White Paper

From Ordinary to High-Hazard: Understanding Occupancy Classification Impacts of Hazardous Materials

Executive Summary

Several organizations, including the International Code Council (ICC) and the National Fire Protection Association (NFPA), publish model codes and standards that serve as the foundation for building design and fire protection requirements. These documents, such as the International Building Code (IBC), the International Fire Code (IFC), and NFPA 1 – Fire Code, are not merely recommended practices—they are intended for adoption by state and local jurisdictions as legally enforceable regulations. The IBC has been adopted, at least in part, by all 50 states. The IFC has been adopted in whole or in part by 39 states, while many others use NFPA 1 as the basis for their fire code.

Depending on the location, facilities may encounter routine code inspections conducted by governmental agencies. In most jurisdictions, applications for building and occupancy permits include a review of compliance with the adopted codes. In either case, requirements arising from these activities are legally binding and enforceable. Facilities can be shut down or, in the case of new facilities, prevented from opening due to fire and building code violations.

Purpose of the Building and Fire Codes

To establish the minimum requirements for providing a reasonable level of life safety and property protection..., and to provide a reasonable level of safety to firefighters and emergency responders during emergency operations.

Hazardous materials play a critical role in determining how buildings are classified for occupancy under fire and building codes. While both the National Fire Protection Association (NFPA) and the International Code Council (ICC) provide frameworks for classifying occupancies, this article focuses on the approach outlined in the International Fire Code (IFC) and International Building Code (IBC). Given the widespread adoption of these model codes across U.S. jurisdictions, understanding how hazardous material quantities, use, and storage affect Group H (High-Hazard) occupancy classification is essential for facility designers, operators, and code officials alike.

Occupancy Classifications

The codes typically classify structures (or portions thereof) into occupancy groups based on the activities that occur within in the structure. The code's aim is to ensure buildings are designed and constructed appropriately for their intended use, considering factors such as fire hazards, occupant safety and potential hazards. The codes establish construction features for buildings depending on the occupancy classification.

The level of protection required by the code is based on the quantity of hazardous material and its intended use. For each category of hazardous materials, the codes identify a Maximum Allowable Quantity (MAQ). The MAQ is defined as the maximum amount of hazardous material allowed to be stored or used within a ***control area*** inside or outside of a building. The maximum allowable quantity per control area is based on the materials state (solid, liquid or gas) and the material's storage or use conditions. Materials stored and used in quantities exceeding the MAQ will require classification as a Group H occupancy. Determining whether the MAQ has been exceeded can, however, be deceivingly complex. Determination of the hazards posed by a material can be confusing, and materials with similar hazards must be considered in aggregate. Compliance can be further confounded when materials possess multiple hazards (e.g., toxic and flammable),and when structures must meet the requirements of more than one of the H-Occupancy types.

The presence of hazardous materials in a structure can increase risk to occupants, the community, and emergency responders. Depending on the quantity of hazardous materials and how they are used, portions or all of a structure may be classified as a Group H occupancy.

Control Area

A space within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, used, or handled.

There are five categories of H Occupancies:

H-1: Materials that pose a detonation hazard
H-2: materials that pose a deflagration hazard or hazards from accelerated burning.
H-3: materials that readily support combustion or pose other significant physical hazards.
H-4: This group includes materials that present a health hazard, such as toxic or corrosive substances.
H-5: This group is specifically for semiconductor fabrication facilities and research and development areas that utilize hazardous production materials (HPM).

Examples of Occupancy Types

Assembly (A)
Business (B)
Educational (E)
Factory and Industrial (F)
High Hazard (H)
Institutional (I)
Mercantile (M)
Residential (R)
Storage (S)
Utility (U).

Navigating Group H Requirements: Three Steps to Safer Compliance

There are three distinct analyses required to properly determine if an H Occupancy exists. Each requires specialized knowledge of not only the appropriate building and fire codes but also of related standards such as NFPA 400 and the Globally Harmonized System for classifying material hazards. Mistakes in one step can propagate through subsequent steps, exacerbating errors. Proper identification of the material hazards, using the correct definition of each hazard type, is critical. The usage categories can easily be misconstrued. What follows is an overview of the process.

Step 1: Characterizing the Hazardous Materials

The IFC identifies 17 Physical Hazard types and three Health Hazards. Each hazard type is defined in NFPA 400, and Appendix J provides a comparison of definitions between NFPA 400, the IFC, and OSHA's Hazard Communication Standard. Appendix E of the IFC maps many of the GHS categories used on Safety Data Sheets (SDS) to the IFC material classifications. The information required to classify hazardous materials sometimes exceeds the standard information available from SDS. Laboratory testing to recognized standards can provide additional information.

Materials may fall into multiple hazard categories and must be evaluated separately for each applicable category. Sources of information on materials hazards include Safety Data Sheets (SDS), testing, or commercial databases such as HMEx Assistant (*www.HMExassistant.com*).

Step 2: Determine the Use Category

After determining the hazard categories to which a material belongs, the type of use for each material must be determined. The IFC defines three types of use:

Storage: The keeping, retention, or leaving of hazardous materials in closed containers, tanks, cylinders, or similar vessels, or vessels supplying operations through closed connections.
Open use: Used in a vessel or system that is continuously open (or the product is exposed) to the atmosphere during normal operations, and vapors are liberated.
Closed use: Vessel or system that remains closed during operation.

In many cases, a material may be both stored and used in the same space. In this case, the aggregate quantity in use and storage is not permitted to exceed the quantity listed for storage.

Step 3: Determine the MAQ

Chapter 50 of the IFC contains tables showing the MAQs based on the material hazard and type of usage (See Figure below). In addition, the tables list the applicable H Occupancy if the MAQ is exceeded. Separate tables for Physical and Health hazards are included, as well as separate tables for outdoor control areas. It is critically important to understand and apply the footnotes to these tables. They can alter the MAQ and provide essential restrictions.

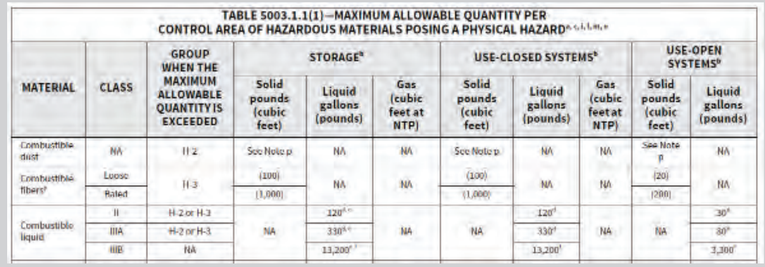

TABLE 5003.1.1(1)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, c, i, l, m, n]

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE[k]			USE-CLOSED SYSTEMS[k]			USE-OPEN SYSTEMS[k]	
			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)
Combustible dust	NA	H-2	See Note p	NA	NA	See Note p	NA	NA	See Note p	NA
Combustible fibers[d]	Loose	H-3	(100)	NA	NA	(100)	NA	NA	(20)	NA
	Baled		(1,000)			(1,000)			(200)	
Combustible liquid	II	H-2 or H-3	NA	120[f, n]	NA	NA	120[f]	NA	NA	30[f]
	IIIA	H-2 or H-3		330[f, n]			330[f]			80[f]
	IIIB	NA		13,200[f]			13,200[f]			3,300[f]

After the MAQ is determined, it must be adjusted for Control Areas located above or below grade level. The MAQ and number of permitted Control Areas are reduced based on the number of stories above or below grade.

IFC Hazardous Materials Requirements

For most of the physical and health hazard categories, Chapters 51 through 67 of the IFC provide additional requirements. Each chapter is specific to a hazard type (e.g. reactive materials, oxidizers, peroxides) and ensures that the unique hazards of each material type are addressed. These requirements are designed to achieve the primary objectives of the codes: Life Safety, Property Protection, and the Safety of Emergency Responders.

Consideration of Modern Refrigerants

There is a global focus on the use of refrigerants with a low Greenhouse Warming Potential (GWP). These include ammonia and new blends of "moderately" flammable gases categorized as A2L by the American Society of Heating,

Refrigerating, and Air-Conditioning Engineers (ASHRAE). These “moderately” flammable refrigerant gases are classified as having High or Low Burning Velocity (BV). The MAQ is significantly increased for gases with a burning velocity of < 10 cm/s.

Care should be taken not to confuse the differentiation of A2L gases with the flammable gas definition used by OSHA. Coverage by their Process Safety Management standard is not affected by the BV of flammable gases, and an inventory of 10,000 pounds of these materials that are interconnected or co-located will trigger the requirements of the PSM Standard.

Combustible Dusts

Combustible dusts are categorized as a specific hazard type in the IFC. However, instead of having an MAQ, H Occupancy applies to any amount of combustible dust that is manufactured, generated, or used in such a manner that the concentration and conditions create a fire or explosion hazard (IFC, Table 503.1.1(1), footnote P). In other words, the storage or use of any quantity of combustible dust may require a group H-2 occupancy. Determination of whether a fire or explosion hazard exists is determined by an engineering analysis based on information prepared in accordance with Section 104.2.2 of the IFC. The requirements of Chapter 22 may also apply where combustible dust is stored or used.

Lifecycle Considerations

Like most safety aspects of processes, they must be maintained for the life of the process. This includes consideration of process changes. Any increase in the quantity of hazardous materials may result in exceeding the MAQ. Adding a new material may result in a new hazard category or exceeding the MAQ for one or more existing hazard categories. A robust Change Management process should include consideration of these aspects.

The IFC, IBC, and NFPA codes are updated on a cyclic basis, as often as every three years. Changes to occupancy classifications and the requirements of the material-specific chapters may alter compliance requirements. These changes should be reviewed and considered for adoption.

Conclusion

Regardless of the adopted Building or Fire Code, features must be provided to protect life, property, and emergency responders. Limiting the amount of hazardous material to less than the MAQ is an Inherently Safer alternative. Multiple control areas, each containing less than the MAQ, are permitted within the limitations of the code. However, many situations make this an untenable solution. Where the MAQ is exceeded, building and fire protection features required by the codes will minimize risk to an acceptable level.

Assessment of hazardous materials, control areas, and H Occupancies requires specialized knowledge and experience working with codes and enforcement officials. Experienced practitioners can offer pragmatic solutions to achieving an acceptable level of risk. In many cases, meetings with code officials will be required to explain the assessment and its outcomes.
Face-to-face discussions allow for questions and provide clarity. DEKRA offers a comprehensive solution to help organizations ensure building and fire code compliance when using or storing hazardous materials.

This service line combines deep regulatory expertise with chemical hazard classification and testing to accurately determine occupancy classifications under the International Building Code (IBC), International Fire Code (IFC), and NFPA 1. DEKRA guides clients through materials classification, Maximum Allowable Quantity (MAQ) evaluations, control area design, and the application of Group H or Protection Level designations. Specialized capabilities include combustible dust evaluations, support for emerging hazards like A2L refrigerants and Li-ion batteries, and integration with Management of Change (MOC) systems. DEKRA also provides clear, defensible documentation and direct support in interfacing with Authorities Having Jurisdiction (AHJs), ensuring facilities remain compliant, safe, and operational.

DEKRA Key Services for HazMat Building & Fire Code Compliance

1. Occupancy Classification Consulting (IBC, IFC, NFPA 1):
Expert application of building and fire codes to determine if operations trigger Group H or NFPA Protection Level classifications, including control area design, MAQ compliance, and identification of code-required building features.

2. Hazardous Material Inventory Assessment and MAQ Analysis:
Detailed evaluation of the types, quantities, and use categories (storage, open/closed systems) of hazardous materials to compare against code-defined thresholds and support defensible compliance documentation.

3. Chemical Hazard Classification Testing:
Laboratory testing services (flammability, explosivity, combustibility, reactivity, toxicity, etc.) to accurately classify substances under code definitions—especially critical for new formulations, mixtures, or uncertain SDS data.

4. Combustible Dust & Emerging Hazards Analysis:
Specialized support for combustible dust classification (H-2/Protection Level 2) through engineering evaluations and Dust Hazard Analyses (DHA), as well as guidance for A2L refrigerants and Li-ion battery storage implications.

5. Code Compliance Support During Change (MOC):
Integration of building/fire code implications into Management of Change (MOC) processes to prevent non-compliance when materials, processes, or layouts change over time.

6. AHJ Interface and Documentation Support:
Preparation of clear, regulator-ready technical reports required under IBC 414.1.3 or IFC 104.2.2 and support during discussions with Authorities Having Jurisdiction (AHJs) to secure permits and maintain operating licenses.

Let's Talk:

Learn More

Contact ***DEKRA*** for comprehensive building and fire code compliance solutions.

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