

Module 2: Commodity Classification

Learning Objectives

Upon completion of this module, you will be able to:

1. Analyze commodity classification accuracy based on permit applicant-provided data and Table 3203.8 of the *International Fire Code*® (IFC®).
2. Question Group A, B and C plastics' impact on permit applicant-provided commodity classifications.
3. Infer mixed commodity classification accuracy based on permit applicant-provided data and IFC Chapter 32 Figures 3203.9(1) and 3203.9(2).
4. Discriminate among pallet types for their impact on permit applicant-provided commodity classes.



Commodity Classification Essentials

Chapter 32 High-Piled Combustible Storage cannot be applied correctly without accurate commodity classification.

Commodity classification is the foundation for all Chapter 32 requirements: fire protection and life safety systems, aisle spacing, storage height, flue spaces and smoke control. Commodity classification is the permit applicant's responsibility; the code official must only review and approve or reject the classification documentation.

Module 1: Scope and Application defined a commodity as the “combination of product, packaging and container.” (See IFC Section 202.)

Commodities are categorized into five classes based on an estimation of their fire potential or known fire behavior from full-scale tests. Commodities with similar characteristics are grouped together into one of five classes ranging from low to high hazard. The assigned classes are used to establish IFC and NFPA fire protection and life safety requirements. IFC classes are ranked I through IV and high-hazard and, in NFPA 13, *Installation of Sprinkler Systems*, Class I through IV and “special occupancy hazard.”

Where materials are stored on pallets, the combination of merchandise and pallet is called a “unit load” (see Figure 2-1). Unit loads are a common method for improved material handling and may exist as self-supporting palletized storage or in rack storage.

Combustible products and packaging are evaluated for two factors: latent heat of combustion and heat release rate (HRR). Latent heat of combustion is the total energy in Btu (kW) released when an object is burned completely under laboratory-controlled conditions. For example, a pound (2.2 kg) of kiln-dried wood will emit about 8,000 to 9,000 Btu (2.34 to 6.63 kW) when con-

Key Concept

Commodity classification is the permit applicant's responsibility; the code official is required only to review and approve or reject the classification documentation. When in doubt, the code official should feel comfortable asking for technical assistance as authorized by IFC Section 104.2.2. If the code official rejects the classification, they must justify the decision in writing in accordance with IFC Section 105.2.1.

sumed. Many plastic products will emit two to three times this amount.

Heat release rate is a measure of the rate at which heat energy is emitted by a material when burned. It is expressed in Btu per minute (J/m² or kW min/m²). Increasing numeric values mean the material emits higher amounts of energy; in short, it burns more ferociously.

A commodity's classification category increases in relationship to its heat of combustion and HRR. Higher classifications represent greater fire protection challenges for control and suppression.

Section 3203 ranks commodities into five different classes: I, II, III, IV and high hazard. Each class's characteristics are listed in a separate section of the IFC (see Table 2-1).



Figure 2-1. Stacked Unit Loads.
(Photo courtesy of Integra Code Consultants)

Table 2-1: COMMODITY CLASS SUMMARY

CLASS	CODE SECTION	DESCRIPTION
I	3203.2	Noncombustible products in ordinary corrugated cartons with or without single-thickness dividers, or in ordinary paper wrappings with or without wood pallets. The amount of Group A plastics shall be limited in accordance with Section 3203.9.
II	3203.3	Class I products in slatted wooden crates, solid wooden boxes, multiple thickness paperboard cartons or equivalent combustible packaging material with or without wood pallets. The amount of Group A plastics shall be limited in accordance with Section 3203.9.
III	3203.4	Wood, paper, natural fiber cloth products or Group C plastics or products thereof, with or without wood pallets.
IV	3203.5	Class I, II or III products containing Group A plastics in ordinary corrugated cartons; Class I, II and III products with Group A plastic packaging; Group B plastics; and free-flowing Group A plastics with or without wood pallets.
High-hazard	3203.6	Products presenting special fire hazards beyond those of Class I, II, III or IV. Group A plastics not otherwise classified are included in this class. Lithium-ion batteries are in this class.

Product, packaging and container combustibility must be evaluated to provide suitable fire protection. Packing materials may include a large volume or weight of plastics that generally exhibit higher heat of combustion compared to other combustible materials. The packaging combustibility may affect commodity class. Consider the definition of a Class II commodity and compare it to a Class I commodity. A Class II commodity includes Class I products that are packaged in slat-

ted wooden crates, solid wooden boxes, multiple-layer paper or fiberboard cartons, or equivalent combustible packaging materials with or without pallets. Clearly, the commodity's classification can also be influenced by its packaging (see Figure 2-2.)

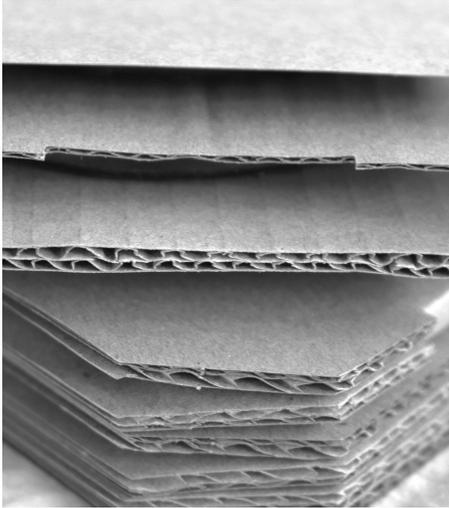


Figure 2-2. Paperboard, Single-, Double-, and Multiple-Thickness Cardboard (top to bottom).
(Photo courtesy of Integra Code Consultants)

Who Can Assign Commodity Classification(s)?

There is no central person, agency or organization that can classify commodities. Classification is as much an art as it is a science. It requires a detailed analysis of the product being stored and the packaging/carton around it. The code official is not responsible for classifying commodities; normally this is accomplished by a product manufacturer, property insurance company, testing laboratory, fire protection engineers or some other competent source the code official approves. As explained below, classification is not so simple as evaluating an individual product for its combustibility; its shape, mass and packaging may have significant impact.

Property insurance underwriters may require their clients to submit various commodities and storage configurations for live fire testing to evaluate suitable fire protection methods. These tests may be performed by nationally recognized testing laboratories like Underwriters Laboratories (UL) or FM¹. The test results help determine commodity classifications or similar characteristics so every new product and storage array does not need a customized or unique fire protection plan. Commodities with similar fire behavior can be grouped together and fire protection plans are developed to match the group or class. Test results may be shared among researchers, insurance providers and those who develop building and fire protection codes and standards.

Classification Challenges

FM is a recognized source for commodity classification. The company produces research-based summaries called data sheets that can be viewed or downloaded from its website. FM offers a guidance when evaluating the packaging of commodities in Data Sheet 8-1, *Commodity Classification*². It characterizes the com-

Key Concept

Small changes in products, packing materials or containers can affect the commodity classification and its fire protection and life safety requirements. Note how a low hazard Class I commodity increases to Class II by something as simple as changing from single-thickness to double-thickness cardboard cartons. (See Figure 2-2.)

Key Concept

To enhance code application consistency, Section 3203.8 requires commodities that appear in Table 3203.8 be assigned the corresponding classification. Products not in the table must be evaluated in accordance with Section 3203.2 through 3203.6 and assigned a class that most nearly represents them.

1. FM is the current name of the company founded in 1835 as Manufacturers Mutual Fire Insurance Company. It has been known throughout its history as Associated Factory Mutual Insurance Companies, Factory Mutual and FM Global.
2. FM classifies products with Arabic numerals (1-4) rather than Roman numerals in the IFC® and NFPA.

plexities involved with commodity classification. For example, consider the following commodity FM assessments:

- Many plastic products stored in cardboard cartons may require protection as a plastic commodity. However, when the plastic materials are stored in five-sided open-top solid metal containers, the arrangement may be protected as a Class 3 ordinary hazard commodity. This arrangement limits the amount of air available for burning and reduces the amount of adjacent vertical and horizontal plastic surfaces where fire could spread. This configuration reduces the overall hazard. Likewise, plastic materials stored in solid metal containers with solid metal tops should be protected as a Class 1 commodity.
- Metal parts in ordinary cardboard cartons are protected as a Class 1 commodity. However, when the metal parts are handled in plastic tote boxes, the arrangement should be protected as a plastic commodity.
- Hypodermic needles are stainless steel. However, each individual needle is stored in its own plastic case. Several of these needles are then packaged in cardboard boxes. They should be protected as a plastic commodity.³

Fuel Geometry

Section 3203.1 requires that the physical form of the commodity be evaluated when assigning the commodity classification. Physical form or geometry can have a significant impact on commodity combustibility. For an analogy, consider how difficult it is to ignite a kiln-dried solid wood stud measuring nominally 2 × 4 inches (51 × 102 mm). Exposed to a match or hand-held flame, the wood will char but not sustain combustion. This characteristic is described as the wood being “thermally thick.”

Think about that same piece of wood chopped into kindling or small chips and stacked in a small pile where there is substantial surface exposure to the air. This arrangement can be ignited easily and is called “thermally thin.” (If ground into fine particles wood dust can create explosive concentrations with catastrophic consequences. Refer to IFC Chapter 22 Combustible Dust for regulatory controls.)

Figure 2-4 is an excellent example of geometry’s influence on commodity classification. On the photograph’s left side are timber slats packed closely together on a cart: a common Class III commodity.

At the photograph’s back and right are the assembled wood fence sections. The sections stacked on the floor are arranged so there is substantial amount of wood surface exposed to air that would promote combustion. The arrangement easily could be justified as a Class IV commodity.

FM offers several data sheets applicable to combustible storage. They cannot be enforced within the scope of the IFC because they are not included in Chapter 80 Referenced Standards. The code official should use them solely for information to better understand this complex topic, or they may be cited and considered as part of IFC Section 104.2.3 alternative materials, design or methods approach.

3. “FM Property Loss Prevention Data Sheet 8-1: Commodity Classification (Johnston, RI:FM) (2024).”

Table 2-2: FM STORAGE-RELATED DATA SHEETS

8-1	Commodity Classification
8-3	Rubber Tire Storage
8-7	Baled Fiber Storage
8-9	Storage of Class 1, 2, 3, 4 and Plastic Commodities
8-21	Rolled Paper Storage
8-24	Idle Pallet Storage
8-30	Storage of Carpets
8-33	Carousel Storage and Retrieval Systems
8-34	Protection for Automatic Storage and Retrieval Systems



Figure 2-3. Dimensional Lumber Cut and Assembled into Uniform Shapes.
(Photo Credit Kevin A Scott and Associates)

Flame Retardants

Section 3203.1 requires commodities to be classified as Class I, II, III, IV or high hazard. Materials listed within each commodity classification are assumed to be unmodified for improved combustion characteristics. Flame-retarding modifiers or the physical form of the material could change the classification. For example, some plastics can be formulated with halogen (e.g., bromine) or phosphorus compounds to reduce combustibility. Likewise, paper and cardboard boxes can be treated with flame retardants like borax, boric acid or alum. This information should be shared by the person or agency performing the classification exercise and should be supported by suitable test data.

Instructions for Use (IFC Table 3203.8)

Commodities are listed in Table 3203.8.

TABLE 3203.8—EXAMPLES OF COMMODITY CLASSIFICATION

PRODUCT CATEGORY	PRODUCT	CLASSIFICATION
Aerosols	Level 1	Class III (See Chapter 51)
	Level 2	Class IV (See Chapter 51)
	Level 3	High-hazard (See Chapter 51)
Batteries	Dry cells (excludes lithium, lithium-ion and other similar exotic metals or combustible electrolyte); without blister packing (if blister packed, refer to the commodity classification definitions)	Class I
	Dry cells (nonlithium or similar exotic metals); in blister packing; cartoned	Class II
	Vehicle; any size (for example, automobile or truck); empty plastic casing	High-hazard (Group A unexpanded)
	Vehicle; large (in other words, truck or larger); dry or wet cells (excludes lithium-ion and other cells containing combustible electrolytes)	High-hazard (Group A unexpanded)
	Vehicle; small (for example, automobile); wet cells (excludes lithium-ion and other cells containing combustible electrolytes)	Class I
	Lithium-ion	High-hazard
Biomass	Circular baled corn stover	Class IV
	Rectangular baled corn stover	Class III
	Rectangular baled switchgrass	High-hazard
Empty containers	Noncombustible	Class I
	PET	Class IV
	Rigid plastic (not including PET)	High-hazard (Group A unexpanded)
	Wood; solid sided (such as crates, boxes)	Class II
Film rolls, including photographic	Polypropylene, polyester, polyethylene; rolled on any reel type	High-hazard (Group A unexpanded)
	35 mm metal film cartridges in polyethylene cans; cartoned	Class III
	Motion picture or bulk rolls in polycarbonate, polyethylene or in metal cans; polyethylene bagged; cartoned	Class II
	Rolls in polycarbonate plastic cassettes; cartoned	Class IV
	Photographic paper; sheets; bagged in polyethylene; cartoned	Class III