

EIGHTH EDITION

Edited by

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With the complete text of the 2018 edition of NFPA® 1, *Fire Code*



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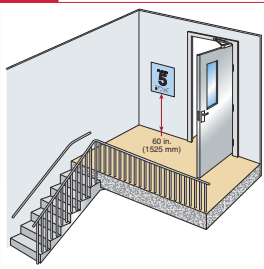
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A Guide to Using the NFPA® 1 Fire Code Handbook

This eighth edition of the *NFPA 1 Fire Code Handbook* contains the complete text of the 2018 edition of NFPA® 1, *Fire Code*, and the nonmandatory annex material. Commentary is provided in this handbook to explain the reasoning behind the *Code's* requirements.

176Chapter 10 • General Safety Requirements

Exhibit 10.7



Stairway identification sign with tactile floor level designator.

Exhibit 10.8



Stairway identification sign with tactile floor level designator.

The provision of 10.11.3.1.16 is needed so that signs installed prior to 2009, when subitems (L) through (O) were added, are not unfairly reclassified as noncompliant.

The provision of 10.11.3.1.8 was revised for the 2018 edition of the Code to add the words "from within the stair enclosure," because misinterpretations were being made that occupants must be able to see the sign before entering the exit stair enclosure.

Exhibit 10.8 shows a stairway identification sign with the information required by 10.11.3.1. The element reading Level 2 was provided for compliance with 10.11.3.1.2, which requires that the signage indicate the floor level, and for compliance with 10.11.3.1.10, which requires that the floor level designation also be tactile. In accordance with ICC/ANSI A117.1, Accessible and Usable Buildings and Facilities, The minimum 5 in. (125 mm) high floor level number — the large 2 in this case — that was provided for compliance with 10.11.3.1.14 cannot serve as the tactile floor level designation because ICC/ANSI A117.1 limits raised characters to being not more than 2 in. (51 mm) in height. Further, the floor level designation is provided in braille below the tactile element, because ICC/ANSI A117.1 requires that raised letters be duplicated in braille.

Δ 10.11.3.2 Wherever an enclosed stair requires travel in an upward direction to reach the level of exit discharge, special signs with directional indicators showing the direction to the level of exit discharge shall be provided at each floor level landing from which upward direction of travel is required, unless otherwise provided in 10.11.3.2.1 and 10.11.3.2.2, and both of the following also shall apply:

- (1) Such signage shall comply with 14.14.8.1 and 14.14.8.2.
- (2) Such signage shall be visible when the door leaf is in the open or closed position.

[1017.2.2.5.4.2]

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Commentary exhibits, including both illustrations and photographs, are set off in red frames.

Commentary tables are printed in red to distinguish them from the *Code* tables.

1134Chapter 66 • Flammable and Combustible Liquids

COMMENTARY TABLE 66.3 GHS Category

GHS Category	Flash Point, °C (°F)	Boiling Point, °C (°F)
1	<23 (73)	≤35 (95)
2	<23 (73)	>35 (95)
3	≥23 (73)	NA
4	≤60 (140)	NA
5	>60 (140)	NA
6	≤93 (200)	NA

NA = Not applicable.

A comparison of the NFPA 30 classification scheme with GHS is shown in Commentary Table 66.3.

There are some differences besides nomenclature between the two systems. For example, while the flash point criteria for NFPA 30 Classes IA and IB match those for GHS Categories I and II, the boiling point criteria are different: 100°F (37.8°C) versus 95°F (35°C). This is relatively minor and could probably be accommodated with little negative effect; also, the flash point range for NFPA 30 Class IIA is effectively identical with that for GHS Category 4. The problem lies with NFPA 30 Classes IC and II compared with GHS Category 3. NFPA 30 considers Class IC liquids to be ignitable at high ambient temperatures, while Class II liquids seldom are. So, for example, open use of Class IC liquids typically would require such precautions as area ventilation and the use of classified electrical equipment. Such is not required by the Code for Class II liquids, unless they are heated to their flash points. However, the OSHA GHS scheme treats these two categories of liquid the same, which likely would cause confusion for users.

66.4.1.1* Boiling Point. See 3.3.27.

A.66.4.1.1 See A.3.3.27.

66.4.1.2 Combustible Liquid. See 3.3.169.1.

66.4.1.3 Flammable Liquid. See 3.3.169.2.

66.4.1.4* Flash Point. See 3.3.134.

A.66.4.1.4 See A.3.3.134.

66.4.1.5 Liquid. See 3.3.172.

66.4.1.6* Vapor Pressure. See 3.3.283.

A.66.4.1.6 See A.3.3.283.

66.4.2* Classification of Liquids. Any liquid within the scope of this Code and subject to the requirements of this Code shall be classified in accordance with this chapter. [304.3]

Δ A.66.4.2 The classification of liquids is based on flash points that have been corrected to sea level, in accordance with the relevant ASTM test procedures. At high altitudes, the actual flash points will be significantly lower than those either observed at sea level or corrected to atmospheric pressure at sea level. Allowances could be necessary for this difference in order to appropriately assess the risk. [30A.4.3]

Table A.66.4.2 presents a comparison of the definitions and classification of flammable and combustible liquids, as set forth in Chapter 66 of this Code, with similar definitions and classification systems used by other regulatory bodies. [30A.4.3]

The Hazardous Materials Regulations of the U.S. Department of Transportation (DOT), as set forth in the 49 CFR 173.120(b)(2) and 173.150(f), provide an exception whereby a flammable liquid that has a flash point between 37.8°C (100°F) and 60.5°C (141°F) and does not also meet the definition of any other DOT hazard class can be reclassified as a combustible liquid [i.e., one having a flash point above 60.5°C (141°F)] for shipment by road or rail within the United States. [30A.4.3]

COMMENTARY TABLE 66.3 NFPA 30 Liquids Classification vs. OSHA Globally Harmonized Standard

NFPA 30			OSHA GHS	
Liquid Class	Flash Point, °F (°C)	Boiling Point, °F (°C)	Flammable Category	Flash Point, °F (°C)
IA	<73 (23)	<100 (38)	1	<73 (23)
IB	<73 (23)	≥100 (38)	2	<73 (23)
IC	73 to <100 (23 to <38)	—	3	73 to 140 (23 to 60)
II	100 to <140 (38 to <60)	—	—	—
IIA	140 to <200 (60 to <93)	—	4	>140 to 200 (> 60 to 93)
IIIB	≥200 (93)	—	—	—

2018 NFPA 1 Fire Code Handbook

A.5.1.3 Qualifications should include experience, education, and credentials that demonstrate knowledgeable and responsible use of applicable models and methods.

5.1.4* Plan Submittal Documentation. When a performance-based design is submitted to the AHJ for review and approval, the owner shall document, in an approved format, each performance objective and applicable scenario, including any calculation methods or models used in establishing the proposed design's fire and life safety performance.

A.5.1.4 The *SPFE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings* outlines a process for using a performance-based approach in the design and assessment of building fire safety design and identifies parameters that should be considered in the analysis of a performance-based design. As can be seen this process requires the involvement of all stakeholders who have a share or interest in the successful completion of the project. The steps that are recommended by the *SPFE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings* for this process are shown in Figure A.5.1.4.

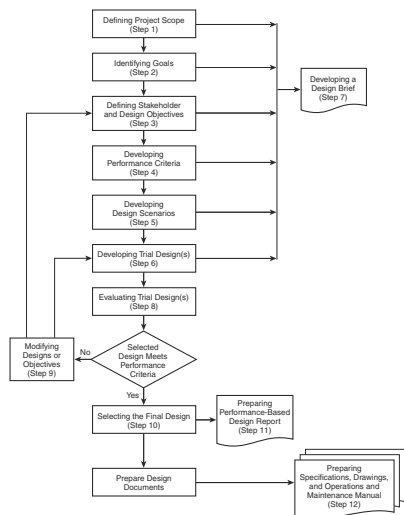


FIGURE A.5.1.4 Steps in the Performance-Based Analysis and the Conceptual Design Procedure for Fire Protection Design.

Code figures and tables are printed in black.

Specific icons and shading within Code text indicate where text has changed from the previous edition.

Based on the definition in 3.9.1.12 of NFPA 13, expanded plastics are those with air pockets embedded within the plastic, such as foam coolers, exercise mats, foam presentation boards, shipping peanuts, and foam insulation boards found at home improvement stores. If the plastic does not fit that description, it would be considered a nonexpanded (or unexpanded) plastic, such as plastic totes or plastic water bottles.

34.2.6.2 Group B. The following materials shall be classified as Group B:

- (1) Chloroprene rubber
- (2) Fluoroplastics (ECTFE — ethylene-chlorotrifluoroethylene copolymer; ETFE — ethylene/tetrafluoroethylene copolymer; FEP — fluorinated ethylene-propylene copolymer)
- (3) Silicone rubber [13:5.6.4.2]

34.2.6.3 Group C. The following materials shall be classified as Group C:

- (1) Fluoroplastics (PCTFE — polychlorotrifluoroethylene; PTFE — polytetrafluoroethylene)
- (2) Melamine (melamine formaldehyde)
- (3) Phenolic
- (4) PVC (polyvinyl chloride — flexible — PVCs with plasticizer content up to 20 percent)
- (5) PVDC (polyvinylidene chloride)
- (6) PVDF (polyvinylidene fluoride)
- (7) Urea (urea formaldehyde) [13:5.6.4.3]

Where the specific plastic commodity cannot be determined, the most conservative approach is to use the highest plastic hazard, Group A plastics. Designing the system to a lesser hazard might lead to insufficient water getting to the fire, allowing the fire to spread and overwhelm the system.

34.2.7* Classification of Rolled Paper Storage. For the purposes of this Code, the classifications of paper described in 34.2.7.1 through 34.2.7.4 shall apply and shall be used to determine the sprinkler system design criteria. [13:5.6.5]

A.34.2.7 Paper Classification. These classifications were derived from a series of large-scale and laboratory-type small-scale fire tests. It is recognized that not all paper in a class burns with exactly the same characteristics. [13:A5.6.5]

Paper can be soft or hard, thick or thin, or heavy or light and can also be coated with various materials. The broad range of papers can be classified according to various properties. One important property is basis weight, which is defined as the weight of a sheet of paper of a specified area. Two broad categories of paper are recognized by industry — paper and paperboard. Paperboard normally has a basis weight of 20 lb (9.1 kg) or greater measured on a 1000 ft² (93 m²) sheet. Stock with a basis weight less than 20 lb/1000 ft² (93 m²) is normally categorized as paper. The basis weight of paper is usually measured on a 3000 ft² (278.7 m²) sheet. The basis weight of paper can also be measured on the total area of a ream of paper, which is normally the case for the following types of printing and writing papers:

- (1) **Bond paper** — 500 sheets, 17 in. × 22 in. (425 mm × 550 mm) = 1300 ft² (121 m²) per ream
- (2) **Book paper** — 500 sheets, 25 in. × 38 in. (635 mm × 950 mm) = 3300 ft² (310 m²) per ream
- (3) **Index paper** — 500 sheets, 25½ in. × 30½ in. (640 mm × 765 mm) = 2700 ft² (250.8 m²) per ream
- (4) **Bristol paper** — 500 sheets, 22½ in. × 35 in. (565 mm × 890 mm) = 2734 ft² (254 m²) per ream
- (5) **Tag paper** — 500 sheets, 24 in. × 36 in. (600 mm × 900 mm) = 3000 ft² (280 m²) per ream [13:A5.6.5]

For the purposes of this Code, all basis weights are expressed in lb/1000 ft² (kg/m²) of paper. To determine the basis weight per 1000 ft² (93 m²) for papers measured on a sheet of different area, the following formula should be applied:

$$\frac{\text{Basis weight}}{1000 \text{ ft}^2} = \text{basis weight} \times 1000 \text{ measured area}$$

Example: To determine the basis weight per 1000 ft² (93 m²) of 16 lb (7.3 kg) bond paper:

$$\left(\frac{16 \text{ lb}}{1300 \text{ ft}^2} \right) 1000 = \frac{12.3 \text{ lb}}{1000 \text{ ft}^2}$$

Large- and small-scale fire tests indicate that the burning rate of paper varies with the basis weight. Heavyweight paper burns more slowly than lightweight paper. Full-scale roll paper fire tests were conducted with the following types of paper:

- (1) **Linerboard** — 42 lb/1000 ft² (0.2 kg/m²) nominal basis weight
- (2) **Newsprint** — 10 lb/1000 ft² (0.05 kg/m²) nominal basis weight
- (3) **Tissue** — 5 lb/1000 ft² (0.02 kg/m²) nominal basis weight [13:A5.6.5]

The rate of firespread over the surface of the tissue rolls was extremely rapid in the full-scale fire tests. The rate of fire spread over the surface of the linerboard rolls was slower. Based on the overall results of these full-scale tests, along with additional data from small-scale testing of various paper grades, the broad range of papers has been classified into three major categories as follows:

- (1) **Heavyweight** — Basis weight of 20 lb/1000 ft² (0.098 kg/m²) or greater
- (2) **Mediumweight** — Basis weight of 10 lb to 20 lb/1000 ft² (0.05 kg to 0.098 kg/m²)
- (3) **Lightweight** — Basis weight of less than 10 lb/1000 ft² (0.05 kg/m²) and tissues regardless of basis weight [13:A5.6.5]

The following SI units were used for conversion of U.S. customary units:

- (1) 1 lb = 0.454 kg
- (2) 1 in. = 25.4 mm
- (3) 1 ft = 0.3048 m; 1 ft² = 0.0929 m² [13:A5.6.5]

The various types of papers normally found in each of the four major categories are provided in Table A.34.2.7. [13:A5.6.5]

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Commentary is printed in red to distinguish it from *Code* text.

Nonmandatory Annex A material is printed in black and follows the *Code* text it references.

is equivalent to the intent of this Code. The information required might include testing data, listing or labeling reports, engineering reports, and other supporting details that allow the AHJ to make an informed decision. The information must be maintained in an appropriate manner so that a record on which a decision was based is available. This information is also important if the applicant files an appeal on the AHJ's decision to the Board of Appeals, as outlined in Section 1.1.10.

§ 1.4.6 Approval. The AHJ shall approve such equivalent, alternative, or modified construction systems, materials, or methods of design when it is substantiated that the standards of this Code are at least equalled. If, in the opinion of the AHJ, the standards of this Code ~~are~~ not equaled by the alternative requested, approval for permanent work shall be withheld. Consideration shall be given to test or prototype installations.

The AHJ has the discretionary authority to approve or refuse an equivalency, alternative, or modification. However, that approval or refusal needs to be based on the ability of the applicant to justify that the equivalent level of life safety and protection has been provided.

1.4.7.1 Whenever evidence of compliance with the requirements of this Code is insufficient or evidence that any material or method of construction does not conform to the requirements of this Code, or to substantiate claims for alternative construction systems, materials, or methods of construction, the AHJ shall be permitted to require proof of proof of compliance to be made by an approved agency at the expense of the builder.

1.4.7.2 Test methods shall be as specified by this Code for the material in question. If appropriate test methods are not specified in this Code, the AHJ is authorized to accept an applicable test procedure from another recognized source.

The question of "What is an appropriate test?" is one that needs careful consideration by the AHJ. If an incorrect type of test is submitted to the AHJ or if the AHJ specifies an incorrect test method, the AHJ's level of safety may not be compromised.

If there is a question about the appropriate test method to be used, the AHJ should consult subject experts and testing laboratories with expertise in the area.

1.4.7.3 Copies of the results of all such tests shall be retained in accordance with Section 1.1.1.

Simultaneous operation provides for common actuation of all fire suppression systems protecting the hazards in the single hazard area. The goal of this requirement is to cover all the components of the cooking operation to suppress a fire.

Arguments have been made against the simultaneous operation approach, especially with respect to chemical systems, which provide a limited supply of extinguishing agent. Some believe it is safer to discharge the chemical only in the areas where the fire is burning. If the fire then spreads to other areas, some remaining chemical is still available. When chemical is prematurely discharged, dry chemical tends to be carried out of the system by fan action, while wet chemical tends to drain out of the system; therefore, if a fire subsequently spreads, no agent remains to extinguish the spreading fire.

The concern regarding premature discharge of extinguishing agent led to the sequential or separate component fire suppression approach as an alternative to simultaneous discharge. This approach is especially effective and practical in the case of a manifold exhaust system in a large restaurant or when manifold multiple types of restaurant exhaust systems in a food court of a shopping mall. In either case, simultaneous actuation of all systems is messy and expensive, especially in the case of a food court, where a real or an accidental discharge in one restaurant can result in multiple lawsuits from the affected restaurants due to premature actuation of adjacent fire protection systems.

NFPA 17 contains requirements for fixed pipe extinguishing systems using dry chemical agents for protection of restaurant hood, duct, and cooking appliance systems. Additionally, NFPA 17A contains requirements for fixed pipe extinguishing systems using wet chemical agents for protection of cooking equipment.

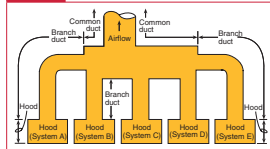
Alternative designs to simultaneous discharge are found in the annexes of NFPA 17 and NFPA 17A. These alternative systems segment the total manifold exhaust in different ways, all of which provide some backup protection in the common duct areas that permits some of the hoods or restaurants to continue operating while shutting down those that have experienced fire or those without a backup system in their common duct. These systems are a necessity for common design solutions for food courts with manifold exhaust systems and can be economical in large restaurants with multiple hoods on manifold exhaust systems. Exhibit 50.6 through Exhibit 50.9 illustrate various system configurations.

Example 1

A fire is detected by System A; its hood and branch duct are operated. Simultaneously, Systems B, C, D, and E are also actuated. All fuel or power to all protected appliances served by the common exhaust duct is shut off.

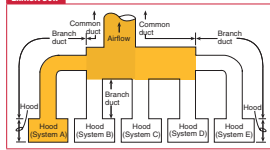
Upon operation of the common exhaust duct systems, the fuel or power to all protected appliances served by the common exhaust duct is shut off. The cooking appliance, hood, and branch duct systems provide protection in accordance with NFPA 17 and NFPA 17A. (See Exhibit 50.6.)

Exhibit 50.6



Simultaneous operation of all systems.

Exhibit 50.7



Simultaneous operation of a single cooking appliance, hood, or branch duct system and the system protecting the common duct.

Example 2

System 1, protecting the entire common exhaust duct, is separate from Systems A, B, C, D, and E. A fire is detected in System A. System 1 operates simultaneously. Shutdown of all appliances protected by Systems A, B, C, D, and E is in accordance with NFPA 17. (See Exhibit 50.7.)

Example 3

System E also provides protection for the entire common exhaust duct. A fire is detected in System C. System C and System E operate simultaneously. Shutdown of all appliances protected by Systems A, B, C, D, and E is in accordance with NFPA 17. (See Exhibit 50.8.)

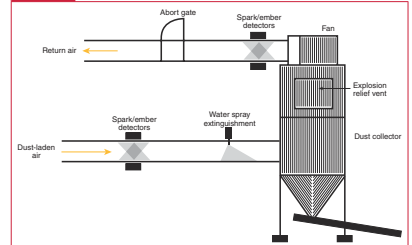
Example 4

System E also provides protection for the entire common exhaust duct. A fire detected in System E will result in the actuation of System E only. Shutdown of all appliances protected by Systems A, B, C, D, and E is in accordance with NFPA 17. (See Exhibit 50.9.)

Examples help illustrate how the Code is applied in real-world situations.

Case Studies illustrate the importance of implementing NFPA 1 requirements.

Exhibit 40.10



Basic spark detection and extinguishment system for a single air-material separator.

Case Study

On February 7, 2008, a series of sugar dust explosions at the Imperial Sugar Company manufacturing facility in Port Wentworth, Georgia, resulted in 14 worker fatalities. In addition to the 14 fatalities, 36 workers were treated for serious burns and injuries, some of which caused permanent, life-altering conditions. The explosions and subsequent fires destroyed the sugar packing buildings, palletizer room, and silos and severely damaged the bulk train car loading area and parts of the sugar refining process areas. The Imperial Sugar manufacturing facility housed a refinery for converting raw cane sugar into granulated sugar. Through a system of conveyors and elevators, the raw sugar was transported from grain silos to sugar processing machines, and the final sugar products were stored in buildings surrounding the silos.

In its investigation report released in September 2009, the U.S. Chemical Safety Board (CSB) found that an initial dust explosion originated in the enclosed steel belt conveyor located below the sugar silos where high concentrations of sugar dust had accumulated inside the enclosure. The initial explosion stirred up sugar dust that had built up on the floors and other surfaces, causing a chain reaction of additional dust explosions through the buildings. Fires resulting from the explosions destroyed the packing buildings, silos, and palletizer building and severely damaged parts of the refinery and sugar loading area.

Many contributing factors to the explosions were identified, including the following:

- Equipment that was not designed or maintained to minimize the release of sugar and sugar dust into the work area
- Inadequate housekeeping practices, which resulted in accumulations of combustible sugar and sugar dust on the floors and other elevated surfaces throughout the packing buildings

- Accumulation of airborne combustible sugar dust above the maximum explosible concentration
- Inadequate evacuation plans

The investigation conducted by the CSB highlighted many safety concerns regarding buildings where dust explosions are a risk and resulted in a list of recommendations to ensure that buildings at risk for dust explosions reduce that risk and even prevent such explosions from occurring. Additional information on the Imperial Sugar Company explosion and fire, as well as the CSB investigation report, in its entirety, can be found online at <http://www.csb.gov/investigations/detail.aspx?SID=6>.

Exhibit CS40.1



(Courtesy of the U.S. Chemical Safety Board)

Product Management: Debra Rose
Production: Tracy Gaudet and Ken Ritchie
Copyediting: Nancy Wirtes
Permissions: Irene Herlihy

Art Direction and Interior Design: Cheryl Langway
Cover Design: Twist Creative Group
Composition: Shepherd, Inc.
Printing/Binding: LSC Communications



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Quincy, Massachusetts 02169-7471



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NFPA 72®

NFPA No.: 1HB18

ISBN (book): 978-1-4559-17549

ISBN (PDF): 978-1-4559-17556

ISBN (e-book): 978-1-4559-17532

Library of Congress Control No.: 2018932048

Printed in the United States of America

18 19 20 21 22 5 4 3 2 1

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