



NFPA 30 (2021) PRACTICAL VIEWPOINTS TO ENSURE CODE COMPLIANCE

Mike Snyder, PE, CSP, CFPS and Sarah Eck, PE, CCPSC

Since 1913, NFPA 30, *Flammable and Combustible Liquids Code*, has served as the leading information source for safe handling and storage of “flammable and combustible liquids.” It is a widely used Recognized and Generally Accepted Good Engineering Practice (RAGAGEP) in the field of Flammable and Combustible Liquid Risk Management.

Introduction

Since 1913, NFPA 30, Flammable and Combustible Liquids Code, has served as the leading information source for safe handling and storage of flammable and combustible liquids. It is a widely used Recognized and Generally Accepted Good Engineering Practice (RAGAGEP) in the field of Flammable & Combustible Liquid Risk Management, and is applied by government authorities, emergency responders and end-users to ensure safe storage and handling of liquids. Many state and regionally adopted Flammable and Combustible Liquid Codes are based on recent editions of NFPA 30. US-OSHA enforces 29 CFR 1910.106, Flammable Liquids, which is based on the NFPA 30 (1969), and include a series of interpretive letters and agency directives.

This paper will overview the principles required to establish a basis of safety for proper handling and storage of liquids. Six significant changes proposed for the 2021 edition of NFPA 30 will be highlighted and their implications to flammable and combustible liquid safety practices reviewed. Practical tips for the Process Safety Professional to efficiently navigate older versions of NFPA 30 that are adopted into present regulatory requirements.

Establishing a Basis of Safety for Liquid Use and Storage

The main purpose of NFPA 30 is to provide information that serves as fundamental safeguards for storage, handling, and use of liquids. This is accomplished by, initially, requiring and recommending measures that focus on preventing the ignition of fire. The fire prevention strategy relies on the reliable application of controls to break one or more than one of the legs of the Fire Triangle (Figure 1 on page 2).

NFPA 30 is structured to recognize that reducing fire risk from prevention, alone, is typically not adequate to address all aspects of the liquid risk. The standard provides additional requirements for the use of fire and explosion safeguards or control systems to provide life and structural safety in the event ignition occurs. The extent of these protective systems is typically based on both the flammability characteristics of the liquids being stored, handled, or used and the quantity of material involved.



Figure 1: The Fire Triangle

FUEL

- > Proper design of containers, piping, and tanks to reduce leakage and to provide containment of liquid in early stages of fire exposure
- > Use of low level and local exhaust ventilation to prevent accumulation of flammable vapors
- > Operational procedures to control emissions from Class I liquids in containers and tanks
- > Housekeeping practice to control fuel sources that could provide initial fire exposure to liquids in use and storage
- > Use of flash arrestor systems to limit exposure of flammable vapors within the headspace of tanks

AIR/OXIDANT

- > In limited situations, container transfers and tank headspaces can have oxygen concentration lowered through the introduction of an inert gas.
- > The basis of safety is to ensure that the oxygen concentration is reliably held below the lower oxygen concentration limit required for combustion.
- > Personnel safety must be carefully considered when using this strategy to avoid worker exposure to asphyxiation risks.

IGNITION SOURCES

- > Section 6.5 of NFPA 30 provides an overview of fundamental strategies, focusing on 12 common sources of ignition in liquid operations
- > Key focus on adequate electrical (hazardous) area classification (Chapter 7)
- > Controls for electrostatic risks, particularly when transferring and dispensing liquids
- > Control of hot work operations

The fire and explosion safeguards typically utilized in NFPA 30 include:

- > Drainage & containment
- > Facility design, including use of fire walls, fire resistive construction, and separation distances
- > Fixed fire protection systems
- > Emergency Plans
- > Explosion protection (containment, relief venting, explosion suppression)

NOTE: Focus on this protection is needed when handling liquids that are highly volatile (Class IA & IB) or are chemically unstable.

Overview of NFPA 30

NFPA 30, Flammable and Combustible Liquids Code, is a widely used Recognized and Generally Accepted Good Engineering Practice (RAGAGEP) in the field of Flammable & Combustible Liquid Risk Management. It is applied by government authorities, emergency responders and end-users to ensure safe storage and handling of liquids.

NFPA 30 has been developed and updated through NFPA's standards development process that is a full, open, consensus-based process. NFPA 30 is revised and updated approximately every three years. The standard's cycle takes approximately two years to complete. Each revision cycle proceeds according to a published schedule, which includes final dates for each stage in the standards development process, and provides several opportunities for all members of the public to provide input and commentary for changing, updating, and improving the standard. This information is tracked on the Document Info pages for each standard¹.

The four fundamental steps in the NFPA standards development process are:

- > Public Input
- > Public Comment
- > NFPA Technical Meeting
- > NFPA Standards Council Action (Appeals and Issuance of Standard)

The Regulations Governing the Development of NFPA Standards detail the procedures used during each step of the NFPA 30 Standards development process².

NFPA Technical Committees serve as the principal consensus bodies responsible for developing and updating all NFPA codes and standards. Committee members appointed by the NFPA Standards Council, representing a balance of interests. NFPA membership is not required in order to participate on a NFPA Technical Committee. Appointment to a Technical Committee is based on such factors as technical expertise, professional standing, commitment to public safety, and the ability to bring to the table the point of view of a category of interested people or groups.

Due to the comprehensive nature of NFPA 30, there are four technical committees and one correlating committee that manage the standard's revision and update. The purpose of the correlating committee is to manage and coordinate the activities of the four technical committees involved with NFPA 30 and to ensure that the document sections managed by each technical committee do not contain conflicts or inconsistencies. The responsibilities for the four

technical committees (Fundamentals, Operations, Storage & Warehousing, and Tank Storage & Piping Systems) are summarized in Table 1.

Common Methods for Safe Storage and Handling of Flammable Liquids

NFPA 30 is a widely used Recognized and Generally Accepted Good Engineering Practice (RAGAGEP) in the field of flammable and combustible liquid risk management. It is routinely applied by government authorities, emergency responders and end-users to ensure safe storage and handling of liquids. Successful management of flammable liquid risks are most efficiently provided by understanding the structure of NFPA 30 and the source of its requirements and recommendations. This allows one to effectively use this information for the design and operation of liquids operations.

Table 1: Topical Coverage and Application of NFPA 30 Chapters

Chapter	Application	NFPA Technical Committee
1-7 (5 is reserved)	Requirements for all facilities where liquids are stored, handled, or used	Fundamentals
8	Reserved	
9 through 12	Storage of liquids in containers, portable tanks, and intermediate bulk containers in the occupancies covered by each chapter's scope	Storage & Warehousing of Containers & Portable Tanks (FLC-SWC)
13	Storage of liquids in containers, portable tanks, and intermediate bulk containers in detached unprotected buildings	
14	Storage of liquids in containers, portable tanks, and intermediate bulk containers in hazardous materials storage lockers	
15	Outdoor storage of liquids in containers, portable tanks, and intermediate bulk containers	
16	Fire protection design criteria used to protect storage of liquid in containers, portable tanks, and intermediate bulk containers	
17	Design and construction of facilities where liquids are processed or used	Operations (FLC-OPS)
18	General requirements related to handling, dispensing, transfer, and use of liquids	
19	Specific equipment & operations that use liquids (recirculating heat transfer systems, vapor recovery & processing systems, solvent distillation, and cooking oil storage tanks in commercial kitchens)	
20	Reserved	
21 through 25	Bulk storage of liquids in tanks.	Tank Storage & Piping Systems (FLC-TAN)
27	Piping systems for transferring liquids	
28	Loading and unloading systems associated with bulk storage of liquids in tanks	Operations (FLC-OPS)
29	Wharves associated with bulk handling of liquids	

NFPA 30 provides several options for facility and tank design for the storage, use, and handling of liquids. The options available are generally based on the hazards presented by the commodity (flash point & boiling point), construction of containers (or tanks) used, and the configuration of storage or use.

As an example, Chapters 9 through 16 of NFPA 30 provide number of options are available for storage of liquids in containers. Depending on the risks involved and protection provided, the volume of storage is limited – which allows several design options based on operational needs. The options available in storage situations include:

- > Storage configurations in detached, unprotected buildings
- > Storage configurations in hazardous materials lockers
- > Outdoor storage configurations
- > Indoor protected storage (large quantities in specific configurations)
- > Indoor unprotected storage (limited quantities and configurations)

A commonly overlooked requirement from Chapter 17 is that processing and handling of Class II and Class III liquids heated at or above their flash point shall follow the requirements for Class I liquids, unless an engineering evaluation conducted in accordance with Chapter 6 justifies following the requirements for some other (lower hazard) liquid class.

Navigating Code Requirements With Legacy Versions of NFPA 30

Generally, NFPA 30 is adopted as part of a local or state level Flammable & Combustible Liquids Code through legislative action. Often, the adopted version is from one or two code cycles earlier than the most current version, and local amendments may be made. The most common amendment is to limit the coverage of the code to liquids with flash points below 200F (93C). NFPA 30 Annex H provides guidance for adopting the standard in a local jurisdiction.

When faced with a local adoption of NFPA 30, it is essential that you have access to both the edition of NFPA 30 that was adopted, as well as a copy of any amendments made during the adoption process. For example, the state of Michigan has adopted the 2012 edition of NFPA 30 and issued a series of amendments³ that both limit the application of the standard to liquids with flash points below 200°F (93°C) and direct certain state activities for inspection and review to specific departments. For facilities subject to NFPA 30, this information will be necessary to ensure that both current operations and new projects are conducted in accordance with the specific state requirements.

Typically, when a jurisdiction has adopted an older version of NFPA 30 and you desire to use features from newer editions, there are variance procedures that can be applied. Generally, the responsibility is placed on the variance requester to demonstrate that the proposed approach provides equivalent safety to the original requirement. With adequate justification, these requests are often approved. The key to success is to engage the local fire code authority early in the process, to discuss the specific details of the request and align on the best way to accomplish the desired objectives.

OSHA 1910.106 (Flammable Liquid Standard) is based on the 1969 edition of NFPA 30. The OSHA standard has been given a limited update to incorporate Globally Harmonized System (GHS) terminology (Categories) along with agency directives to address the introduction of plastic containers that did not exist when the 1969 edition was published⁴.

In 1995, OSHA produced a letter of interpretation that allowed facility owners to use a more current version of NFPA 30 in lieu of the older requirements in 1910.106⁵. OSHA states that they will accept later editions of consensus standards (such as NFPA 30) when those later editions set forth requirements which are as protective as current requirements of the standard. In such situations, the employer has the burden of proof to demonstrate that the protective measures implemented are in fact equivalently protective.

Table 2: OSHA Citations Against 1910.106 (2010 – 2019) – 71% of Citations Issued

OSHA Section	Coverage Area	Number of Citations
1910.106 (e)(6)	Sources of ignition	1721
1910.106 (e)(2)	Incidental storage or use of flammable liquids	1379
1910.106 (d)(2)	Design, construction, and capacity of containers	1087
1910.106 (e)(9)	Housekeeping	768
1910.106 (d)(4)	Design and construction of inside storage rooms	634
1910.106 (g)(3)	Service stations: Dispensing systems	507
1910.106 (d)(3)	Design, construction, and capacity of storage cabinets	505

OSHA's Citation History Involving 1910.106 (Flammable Liquids Standard)

As previously referenced, OSHA 1910.106 (Flammable Liquid Standard) is based on the 1969 edition of NFPA 30. The OSHA standard has been given a limited update to incorporate Globally Harmonized System (GHS) terminology along with agency directives to address the introduction of plastic containers that did not exist when the 1969 edition was published. The OSHA Standard applies to flammable liquids divided into four GHS categories. The standard scope covers liquids with flash points below 199.4°F (93°C) or any liquid that is heat above or within 30°F (16.7°C) of its flash point.

In the period 2010 to 2019, Federal and State-based OSHA inspectors issued over 9000 individual violations that referenced a specific section of the OSHA 1910.106 standard⁶. A summary of the most common violations is in Table 2 below.

The key observations from this analysis highlight the following common risk factors in industry. Each of these areas is well covered by the modern editions of NFPA 30:

- > Improper ignition source management, including both electrical (hazardous) area classification and proper management of static electricity hazards represent more than 10% of citations issued.
- > Many industrial and manufacturing facilities where the use and handling of flammable liquids is only incidental to the principal business have weak practices related to the handling and storage of liquids. Impacted businesses include automobile assembly, construction of electronic equipment, and furniture manufacturing.
- > Proper containers use and selection for the storage and handling of liquids remains a common problem area.
- > Housekeeping and control of materials that can become initial sources of ignition remain a common threat in many industrial and manufacturing occupancies.
- > The design and construction of small liquid storage rooms (<500 ft²; 46.5 m²) frequently have problems with excessive storage volumes, electrical wiring, and ventilation.
- > Flammable liquid cabinet use, design, and loading of flammable liquids remains a major identified non-compliance.

Key Changes Proposed for NFPA 30 (2021 Edition)

The structure and chapter architecture of NFPA 30 (2021) will remain identical to that of NFPA 30 (2018). To address both continued challenges experienced in liquid risk management and to resolve technical challenges presented by new containers and storage configurations, several specific technical changes were made, which are summarized below. Two significant changes were proposed during the first draft of the document, and through the consensus process were reversed during the second draft processing. All proposed changes will be presented to the NFPA Standards Council for adoption once any Notice of Intent to Make a Motion (NITMAM) are processed at the NFPA Annual meeting in June 2020. One NITMAM was filed prior to the February 19, 2020 deadline; however, it is not focused on any of the technical changes reviewed here.

Flammable & Combustible Liquid Nomenclature

Throughout NFPA 30 (2021), the term “ignitable (flammable or combustible)” will be used to denote any liquid that has a flash point. When referring to a specific type of ignitable liquid, NFPA 30 uses liquid class to denote boiling point and flash point ranges. Liquid classification is summarized in Table 3 below.

This action begins the process of reducing the use of the terms “flammable” or “combustible” to reduce confusion of terminology arising from the definitions used by different agencies and the Globally Harmonized System (GHS). For example, OSHA uses 140°F (60°C) to delineate between flammable and combustible liquid classification, whereas NFPA uses 100°F (37.8°C). Longer term, use of liquid class provides more consistency in evaluating any liquid with a flash point. In these cases, any liquid with a flash point can burn (that is, are ignitable liquids) given a sufficient ignition source. When ignited, these liquids generally produce high levels of heat output. The liquid classification (e.g. Class I, Class II, and Class III) can provide more of a perspective on the relative ease of ignition.

Table 3: Flash Points and Boiling Points of Liquid Classes used in NFPA 30 (Chapter 4)

Liquid Class	Flash Point	Boiling Point
IA	Below 73°F (22.8°C)	Less than 100°F (37.8°C)
IB	Below 73°F (22.8°C)	At or Above 100°F (37.8°C)
IC	At or Above 73°F (22.8°C) but below 100°F (37.8°C)	Any
II	At or above 100°F (37.8°C) but below 140°F (60°C)	Any
IIIA	At or above 140°F (60°C) but below 200°F (93°C)	Any
IIIB	At or above 200°F (93°C), subject to having a Flash Point	Any

Treatment of Beverages, Medicines, and Other Consumer Products Containing Not More Than 20% Water-Miscible Liquids

In the 2018 edition of NFPA 30, beverages, medicines, foodstuffs, cosmetics, and other consumer products are excluded from NFPA coverage if they contained not more than 50 percent by volume of water-miscible flammable or combustible liquids, with the remainder of the product consisting of components that do not burn. This exception in Section 9.1.4(4) applies to liquids in containers that do not exceed 1.3 gallons (5 liters). Table 16.4.1(a) indicates that they were to be stored and protected as either a Class I or Class II commodity as described in NFPA 13, Standard for the Installation of Sprinkler Systems (2019)⁷.

During the current revision cycle, additional fire testing data was presented to support the reduction of this exclusion to not more than 20 percent by volume of water-miscible liquid. The 2021 edition of NFPA 30 will provide specific protection coverage in Tables 16.5.2.17 or 16.5.2.18, as applicable, or potentially treat the storage as unprotected.

Improvements to Application Flowcharts and New Fire Protection Design Options in Chapter 16 (Protected Storage)

Chapter 16 provides specifications for the design and configuration of automatic fire protection systems for all inside storage of ignitable liquids in containers, intermediate bulk containers (IBCs), and portable tanks that are being used in accordance with the container requirements specified in Section 9.4. When liquids are protected in accordance with the applicable requirements of this chapter, they are considered protected storage. Protected storage allows for virtually unlimited quantities of storage in the protected configuration.

Commercial use and development of liquids continues to drive the need for new containers and configurations of storage, which require careful evaluation of what is required for effective fire protection design. The protection criteria modifications were validated by full scale fire testing described in reports reviewed by the FLC-SWC technical committee⁸. The testing information was produced in alignment with the guidelines outlined in Annex D & Annex E of NFPA 30, which focus on the development of fire protection system design criteria used in Chapter 16.

Significant additions to this Chapter include the following:

- > Three new protection schemes are added in Section 16.5 for small (<1 gallon; 3.7 liter) containers of alcohols and 50-50 alcohol-water mixtures
- > New section 16.5.2.13 and 16.6.5 adding in-rack protection criteria for Class II liquids in metal containers using K25.2 extended coverage sprinklers
- > New section 16.5.2.14 provides new fire protection criteria for liquids with flash points less than 200°F (93°C) in cartoned, two-ounce, plastic bottles
- > New sections 16.5.2.15 and 16.6.4 provides new sprinkler protection criteria for liquids with flash points greater than or equal to 450°F (232°C)

Flammable Liquid Cabinet Self Closing Doors (Section 9.5.3)

NFPA 30 has been updated to require that all new flammable liquid storage cabinets must have self-closing doors. This resolves conflicts

that previous editions of NFPA 30 had with other model Fire & Safety Codes on this issue.

Anchoring of Tanks (Section 22.5.3)

During the first revision, this new section was added to NFPA 30 to specify the conditions under which anchorage of tanks is required. The new section makes the consideration method for anchorage explicit and detailed.

Metallic/Nonmetallic Composite Piping (Section 27.4.7)

A new subsection was added to cover metallic/nonmetallic composite piping. This listed piping material for flammable and combustible liquids has been in use for 20 years with a variety of flammable liquids. The piping system contains an inner metallic liquid conducting tube and an outer nonmetallic tube, which contains any leakage from the inner metallic tube. The space between the inner and outer tubes can be monitored for pressure, to indicate leakage.

Significant Changes Considered But Not Implemented

Composite Intermediate Bulk Containers (Chapter 9)

The fire risks presented by composite IBCs storing combustible liquids are well documented in the literature⁹. During the first revision, additional restrictions on the use of composite IBCs were proposed that were subsequently removed and returned to language from the 2018 edition of NFPA 30. In summary, the requirements for use and storage of composite IBCs include:

- > Composite IBCs are not authorized for the storage of Class I liquids, except in specific limited situations detailed in Section 9.1.4 of NFPA 30.
- > Composite IBCs containing a Class II or Class IIIA liquid must be listed and labeled. Units not listed and labelled are prohibited.
- > Section 18.5.4.1, related to allowances for storage of liquids in incidental-use applications, sets out requirements for conducting a hazard analysis and implementing a lower threshold for maximum allowable quantities that can be staged. It reduces the number of Composite IBCs that can be temporarily staged in an operational area.

Local Exhaust Ventilation Credit Reductions (Section 17.11)

During the first revision, the maximum credit available to be taken for required ventilation available from local exhaust ventilation (LEV) was proposed for reduction from 75% to 50%, based on opinions expressed about ventilation compromise that could exist by improper use of LEV equipment. This was reversed during the Technical Committee's work during second draft and restored to the maximum 75% credit.

Conclusion

DEKRA has applied the principles within NFPA 30 for decades and recognizes them as a key part of an effective Loss Control Engineering Program. We are committed to partnering with our clients to adapt to the changes presented by the 2021 edition and to apply existing requirements to address our Client's unique needs. Contact us to talk about how to manage these and other fire hazards!

References

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DEKRA Process Safety
dekra.us/process-safety
process-safety-usa@dekra.com