NFPA 432
Code for the Storage of Organic Peroxide Formulations

2002 Edition

NFPA, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 432

Code for the

Storage of Organic Peroxide Formulations

2002 Edition

This edition of NFPA 432, *Code for the Storage of Organic Peroxide Formulations*, was prepared by the Technical Committee on Hazardous Chemicals and acted on by NFPA at its May Association Technical Meeting held May 19–23, 2002, in Minneapolis, MN. It was issued by the Standards Council on July 19, 2002, with an effective date of August 8, 2002, and supersedes all previous editions.

This edition of NFPA 432 was approved as an American National Standard on July 19, 2002.

Origin and Development of NFPA 432

The development of NFPA 432 (formerly NFPA 43B in previous editions) began in 1969 with the tentative adoption by the Association of NFPA 499-T, *Code for the Storage and Transportation of Oxidizing Materials and Organic Peroxides*. As a result of suggestions by reviewers of this Tentative Code, the Technical Committee on Storage, Handling and Transportation of Hazardous Chemicals decided to replace NFPA 499-T with two codes, one for the storage of liquid and solid oxidizing materials and the other for organic peroxides.

The Technical Committee experienced great difficulty in developing NFPA 43B, primarily because initial attempts to classify burning behavior of the various organic peroxides considered only the peroxide itself. By 1975, it had become apparent to the Committee that any classification system would have to take into account the composition of each formulation (i.e., concentration of peroxide, active oxygen, and diluent) and the strength and size of the shipping container, if an accurate assessment of fire and explosion hazard were to be made. By analyzing the characteristics of most of the commercially available organic peroxide formulations and by conducting a limited number of full-scale fire tests, the Committee developed a valid classification scheme and storage requirements.

The first edition of NFPA 43B was adopted at the 1985 NFPA Fall Meeting.

The 1993 edition of NFPA 43B contained enhanced fire protection and storage requirements for all classes of organic peroxide formulations. The Committee on Hazardous Chemicals clarified the storage limitations for both sprinklered and nonsprinklered storage of all classes of organic peroxide formulations. The Committee also clarified the separation distance from the storage of incompatible materials. In addition, Appendix B contained expanded and updated tables of typical organic peroxide formulations that included more listed formulations and information on temperature control recommendations as well as hazard identification ratings.

For the 1997 edition, NFPA 43B was redesignated as NFPA 432. Provisions were added to address the classification of electrical equipment on the interior of any nonventilated, nonrefrigerated storage cabinet used for the storage of Class I, II, or III organic peroxide formulations. In addition, a table alphabetizing all the organic peroxide formulations was added to Appendix B.

Revisions to the tables of Typical Class Formulations included the following:

(1) Class I Formulations — The Health Hazard Identification Rating was revised for five organic peroxide formulations.
(2) Class II Formulations — The Health Hazard Identification Rating was revised for eight organic peroxide formulations.
(3) Class III Formulations — The Health Hazard Identification Rating was revised for 17 organic peroxide formulations, and the Flammability Hazard Identification Rating for cumyl hydroperoxide was also revised.
(4) Class IV Formulations — The Health Hazard Identification Rating was revised for nine organic peroxide formulations.
(5) Class V Formulations — The Health Hazard Identification Rating was revised for five organic peroxide formulations.
(6) The classification for 2,4-Pentanedione peroxide was revised.

Other changes were editorial in nature to bring the document into conformance with the NFPA *Manual of Style*.

For the 2002 edition, there were changes made to conform to NFPA's *Manual of Style*. These changes included reordering chapters and restructuring the definition section. The tables found in Annex B listing different classes of organic peroxides have been clarified to increase ease of use. Names of several compounds were corrected and clarifying footnotes were added.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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NFPA 432

Code for the

Storage of Organic Peroxide Formulations

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet between the paragraphs that remain.

Information on referenced publications can be found in Chapter 2 and Annex D.

Chapter 1 Administration

1.1 Scope.

1.1.1 This code shall apply only to commercially available organic peroxide formulations in U.S. Department of Transportation- or Canadian Ministry of Transport-approved packages.

1.1.2 This code shall not apply to the storage of such formulations in process areas where they are manufactured or used.

1.1.3 This code does not apply to organic peroxide formulations that are capable of detonation in their normal shipping containers under conditions of fire exposure. Such formulations shall be handled and stored as Explosives 1.1 (formerly known as Class A explosives) in accordance with NFPA 495, *Explosive Materials Code*.

1.2 Purpose. The purpose of this code is to provide reasonable requirements for the safe storage of commercially available formulations containing organic peroxides.

1.3 Application. The requirements of NFPA 30, *Flammable and Combustible Liquids Code*, and NFPA 230, *Standard for the Fire Protection of Storage*, shall apply where applicable and where they are more restrictive than this code.

1.4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices that provide equivalent protection from fire and explosion, provided that suitable data is available to demonstrate equivalency.

1.5 Enforcement. This code shall be administered and enforced by the authority having jurisdiction designated by the governing authority. *(See Annex C for sample wording for enabling legislation.)*

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this code and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers,* 1998 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 1999 edition.

NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems,* 2000 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection,* 2001 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances,* 1995 edition.

NFPA 30, *Flammable and Combustible Liquids Code,* 2000 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work,* 1999 edition.

NFPA 70, *National Electrical Code®,* 2002 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows,* 1999 edition.

NFPA 230, *Standard for the Fire Protection of Storage,* 1999 edition.

NFPA 251, *Standard Methods of Fire Endurance of Building Construction and Materials,* 1999 edition.

NFPA 495, *Explosive Materials Code,* 2001 edition.

2.3 Other Publications. (Reserved)

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this code. Where terms are not included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

3.2.3* Code. A standard that is an extensive compilation of provisions covering broad subject matter or that is suitable for adoption into law independently of other codes and standards.

3.2.4 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.5* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.6 Shall. Indicates a mandatory requirement.

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3.2.7 Should. Indicates a recommendation or that which is advised but not required.

3.3 General Definitions.

3.3.1 Deflagration. Propagation of a reaction zone at a velocity that is less than the speed of sound in the unreacted medium.

3.3.2 Detonation. Propagation of a reaction zone at a velocity that is at or above the speed of sound in the unreacted medium.

3.3.3* Explosive Decomposition. Rapid chemical reaction resulting in a large, almost instantaneous, release of energy.

3.3.4* Incompatible Materials. Materials that can initiate, catalyze, or accelerate the decomposition of organic peroxide formulations or that can cause hazardous reactions when in contact with such formulations.

3.3.5 Organic Peroxide. Any organic compound having a double oxygen or peroxy (-O-O-) group in its chemical structure.

3.3.6* Organic Peroxide Formulation. A pure organic peroxide or a mixture of one or more organic peroxides with one or more other materials in various combinations and concentrations.

3.3.7 Organic Peroxide Storage Area. An area used for the storage of organic peroxide formulations.

Chapter 4 Basic Requirements

4.1 Identification. All storage areas containing organic peroxide formulations shall be conspicuously identified by the words "Organic Peroxides" and by the class, as defined in Section 4.12.

4.1.1* When organic peroxide formulations having different classifications as defined by Section 4.12 are stored in the same area, the area shall be marked for the most severe class present.

4.1.2 Packages containing organic peroxide formulations shall be individually marked with the chemical name of the organic peroxide or with other pertinent information to allow proper area classification as required by this section.

4.1.3 Packages containing organic peroxide formulations that require temperature control shall be marked with the recommended storage temperature range.

4.2 Employee Instruction. Personnel involved in operations in organic peroxide storage areas shall be instructed in proper and safe handling of such materials, proper use of personal protective equipment, fire suppression equipment, proper and safe disposal of spilled material, and proper emergency procedures. Records shall be maintained of such training. Manufacturers' instructions shall be consulted for each specific formulation.

4.3 Building Construction. Any construction materials that can be contacted by organic peroxide formulations shall be compatible with the materials stored.

4.4 Heating and Cooling.

4.4.1 Storage areas shall be maintained within the recommended storage temperature range for the materials stored. *(See Annex B for compounds needing refrigeration systems.)*

4.4.2* Where the required storage temperature range extends beyond normal ambient temperatures, high or low temperature limit switches, as applicable, shall be provided in addition to the normal temperature controls. These limit switches shall actuate an alarm arranged to ensure prompt response.

4.4.3 Heating systems shall use hot water, low pressure [less than 15 psig (103 kPa gauge)] steam, or indirectly heated warm air. Cooling systems shall not utilize direct expansion of a flammable gas.

4.4.4 Heating coils, radiators, air diffusers, cooling coils, piping, and ducts shall be installed so as to prevent direct contact with containers and to prevent overheating or overcooling of the materials stored.

4.5 Electrical Installations.

4.5.1 Electrical installations shall meet all applicable requirements of NFPA 70, *National Electrical Code®*.

4.5.2 The interior of any refrigerator or freezer cabinet used for the storage of Class I, II, or III organic peroxide formulations shall be considered a Class I, Group D, Division 1 location as defined in Article 500 of NFPA 70, *National Electrical Code*. Any electrical equipment installed in the interior of such cabinets shall be approved for such use and shall be installed according to the requirements of Article 501 of NFPA 70, *National Electrical Code*.

4.5.3 The interior of any nonventilated, nonrefrigerated storage cabinet used for the storage of Class I, II, or III organic peroxide formulations shall be considered a Class I, Division 1 location as defined in Article 500 of NFPA 70, *National Electrical Code*.

4.5.4 Where the storage cabinet is ventilated, the electrical equipment shall be considered a Class I, Division 2 location as defined in Article 500 of NFPA 70, *National Electrical Code*. Mechanical ventilation systems shall provide at least 1 ft^3 per min per ft^2 of floor area (0.09 m^2 per min per 0.03 m^3).

4.6 Smoking. Smoking shall be prohibited in all organic peroxide storage areas. "No Smoking" signs shall be placed conspicuously at all entrances to and within storage areas.

4.7 Maintenance Operations.

4.7.1 Maintenance operations in organic peroxide storage areas shall be subject to prior review by and approval of supervisory personnel.

4.7.2 Cutting and welding operations in organic peroxide storage areas shall not be conducted until all organic peroxide formulations have been removed. Cutting and welding operations shall be conducted according to the requirements of NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*.

4.8 Fire Protection.

4.8.1* Manual fire-fighting equipment shall be provided according to manufacturers' recommendations and maintained according to the requirements of NFPA 10, *Standard for Portable Fire Extinguishers*, and NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems*.

4.8.2* Where required by other provisions of this code, automatic sprinklers and water spray systems shall be designed and installed according to the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, and NFPA 15, *Standard for*

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Water Spray Fixed Systems for Fire Protection, and shall provide the following discharge densities:

(1) Class I — 0.50 gpm/ft^2 (20.4 L/min·m^2)
(2) Class II — 0.40 gpm/ft^2 (16.3 L/min·m^2)
(3) Class III — 0.30 gpm/ft^2 (12.2 L/min·m^2)
(4) Class IV — 0.25 gpm/ft^2 (10.2 L/min·m^2)

4.8.2.1 The system shall be designed to provide the required density over a 3000 ft^2 (280 m^2) area for areas protected by a wet pipe sprinkler system or 3900 ft^2 (360 m^2) for areas protected by a dry pipe sprinkler system. The entire area of any building of less than 3000 ft^2 (280 m^2) shall be used as the area of application.

4.8.3 Where required, water supplies for automatic sprinklers, fire hydrants, and so forth, shall be provided in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, and shall be capable of supplying the anticipated demand for at least 90 minutes.

4.9 Housekeeping and Waste Disposal.

4.9.1 Any accumulation of combustible waste in organic peroxide storage areas shall be prohibited.

4.9.2* Spilled material and leaking or damaged containers and packages shall immediately be removed to a safe location for disposal.

4.9.3 Specific disposal procedures shall be established for all organic peroxide storage areas. Disposal procedures shall conform to all applicable federal, state, and local regulations and with the manufacturers' recommendations.

4.10 Storage Limitations.

4.10.1 Storage of organic peroxide formulations shall be limited to those areas within the scope of this code. The maximum allowable quantities of organic peroxide formulations that can be stored in a single area or building shall depend on the classification of the formulations and the classification of the storage facility, as set forth in Table 4.10(a) and Table 4.10(b).

4.10.1.1 The quantity of Class III organic peroxide formulations as it appears in Table 4.10(a) in cut-off storage shall be permitted to be increased to 20,000 lb (9070 kg) if the walls or partitions providing the cut-off have a fire resistance rating of at least 4 hours.

4.10.1.2 Class I organic peroxide formulation cut-off storage as it appears in Table 4.10(b) shall have interior walls with a blast resistance of 432 psf (0.2 bar).

Table 4.10(a) Maximum Allowable Quantity of Organic Peroxide Formulations in Nonsprinklered Buildings

Class of Organic Peroxide Formulation	Segregated Storage		Cut-Off Storage		Detached Storage Minimum Separation[1] 50 ft (15 m)		100 ft (30.5 m)		150 ft (46 m)	
	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
I	N/A	N/A	N/A	N/A	1,000	454	4,000	1,810	10,000	4,540
II	N/A	N/A	2,000	907	20,000	9,070	80,000	36,300	500,000	227,000
III	1,500	680	3,000	1,360	70,000	31,800	200,000	90,700	750,000	340,000
IV	100,000	45,400	200,000	90,700	300,000	136,000	500,000	227,000	1,000,000	454,000
V	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL

Note: N/A — Not Allowed; UNL — Unlimited
[1]Minimum separation means the distance from the line of property that is or can be built upon, including the opposite side of a public way, or the distance from the nearest important building on the same property.

Table 4.10(b) Maximum Allowable Quantity of Organic Peroxide Formulations in Sprinklered Buildings

Class of Organic Peroxide Formulation	Segregated Storage		Cut-Off Storage		Detached Storage Minimum Separation[1] 50 ft (15 m)		100 ft (30.5 m)		150 ft (46 m)	
	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
I	N/A	N/A	2,000	907	2,000	907	20,000	9,070	175,000	79,400
II	4,000	1,810	50,000	22,700	100,000	45,400	200,000	90,700	UNL	UNL
III	50,000	22,700	100,000	45,400	200,000	90,700	UNL	UNL	UNL	UNL
IV	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL
V	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL	UNL

Note: N/A — Not Allowed; UNL — Unlimited
[1]Minimum separation means the distance from the line of property that is or can be built upon, including the opposite side of a public way, or the distance from the nearest important building on the same property.

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4.10.1.3* Class I organic peroxide formulation cut-off storage as it appears in Table 4.10(b) shall have deflagration venting provided for exterior walls.

4.10.2* Where two or more different classes of organic peroxide formulations are stored in the same area, the maximum quantity permitted shall be limited to the sum of the proportional amounts that each class bears to the maximum permitted for that class. The total of the proportional amounts shall not exceed 100 percent.

4.10.3 Where the storage area is protected by a specially engineered fire protection system acceptable to the authority having jurisdiction, the quantity of organic peroxide formulations shall be permitted to be increased.

4.10.4 Organic peroxide formulations shall not be stored where they can be exposed to explosive materials.

4.11 Storage Arrangements.

4.11.1 Storage shall be arranged to facilitate manual access and handling, to maintain pile stability, to minimize breakage and spillage, and to promote good housekeeping.

4.11.2 A clear space of at least 2 ft (0.6 m) shall be maintained between organic peroxide storage and uninsulated metal walls.

4.11.3 Separation Distance.

4.11.3.1 Incompatible materials and flammable liquids shall not be stored within 25 ft (7.6 m) of organic peroxide formulations. The effective separation distance shall be maintained by floor slope, drains, or dikes to prevent liquid leakage from encroaching on the organic peroxide formulation storage area.

Exception: Organic peroxide formulations that can also be classified as flammable liquids by their flash point shall be permitted to be stored with other organic peroxide formulations, and the more restrictive requirements of NFPA 30, Flammable and Combustible Liquids Code, or this code shall apply.

4.11.3.2 As an alternative to the 25-ft (7.6-m) separation distance, a 1-hour, liquidtight fire barrier shall be permitted.

4.11.4 Only closed containers and packages shall be permitted in storage areas.

4.11.5 Storage of bags, drums, and other containers and packages of organic peroxide formulations shall be in accordance with Table 4.11.5.

4.11.6* Storage of 55-gal (208-L) drums of Class II and Class III organic peroxide formulations shall be stored one high only.

4.11.7 Storage of Class V organic peroxide formulations shall meet the requirements of NFPA 230, *Standard for the Fire Protection of Storage*, as applicable.

4.12* Classification of Organic Peroxide Formulations. For the purpose of this code, organic peroxide formulations shall be classified according to the system described in this section.

4.12.1 Class I shall describe those formulations that are capable of deflagration but not detonation.

4.12.2 Class II shall describe those formulations that burn very rapidly and that present a severe reactivity hazard.

4.12.3 Class III shall describe those formulations that burn rapidly and that present a moderate reactivity hazard.

Table 4.11.5 Provisions for Storage Arrangement by Class of Organic Peroxide Formulation

Class of Organic Peroxide Formulation	Max. Pile Height		Max. Pile Width		Min. Main Aisle Width		Min. Addnl Aisle Width	
	ft	m	ft	m	ft	m	ft	m
I	6	1.8	4	1.2	8	2.4	4	1.2
II*	8	2.4	8	2.4	6	1.8	4	1.2
III*	8	2.4	8	2.4	6	1.8	4	1.2
IV	10	3.0	16	4.9	4	1.2	3	0.9
V	See 4.11.7.							

*See 4.11.6.

4.12.4 Class IV shall describe those formulations that burn in the same manner as ordinary combustibles and that present a minimal reactivity hazard.

4.12.5 Class V shall describe those formulations that burn with less intensity than ordinary combustibles or do not sustain combustion and that present no reactivity hazard.

4.13 Classification of Storage Facilities.

4.13.1 Segregated storage shall refer to storage in the same room or inside area, but physically separated by distance from incompatible materials. Sills, curbs, intervening storage of nonhazardous compatible materials, and aisles shall be permitted to be used as aids in maintaining spacing. *(See Chapter 5.)*

4.13.2 Cut-off storage shall refer to storage in the same building or inside area, but physically separated from incompatible materials by partitions or walls. *(See Chapter 6.)*

4.13.3 Detached storage shall refer to storage in either an open outside area or a separate building containing no incompatible materials and located away from all other structures. *(See Chapter 7.)*

Chapter 5 Segregated Storage

5.1 Scope. This chapter shall apply to the storage of organic peroxide formulations when stored under segregated conditions as defined in Section 4.13 of this code and in quantities not exceeding those shown in Table 4.10(a) and Table 4.10(b).

5.2 Basic Requirements. The basic requirements set forth in Chapter 4 shall apply to the segregated storage of organic peroxide formulations.

5.3 Building Construction. If there are any floors or open spaces located below the organic peroxide storage area, the floor of the storage area shall be made watertight and shall be provided with drainage that leads to a safe location. Every means shall be taken to ensure that spilled material cannot run down into areas below the organic peroxide storage area.

5.4 Storage Arrangement.

5.4.1 A minimum of 8 ft (2.4 m) of clear space shall be maintained between organic peroxide storage and any other storage.

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5.4.2 Segregated storage areas shall meet all applicable requirements of NFPA 230, *Standard for the Fire Protection of Storage*, as applicable.

5.4.3* A clear space of at least 4 ft (1.2 m) shall be maintained between organic peroxide storage and any walls of combustible or limited-combustible construction.

5.5 Fire Protection. Automatic sprinkler protection shall be provided for segregated storage areas in accordance with 4.8.2 and 4.8.3, under the following conditions:

(1) Storage areas of combustible construction containing Classes II, III, or IV organic peroxide formulations
(2) Storage areas of noncombustible construction where quantities exceed the following:
   (a) 100,000 lb (45,400 kg) of Class IV organic peroxide formulations
   (b) 1500 lb (680 kg) of Class III organic peroxide formulations
   (c) Any quantity of Class II organic peroxide formulation

Chapter 6 Cut-Off Storage

6.1 Scope. This chapter shall apply to the storage of organic peroxide formulations when stored under cut-off conditions as defined in Section 4.13 of this code and in quantities not exceeding those shown in Table 4.10(a) and Table 4.10(b).

6.2 Basic Requirements. The basic requirements set forth in Chapter 4 shall apply to cut-off storage of organic peroxide formulations.

6.3 Building Construction.

6.3.1 Cut-off storage areas for Class I, Class II, or any refrigerated organic peroxide formulations shall be single story, without a basement or crawl space.

6.3.2 Where any Class I organic peroxide formulations are stored in excess of 100 lb (45 kg), internal walls and any wall, roof, or ceiling that joins with another occupied building shall be capable of withstanding an internal overpressure of 432 psf (0.2 bar).

6.3.3 Where Class II or any refrigerated organic peroxide formulations are stored, any internal walls or any wall, roof, or ceiling that joins with another occupied building shall be capable of withstanding an internal overpressure of 125 psf (0.06 bar).

6.3.4* For Class I, Class II, or any refrigerated organic peroxide formulation that gives off flammable gases upon decomposition, the storage area shall be provided with deflagration venting.

6.3.5 Any walls common with another building shall have a fire resistance of at least 2 hours, as measured by the procedure described in NFPA 251, *Standard Methods of Fire Endurance of Building Construction and Materials*.

6.3.5.1 Any door or window openings in such walls shall be protected by approved fire doors and fire windows suitable for the opening and shall be installed according to NFPA 80, *Standard for Fire Doors and Fire Windows*.

6.4* Storage Arrangement. A clear space of at least 4 ft (1.2 m) shall be maintained between organic peroxide storage and any walls of combustible or limited-combustible construction.

6.5 Fire Protection.

6.5.1 Automatic sprinkler protection in accordance with 4.8.2 and 4.8.3 shall be provided for all storage areas of combustible construction, regardless of the class of formulation stored.

6.5.2 Automatic sprinkler protection shall be provided for all storage areas of noncombustible construction where any quantity of Class I organic peroxide formulations are stored.

6.5.3 Automatic sprinkler protection shall be provided for all storage areas of noncombustible construction where quantities exceed the following:

(1) 2000 lb (907 kg) of Class II organic peroxide formulations
(2) 3000 lb (1360 kg) of Class III organic peroxide formulations
(3) 200,000 lb (90,700 kg) of Class IV organic peroxide formulations

Chapter 7 Detached Storage

7.1 Scope. This chapter shall apply to the storage of organic peroxide formulations when stored under detached conditions as defined in Section 4.13 and in quantities and at separation distances as specified in Table 4.10(a) and Table 4.10(b).

7.2 Basic Requirements. The basic requirements set forth in Chapter 4 shall apply to detached storage of organic peroxide formulations.

7.3 Building Location.

7.3.1* Detached storage buildings shall be separated from the lines of property that are or can be built upon, including the opposite side of a public way, or from the nearest important building on the same property.

7.3.2 For Classes II, III, and IV organic peroxide formulations, detached storage buildings separated by less than 50 ft (15.3 m) shall be considered to be a single area when applying the limits for Table 4.10(a) and Table 4.10(b).

7.3.3 For Class I organic peroxide formulations, detached storage buildings shall be separated from each other in accordance with Table 7.3.3.

Table 7.3.3 Separation of Individual Storage Buildings

Nonsprinklered				Automatic Sprinklered			
Quantity		Distance		Quantity		Distance	
lb	kg	ft	m	lb	kg	ft	m
1,000	454	20	6	2,000	907	20	6
4,000	1,810	75	23	20,000	9,070	75	23
10,000	4,540	100	30	175,000	79,400	100	30

7.4 Building Construction and Utilities.

7.4.1* Detached storage buildings shall be single story, without a basement or crawl space.

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7.4.2 Nonsprinklered buildings for storing more than 5000 lb (2270 kg) of Class I, Class II, or any refrigerated organic peroxide formulation that gives off flammable gases upon decomposition shall be built of noncombustible construction.

7.4.3* Buildings of combustible construction employing sun shields shall be permitted to be used for detached storage buildings storing less than 5000 lb (2270 kg) of organic peroxide formulations. *(See Figure A. 7.4.3 for an example of a building of combustible construction employing sun shields.)*

7.5 Fire Protection.

7.5.1 Where required, automatic sprinkler systems and their water supplies shall meet the requirements of 4.8.2 and 4.8.3.

7.5.2 Where required for Class I organic peroxide formulations in quantities exceeding 2000 lb (907 kg), automatic sprinkler protection shall be open-head deluge-type, designed and installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems.*

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.3 Code. The decision to designate a standard as a "code" is based on such factors as the size and scope of the document, its intended use and form of adoption, and whether it contains substantial enforcement and administrative provisions.

A.3.2.5 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.3 Explosive Decomposition. The term includes both deflagration and detonation.

A.3.3.4 Incompatible Materials. Information on incompatible materials for organic peroxide formulations can be found in material safety data sheets (MSDS) or manufacturers' product bulletins.

A.3.3.6 Organic Peroxide Formulation. Terms such as *accelerator, catalyst, initiator,* and so forth, are sometimes used to describe organic peroxide formulations. These terms are misleading because they can also refer to materials that are not or do not contain organic peroxides, some of which might present increased hazard when mixed with organic peroxides.

A.4.1.1 The classification system described in Section 4.12 is used only to determine the storage requirements established by this code. It is not meant to be a substitute for the hazard identification system established by NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response.* Since the hazard characteristics of organic peroxide formulations vary widely depending on the type of organic peroxide, the diluent, and their relative concentrations, each specific formulation will have to be rated individually according to the criteria established in NFPA 704.

A.4.4.2 Considerations should be given for maintaining proper refrigeration capability in the event of a loss of power. Some materials, when frozen, could cause separation of a carrier from the organic peroxide.

A.4.8.1 Manual fire-fighting equipment can consist of small hose equipped with adjustable spray nozzles or portable fire extinguishers suitable for Class A and for Class B:C fires, or both. Manual fire fighting in storage areas should be undertaken only by those having a clear understanding of the storage conditions and the characteristics of fires involving organic peroxides.

A.4.8.2 The use of high-expansion foam or liquid nitrogen flooding can be substituted for automatic sprinkler protection if installed subject to the approval of the authority having jurisdiction. For Class I organic peroxide formulations, see 7.5.2.

A.4.9.2 The method of disposal can vary depending on the specific formulation and materials with which they might have been contaminated. Refer to the manufacturer or the supplier of the specific formulation for advice.

A.4.10.1.3 See A.6.3.4.

A.4.10.2 For example, a sprinklered building, detached by 50 ft (15.3 m), can contain up to 500 lb (227 kg) of Class I, 50,000 lb (22,700 kg) of Class II, and 50,000 lb (22,700 kg) of Class III formulations, according to the following ratios:

(1) Class I:

$$\frac{500\text{ lb}}{2000\text{ lb (max)}} \times 100 = 25\% \qquad \frac{227\text{ kg}}{907\text{ kg (max)}} \times 100 = 25\%$$

(2) Class II:

$$\frac{50{,}000\text{ lb}}{100{,}000\text{ lb (max)}} \times 100 = 50\% \qquad \frac{22{,}700\text{ kg}}{45{,}400\text{ kg (max)}} \times 100 = 50\%$$

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(3) Class III:

$$\frac{50{,}000 \text{ lb}}{200{,}000 \text{ lb (max)}} \times 100 = 25\% \qquad \frac{22{,}700 \text{ lb}}{90{,}700 \text{ lb (max)}} \times 100 = 25\%$$

In no case does the quantity in storage exceed the maximum for its class, nor does the sum of the percentages exceed 100 percent.

A.4.11.6 Since no commercially available Class I organic peroxide formulations are supplied in 55-gal (208-L) drums, there is no requirement for such storage.

A.4.12 Test procedures described in *United Nations Recommendation on Transportation of Dangerous Goods, Tests and Criteria* are useful in determining the classification of organic peroxide formulations.

The system is based on the behavior of certain specific formulations in their U.S. Department of Transportation- or Canadian Ministry of Transport-approved shipping containers and under conditions of fire exposure. *(See Annex B for classification of typical organic peroxide formulations.)*

A.5.4.3 For information on combustible or limited-combustible construction, see NFPA 220, *Standard on Types of Building Construction*.

A.6.3.4 In the venting equation, use the fuel characteristic constant for "gases with fundamental burning velocity less than 1.3 times that of propane." See NFPA 68, *Guide for Venting of Deflagrations*, for information on vent design. Refer to manufacturers' technical data for information on organic peroxide formulations that give off flammable gases upon decomposition.

A.6.4 For information on combustible or limited-combustible construction, see NFPA 220, *Standard on Types of Building Construction*.

A.7.3.1 For the purpose of this document, an important building is one that is occupied or that contains facilities vital to the operation of the plant.

A.7.4.1 A detached, mechanically refrigerated building for storing organic peroxide formulations that require temperature control is illustrated in Figure A.7.4.1.

A.7.4.3 Figure A.7.4.3 is an example of a nonrefrigerated building for storing less than 5000 lb (2270 kg) of organic peroxide formulations for detached storage as allowed by 7.4.3.

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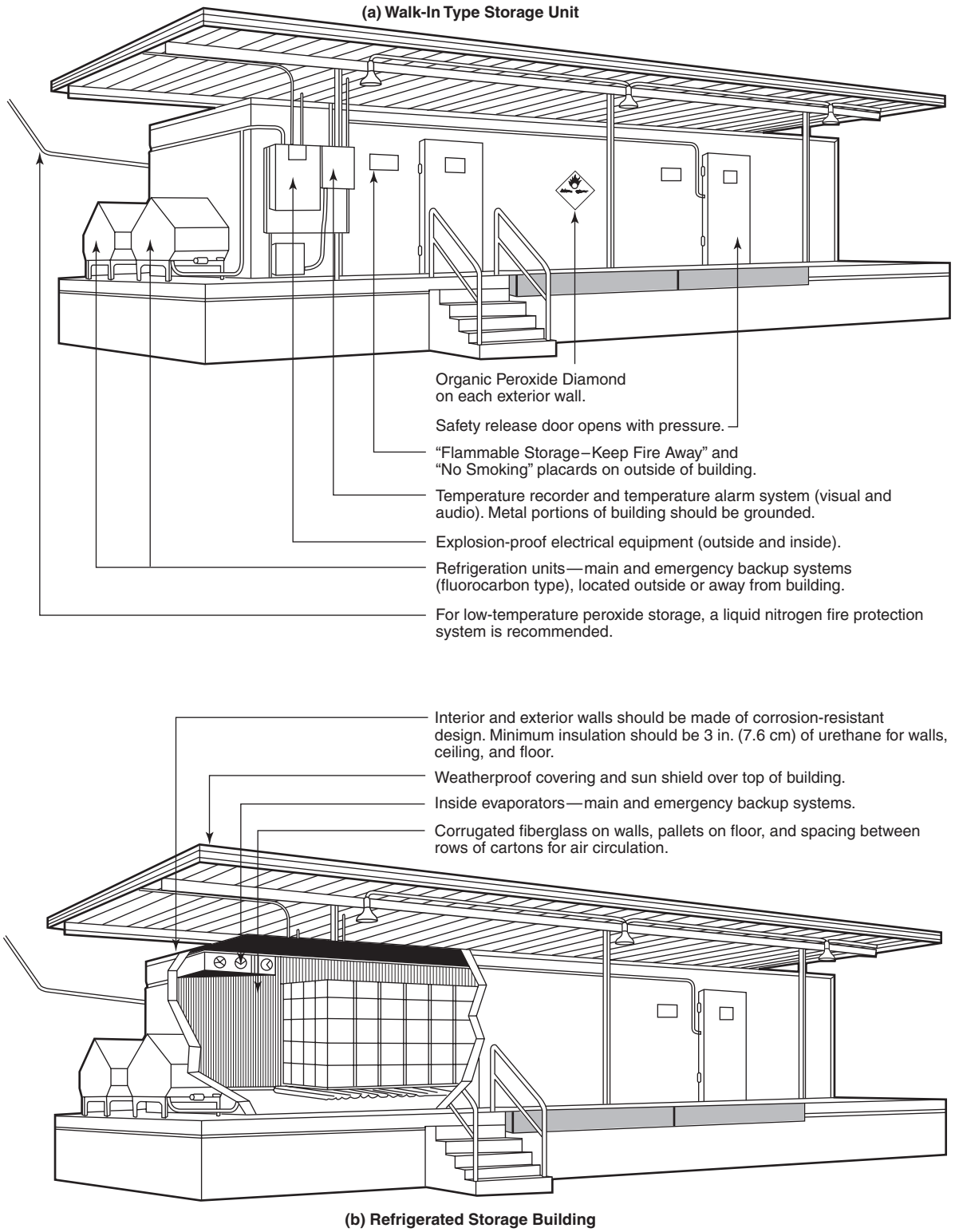


FIGURE A.7.4.1 Refrigerated Storage Building and Key Recommendations.

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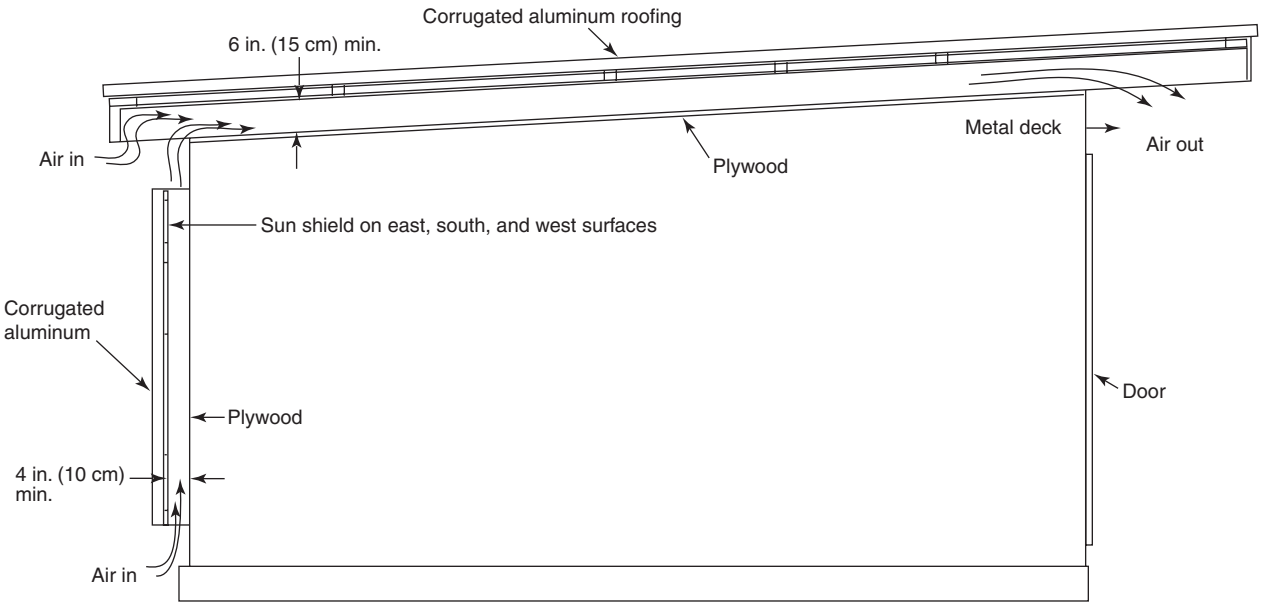


FIGURE A.7.4.3 Detached Storage Building for Storing Less than 5000 lb (2270 kg) of Organic Peroxide Formulations.

Annex B Typical Organic Peroxide Formulations

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 General. The assignment of the organic peroxide formulation classifications shown in the tables in this annex are based on the container sizes shown. A change in the container size could affect the classification.

For an alphabetical listing of typical organic peroxide formulations, see Table B.1.

B.2 Class I Formulations.

B.2.1 Fire Hazard Characteristics. Class I formulations present a deflagration hazard through easily initiated, rapid explosive decomposition. Class I includes some formulations that are relatively safe only under closely controlled temperatures. Either excessively high or low temperatures can increase the potential for severe explosive decomposition.

B.2.2 Fire-Fighting Information. The immediate area should be evacuated and the fire should be fought from a remote location. Some damage to structures from overpressure can be expected should a deflagration occur.

B.2.3 Typical Class I Formulations. See Table B.2.3.

B.3 Class II Formulations.

B.3.1 Fire-Hazard Characteristics. Class II formulations present a severe fire hazard similar to Class I flammable liquids. The decomposition is not as rapid, violent, or complete as that produced by Class I formulations. As with Class I formulations, this class includes some formulations that are relatively safe when under controlled temperatures or when diluted.

B.3.2 Fire-Fighting Information. Fires should be fought from a safe distance because a hazard exists from rupturing containers.

B.3.3 Typical Class II Formulations. See Table B.3.3.

B.4 Class III Formulations.

B.4.1 Fire Hazard Characteristics. Class III formulations present a fire hazard similar to Class II combustible liquids. They are characterized by rapid burning and high heat liberation due to decomposition.

B.4.2 Fire-Fighting Information. Caution should be observed due to possible unexpected increases in fire intensity.

B.4.3 Typical Class III Formulations. See Table B.4.3.

B.5 Class IV Formulations.

B.5.1 Fire Hazard Characteristics. Class IV formulations present fire hazards that are easily controlled. Reactivity has little effect on fire intensity.

B.5.2 Fire-Fighting Information. Normal fire-fighting procedures can be used.

B.5.3 Typical Class IV Formulations. See Table B.5.3.

B.6 Class V Formulations.

B.6.1 Fire Hazard Characteristics. Class V formulations do not present severe fire hazards. Those that do burn, do so with less intensity than ordinary combustibles.

B.6.2 Fire-Fighting Information. Fire-fighting procedures need primarily consider the combustibility of containers.

B.6.3 Typical Class V Formulations. See Table B.6.3.

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Table B.1 Typical Organic Peroxide Formulations

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Class	Container
t-Amyl hydroperoxide	88	Water					3	3	2	III	55 gal (208 L)
t-Amyl peroxyacetate	60	OMS					2	3	2	III	5 gal (19 L)
t-Amyl peroxybenzoate	96	—					2	3	2	II	5 gal (19 L)
t-Amyl peroxy-2-ethylhexanoate	96	—	68	20	77	25	0	3	2	III	55 gal (208 L)
t-Amyl peroxyneodecanoate	75	OMS	32	0	50	10	1	3	2	III	5 gal (19 L)
t-Amyl peroxypivalate	75	OMS	50	10	59	15	1	3	2	III	5 gal (19 L)
t-Butyl cumyl peroxide	95	—					2	2	2	IV	55 gal (208 L)
n-Butyl-4,4-di(*t*-butyl peroxy) valerate	98	—					2	3	2	II	5 gal (19 L)
t-Butyl hydroperoxide	90	Water & *t*-BuOH					3	3	3	I	5 gal (19 L)
t-Butyl hydroperoxide	70	DTBP & *t*-BuOH					3	3	3	II	55 gal (208 L)
t-Butyl hydroperoxide[3]	70	Water					3	2	2	IV	55 gal (208 L)
t-Butyl monoperoxymaleate	98	—					2	3	3	I	50 @ 1 lb (50 @ 0.5 kg)
t-Butyl peroxyacetate	75	OMS					1	3	3	I	5 gal (19 L)
t-Butyl peroxyacetate	60	OMS					1	3	3	I	5 gal (19 L)
t-Butyl peroxybenzoate	98	—					1	3	3	II	5 gal (19 L)
t-Butyl peroxy-2-ethylhexanoate	97	—	68	20	77	25	1	3	3	III	5 gal (19 L)
t-Butyl peroxy-2-ethylhexanoate	97	—	68	20	77	25	1	3	3	II	55 gal (208 L)
t-Butyl peroxy-2-ethylhexanoate	50	DOP or OMS	86	30	95	35	1	2	2	IV	5 gal (19 L)
t-Butyl peroxy-2-ethylhexanoate	50	DOP or OMS	86	30	95	35	1	2	2	III	55 gal (208 L)
t-Butylperoxy 2-ethylhexyl carbonate	95	—					1	3	2	III	5 gal (19 L)
t-Butyl peroxyisobutyrate	75	OMS	59	15	68	20	2	3	3	II	5 gal (19 L)
t-Butylperoxy isopropyl carbonate	92	OMS					1	3	3	I	5 gal (19 L)
t-Butylperoxy isopropyl carbonate	75	OMS					1	3	3	II	5 gal (19 L)
t-Butyl peroxyneodecanoate	75	OMS	32	0	50	10	2	3	2	III	5 gal (19 L)
t-Butyl peroxypivalate	75	OMS	32	0	50	10	2	3	3	II	5 gal (19 L)
t-Butyl peroxypivalate	45	OMS	32	0	50	10	2	2	2	IV	5 gal (19 L)
Cumyl hydroperoxide	88	Cumene					3	2	2	III	55 gal (208 L)
Cumyl peroxyneodecanoate	75	OMS	14	–10	32	0	1	3	2	III	5 gal (19 L)
Cumyl peroxyneoheptanoate	75	OMS	32	0	50	10	2	3	2	III	5 gal (19 L)
Diacetyl peroxide	25	DMP	68	20	77	25	2	3	3	II	5 gal (19 L)
1,1-Di(*t*-amylperoxy) cyclohexane	80	OMS or BBP					2	3	2	III	5 gal (19 L)

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Table B.1 *Continued*

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Class	Container
Dibenzoyl peroxide	98	—					1	3	4	I	1 lb (0.5 kg)
Dibenzoyl peroxide	78	Water					1	2	3	II	25 lb (11 kg)
Dibenzoyl peroxide	75	Water					1	2	2	III	25 lb (11 kg)
Dibenzoyl peroxide	70	Water					1	2	2	IV	25 lb (11 kg)
Dibenzoyl peroxide (paste)	55	Plasticizer		T			1	2	2	III	350 lb (160 kg)
Dibenzoyl peroxide (paste)	55	Plasticizer & Water		T			1	2	2	IV	350 lb (160 kg)
Dibenzoyl peroxide (paste)	50	Plasticizer		T			1	2	2	III	380 lb (170 kg)
Dibenzoyl peroxide (paste)	50	Plasticizer & Water		T			1	2	2	IV	380 lb (170 kg)
Dibenzoyl peroxide (slurry)	40	Water & Plasticizer		T			1	2	2	IV	380 lb (170 kg)
Dibenzoyl peroxide (slurry)	40	Water					1	2	2	IV	5 gal (19 L)
Dibenzoyl peroxide (powder)	35	Dicalcium phosphate dihydrate or Calcium sulfate dihydrate					1	0	0	V	100 lb (45 kg)
Dibenzoyl peroxide (powder)	35	Starch					1	2	2	IV	100 lb (45 kg)
Di (4-*t*-butylcyclohexyl) peroxydicarbonate	98	—	86	30	95	35	1	3	2	III	88 lb (40 kg)
Di-*t*-butyl peroxide[3]	99	—					1	3	2	III	55 gal (208 L)
2,2-Di(*t*-butylperoxy) butane	50	Toluene					1	3	3	I	1 gal (4 L)
1,1-Di(*t*-butylperoxy) cyclohexane	80	OMS or BBP					1	3	3	II	5 gal (19 L)
Di-*sec*-butyl peroxydicarbonate	98	—	–4	–20	14	–10	1	3	3	II	1 gal (4 L)
Di-*sec*-butyl peroxydicarbonate	75	OMS	–4	–20	14	–10	1	3	3	II	5 gal (19 L)
Di(2-*t*-butylperoxy-isopropyl) benzene	96	—					1	2	2	III	100 lb (45 kg)
Di(2-*t*-butylperoxyisopropyl) benzene	40	Clay					1	1	0	V	100 lb (45 kg)
Di(butylperoxy) phthalate	40	DBP					2	2	2	IV	30 gal (110 L)
1,1-Di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane	75–95	—					2	3	3	II	5 gal (19 L)
1,1-Di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane	40	Calcium carbonate					1	1	1	V	100 lb (45 kg)
Dicetyl peroxydicarbonate	85	—	86	30	95	35	1	2	2	IV	44 lb (20 kg)
Dicumyl peroxide	98	—					2	2	2	IV	55 gal (208 L)

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Table B.1 *Continued*

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Class	Container
Dicumyl peroxide	40	Clay or Calcium carbonate					1	1	1	V	100 lb (45 kg)
Didecanoyl peroxide	98	—	86	30	95	35	1	3	2	III	50 lb (23 kg)
Di-2,4-dichlorobenzoyl peroxide	50	DBP & Silicone		T			1	2	2	III	5 gal (19 L)
Di(2-ethylhexyl) peroxydicarbonate	97	—	–4	–20	14	–10	1	3	3	II	1 gal (4 L)
Di(2-ethylhexyl) peroxydicarbonate	40	OMS	5	–15	23	–5	1	2	2	IV	5 gal (19 L)
Diisopropyl peroxydicarbonate	99	—	5	–15	23	–5	2	3	4	I	10 lb (4.5 kg)
Diisopropyl peroxydicarbonate	30	Toluene	14	–10	32	0	2	3	2	III	5 lb (2.3 kg)
Di-*n*-propyl peroxydicarbonate	98	—	–13	–25	5	–15	2	3	4	I	1 gal (4 L)
Di-*n*-propyl peroxydicarbonate	85	OMS	–13	–25	5	–15	2	3	4	I	1 gal (4 L)
Dilauroyl peroxide	98	—					1	2	2	IV	110 lb (50 kg)
2,5-Dimethyl-2,5-di (benzoylperoxy)hexane	95	—					2	3	3	II	4 @ 5 lb (4 @ 2.3 kg)
2,5-Dimethyl-2,5-di (*t*-butylperoxy)hexane	92	—					2	3	2	III	30 gal (110 L)
2,5-Dimethyl-2,5-di (*t*-butylperoxy)hexane	47	Calcium carbonate or Silica					1	1	1	V	100 lb (45 kg)
2,5-Dimethyl-2,5-di (2-ethylhexanoylperoxy) hexane	90	—	68	20	77	25	0	3	2	III	5 gal (19 L)
2,5-Dimethyl-2,5-dihydro-peroxyhexane	70	Water					2	3	3	II	100 lb (45 kg)
Ethyl-3,3-di(*t*-amylperoxy) butyrate	75	OMS					1	3	2	III	5 gal (19 L)
Ethyl-3,3-di(*t*-butylperoxy) butyrate	75	OMS					2	2	2	III	5 gal (19 L)
Ethyl-3,3-di(*t*-butylperoxy) butyrate	40	Clay or Calcium silicate					1	3	2	V	100 lb (45 kg)
p-Menthyl hydroperoxide	54	Alcohols & Ketones					3	2	2	IV	55 gal (208 L)
Methyl ethyl ketone peroxide	9.0% AO	DMP					3	2	2	III	5 gal (19 L)
Methyl ethyl ketone peroxide	5.5% AO	DMP					3	2	2	IV	5 gal (19 L)
Methyl ethyl ketone peroxide	9.0% AO	Water & Glycols					3	2	2	IV	5 gal (19 L)

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Table B.1 *Continued*

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Class	Container
Methyl ethyl ketone peroxide and Cyclohexanone peroxide mixture	9.0% AO	DMP					3	2	2	III	5 gal (19 L)
2,4-Pentanedione peroxide	4.0% AO	Water & Solvent					2	1	1	IV	5 gal (19 L)
Peroxyacetic acid, Type E, stabilized	43	Water, HOAc, & H_2O_2					3	2	3	II	30 gal (110 L)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.

[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.

[3]See NFPA 30, *Flammable and Combustible Liquids Code*, for additional storage requirements.

T — Temperature control should be considered to reduce fire hazard depending on packaging size and recommendations in manufacturers' literature.

Note: Diluents: BBP — Butyl benzyl phthalate; DBP — Dibutyl phthalate; DMP — Dimethyl phthalate; DOP — Dioctyl phthalate; DTBP — Di-tertiary-butyl peroxide; HOAc — Acetic acid; H_2O_2 — Hydrogen peroxide; OMS — Odorless mineral spirits; *t*-BuOH — Tertiary butanol.

Table B.2.3 Typical Class I Formulations

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
t-Butyl hydroperoxide	90	Water & *t*-BuOH					3	3	3	5 gal (19 L)
t-Butyl monoperoxymaleate	98	—					2	3	3	50 @ 1 lb (50 @ 0.5 kg)
t-Butyl peroxyacetate	75	OMS					1	3	3	5 gal (19 L)
t-Butyl peroxyacetate	60	OMS					1	3	3	5 gal (19 L)
t-Butylperoxy isopropyl carbonate	92	OMS					1	3	3	5 gal (19 L)
Dibenzoyl peroxide	98	—					1	3	4	1 lb (0.5 kg)
2,2-Di(*t*-butylperoxy) butane	50	Toluene					1	3	3	1 gal (4 L)
Diisopropyl peroxydicarbonate	99	—	5	–15	23	–5	2	3	4	10 lb (4.5 kg)
Di-*n*-propyl peroxydicarbonate	98	—	–13	–25	5	–15	2	3	4	1 gal (4 L)
Di-*n*-propyl peroxydicarbonate	85	OMS	–13	–25	5	–15	2	3	4	1 gal (4 L)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.

[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.

Note: Diluents: OMS — Odorless mineral spirits; *t*-BuOH — Tertiary butanol.

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Table B.3.3 Typical Class II Formulations

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
t-Amyl peroxybenzoate	96	—					2	3	2	5 gal (19 L)
n-Butyl-4,4-di(*t*-butylperoxy) valerate	98	—					2	3	2	5 gal (19 L)
t-Butyl hydroperoxide[3]	70	DTBP & *t*-BuOH					3	3	3	55 gal (208 L)
t-Butyl peroxybenzoate	98	—					1	3	3	5 gal (19 L)
t-Butyl peroxy-2-ethyl-hexanoate	97	—	68	20	77	25	1	3	3	55 gal (208 L)
t-Butyl peroxyisobutyrate	75	OMS	59	15	68	20	2	3	3	5 gal (19 L)
t-Butylperoxy isopropyl carbonate	75	OMS					1	3	3	5 gal (19 L)
t-Butyl peroxypivalate	75	OMS	32	0	50	10	2	3	3	5 gal (19 L)
Diacetyl peroxide	25	DMP	68	20	77	25	2	3	3	5 gal (19 L)
Dibenzoyl peroxide	78	Water					1	2	3	25 lb (11 kg)
1,1-Di(*t*-butylperoxy) cyclohexane	80	OMS or BBP					1	3	3	5 gal (19 L)
Di-*sec*-butyl peroxydicarbonate	98	—	–4	–20	14	–10	1	3	3	1 gal (4 L)
Di-*sec*-butyl peroxydicarbonate	75	OMS	–4	–20	14	–10	1	3	3	5 gal (19 L)
1,1-Di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane	75–95	—					2	3	3	5 gal (19 L)
Di(2-ethylhexyl) peroxydicarbonate	97	—	–4	–20	14	–10	1	3	3	1 gal (4 L)
2,5-Dimethyl-2,5-di(benzoylperoxy) hexane	95	—					2	3	3	4 @ 5 lb (4 @ 2.3 kg)
2,5-Dimethyl-2,5-dihydroperoxy hexane	70	Water					2	3	3	100 lb (45 kg)
Peroxyacetic acid, Type E, stabilized	43	Water, HOAc, & H_2O_2					3	2	3	30 gal (110 L)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.

[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.

[3]Also a flammable liquid; see NFPA 30, *Flammable and Combustible Liquids Code*, for storage requirements.

Note: Diluents: BBP — Butyl benzyl phthalate; DMP — Dimethyl phthalate; DTBP — Di-tertiary-butyl peroxide; HOAc — Acetic acid; H_2O_2 — Hydrogen peroxide; OMS — Odorless mineral spirits; *t*-BuOH — Tertiary butanol.

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Table B.4.3 Typical Class III Formulations

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
t-Amyl hydroperoxide	88	Water					3	3	2	55 gal (208 L)
t-Amyl peroxyacetate	60	OMS					2	3	2	5 gal (19 L)
t-Amyl peroxy-2-ethylhexanoate	96	—	68	20	77	25	0	3	2	55 gal (208 L)
t-Amyl peroxyneodecanoate	75	OMS	32	0	50	10	1	3	2	5 gal (19 L)
t-Amyl peroxypivalate	75	OMS	50	10	59	15	1	3	2	5 gal (19 L)
t-Butyl peroxy-2-ethylhexanoate	97	—	68	20	77	25	1	3	3	5 gal (19 L)
t-Butyl peroxy-2-ethylhexanoate	50	DOP or OMS	86	30	95	35	1	2	2	55 gal (208 L)
t-Butyl peroxy-2-ethylhexyl carbonate	95	—					1	3	2	5 gal (19 L)
t-Butyl peroxyneodecanoate	75	OMS	32	0	50	10	2	3	2	5 gal (19 L)
Cumyl hydroperoxide	88	Cumene					3	2	2	55 gal (208 L)
Cumyl peroxyneodecanoate	75	OMS	14	–10	32	0	1	3	2	5 gal (19 L)
Cumyl peroxyneoheptanoate	75	OMS	32	0	50	10	2	3	2	5 gal (19 L)
1,1-Di(*t*-amylperoxy) cyclohexane	80	OMS or BBP					2	3	2	5 gal (19 L)
Dibenzoyl peroxide	75	Water					1	2	2	25 lb (11 kg)
Dibenzoyl peroxide (paste)	55	Plasticizer		T			1	2	2	350 lb (160 kg)
Dibenzoyl peroxide (paste)	50	Plasticizer		T			1	2	2	380 lb (170 kg)
Di(4-*t*-butylcyclohexyl) peroxydicarbonate	98	—	86	30	95	35	1	3	2	88 lb (40 kg)
Di-*t*-butyl peroxide[3]	99	—					1	3	2	55 gal (208 L)
Di(2-*t*-butylperoxy-isopropyl) benzene	96	—					1	2	2	100 lb (45 kg)
Didecanoyl peroxide	98	—	86	30	95	35	1	3	2	50 lb (23 kg)
Di-2,4-dichlorobenzoyl peroxide	50	DBP & Silicone		T			1	2	2	5 gal (19 L)
Diisopropyl peroxydicarbonate	30	Toluene	14	–10	32	0	2	3	2	5 lb (2.3 kg)
2,5-Dimethyl-2,5-di (*t*-butylperoxy) hexane	92	—					2	3	2	30 gal (110 L)
2,5-Dimethyl-2,5-di-(2-ethyl hexanoylperoxy) hexane	90	—		20		25	0	3	2	5 gal (19 L)
Ethyl-3,3-di (*t*-amylperoxy) butyrate	75	OMS					1	3	2	5 gal (19 L)

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Table B.4.3 *Continued*

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
Ethyl-3,3-di (*t*-butylperoxy) butyrate	75	OMS					2	2	2	5 gal (19 L)
Methyl ethyl ketone peroxide	9.0% AO	DMP					3	2	2	5 gal (19 L)
Methyl ethyl ketone peroxide and Cyclohexanone peroxide mixture	9.0% AO	DMP					3	2	2	5 gal (19 L)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.

[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.

[3]See NFPA 30, *Flammable and Combustible Liquids Code*, for storage requirements.

T — Temperature control should be considered to reduce fire hazard depending on packaging size and recommendations in manufacturers' literature.

Note: Diluents: BBP — Butyl benzyl phthalate; DBP — Dibutyl phthalate; DMP — Dimethyl phthalate; DOP — Dioctyl phthalate; OMS — Odorless mineral spirits; AO — Active oxygen.

Table B.5.3 Typical Class IV Formulations

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
t-Butyl cumyl peroxide	95	—					2	2	2	55 gal (208 L)
t-Butyl hydroperoxide	70	Water					3	2	2	55 gal (208 L)
t-Butyl peroxy-2-ethylhexanoate	50	DOP or OMS	86	30	95	35	1	2	2	5 gal (19 L)
t-Butyl peroxypivalate	45	OMS	32	0	50	10	2	2	2	5 gal (19 L)
Dibenzoyl peroxide	70	Water					1	2	2	25 lb (11 kg)
Dibenzoyl peroxide (paste)	55	Plasticizer & Water		T			1	2	2	350 lb (160 kg)
Dibenzoyl peroxide (paste)	50	Plasticizer & Water		T			1	2	2	380 lb (170 kg)
Dibenzoyl peroxide (slurry)	40	Water & Plasticizer		T			1	2	2	380 lb (170 kg)
Dibenzoyl peroxide (slurry)	40	Water					1	2	2	5 gal (19 L)
Dibenzoyl peroxide (powder)	35	Starch					1	2	2	100 lb (45 kg)
Di(*t*-butylperoxy) phthalate	40	DBP					2	2	2	30 gal (110 L)
Dicetyl peroxydicarbonate	85	—	86	30	95	35	1	2	2	44 lb (20 kg)
Dicumyl peroxide	98	—					2	2	2	55 gal (208 L)
Di(2-ethylhexyl) peroxydicarbonate	40	OMS	5	–15	23	–5	1	2	2	5 gal (19 L)

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Table B.5.3 *Continued*

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
Dilauroyl peroxide	98	—					1	2	2	110 lb (50 kg)
p-Menthyl hydroperoxide	54	Alcohols & Ketones		T			3	2	2	55 gal (208 L)
Methyl ethyl ketone peroxide	5.5% AO	DMP					3	2	2	5 gal (19 L)
Methyl ethyl ketone peroxide	9.0% AO	Water & Glycols					3	2	2	5 gal (19 L)
2,4-Pentanedione peroxide	4.0% AO	Water & Solvent					2	1	1	5 gal (19 L)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.

[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.

T — Temperature control should be considered to reduce fire hazard depending on packaging size and recommendations in manufacturers' literature.

Note: Diluents: DBP — Dibutyl phthalate; DMP — Dimethyl phthalate; DOP — Dioctyl phthalate; OMS — Odorless mineral spirits; AO — Active oxygen.

Table B.6.3 Typical Class V Formulations

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
Dibenzoyl peroxide (powder)	35	Dicalcium phosphate dihydrate or Calcium sulfate dihydrate					1	0	0	100 lb (45 kg)
Di(2-*t*-butylperoxy-isopropyl) benzene	40	Clay					1	1	0	100 lb (45 kg)
1,1-Di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane	40	Calcium carbonate					1	1	1	100 lb (45 kg)
Dicumyl peroxide	40	Clay or Calcium carbonate					1	1	1	100 lb (45 kg)
2,5-Dimethyl-2,5-di(*t*-butylperoxy) hexane	47	Calcium carbonate or Silica					1	1	1	100 lb (45 kg)
Ethyl-3,3-di(*t*-butylperoxy) butyrate	40	Clay or Calcium silicate					1	3	2	100 lb (45 kg)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.

[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.

AO — Active oxygen.

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Annex C Sample Ordinance Adopting NFPA 432

C.1 The following sample ordinance is provided to assist a jurisdiction in the adoption of this code and is not part of this code.

ORDINANCE NO. _____

An ordinance of the *[jurisdiction]* adopting the *[year]* edition of NFPA *[document number]*, *[complete document title]* documents listed in Chapter 2 of that code; prescribing regulations governing conditions hazardous to life and property from fire or explosion; providing for the issuance of permits and collection of fees; repealing Ordinance No. _____ of the *[jurisdiction]* and all other ordinances and parts of ordinances in conflict therewith; providing a penalty; providing a severability clause; and providing for publication; and providing an effective date.

BE IT ORDAINED BY THE *[governing body]* OF THE *[jurisdiction]*:

SECTION 1 That the *[complete document title]* and documents adopted by Chapter 2, three (3) copies of which are on file and are open to inspection by the public in the office of the *[jurisdiction's keeper of records]* of the *[jurisdiction]*, are hereby adopted and incorporated into this ordinance as fully as if set out at length herein, and from the date on which this ordinance shall take effect, the provisions thereof shall be controlling within the limits of the *[jurisdiction]*. The same are hereby adopted as the code of the *[jurisdiction]* for the purpose of prescribing regulations governing conditions hazardous to life and property from fire or explosion and providing for issuance of permits and collection of fees.

SECTION 2 Any person who shall violate any provision of this code or standard hereby adopted or fail to comply therewith; or who shall violate or fail to comply with any order made thereunder; or who shall build in violation of any detailed statement of specifications or plans submitted and approved thereunder; or failed to operate in accordance with any certificate or permit issued thereunder; and from which no appeal has been taken; or who shall fail to comply with such an order as affirmed or modified by or by a court of competent jurisdiction, within the time fixed herein, shall severally for each and every such violation and noncompliance, respectively, be guilty of a misdemeanor, punishable by a fine of not less than $ _____ nor more than $_____ or by imprisonment for not less than _____ days nor more than _____ days or by both such fine and imprisonment. The imposition of one penalty for any violation shall not excuse the violation or permit it to continue; and all such persons shall be required to correct or remedy such violations or defects within a reasonable time; and when not otherwise specified the application of the above penalty shall not be held to prevent the enforced removal of prohibited conditions. Each day that prohibited conditions are maintained shall constitute a separate offense.

SECTION 3 Additions, insertions, and changes — that the *[year]* edition of NFPA *[document number]*, *[complete document title]* is amended and changed in the following respects:

List Amendments

SECTION 4 That ordinance No. _____ of *[jurisdiction]* entitled *[fill in the title of the ordinance or ordinances in effect at the present time]* and all other ordinances or parts of ordinances in conflict herewith are hereby repealed.

SECTION 5 That if any section, subsection, sentence, clause, or phrase of this ordinance is, for any reason, held to be invalid or unconstitutional, such decision shall not affect the validity or constitutionality of the remaining portions of this ordinance. The *[governing body]* hereby declares that it would have passed this ordinance, and each section, subsection, clause, or phrase hereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses, and phrases be declared unconstitutional.

SECTION 6 That the *[jurisdiction's keeper of records]* is hereby ordered and directed to cause this ordinance to be published. [NOTE: An additional provision may be required to direct the number of times the ordinance is to be published and to specify that it is to be in a newspaper in general circulation. Posting may also be required.]

SECTION 7 That this ordinance and the rules, regulations, provisions, requirements, orders, and matters established and adopted hereby shall take effect and be in full force and effect *[time period]* from and after the date of its final passage and adoption.

Annex D Informational References

D.1 Referenced Publications. The following documents or portions thereof are referenced within this code for informational purposes only and are thus not part of the requirements of this document unless also listed in Chapter 2.

D.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 30, *Flammable and Combustible Liquids Code,* 2000 edition.

NFPA 68, *Guide for Venting of Deflagrations,* 2002 edition.

NFPA 220, *Standard on Types of Building Construction,* 1999 edition.

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response,* 2001 edition.

D.1.2 Other Publications.

D.1.2.1 UN Publication. United Nations Publications, Sales Section, DC2-853, Dept. I004, New York, NY 10017.

United Nations Recommendation on Transportation of Dangerous Goods, Tests and Criteria, Second Edition, 1990.

D.1.2.2 U.S. Government Publication. U.S. Government Printing Office, Washington, DC 20402.

Title 49, *Code of Federal Regulations,* Part 173.225.

D.2 Informational References. (Reserved)

D.3 References for Extracts. (Reserved)

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