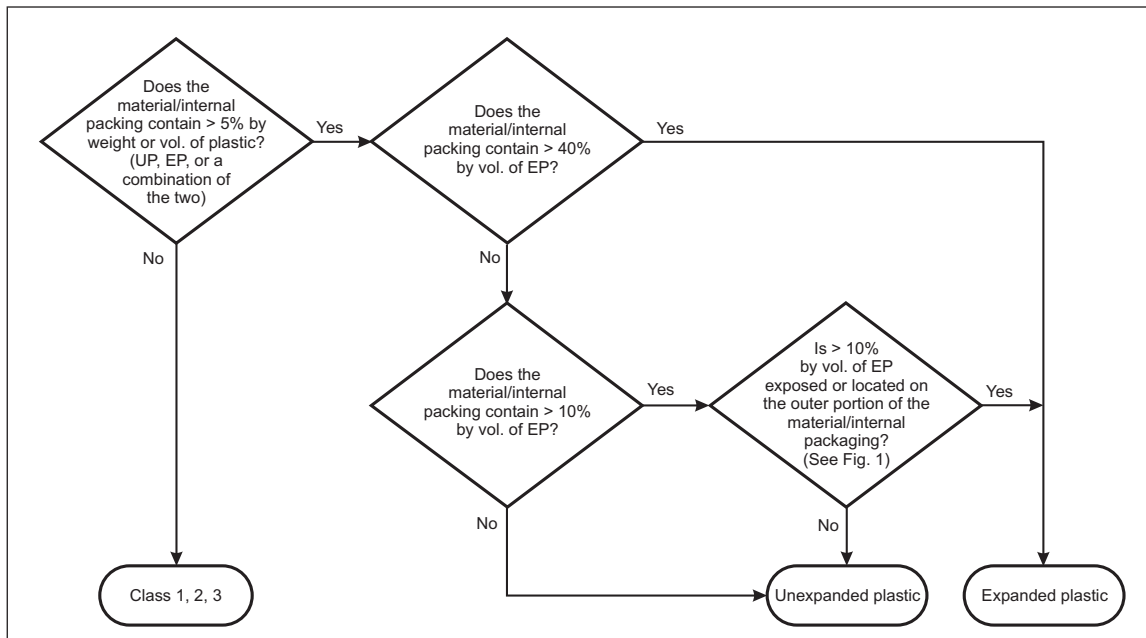


Fig. 3. Classify cartoned commodities containing plastic

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. A commodity that consists of plastic materials stored in a corrugated cardboard carton is treated as a cartoned plastic commodity (CUP or CEP). On the other hand, cartons burn easily and quickly. Noncombustible solids in corrugated cardboard cartons are protected as Class 1 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 4 and 5): In general, plastic storage containers drive the fire protection. Treat the commodity in accordance with Table 1.



Fig. 4. Examples of gridded plastic containers (i.e., plastic containers that are significantly open on the sides and/or bottoms)



Fig. 5. Examples of solid plastic containers (i.e., plastic containers that do not have openings on the sides and/or bottoms)

Table 1. Products Stored in Plastic Containers

General Contents	Container Sides and/or Bottoms	Wall Thickness in. (mm)	Volume 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 containing nonignitable liquids/semi-liquids	Class 1	
	Solid	Any	Any	Bottles or jars containing nonignitable liquids/semi-liquids	UUP	
			≤ 5 (19)	Nonignitable liquids/semi-liquids	Class 1	
			≥ 1/4 (6)	> 5 (19)	Nonignitable liquids/semi-liquids	UUP
			< 1/4 (6)	> 5 (19)	Nonignitable liquids/semi-liquids	Class 2

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.

2.2.9.2 Unexpanded plastic pallets (not FM Approved): There is no increase in commodity classification if the material itself is considered a plastic 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/ft³ (32 kg/m³)
- 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 ft³ (1.7 m³) on a pallet

2.3 Examples of Commodities

Table 2 includes a list of example materials.

Classifications listed in Table 2 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 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. 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. For example: "Mineral spirit-impregnated charcoal, cartoned or uncartoned" is classified as UUP whether the charcoal is cartoned or not.

Table 2. Examples of Material Classification

Item	Category	Material	Class
1	Batteries	Batteries, dry cell (non lithium or lithium-ion). Uncartoned.	Class 1
2	Batteries	Batteries, wet cell (non-ignitable electrolyte) (e.g. automobile, boats). Uncartoned.	Class 1
3	Batteries	Batteries, dry cell (non-lithium or lithium-ion). Cartoned.	Class 2
4	Batteries	Batteries, wet cell(non-ignitable electrolyte) (e.g. automobile, boats). Cartoned.	Class 2
5	Batteries	Batteries (plastic casing), empty	UP
6	Batteries	Batteries, wet-cell (non-ignitable electrolyte) large vehicles (e.g. truck)	UP
7	Batteries	Li-ion cells and batteries	See Section 2.4.2.
8	Beer and Wine	Beer and wine (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	Beer and Wine	Beer and wine (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
10	Beer and Wine	Beer and wine (20% or less alcohol). Considered non-ignitable liquid. Stored in wood barrels	Class 1
11	Beer and Wine	Molded polyurethane/stainless steel beer kegs, empty	EP
12	Construction Materials/ Appliances	Electrical heating coils	Non-combustible
13	Construction Materials/ Appliances	Metal appliances that do not include combustible parts (stoves, washer, dryers)	Non-combustible
14	Construction Materials/ Appliances	Metal pots and pans	Non-combustible
15	Construction Materials/ Appliances	Mirrors	Non-combustible
16	Construction Materials/ Appliances	Paint, water-based (latex). Stored in metal cans.	Class 1
17	Construction Materials/ Appliances	Polyurethane (not exposed) filled metal door panels	Class 1

Table 2. Examples of Material Classification (continued)

Item	Category	Material	Class
18	Construction Materials/ Appliances	Fiberglass insulation: paper-backed rolls, bagged or unbagged	Class 2
19	Construction Materials/ Appliances	Appliances with plastic interiors (e.g. refrigerators)	Class 3
20	Construction Materials/ Appliances	Fiberglass matting (e.g. roofing material)	Class 3
21	Construction Materials/ Appliances	Roof insulation boards (phenolic foam)	Class 3
22	Construction Materials/ Appliances	Roofing shingles, fiberglass	Class 3
23	Construction Materials/ Appliances	Roofing shingles, asphalt.	Class 3
24	Construction Materials/ Appliances	Roofing, felt	Class 3
25	Construction Materials/ Appliances	Metal panels or doors insulated with polyurethane. Polyurethane is exposed or the thickness of the metal is less than 24 gauge.	CUP
26	Construction Materials/ Appliances	Polyisocyanurate board, Class 1 roofing material. Cartoned or uncartoned.	UUP
27	Construction Materials/ Appliances	Water-barrier for building construction, manufactured with nonwoven HDPE fiber	UP
28	Construction Materials/ Appliances	Polyethylene foam pipe insulation	EP
29	Construction Materials/ Appliances	Sealants and electrical insulation (paraffin wax based)	EP
30	Electronics	Cartoned computer software packages. Includes owner's manual and compact disc in an envelope. No plastic in packaging.	Class 2
31	Electronics	Circuit board, copper clad	Class 3
32	Electronics	Circuit boards, FRP backed	Class 3
33	Electronics	Glass light bulbs, cartoned.	Class 3
34	Electronics	Personal computer printers	UP
35	Electronics	Plastic computer terminal housing	UP
36	Electronics	E-cigarettes (excludes large quantities of e-cig fluid)	CUP
37	Empty Container	Glass bottles or jars, empty	Non-combustible
38	Empty Container	Metal cans, empty. Packaged on corrugated cardboard trays, in cartons, or slipsheets. No plastic (except plastic sheet wrap or banding).	Class 1
39	Plastic Containers, Empty	Polyethylene Terephthalate (PET) bottles, empty, uncartoned or cartoned	CUP
40	Empty Container	Cardboard drink boxes (plastic-coated, wax-coated, and/or aluminum-lined), empty, cartoned or uncartoned	CUP
41	Plastic Containers, Empty	Plastic containers, gridded or solid, collapsed	UUP
42	Plastic Containers, Empty	Plastic containers, gridded or solid, nested with no air spaces	UUP

Table 2. Examples of Material Classification (continued)

Item	Category	Material	Class
43	Empty Container	Collapsed wood containers, treat as UUP unless protection requirements are provided in DS 8-24 for wood pallets	UUP
44	Plastic Containers, Empty	Plastic containers, empty, including cups, bottles, or jars (not PET), up to 32 oz (1 L)	UP
45	Plastic Containers, Empty	Plastic bottles (including PET), empty, stored in plastic containers, gridded or solid, any volume	UEP
46	Plastic Containers, Empty	Plastic containers, empty, not collapsed, gridded or solid, greater than 32 oz (1 L)	EP
47	Plastic Containers, Empty	Empty composite intermediate bulk containers (IBC) with plastic, wood, or steel pallets that exceed the conditions established in DS 7-29; see DS 7-29 for protection options for storage under 15 ft (4.5 m)	See Section 2.4.3
48	Food Products - Frozen	Frozen solid foods (e.g., prepared frozen meals on thin plastic trays and cartoned)	Class 2
49	Food Products - Frozen	Meat, frozen, on plastic trays, cartoned or uncartoned	Class 2
50	Food Products - Not Frozen	Fresh fruit and vegetables	Non-combustible
51	Food Products - Not Frozen	Meat, bulk, uncartoned	Class 1
52	Food Products - Not Frozen	Butter stored in plastic containers, cartoned or uncartoned	Class 3
53	Food Products - Not Frozen	Dry pet food in plastic-laminated paper bags	Class 2
54	Food Products - Not Frozen	Margarine stored in plastic containers, cartoned or uncartoned	Class 3
55	Food Products - Not Frozen	Meat, fresh, cartoned, no plastic	Class 2
56	Food Products - Not Frozen	Cereal or combustible food products stored in cartons	Class 3
57	Food Products - Not Frozen	Cheese, wheels, wax-coated, cartoned or uncartoned	Class 3
58	Food Products - Not Frozen	Cookies, cartoned or uncartoned	Class 3
59	Food Products - Not Frozen	Chocolate, cartoned or uncartoned	Class 3
60	Food Products - Not Frozen	Dry pet food in cartons	Class 3
61	Food Products - Not Frozen	Meat, fresh, on plastic trays, cartoned or uncartoned	Class 3
62	Food Products - Not Frozen	Candy, stored in plastic trays and packaged in cardboard boxes	Class 3
63	Food Products - Not Frozen	Produce, fresh, bulk, stored in gridded plastic containers, any volume	Class 3
64	Food Products - Not Frozen	Chewing gum, cartoned or uncartoned	Class 3
65	Food Products - Not Frozen	Eggs stored in expanded polystyrene (PS) containers, cartoned	CUP
66	Food Products - Not Frozen	Snack foods (e.g., potato chips) in plasticized aluminum bags, cartoned	CUP
67	Food Products - Not Frozen	Produce, fresh, bulk, stored in solid plastic containers that hold more than 5 gal (19 L).	UUP
68	Food Products - Not Frozen	Polystyrene foam plates, cups, etc.	EP

Table 2. Examples of Material Classification (continued)

Item	Category	Material	Class
69	Food Products - Not Frozen	Produce, fresh, bulk, stored in solid plastic containers 5 gal (19 L) or less	Class 3
70	Furniture and Bedding	Metal cabinets	Non-combustible
71	Furniture and Bedding	Metal desks with plastic tops and trim	Class 1
72	Furniture and Bedding	Wood furniture (e.g. doors, frames, windows, window frames, cabinets, chairs, tables, etc.)	Class 3
73	Furniture and Bedding	Comforters, quilts or duvets. Natural or synthetic	EP
74	Furniture and Bedding	Mattress, foam	EP
75	Furniture and Bedding	Polyisocyanurate foam cushions	EP
76	Furniture and Bedding	Upholstered furniture, containing expanded foam.	EP
77	Ignitable Liquid	Plastic containers of alcohol based hand sanitizing wipes	UP
78	Ignitable Liquid	Mineral spirit impregnated charcoal, cartoned or uncartoned.	UUP
79	Miscellaneous	Fiberglass basketball backboard	Class 3
80	Miscellaneous	Tobacco products in paperboard cartons	Class 3
81	Miscellaneous	Polystyrene finished toy products	UP
82	Miscellaneous	Stuffed toys	EP
83	Non-Ignitable Liquids	Glass bottles or jars, filled with non-ignitable liquids	Non-combustible
84	Non-Ignitable Liquids	Cardboard drink boxes (plastic-coated, wax-coated, and/or aluminum-lined) filled with non-ignitable liquid. Uncartoned or on corrugated carton trays.	Class 1
85	Non-Ignitable Liquids	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
86	Non-Ignitable Liquids	Non-ignitable liquids in plastic containers that are 5 gal (19 l) or less	Class 1
87	Non-Ignitable Liquids	Semi-liquids (non-ignitable). Including: crushed fruits and vegetables. Stored in solid plastic containers that are 5 gal (19 l) or less	Class 1
88	Non-Ignitable Liquids	Glass bottles or jars filled with non-ignitable liquids. Stored in gridded plastic containers	Class 1
89	Non-Ignitable Liquids	Plastic bottles (<5 gal/19 l), filled with non-ignitable liquid. Stored in gridded plastic containers	Class 1
90	Non-Ignitable Liquids	Polyethylene Terephthalate (PET) bottles, filled with non-ignitable liquids. Stored in gridded plastic containers.	Class 1
91	Non-Ignitable Liquids	Cardboard drink boxes (plastic-coated, wax-coated, and/or aluminum-lined) filled with non-ignitable liquid. Cartoned.	Class 2
92	Non-Ignitable Liquids	Metal cans, filled with non-ignitable liquids or semi-solids. On plastic slipsheets (i.e. dividers)	Class 2
93	Non-Ignitable Liquids	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
94	Non-Ignitable Liquids	Glass bottles or jars that are empty or filled with non-ignitable liquids, stored in solid plastic containers	UUP
95	Non-Ignitable Liquids	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
96	Non-Ignitable Liquids	Plastic bottles, filled with non-ignitable liquid. Stored in solid plastic containers.	UUP
97	Nonwoven	Nonwoven finished products. Refer to Data Sheet 8-23 Rolled Nonwoven Fabric Storage for unfinished products.	UP

Table 2. Examples of Material Classification (continued)

Item	Category	Material	Class
98	Nonwoven	Shrink-wrapped diapers, uncartoned.	UP
99	Packaging Material	Cornstarch packaging material	Class 3
100	Packaging Material	Bubble wrap	EP
101	Packaging Material	Polyethylene foam packaging material	EP
102	Packaging Material	Polypropylene foam packaging material	EP
103	Packaging Material	Polystyrene foam packaging material	EP
104	Paper Products	Book signatures. Cartoned or uncartoned.	Class 2
105	Paper Products	Aluminum foil laminate paper	Class 3
106	Paper Products	Fiberboard (cellulosic material)	Class 3
107	Paper Products	Paper products: books, magazines, stationary, newspaper, paper or cardboard games. Cartoned or Uncartoned.	Class 3
108	Paper Products	Paper Matches, cartoned or uncartoned.	Class 3
109	Paper Products	Latex-laminated Kraft paper, sheets	Class 3
110	Paper Products	Wallpaper, rolls (finished products).	Class 3
111	Paper Products	Cellulosic products. Stored in cartons (e.g. paper plates, cups, towels).	Class 3
112	Paper Products	Finished light weight paper products, cartoned. (E.g. tissue paper). Product within carton may or may not be wrapped in plastic sheeting)	Class 3
113	Paper Products	Polyethylene-laminated Kraft paper, sheets	CUP
114	Paper Products	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
115	Pharmaceutical	Noncombustible creams/gels in plastic containers that are 4–8 oz (0.12–0.24 l), stored in cartons.	Class 3
116	Pharmaceutical	Medicine tablets or capsules in glass jars, stored in cardboard and/or cartons.	Class 3
117	Pharmaceutical	Hypodermic needles (stainless steel) stored individually in plastic containers. Cartoned	CUP
118	Pharmaceutical	Medicine tablets or capsules in plastic containers. Cartoned	CUP
119	Pharmaceutical	Medicine tablets or capsules in plastic-faced foil packs. Cartoned	CUP
120	Plastic Containers	Corrugated plastic boxes filled with cardboard box flats	Class 3
121	Plastic Containers	Plastic containers, solid, storing noncombustible solids, 1 gal (4 L) or less	CUP
122	Plastic Containers	Phenolic Resin powder in 55 gal (210 l) Plastic Drums	UUP
123	Plastic Containers	Plastic containers, solid or gridded. Storing combustible solids (that would be considered Class 1, 2, 3, or unexpanded plastics). All volumes. Completely full.	UUP
124	Plastic Containers	Plastic containers, solid. Storing noncombustible solids. > 1 gal (4 l) in volume.	UUP
125	Plastic Containers	Plastic containers, solid or gridded. Storing commodities considered expanded plastic. All volumes	UEP
126	Plastic, General	Phenolic plastic	Class 3
127	Plastic, General	Regenerated cellulosic (cellophane)	Class 3
128	Plastic, General	Solid silicones	Class 3
129	Plastic, General	Polyethylene Terephthalate (PET) plastic (other than cups and bottles)	UP
130	Plastic, General	Acrylic/epoxy traffic lane dividers	UP
131	Plastic, General	Acrylics	UP
132	Plastic, General	Nylons	UP

Table 2. Examples of Material Classification (continued)

Item	Category	Material	Class
133	Plastic, General	Plastic "flip-flop" sandals	UP
134	Plastic, General	Plastic drip trays	UP
135	Plastic, General	Plastic light reflectors	UP
136	Plastic, General	Polycarbonate products	UP
137	Plastic, General	Polyester products	UP
138	Plastic, General	Polyisobutylene tubing	UP
139	Plastic, General	Polypropylene decorative ribbon or bows	UP
140	Plastic, General	Shoes with vinyl sides, crepe soles	UP
141	Plastic, General	Vinyl boots	UP
142	Plastic, General	Vinyl tablecloth	UP
143	Plastic, General	Plastic pallets, idle. (Not FM Approved). See DS 8-24 for more information.	UUP
144	Plastic, General	Acrylonitrile-butadiene-styrene (ABS)	EP
145	Plastic, General	Corrugated plastic	EP
146	Plastic, General	Polyurethane foam	EP
147	Plastic, General	Polystyrene, expanded (e.g.: egg crates, packing peanuts/chips)	EP
148	Plastic, PVC	Rigid polyvinyl chloride (PVC) finished products (e.g., pipes, ducts, building panels, siding)	Class 3
149	Plastic, PVC	PVC finished products, with plasticizer contents up to 20%	Class 3
150	Plastic, PVC	ABS	UP
151	Plastic, PVC	Film, PVC Christmas garlands ("tinsel")	UP
152	Plastic, PVC	PVC finished products, with plasticizer greater than 20%	UP
153	Plastic, PVC	Polyvinyl chloride (PVC) insulated cable, on plastic reels. Uncartoned.	UUP
154	Plastic, Rubber Products	Pre-cured tire tread	UP
155	Plastic, Rubber Products	Rubber products (aprons, pants, gloves, boots, tire retread, ear plugs, stoppers, etc.)	UP
156	Plastic, Rubber Products	Rubber, baled crude	UP
157	Plastic, Rubber Products	Running shoes with nylon cover, rubber soles	UP
158	Plastic, Rubber Products	Running shoes with vinyl cover, rubber soles	UP
159	Plastic, Rubber Products	Santoprene (synthetic rubber)	UP
160	Powders/ Granulars	Free-flowing inert materials stored in combustible bags in racks (e.g. cement, calcium chloride, clay, iron oxide, sodium chloride, sodium silicate).	Class 1
161	Powders/ Granulars	Granular/free-flowing unexpanded plastics (e.g. polystyrene bottle caps) stored in bags or cartons.	CUP
162	Powders/ Granulars	Polyester/epoxy coating powder	CUP
163	Powders/ Granulars	Toner powder (polymer/carbon black mix) in plastic bottles.	UP
164	Solid Metal Containers	Closed metal containers containing plastic materials	Class 1
165	Solid Metal Containers	Plastics stored in open-top metal containers	Class 3
166	Solid Metal Containers	Plastic materials stored in 5-sided solid metal container	Class 3
167	Textiles	Clothing and textiles, natural fiber (e.g. wool, cotton) and viscose. Not hanging. See Data Sheet 8-18 for hanging garments.	Class 3
168	Textiles	Leather, finished products (e.g. shoes, jackets, gloves, bags, luggage, belts, etc.). Cartoned and uncartoned.	Class 3
169	Textiles	Yarn and thread, natural fiber and viscose (100% cellulose based)	Class 3

Table 2. Examples of Material Classification (continued)

Item	Category	Material	Class
170	Textiles	Fibers, natural. Baled and stored in cartons	Class 3
171	Textiles	Clothing and textiles, synthetic. Not hanging. See Data Sheet 8-18 for hanging garments. Cartoned and uncartoned.	CUP
172	Textiles	Synthetic yarns and fibers such as polypropylene, polyethylene, and nylon	See Section 2.1.3.24 of DS 7-1
173	Textiles	Spandex elastic thread	UP
174	Textiles	Fabric softener sheets, wax-coated	EP
175	Tools and Parts	Metal parts	Non-combustible
176	Tools and Parts	Motors, electric. Metal housing.	Non-combustible
177	Tools and Parts	Metal parts stored in cartons	Class 1
178	Tools and Parts	Polyester/fiberglass fishing rod	CUP
179	Tools and Parts	Plastic screwdriver handles	UP
180	Tools and Parts	Automobile bumpers	EP
181	Wax Products	Wax, dental. Finished product (in plastic container)	UP
182	Wax Products	Candles - see Wax, paraffin	EP
183	Wax Products	Natural "beeswax"	EP
184	Wax Products	Wax crayons	EP
185	Wax Products	Wax, dental. Raw material	EP
186	Wax Products	Wax, paraffin	EP
187	Wax Products	Wax-coated, polyester/nylon stripping pads	EP
188	Wire/Cable/Spool	Polyvinyl chloride (PVC) insulated cable, on metal reels	Class 1
189	Wire/Cable/Spool	Polyvinyl chloride (PVC) insulated cables, on wood, or paper reels.	Class 3
190	Wire/Cable/Spool	Wood spools (empty)	Class 3
191	Wire/Cable/Spool	Rubber hose (exterior), woven metal (interior)	CUP
192	Wire/Cable/Spool	Film, rolled polyester on any type of reel	UP
193	Wire/Cable/Spool	Film, rolled polyethylene on any type of reel	UP
194	Wire/Cable/Spool	Wire, bare on plastic spools. Uncartoned.	UUP
195	Wire/Cable/Spool	Plastic (other than PVC) insulated conductor and power cable on wood or metal reels or in cartons.	CUP
196	Wire/Cable/Spool	Film, rolled polypropylene on any type of reel	UP
197	Wood Products	Noncombustible commodities stored on wood pallets.	Class 1
198	Wood Products	Wood products (e.g., plywood, bundled or stacked lumber, particleboard, empty barrels with moisture content below 8%)	Class 3
199	Wood Products	Empty wood barrels (with moisture content above 8%)	Class 1
200	Wood Products	Matches, wooden matches, cartoned or uncartoned.	CUP
201	Wood Products	Fireplace logs, impregnated with ignitable liquids or wax. Cartoned or uncartoned.	UEP
202	Wood Products	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 Lithium-Ion (Li-ion) Batteries

2.4.2.1 Protect batteries meeting the criteria in Table 3 with 12 (twelve) K22.4 or K25.2 (K320 or K360) sprinklers, operating at 35 psi (2.4 bar). Limit storage to three tiers high (maximum 15 ft (4.5 m) high in racks or palletized). No storage is permitted above the batteries. Ceiling height is limited to 40 ft (12 m).

For storage of batteries that falls outside the criteria given in Table 3, Scheme A protection per Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*, is recommended.

Table 3. Protection of Cartoned Lithium-Ion Batteries

State of Charge	≤60%
Electrolyte weight	≤20%
Capacity	≤41 Ah
Packaging	Cartoned, with cellulosic and/or unexpanded plastic internal packaging only

2.4.2.2 Packaging of batteries is a key consideration in terms of protection. With cartoned batteries, the aim of fire protection is for the sprinklers to be activated by the cardboard packaging fire and be suppressed before the batteries are heated and start to drive the fire spread. For protection to be successful, the packaging must strictly conform to a cartoned classification. Typical packaging of batteries comprises fibrous inserts, unexpanded plastic dividers, and insulation in cardboard cartons. However, it is common for larger batteries to be packaged in rigid or expanded foam packaging. If expanded plastic packaging materials are present, protect batteries with Scheme 8-9A per Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*.

2.4.2.3 Different transport authorities legislate on the state of charge (SoC) for shipping and storage, which is typically a charge between 30% and 60%. Tests have been conducted at these levels of charge. States of charge above 60% are generally intended for immediate use rather than indefinite storage. The higher the state of charge, the more reactive a battery is in a fire scenario. Therefore, batteries with SoC above 60% should be protected using Scheme 8-9A per Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*.

2.4.3 Empty Plastic Intermediate Bulk Containers (IBCs)

2.4.3.1 Protect palletized storage of empty plastic IBCs and “recon” (reconditioning of used) empty plastic IBCs per the guidance in Table 4. This protection applies to wet systems only.

Table 4. Protection of Empty Intermediate Bulk Containers (IBCs)

Building Height	Storage Height	QR, 160°F (70°C)		
		K14.0 (K200) ¹	K22.4 (K320)	K25.2 (K360)
30 ft (9.0 m)	15 ft (4.5 m), maximum 3 IBCs high (on wooden pallets)	12 @ 18 psi (1.2 bar)	NANA	NA
	15 ft (4.5 m), maximum 3 IBCs high (on plastic pallets)	12 @ 32 psi (2.2 bar)	NA	
40 ft (12 m)	30 ft (9 m), maximum	NA	12 @ 60 psi (4.1 bar)	12 @ 60 psi (4.1 bar)
48 ft (14.5 m)	6 IBCs high (any pallet type)	NA	NA	12 @ 75 psi (5.2 bar)

¹These protection options are for pendent sprinklers only.

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 Global 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/ft² 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 Global'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 for a list of FM Global'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 5. FM Global 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 ft² (19-28 m²) area of the commodity tested. Only a small amount of material has to burn to create relatively large sprinkler operating area (1500-2500 ft² [140-230 m²]). 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 Global

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 Cylinders*
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

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.

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.

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 Global 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).

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 Global.
- 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.