Commodity Classification
By: Kevin Geidel, CFPS, CET

Defining a commodity
Importance of correct classification
How to determine classification
Hazards associated with storage
Commodity classification testing
Closing

What is a commodity?
• Product of stored materials, external packaging, internal packaging, and material handling products

Determining a Commodity
• Three factors to consider:
  1. Specific item or product
     I. Heat of combustion
     II. Heat release rate
     III. Flame spread rate
  2. Packaging of item or product
     I. Interior and exterior packaging components
     II. Type of pallet it is stored on
  3. Individual storage units
     I. Makeup of individual storage units
     II. Tables from NFPA 13 and FM Global DS 8-1

NFPA vs. FM Global Commodity Classes

<table>
<thead>
<tr>
<th>NFPA 13</th>
<th>FM Global (DS 8-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Noncombustible</td>
</tr>
<tr>
<td>Class I</td>
<td>Class 1</td>
</tr>
<tr>
<td>Class II</td>
<td>Class 2</td>
</tr>
<tr>
<td>Class III</td>
<td>Class 3</td>
</tr>
<tr>
<td>Class IV</td>
<td>Class A/ Cartoned Unexpanded Plastic (CUP)</td>
</tr>
<tr>
<td>Group A</td>
<td>Cartoned Expanded Plastic (CEP)</td>
</tr>
<tr>
<td>Group B</td>
<td>Uncarton/Unexpanded Plastic (UUP)</td>
</tr>
<tr>
<td>Group C</td>
<td>Uncarton/Unexpanded Plastic (UEP)</td>
</tr>
</tbody>
</table>

Class I Commodity (NFPA 13)
• Noncombustible products that meet one of the following:
  1. Placed directly on wood pallets
  2. Placed in single-layer corrugated cartons, with or without single-thickness cardboard dividers, with or without pallets
  3. Shrink-wrapped or paper-wrapped as a unit load with or without pallets
Class II Commodity (NFPA 13)
- Noncombustible product in slated wooden crates, solid wood boxes, multiple-layered corrugated cartons, or equivalent combustible packaging material, with or without pallets.

Class III Commodity (NFPA 13)
- Product fashioned from wood, paper, natural fibers, or Group C plastics with or without cartons, or crates and with or without pallets.
- May contain a limited (5% by weight or volume or less) of Group A or Group B plastics.

Class IV Commodity (NFPA 13)
- Product with or without pallets, that meets one of the following criteria:
  1. Constructed partially or totally of Group B plastics
  2. Consists of free-flowing Group A plastic materials
  3. Contains within itself or its packaging an appreciable amount (5% - 15% by weight or 5% - 25% by volume) of Group A plastics
- Remaining material must be metal, wood, paper, natural or synthetic fibers, or Group B or Group C plastics.

Plastics, Elastomers, and Rubber
- Three classes for these materials:
  1. Group A
  2. Group B
  3. Group C

Group A Plastics (NFPA 13)

Group B Plastics (NFPA 13)
Group C Plastics (NFPA 13)

Noncombustible (FM Global)
- Materials that do not burn.
  A. These, by themselves, do not require sprinkler protection.
  B. Consideration should be given to construction, occupancy, material-handling processes and future changes when determining sprinkler protection.

Class 1 (FM Global)
- Stored material that meet the following:
  A. Noncombustible materials on wood or FM Approved pallets.
  B. Noncombustible materials packaged in single-layer corrugated cardboard cartons, slatted wood containers, solid wooden boxes, or equivalent combustible packaging material on wood or FM approved pallets.
  C. May contain negligible amount of plastic trim such as knobs or handles.

Class 2 (FM Global)
- Stored material that meet the following:
  A. Noncombustible or Class 1 commodities stored in multiple-thickness corrugated cardboard cartons, slatted wooden containers, solid wooden boxes, or equivalent combustible material on wood or FM Approved pallets.

Class 3 (FM Global)
- Stored material that meet the following:
  A. Cellulosic materials, such as wood, paper, or natural textiles, on wood or FM Approved pallets.
  B. May or may not be stored in corrugated cardboard cartons.
  C. Class 1, 2, and 3 materials containing no more than 5% plastic by either weight or volume.

Class 4/Unexpanded Plastic (FM Global)
- Stored material that meet the following:
  A. Total weight by volume of plastic (unexpanded, expanded, or combination of the two) is more than 5% for a single pallet load.
  B. Total volume of expanded plastic (foam plastic) is from 5% - 40% for a single pallet load.
  C. Total volume of expanded plastic is between 5% - 10% when exposed or located on the outer portion of the material (protects or envelops the material)
Expanded Plastic (FM Global)
- Stored material that meet the following:
  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.
  C. Empty plastic containers that hold more than 32 oz. (1L) and are not nested

Cartoned vs. Uncarton (FM Global)
- If material is stored in corrugated cardboard cartons, treat the commodity as cartooned (CUP or CEP). Otherwise, treat it as uncartoned.
- Some exceptions apply and are listed in DS 8-1.

Cartoned Plastic Commodities

External Packaging
- Drives the early stages of fire growth
- Can be higher or lower hazard than commodity being stored
- Classification can be raised or lowered based on external packaging

Typical External Packaging
- Cardboard cartons
- Solid metal containers
- Solid and/or gridded UP containers
Cardboard Cartons
- Absorb sprinkler water
- Wetting can reduce fire spread
- Plastics can be CUP or CEP
- Noncombustible should be considered Class 1

Solid Metal Containers
- Decreases hazard
- Plastics in five-sided container:
  - Open top = Class 3
  - Closed top = Class 1

Solid/Gridded UP Containers

<table>
<thead>
<tr>
<th>Stored Material</th>
<th>CUP</th>
<th>UUP</th>
</tr>
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<tbody>
<tr>
<td>Class 1</td>
<td>Nonignitable liquids/semi-liquids in solid containers that hold 5 gal. (19 L) or less.</td>
<td></td>
</tr>
<tr>
<td>Class 2</td>
<td>Nonignitable liquids/semi-liquids in solid containers that hold more than 5 gal and have a wall thickness of ¼” (6 mm). (Generally 55 gal drums meet this criteria.)</td>
<td></td>
</tr>
<tr>
<td>CUP</td>
<td>Noncombustible solids in containers that hold 1 gal. (4 L) or less.</td>
<td></td>
</tr>
<tr>
<td>UUP</td>
<td>Noncombustible solids (Class 1, 2, 3, or UEP).</td>
<td></td>
</tr>
<tr>
<td>UEP</td>
<td>Nonignitable liquids/semi-liquids in solid containers larger than 5 gal.</td>
<td></td>
</tr>
<tr>
<td>UEP</td>
<td>Nonignitable liquids/semi-liquids in solid containers larger than 5 gal. and have a wall thickness of greater than ¼”</td>
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*Containers typically drive fire protection requirements

Pallets (FM Global)
- Wood or FM Approved:
  - No increase in classification
  - Exception: Noncombustible = Class 1
- Unexpanded Plastic:
  - No increase for plastics
  - Increase by one level for others if pallet volume = 15% or more of load

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**Mixed Commodities (NFPA 13)**

- Typically based on highest classified commodity and storage arrangement
- Exception if all of following:
  - Up to 10 pallets of higher commodity in area less than 40,000 ft.$^{3}$
  - Higher hazard commodity is randomly dispersed (no adjacent loads in any direction)
  - Ceiling protection is based on Class I or Class I commodities, number of pallets of Class IV or Group A is reduced to five

**Mixed Commodities (FM Global)**

- Do not base protection on average of commodities
- Fire tests indicate replacing one tier of a four-tier rack array produced a hazard much higher than 100% lower hazard
- Increasing the hazard may increase burning area and overtax suppression system
- “Averaging the commodities” requires continual monitoring which is very difficult and generally not feasible

**Mixed Commodity Segregation**

- Lower class commodity protection strategy may be used in area of lower classification when higher hazard material is confined to designated area protected to the higher hazard requirements

**Importance of Classification**

- Basis of design (1st Decision)
- Sprinkler design density
- Building construction
- Storage/building height
- Aisle width

**Ongoing Classification Needs**

- Multi-tenant facilities
- Change of material/quantity
- Storage arrangement
- Moveable rack storage
- Change of protection strategy

**Commodity Classification Analysis**

- Products and packaging composition always changing
  - Raw materials available
  - Raw materials price
  - Product design
  - Packaging Technologies
  - Packaging Design
Commodity Classification Analysis

- Storage facilities always changing
  - Ownership
  - Storage commodity
  - Storage schemes

Commodity Classification Testing

- Standardized test method (FM Global)
  - Burn commodity with standardized water application
  - Determine the resulting HRR
  - Rank the hazard for the appropriate suppression strategy

Commodity Classification Testing

- Assessment of ability of stored material to be protected by water applied to top of storage arrangement
- Tool to effectively assess fire risk of storage commodity protected by sprinklers
- Fire risk of non-sprinklered storage arrangements not considered

Burning Characteristics

- Percent of Inert Material
  - Bench-scale Lab Tests
  - Oxygen Bomb Calorimeter
  - Fire Propagation Apparatus (FPA)
  - Fire Products Collector (FPC)

ASTM

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Class III Commodity Fire Test

- [https://www.youtube.com/watch?v=66SQU46xy8Q](https://www.youtube.com/watch?v=66SQU46xy8Q)
Group A Plastics Fire Test

- https://www.youtube.com/watch?v=6hpJujNK3_w&list=PL89E7D9357E74E42D

FM Global Loss History

- Fires in storage occupancies are controlled by existing sprinklers when no major system deficiencies were present.
- Protection deficiencies were identified in all storage losses where fire was uncontrolled.
  - Deficiencies include inadequate water supply, closed/partially closed valves, obstructed piping, missing sprinklers, and flammable liquids or aerosol protection inadequate.

FM Global Loss History

- Rack storage losses with no protection deficiencies have taught us:
  1. In-rack sprinklers, used in conjunction with ceiling level sprinklers, are overwhelmingly successful.
  2. Amount of damage and number of sprinklers that open increase with high storage/building heights.

In Review

- What is a commodity?

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- Why is it important to correctly classify a commodity?

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- Where can we find information on Commodity Classification?
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Questions? Comments?

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New York State Empire Chapter
Society of Fire Protection Engineers

Thank You