

TechNotes Issue # 370  
March 28, 2017

## **Navigating the Relationship of NFPA 30 and NFPA 13: Sprinklers for Flammable and Combustible Liquids**

### **NFPA 13, Standard for the Installation of Sprinkler Systems**

First and foremost, NFPA 13 is an installation standard. It doesn't say when sprinklers are required; it says how to go about installing them. Its primary focuses are on the requirements for physically installing sprinkler systems and methods for hydraulic calculation to model anticipated system demands. It also provides prescriptive requirements for the layout and design of sprinkler systems for both storage and non-storage occupancies based on the classification of hazards.

#### **1.1 Scope.**

**1.1.1** This standard shall provide the minimum requirements for the design and installation of automatic fire sprinkler systems and exposure protection sprinkler systems covered within this standard.

NFPA 13 deals directly with very little in the combustible and flammable liquid realm. For non-storage applications, combustible and flammable liquids are not mentioned at all until we get to Section 5.4 Extra Hazard Occupancies. Of course, we know that there are many combustible and flammable liquids found in occupancies typically classified as Light Hazard and Ordinary Hazard.

**5.4.1\* Extra Hazard (Group 1).** Extra hazard (Group 1) occupancies shall be defined as occupancies or portions of other occupancies where the quantity and combustibility of contents are very high and dust, lint, or other materials are present, introducing the probability



of rapidly developing fires with high rates of heat release but with little or no combustible or flammable liquids.

**5.4.2\* Extra Hazard (Group 2).** Extra hazard (Group 2) occupancies shall be defined as occupancies or portions of other occupancies with moderate to substantial amounts of flammable or combustible liquids or occupancies where shielding of combustibles is extensive.

Where storage is concerned, combustible and flammable liquids are not mentioned in 5.6.1.1\* Classification of Commodities at all but appear in the annex commentary. Although suggestions are provided for up to 20% alcohol and some specific commodities, little guidance overall is provided for combustible and flammable liquids. As with all occupancy and commodity classification, it is up to the responsible design professional to evaluate occupancies that include the incidental presence of combustible and flammable materials.

Combustible and Flammable Liquids Classification Guidelines from Annex A Commentary	
Class I	Up to 20% alcohol in metal, glass, or ceramic; or in plastic bottles or jars up to 5 gallons
Class II	Up to 20% alcohol in containers >5 gallons with walls ≤ 1/4" or in wood containers
Class III	Aerosol, Level 1
Class IV	-
Group A	Butane lighters in blister packs, cartoned; Up to 20% alcohol in containers >5 gallons with walls > 1/4"

NFPA 13 Section 11.2.1.2.3 provides information to classify hazards including the presence of combustible and flammable liquids. Where the type or quantity of combustible and flammable liquids exceeds the scope of NFPA 13, the designer is directed to NFPA 30 by Section 22.2.1. This jump is not always intuitive and designers may miss the need to at least evaluate whether or not they are faced with a situation that should be evaluated under NFPA 30.

**11.2.1.2.3 Occupancies or portions of occupancies**



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shall be classified according to the quantity and combustibility of contents, the expected rates of heat release, the total potential for energy release, the heights of stockpiles, and the presence of flammable and combustible liquids, using the definitions contained in Section 5.2 through Section 5.5.

**22.2.1 Design Requirements.** Sprinkler system discharge criteria for the protection of flammable and combustible liquids shall comply with NFPA 30.

## **NFPA 30, Flammable and Combustible Liquids Code**

The first thing that should be noted about NFPA 30 is that it is a complete code intended to govern all aspects of protection for flammable and combustible liquids with the exception of certain exotic categories of liquids and those situations governed by other standards or regulations.

### **1.1 Scope.**

**1.1.1\*** This code shall apply to the storage, handling, and use of flammable and combustible liquids, including waste liquids, as herein defined and classified.

**1.1.2** This code shall not apply to the following:

- (1)\*** Any liquid that has a melting point of 100°F (37.8°C) or greater
- (2)\*** Any liquid that does not meet the criteria for fluidity given in the definition of liquid in Chapter 3 and in the provisions of Chapter 4
- (3)** Any cryogenic fluid or liquefied gas, as defined in Chapter 3
- (4)\*** Any liquid that does not have a flash point, but which is capable of burning under certain conditions
- (5)\*** Any aerosol product
- (6)** Any mist, spray, or foam
- (7)\*** Transportation of flammable and combustible liquids as governed by the U.S. Department of Transportation
- (8)\*** Storage, handling, and use of fuel oil tanks and containers connected with oil-burning equipment
- (9)\*** Use and installation of alcohol-based hand rub (ABHR) dispensers

The Code includes requirements for fire resistance-rated construction, diking, drainage, and ventilation in addition to fire control systems which are only a small part of the document. Where the Code requires fire control systems, Section 6.7.6 references a variety of installation standards including NFPA 13. For the purposes of this article, only

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sprinkler based systems will be considered.

**6.7.6** Where provided, fire control systems shall be designed, installed, and maintained in accordance with the following NFPA standards, as applicable:

- (1) NFPA 11, Standard for Low-, Medium-, and High-Expansion Foam
- (2) NFPA 12, Standard on Carbon Dioxide Extinguishing Systems
- (3) NFPA 12A, Standard on Halon 1301 Fire Extinguishing Systems
- (4) NFPA 13, Standard for the Installation of Sprinkler Systems
- (5) NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection
- (6) NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
- (7) NFPA 17, Standard for Dry Chemical Extinguishing Systems
- (8) NFPA 750, Standard on Water Mist Fire Protection Systems
- (9) NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems

### **Classification of Combustible and Flammable Liquids**

Unlike NFPA 13 where hazards must be evaluated subjectively by the design professional, the relative hazards of combustible and flammable liquids are classified in Section 4.3.1 of NFPA 30 by the objectively determined physical and chemical properties of each liquid, blend, or mixture of liquids. Documentation providing these physical and chemical properties can usually be readily obtained in the form of Material Safety Data Sheets (MSDS).

For hazard classification purposes, combustible and flammable liquids are categorized based on their flash point and boiling point. Flash point is the temperature where a liquid releases sufficient vapor to ignite momentarily in the presence of an ignition source. Boiling point is the temperature where a liquid's vapor pressure is equal ambient pressure. Both of these reference temperatures are determined at standard laboratory conditions. Liquids with flash points below 100°F are deemed flammable; those at or above 100°F are deemed combustible. Classifications for flammable liquids run from Class IC Liquids (flash points between 73°F and 100°F), the least flammable, to Class IA Liquids (flash point < 73°F, boiling point < 100°F), the most flammable. Classifications for combustible liquids run from Class IIIB Liquids (flash point > 200°F) the least combustible, to Class II Liquids (flash point

between 100°F and 140°F), the most combustible.

Once the liquid has been classified, the requirements in NFPA 30 are based on additional characteristics of the liquid, how it is contained, and the nature of the occupancy housing it.

### **Storage of Liquids in Containers - General Requirements**

Chapter 9 and Table 9.6.1 introduces the concept of Maximum Allowable Quantity (MAQ) regulating the quantity of each class of liquid per control area. Where sprinkler systems are provided in compliance with NFPA 13, the MAQ is doubled; where they are provided in compliance with NFPA 13 and Chapter 16, quantities are unlimited.

Additional smaller MAQ limits are imposed by 9.6.2.1 based on occupancy. MAQs for Assembly, ambulatory health care, business, day care, detention and correctional, educational, health care, and residential occupancies are limited by Table 9.6.2.1. For ambulatory health care, day care, educational, and health care occupancies, the MAQ for Class IIIB liquids can be doubled if sprinklers are provided in accordance with NFPA 13. Where any of these occupancies has less than the MAQ of combustible and flammable liquids on premises.

Class I & II	10 gallons
Class IIIA	60 gallons
Class IIIB	120 gallons

Lastly, the MAQ is reduced by Table 9.7.2 depending on how far a control area is located above or below the grade plane. Higher floors are permitted lower quantities of combustible and flammable liquids. Below grade floors have additional restrictions. The remaining occupancy groups are addressed separately.

### **Storage of Liquids in Containers - Mercantile Occupancies**

Mercantile occupancies get their own MAQs in Table 10.7.1 MAQs for Storage and Display in Mercantile Occupancies. Different quantities are permitted based on whether the occupancy is unprotected stored up to 12 feet in height, protected with NFPA 13 OH2 stored up to 12 feet in height, or protected with Chapter 16.

## **Storage of Liquids in Containers - Storage Occupancies**

One item that commonly causes confusion in NFPA 30 Chapter 12 and elsewhere is the idiosyncratic use of the terms "protected" and "unprotected". Protected storage refers specifically to storage installed after January 1, 1997 protected in accordance with Chapter 16 or an approved alternative means as indicated by 12.3.4. All other storage, regardless of fire control systems, is considered unprotected for the purposes of this chapter.

**12.3.4** For the purposes of this chapter, protected storage shall mean storage installed after January 1, 1997, that is protected in accordance with Chapter 16. All other storage shall be considered unprotected storage unless an alternate means of protection has been approved by the authority having jurisdiction. (See 16.3.5 and Section 16.9.)

This is important when applying the quantity limitations contained in Table 12.6.2.2 Quantity Limitations for Unprotected Liquid Warehouses as this table sets the maximum quantities of liquids that can be stored in liquid warehouses not in compliance with Chapter 16 fire control measures.

For general-purpose warehouses, 12.8.1\* provides the option to provide protection using either Chapter 16 or NFPA 13 as for 20-foot high storage of Class IV commodities. It should be noted, however, that the annex note to section A.12.8.1 suggests that "[the NFPA 13 criteria] should not be construed as providing adequate protection". A.12.8.1 should be reviewed carefully before choosing that option!

**12.8.1\*** Class IB and IC liquids in containers of 1.3 gal (5 L) or less capacity, Class II liquids in containers of 5.3 gal (20 L) or less capacity, Class IIIA liquids in containers of 60 gal (230 L) or less capacity, and Class IIIB liquids in containers, intermediate bulk containers, or portable tanks of 275 gal (1040 L) or less capacity shall be permitted to be stored in warehouses that handle combustible commodities, as defined in NFPA13, Standard for the Installation of Sprinkler Systems, provided that the storage area for liquids is protected with automatic sprinklers in accordance with either of the following:

- (1) The applicable provisions of NFPA 13 for 20 ft (6 m) high storage of Class IV commodities based on the storage configuration of the liquids
- (2) The provisions of Chapter 16

**A.12.8.1** The provision of automatic sprinklers designed to protect Class IV commodities to a height of 20 ft (6 m) for the liquid storage quantities and arrangements allowed in a general-purpose warehouse should not be construed as providing adequate protection. Fire tests utilizing such design criteria on the allowed storage arrangements have never been conducted, and other test results imply that control of a liquid pool fire might not be obtained. Examples of fire protection can be found in Chapter 16.

### **Automatic Fire Protection for Inside Liquid Storage Areas**

Chapter 16 is built around three decision trees selected in accordance with the type of container in use. The trees branch based on the physical and chemical properties of the liquids, storage configurations, or container size.

**FIGURE 16.4.1(a) Fire Protection Criteria Decision Tree for Miscible and Nonmiscible Flammable and Combustible Liquids in Metal Containers.**

**FIGURE 16.4.1(b) Fire Protection Criteria Decision Tree for Miscible and Nonmiscible Flammable and Combustible Liquids in Nonmetallic Containers.**

**FIGURE 16.4.1(c) Fire Protection Criteria Decision Tree for Miscible Flammable and Combustible Liquids in Nonmetallic Containers.**

The end points of these decision trees indicate one of three possibilities: That the given liquid in the given container can be protected in accordance with a given NFPA 13 commodity class; that it can be protected in accordance with the criteria provided in a given table in Chapter 16; or that it falls outside of the scope of Chapter 16.

For those arrangements that fall within the scope of Chapter 16, one or more specific sprinkler discharge criteria tables for ceiling and rack sprinklers are provided for permissible storage arrangements for each branch of the decision tree with a Chapter 16 terminus. The options available for any given combination of liquids, containers, and storage configurations represent fire protection schemes that have been tried successfully in large scale testing. With the exception of those specific sprinkler criteria and any stated exceptions, the rest of the sprinkler installation is governed by NFPA 13 including hydraulic calculation methods and acceptance testing.



## Summary

NFPA 13 provides very limited guidance with regard to the protection of combustible and flammable liquids. When such liquids are present in greater than incidental quantities, NFPA 30 should be consulted. Although NFPA 13 does not define a threshold quantity of combustible liquids that are outside its scope, NFPA 30 does define Maximum Allowable Quantities (MAQ) requiring no protection and those which can be sufficiently protected by NFPA 13. That information can be of use to the qualified design professional determining occupancy hazards for buildings with combustible and flammable liquids that are to be protected using NFPA 13 even if NFPA 30 does not apply.

In some cases, NFPA 30 will simply assign protection based on NFPA 13 occupancy hazard classes. In others, it will define its own specific sprinkler discharge criteria but relying on NFPA 13 for rules of basic installation, calculation, and acceptance testing. In other cases, protection criteria will fall outside the prescriptive scope of NFPA 30 altogether and a hazard analysis will have to be conducted as defined in Chapter 6 Fire and Explosion Prevention and Risk Control to determine appropriate protection.

## References

*NFPA 13. 2015. Standard for the Installation of Sprinkler Systems. 2016. Quincy, MA: National Fire Protection Association.*

*NFPA 30. 2014. Flammable and Combustible Liquids Code. 2015. Quincy, MA: National Fire Protection Association.*

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