

SAFETY 2019



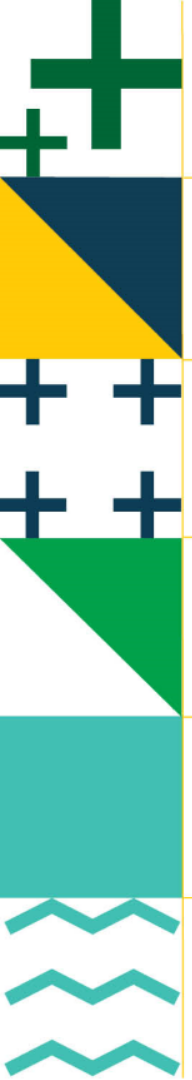
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How Hazmat Use and Storage Impacts Your Facility's Occupancy Classification

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Session S5084





Outline for Today's Discussion

- **Role of Building & Fire Codes**
- **Occupancy Classification (Implications of Group H)**
- **3 Step Process for Accurate Occupancy Classification**
 - **Characterize the Hazardous Material(s) Planned or Used**
 - **Determine Use Category for Each Hazardous Material**
 - **Properly Account for the Quantity of Hazardous Material**
- **A Brief Case Study**
 - **“I want to Start using Flammable Liquids in my Building”**
- **Combustible Dust: New Occupancy Classification Challenges**
- **Conclusion**



Disclaimer

- **We will be reviewing several important regulatory issues regarding Fire & Building Codes in this presentation**
- **A set of informational references is included in this presentation Appendix.**
- **Information in this presentation is not intended to provide, nor should it be construed as providing, legal advice.**

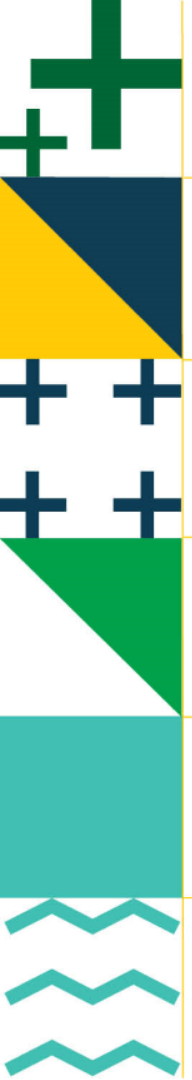
Role of Building & Fire Codes



- Govern design, construction and use of “the built environment”
- Adopted and enforced at the local, regional, or state level
- Often more modern (and restrictive) than OSHA requirements
 - OSHA 1910.106: Based on 1969 edition of NFPA 30
 - IFC 2018: Based on 2015 edition of NFPA 30
- Implications at building permit, certificate of occupancy, and periodic inspection milestones
- International Code Series most commonly adopted in the US

Overview of Occupancy Classification

- Classification of buildings and structures that manages the use and occupancy
- Provides a rationale criteria that is relative to fire hazard and life safety considerations
- Implications on building construction, size, & layout
- Typical Classifications:
 - Group F: Factory Industrial
 - Group S: Moderate- and Low-Hazard Storage
 - **Group H: High Hazard**

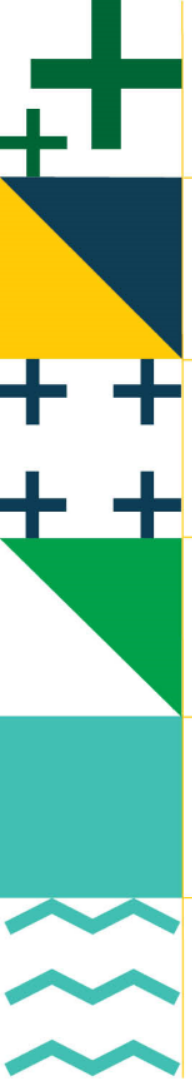


Implications of a Group H Occupancy

- **Hazardous Materials (above de minimis levels) require:**
 - More robust building materials (fire resistance)
 - Automatic fire protection
 - Robust ventilation systems
 - Drainage & containment
 - Restricted size, height, and layout
- **Group H Classifications:**
 - Group H-1: Presenting a Detonation Hazard
 - Group H-2: Presenting a Deflagration Hazard or Accelerated Burning
 - Group H-3: Physical Hazard or Readily Supports Combustion
 - Group H-4: Materials Presenting Health Hazards
 - Group H-5: Semiconductor Fabrication & Research

Occupancy Classification Process

- 3 Step-Process:
 - Characterize the Hazardous Material(s) Planned or Used
 - Determine Use Category of Each Hazardous Material
 - Properly Account for the Quantity of Hazardous Material



Occupancy Classification Process:

Step 1: Characterize Hazardous Material(s)

- The code classifies hazards materials as a Physical Hazard and/or a Health Hazard
- There are a number of subcategories used in the code (next slide)
- Each hazardous material used must have subcategories determined
- This can become a bit of a detective project:
 - Use the definitions in the code for guidance
 - Reference Safety Data Sheets, particularly Section 14 (SDS)
 - Appendix E of the IFC (Hazards Categories)
 - NFPA 400 (2019), Hazardous Materials Code
 - Hazardous Materials Expert Assistance – Version 6 (Obsolete)

Occupancy Classification Process:

Step 1: Characterize Hazardous Material(s)

Physical Hazards	Health Hazards
• Combustible Dust • Combustible Liquid • Combustible Fiber • Consumer Fireworks • Cryogenics, Flammable • Cryogenics, Inert • Cryogenics, Oxidizing • Explosives • Flammable Gas • Flammable Liquid, Combination • Flammable Solid • Organic Peroxide • Oxidizer • Oxidizing Gas • Pyrophoric Material • Unstable (Reactive) • Water Reactive	• Corrosive • Highly Toxic • Toxic

Code Definitions: IFC & IBC Chapter 2

TOXIC. A chemical falling within any of the following categories:

1. A chemical that has a median lethal dose (LD_{50}) of more than 50 milligrams per kilogram, but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose (LD_{50}) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration (LC_{50}) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than 2 milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

FLAMMABLE LIQUID. A liquid having a closed cup flash point below 100°F (38°C). Flammable liquids are further categorized into a group known as Class I liquids. The Class I category is subdivided as follows:

Class IA. Liquids having a flash point below 73°F (23°C) and having a *boiling point* below 100°F (38°C).

Class IB. Liquids having a *flash point* below 73°F (23°C) and having a *boiling point* at or above 100°F (38°C).

Class IC. Liquids having a *flash point* at or above 73°F (23°C) and below 100°F (38°C).

Appendix E of the International Fire Code:

Hazard Categories

E102.1.10 Unstable (reactive) materials. Examples include:

Class 4: acetyl peroxide, dibutyl peroxide, dinitrobenzene, ethyl nitrate, peroxyacetic acid and picric acid (dry) trinitrobenzene.

Class 3: hydrogen peroxide (greater than 52 percent), hydroxylamine, nitromethane, paranitroaniline, perchloric acid and tetrafluoroethylene monomer.

Class 2: acrolein, acrylic acid, hydrazine, methacrylic acid, sodium perchlorate, styrene and vinyl acetate.

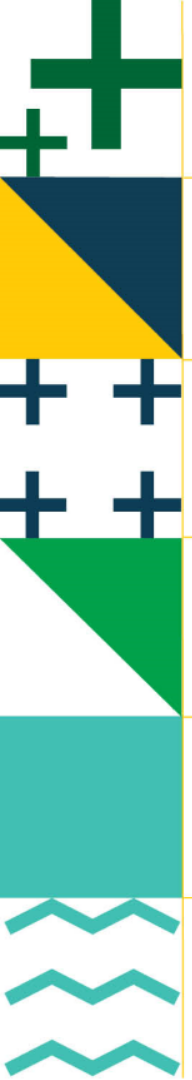
Class 1: acetic acid, hydrogen peroxide 35 percent to 52 percent, paraldehyde and tetrahydrofuran.

E102.1.11 Water-reactive materials. Examples include:

Class 3: aluminum alkyls such as triethylaluminum, isobutylaluminum and trimethylaluminum; bromine pentafluoride, bromine trifluoride, chlorodiethylaluminum and diethylzinc.

Class 2: calcium carbide, calcium metal, cyanogen bromide, lithium hydride, methylchlorosilane, potassium metal, potassium peroxide, sodium metal, sodium peroxide, sulfuric acid and trichlorosilane.

Class 1: acetic anhydride, sodium hydroxide, sulfur monochloride and titanium tetrachloride.



Occupancy Classification Process:

Step 2: Determine Use Category

- **Storage**
 - Keeping or retention of hazardous materials in closed containers, tanks, cylinder or similar vessels
 - Vessels supplying operations through closed connections
- **Use (Closed System)**
 - Operations involving closed vessel or system that remains closed during normal operations
 - All uses of compressed gases
- **Use (Open System)**
 - Operations involving systems that are continuously open to the atmosphere during normal operation
 - Vapors are routinely liberated; material is exposed to atmosphere during normal operations

Occupancy Classification Process:

Step 3: Properly Account for Quantity

TABLE 5003.1.1(1) (TABLE 307.1(1))

MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD (a,j,m,n,p)

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE			USE-CLOSED SYSTEMS			USE-OPEN SYSTEMS	
			Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Flammable Liquid (c)	IA	H-2 or H-3	NA	30(d,e)	NA	NA	30(d)	NA	NA	10(d)
	IB & IC			120 (d,e)			120(d)			30(d)
Flammable Liquid, Combination (IA, IB, IC)	NA	H-2 or H-3	NA	120 (d,e,h)	NA	NA	120 (d,h)	NA	NA	10(d,h)

Occupancy Classification Process:

Step 3: Properly Account for Quantity

- **Analysis must be done for each hazard category**
 - Separate tables for physical and health hazards
 - IFC Table 5003.1.1(1) or IBC Table 307.1(1): Physical Hazards
 - IFC Table 5003.1.1(2) or IBC Table 307.1(2): Health Hazards
 - Most restrictive hazard category governs occupancy classification
- **Limits for each use category;**
 - Max quantity allowed: Storage
- **Review footnotes: Many important allowances & adders**
- **Document basis and quantities (Management of Change)**

Calculating HazMat Quantity Limits

- **Base Amounts**
 - From Hazmat Tables in the IFC and IBC
- **Additional Allowances in Footnotes (Generally +)**
- **Levels Above and Below Grade (Generally -)**
 - IBC Table 414.2.2
 - IFC Table 5003.8.3.2

FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA*
Above grade plane	Higher than 9	5
	7-9	5
	6	12.5
	5	12.5
	4	12.5
	3	50
	2	75
	1	100
Below grade plane	1	75
	2	50
	Lower than 2	Not Allowed

A Brief Example:

“I want to use some Flammable Liquids”

- **Spec building for traditional manufacturing operations**
- **New opportunity to use a flammable liquid:**
 - Flash Point: 45 F (7.2C) Boiling Point: 150 F (65.5 C)
 - Class IB liquid (Physical Hazard)
- **Using Table 307.1(1) in IBC or Table 5003.1.1(1) in IFC**
 - Limits: 30 gallons in Open System; 120 gallons in Closed System or Storage
 - Ability to double amount if automatic sprinkler system is installed (Note d)
 - Ability to double (again) amount for storage in fire resistant cabinets (Note e)
 - Deductions for floors above and below grade level (IBC Table 414.2.2)
- **Basic Approach: If above these quantities → Group H**
- **Other hazard categories evaluated similarly**

A Brief Example:

“I want to use some Flammable Liquids”

[F] TABLE 307.1(1)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD (a,j,n,m,p)

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE (b)			USE-CLOSED SYSTEMS (b)			USE-OPEN SYSTEMS (b)	
			Solid Pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Flammable Liquid (c)	IA	H-2 or H-3	NA	30 (d,e)	NA	NA	30 (d)	N/A	NA	10 (d)
	IB and IC			120 (d,e)			120 (d)			30 (d)

Diagram showing red brackets and numbers 1 through 5 below the table, indicating the following categories:

- 1: Material
- 2: Class
- 3: Storage (Maximum Base Quantity Allowed)
- 4: Closed Systems
- 5: Open Systems

- 1 – Chemical Category
- 2 – Occupancy Classification if Allowable Quantity is Exceeded
- 3 – Maximum Quantity for Storage (Maximum Base Quantity Allowed)
- 4 – Maximum Quantity for Closed Systems
- 5 – Maximum Quantity for Open System



A Brief Example:

“I want to use more Flammable Liquids”

- “But, I want more flammable liquids in my building!”
- May work on establishing fire resistive control areas (zones) to allow up to the exempt amount in multiple areas
 - 4 Control areas for ground floor
 - Less control areas allowed on higher (and lower) floors
 - Refer to IBC Table 414.2.2 or IFC Table 5003.8.3.2 for detailed information
- Important to consider the life cycle of building operations

A Brief Example:

“I want to use more Flammable Liquids”

- I want to Store Flammable Liquids on the Grade Level, and I have a Sprinkler System
 - Base Storage Amount is 120 Gallons
 - Note (d) allows a doubling for Sprinkler System: 240 Gallons
 - Table 5003.8.3.2 allows up to 4 Control Areas on Grade Level
 - 4 Fire Separated Areas, each with up to 240 Gallons

TABLE 5003.8.3.2
DESIGN AND NUMBER OF CONTROL AREAS

FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA ^a	NUMBER OF CONTROL AREAS PER FLOOR	FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS ^b
Above grade plane	Higher than 9	5	1	2
	7-9	5	2	2
	6	12.5	2	2
	5	12.5	2	2
	4	12.5	2	2
	3	50	2	1
	2	75	3	1
	1	100	4	1
Below grade plane	1	75	3	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 5003.1.1(1) and 5003.1.1(2), with all increases allowed in the footnotes to those tables.

b. Separation shall include fire barriers and horizontal assemblies as necessary to provide separation from other portions of the building.

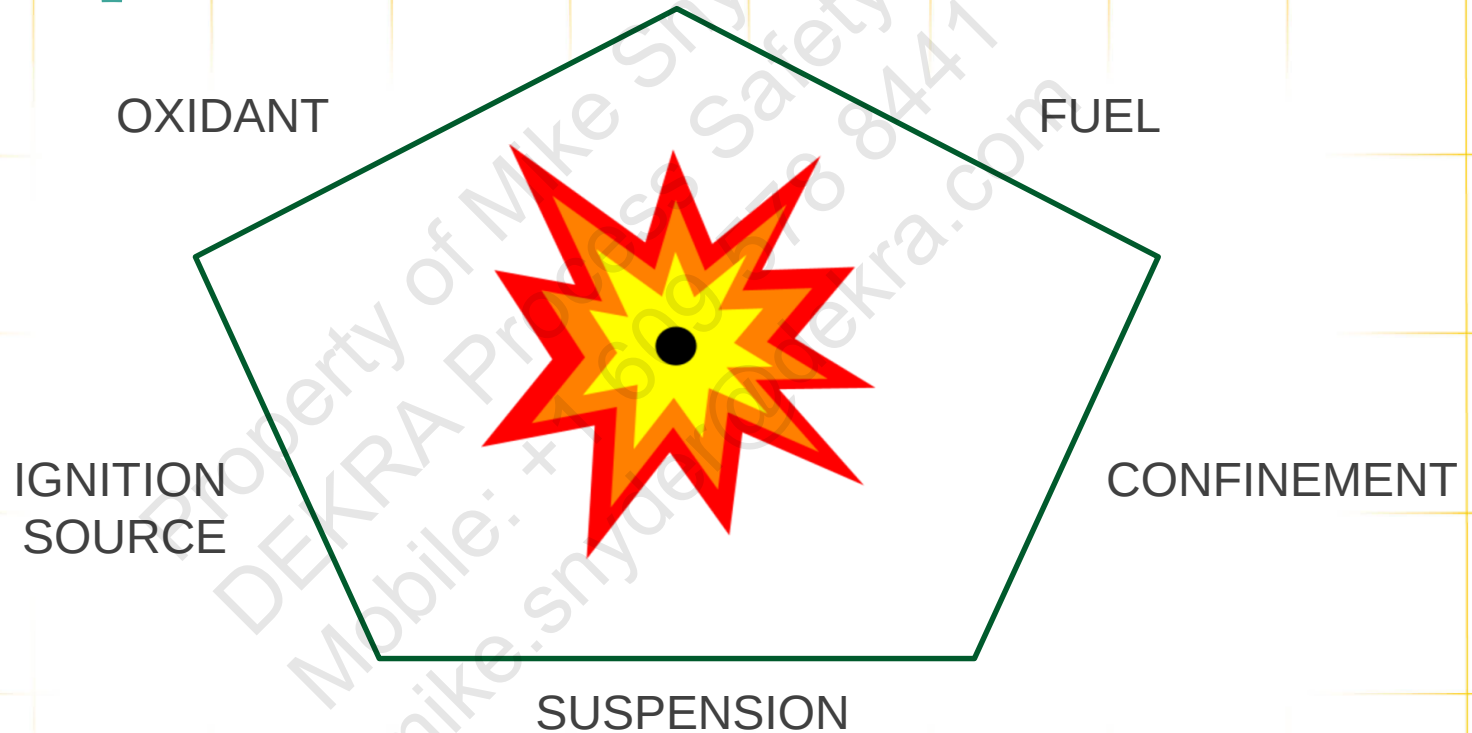
Combustible Dust:

New Occupancy Classification Challenges

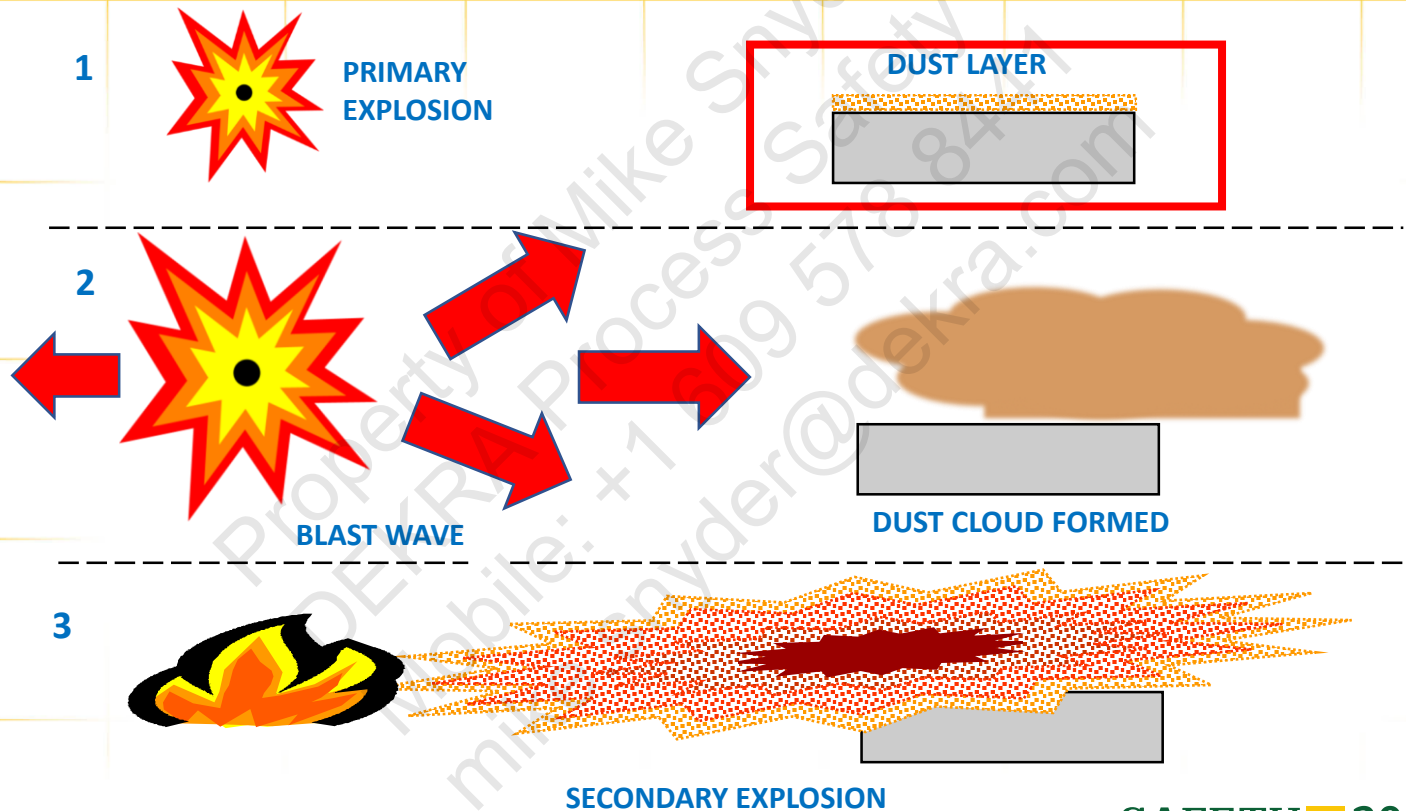
- New requirements established in 2012
- No “Exempt Amounts”
- Dust manufactured or used in a fashion presenting a fire or explosion hazard
 - IBC Table 307.1(1) & IFC Table 5003.1.1(1)
 - Occupancy Classification: Group H-2
- Engineering evaluation in Section 414.1.3 to quantitatively document analysis for not classifying as Group H-2
 - Dust Hazard Analysis
 - Additional information in Chapter 22 of the IFC



Combustible Dust Fire or Dust Explosion: Required Conditions



Secondary Explosions Present Additional Risk



Conclusions



- **Hazardous materials storage & use can have significant implications on your building utilization and configuration**
- **Proper determination of occupancy classification is key!**
 - Characterize the Hazardous Material(s) Planned or Used
 - Determine Use Category of Each Hazardous Material
 - Properly Account for the Quantity of each Hazardous Material
- **Ensure sensitivity for modifications to hazardous materials use or anticipated future quantities (Management of Change)**
- **Awareness of potential for Group H-2 occupancy classification issues related to combustible dust**

Thank You for Participating in Today's Session

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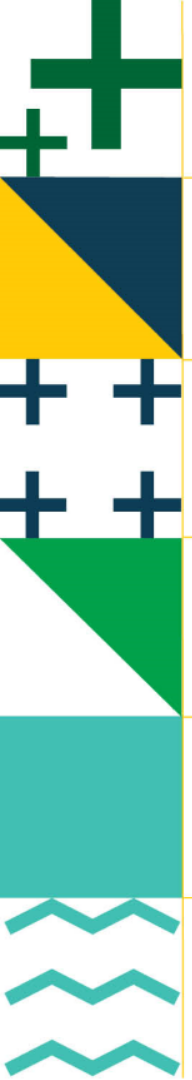
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References:

- International Building Code (2018):
 - <https://codes.iccsafe.org/content/IBC2018>
- 2018 International Fire Code (2018):
 - <https://codes.iccsafe.org/content/IFC2018>
- NFPA 400: Hazardous Materials Code
 - <http://www.nfpa.org/400>
- NFPA 652: Standard on the Fundamentals of Combustible Dust
 - <http://www.nfpa.org/652>
- [SAFETY GUIDE : A strategic guide to characterization and understanding Handling Dusts and Powders Safely](#)



YOUR FEEDBACK IS IMPORTANT

Electronic Session Evaluations can be completed:

- On the Safety 2019 App under each session's description
 - How Hazmat Use and Storage Impacts Your Facility's Occupancy Classification
 - Session S5084