NFPA 430
Code for the Storage of Liquid and Solid Oxidizers

1995 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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Storage of Liquid and Solid Oxidizers

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This edition of NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers*, was prepared by the Technical Committee on Hazardous Chemicals, and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 22-25, 1995, in Denver, CO. It was issued by the Standards Council on July 21, 1995, with an effective date of August 11, 1995, and supersedes all previous editions.

This edition of NFPA 430 was approved as an American National Standard on August 11, 1995.

Origin and Development of NFPA 430

At the 1969 NFPA Annual Meeting, the Sectional Committee on Storage, Handling and Transportation of Hazardous Chemicals obtained tentative adoption of a *Code for the Storage and Transportation of Oxidizing Materials and Organic Peroxides*, No. 499-T. Subsequently, the Sectional Committee decided to replace No. 499-T with two codes, one for the storage of liquid and solid oxidizers and the other for organic peroxides.

The text printed here contains those requirements that the Sectional Committee believes to be essential for the safe storage of liquid and solid oxidizers. It was processed in accordance with the NFPA Regulations Governing Committee Projects. A draft was adopted as a Tentative Code in 1971. In 1972, an amended version of the 1971 edition was adopted as a Tentative Code. The 1972 edition, with further revisions, was officially adopted by the Association in 1973, Amendments were adopted in 1974, 1975, and 1980.

For the 1990 edition of NFPA 43A, the Committee initiated a complete revision of the document that incorporates revised limits for the quantities of oxidizers stored in buildings, whether they are sprinklered or nonsprinklered. The limits were revised in consideration of the burning characteristics and loss experience this class of chemicals has demonstrated over the past few years. In this edition, the Committee has provided enhanced requirements for the storage of oxidizers in retail establishments. The Committee also included an enhanced list of typical oxidizers covered by this code in the appendix as a guide to users of the document.

This 1995 edition of NFPA 430 consists of a renumbering of the former code NFPA 43A. It represents a complete revision of the document to update the requirements for the safe handling, fire prevention, and storage provisions for liquid and solid oxidizers. This edition incorporates new material into the document to reflect changes in protection technology, particularly in the requirements for sprinkler protection of oxidizers stored in rack storage configurations. The Committee completely revised the document to make it compatible with industry practices and to incorporate enhanced provisions for the safe handling and storage of liquid and solid oxidizers.

Technical Committee on Hazardous Chemicals

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Brookfield, CT

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Rep. Industrial Risk Insurers

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Rep. The Chlorine Inst.
Lynn K. Underwood, Wausau Insurance Cos., WI
Matthew C. Woody, Des Moines Fire Dept., IA

Alternate

Richard D. Gottwald, Society of the Plastics Industry, DC
(Vot. Alt. to SPI Rep.)
Peter F. Langan, Industrial Risk Insurers, CT
(Alt. to J. A. Davenport)
Roger McKim, Wausau Insurance Co., OR
(Alt. to L. K. Underwood)
P. Kirk Mitchell, BioLab, Inc., GA
(Alt. to C. L. Gibson)
Manfred G. Noack, Olin Corp., CT
(Alt. to B. A. Jacobsen)

Nonvoting

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(Member Emeritus)
Robert W. VanDolah, San Diego, CA
(Member Emeritus)

Martha H. Curtis, NFPA Staff Liaison

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on, and maintain current codes for, classes of hazardous chemicals and codes for specific chemicals where these are warranted by virtue of widespread distribution or special hazards.

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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 Appendix A.

Information on referenced publications can be found in Chapter 7 and Appendix C.

Chapter 1 General

1-1 Scope.

1-1.1 This code shall apply to the storage of oxidizers that are liquid or solid at ambient conditions.

Exception: This code shall not apply to the storage of solid and liquid oxidizers for normal use on the premises of single-family dwellings.

1-1.1.1 Separate chapters specify requirements for storage of oxidizers by class where the quantities stored are greater than the stated minimums.

1-1.1.2* For quantities of a class of oxidizer that are less than the minimum covered by the separate chapter for that class, those parts of that chapter pertaining to fire prevention and sprinkler protection and compatibility, and all of Chapter 2 of this code shall be used as requirements.

1-1.1.3 Existing buildings storing oxidizers that do not comply with the requirements of this code that pertain to types of construction, separation of buildings, and fixed fire protection shall be used at the discretion of the authority having jurisdiction, provided they do not constitute a distinct hazard to life or adjoining property.

1-1.2 This code shall not apply to explosives or blasting agents, which are covered by NFPA 495, *Explosive Materials Code*; or to ammonium nitrate, which is covered in NFPA 490, *Code for the Storage of Ammonium Nitrate*; or to organic peroxides, which are covered in NFPA 43B, *Code for the Storage of Organic Peroxide Formulations.*

1-1.3 The quantity and arrangement limits in this code shall not apply to the storage of oxidizers at manufacturing plants where oxidizers are manufactured.

1-1.4 The quantity and arrangement limits in this code shall not apply to facilities that use ammonium perchlorate in the commercial manufacture of large-scale rocket motors.

1-2* Purpose. The purpose of this code shall be to provide reasonable requirements for the safe storage of commercially available strengths of liquid and solid oxidizers. The hazards of stored oxidizers can manifest themselves in one or more of five distinct hazardous situations as follows:

(a) They increase the burning rate of combustible materials.

(b) They can cause spontaneous ignition of combustible materials.

(c) They can decompose rapidly.

(d) They can liberate hazardous gases.

(e) They can undergo self-sustained decomposition, which can result in an explosion.

1-3 Applicability of Other Documents. The requirements of NFPA 30, *Flammable and Combustible Liquids Code,* and NFPA 231, *Standard for General Storage,* shall apply where applicable and where they are more restrictive than this code.

1-4 Equivalency. Nothing in this code is intended to prevent the use of systems, methods, or devices equivalent to those prescribed by this code, provided technical documentation is submitted to the authority having jurisdiction that demonstrates equivalency, and the system, method, or device is approved for the intended purpose.

1-5 Definitions. For the purposes of this code, the following terms are defined below:

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Combustible Containers. Containers that include paper bags, fiber drums, plastic containers, and wooden or fiber boxes or barrels. They also include noncombustible containers having removable combustible liners or packing and include noncombustible containers in combustible overpacks.

Compatible Material. A material that, when in contact with an oxidizer, will not react with the oxidizer or promote or initiate its decomposition.

Explosive Reaction.* A reaction producing a sudden rise in pressure with potentially destructive results. Such a reaction includes both deflagration and detonation.

Incompatible Material. A material that, when in contact with an oxidizer, can cause hazardous reactions or can promote or initiate decomposition of the oxidizer.

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.

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

Manufacturing Plants. Those facilities where oxidizers are produced by chemical means.

Noncombustible Container. A container constructed of glass or metal. The metal container can be coated with a polymeric material no more than 2 mils in thickness.

Noncombustible Material.* A material that, in the form in which it is used and under the conditions anticipated, will not ignite, supports combustion, burn, or release flammable vapors when subjected to fire or heat. Materials that are reported as having passed ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C,* shall be considered noncombustible materials. For the purposes of this code, noncombustible construction and lim-

ited-combustible construction are both considered to be noncombustible.

Oxidizer. Any material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials. Examples of other oxidizing gases include bromine, chlorine, and fluorine.

Pile. Material in a single contiguous storage area. Any material not properly separated by appropriate distance is considered to be part of the same pile.

Processing Plants. Those facilities not located on the premises of manufacturing plants where oxidizers are pelletized, ground, dissolved, packaged, mixed, or blended.

Retail Establishments. Those facilities where oxidizers are sold directly to the general public.

Shall. Indicates a mandatory requirement.

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

Warehouses. Those facilities where oxidizers are received, stored, and subsequently shipped in their original containers.

1-6 Classification of Oxidizers. For the purpose of this code, oxidizers shall be classified according to the system described in this section. The classification is based on the technical committee's evaluation of available scientific and technical data, actual experience, and its considered opinion. Classification refers to the pure oxidizer. Gross contamination can cause oxidizers of all classes to undergo exothermic or explosive reaction, particularly if they also are subjected to confinement and heating. (*See definition of oxidizer.*) (*See Sections B-1 through B-4 for oxidizer classifications.*)

1-6.1 Class 1. An oxidizer whose primary hazard is that it slightly increases the burning rate but does not cause spontaneous ignition when it comes in contact with combustible materials.

1-6.2 Class 2. An oxidizer that will cause a moderate increase in the burning rate or that causes spontaneous ignition of combustible materials with which it comes in contact.

1-6.3* Class 3. An oxidizer that will cause a severe increase in the burning rate of combustible materials with which it comes in contact or that will undergo vigorous self-sustained decomposition due to contamination or exposure to heat.

1-6.4* Class 4. An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock. In addition, the oxidizer will enhance the burning rate and can cause spontaneous ignition of combustibles.

1-7 Classification of Storage Facilities.

1-7.1* Segregated. Storage in the same room or inside area, but physically separated by distance from incompatible materials.

1-7.2 Cutoff. Storage in the same building or inside area, but physically separated from incompatible materials by partitions or walls, or storage in a fixed tank.

1-7.3 Detached. Storage in either an open outside area or a separate building containing no incompatible materials, and located away from all other structures.

Chapter 2 Basic Requirements

2-1 Hazard Management.

2-1.1 The design of a new or enlarged facility for storage of oxidizers shall be reviewed by the authority having jurisdiction. (*For existing structures, see 1-1.1.3.*)

2-1.2 Emergency plans shall be prepared for each facility. These plans shall be reviewed and training exercises shall be conducted at least annually in cooperation with local emergency organizations.

2-2 Identification of Materials in Storage.

2-2.1* All storage areas containing oxidizers shall be conspicuously identified by the words "Class (appropriate classification number) Oxidizers," as defined in Section 1-6.

NOTE: The hazard rating classifications for oxidizers do not correlate to the reactivity classification in NFPA 704, *Standard System for the Identification of the Fire Hazards of Materials.*

Exception: Retail display areas.

2-2.2 Where oxidizers having different classifications as defined by Section 1-6 are stored in the same area, the area shall be marked for the most severe hazard class present.

2-2.3 All packages shall be approved and individually marked with the chemical name of the oxidizer.

2-3 Storage Containers, Tanks, and Bins.

2-3.1 Shipping Containers. Where a storage container for solid and liquid oxidizers also functions as the shipping container, the container shall meet the requirements of the U.S. Department of Transportation or the Canadian Ministry of Transport (Transport Canada).

2-3.2 Tanks and Bins. Tanks for the storage of bulk liquid oxidizers and bins for the storage of bulk solid oxidizers shall meet the following requirements:

(a) Materials of construction shall be compatible with the oxidizer being stored.

(b) Tanks and bins shall be designed and constructed in accordance with federal, state, and local regulations, or, as a minimum, in accordance with nationally recognized engineering practices (e.g., ASME, API).

(c) Tanks and bins shall be equipped with an adequately sized vent or other relief device to prevent overpressurization due to decomposition or fire exposure.

2-3.3 Bulk Liquid Storage. Bulk liquid storage is defined as the storage of more than 600 gal (U.S.) (2271 L) in a single container.

2-3.4 Bulk Solid Storage. Bulk solid storage is defined as the storage of more than 6000 lb (2722 kg) in a single container.

2-3.5 Outside Storage. Outside storage tank size shall not be limited by this code.

Exception: Class 4 oxidizers.

2-4 Storage Arrangements.

2-4.1 The arrangement and quantity of oxidizers in storage shall depend upon their classification, type of container, type of storage (segregated, cutoff, or detached), and fire protection as specified in succeeding chapters and in the manufacturer's or processor's instructions.

2-4.1.1* The arrangement and quantity of oxidizers in storage shall be permitted to deviate from the requirements of succeeding chapters where specially engineered fire prevention or fire protection systems acceptable to the authority having jurisdiction are provided.

2-4.2* Oxidizers shall be stored to avoid contact with incompatible materials such as ordinary combustibles, combustible or flammable liquids, greases, and those materials that could react with the oxidizer or promote or initiate its decomposition. These shall not include approved packaging materials, pallets, or other dunnage.

Exception: Hydrogen peroxide (Classes 2 through 4) stored in drums shall not be stored on wooden pallets.

2-4.2.1 Special care shall be taken to prevent any contamination of oxidizers in storage.

2-4.2.2 Where oxidizers are stored in segregated warehouses with flammable liquids, the oxidizer containers and flammable liquid drums shall be separated by at least 25 ft (7.6 m). The separation shall be maintained by dikes, drains, or floor slopes to prevent flammable liquid leakage from encroaching on the separation.

2-4.3 Where Class 2, Class 3, or Class 4 liquid oxidizers are stored, means shall be provided to prevent the liquid oxidizer from flowing out of a cutoff area into an area containing incompatible materials.

2-4.4 Retail Storage of Oxidizers.

2-4.4.1 Oxidizers in retail storage in areas accessible to the public shall be arranged in retail display as described in 2-4.4.2 through 2-4.4.7.

2-4.4.2* Shelves and vertical barriers shall be placed between incompatible materials and shall be solid and of noncombustible construction.

2-4.4.3 Solid oxidizers shall not be stored directly beneath incompatible liquids.

2-4.4.4 Shelves shall be no greater than 24 in. (61 cm) deep.

2-4.4.5 Storage shall be no greater than 6 ft (1.8 m) high.

2-4.4.6 The total amount of all oxidizers in all classes shall be limited to 2 tons (1814 kg) in nonsprinklered areas and 4 tons (3630 kg) in sprinklered areas. Sprinklers shall be designed for the most severe oxidizer class stored.

2-4.4.7 The quantities provided for sprinklered retail sales areas shall be permitted to be applied to a maximum of two sales areas within one retail sales store if the two retail sales areas are separated from each other by a fire partition having at least a 1-hr fire resistance rating.

2-5* Storage Limitations. Where two or more different classes of oxidizers are stored in the same segregated, cutoff, or detached area, the maximum quantity permitted for each class shall be limited to the sum of the maximum proportion permitted for that class. The total of the proportional amounts shall not exceed 100 percent.

2-6 Other Considerations.

2-6.1 In storage facility design, consideration shall be given to the need to provide for containment. Containment on-site or off-site shall be required where necessary to protect the environment from oxidizers, fire extinguishing agents, and their liquid decomposition products.

2-6.2 Approval of the arrangement of storage shall take into consideration the potential evolution of large quantities of smoke and toxic fumes, especially as storage affects manual fire-fighting operations, building egress, and evacuation of adjacent occupancies or communities.

2-7 Employee Instruction.

2-7.1 Personnel involved in operations where oxidizers are stored shall receive instruction in handling the materials in a safe manner, including the manufacturer's and processor's recommendations.

2-7.2 Particular attention shall be given to proper disposal of spilled material to prevent contamination.

2-8 Heating and Electrical Installations.

2-8.1 Heating shall be arranged so that stored materials cannot be placed in direct contact with heating units, piping, or ducts and oxidizers shall be separated so that they cannot be heated to within 25°F (14°C) of their decomposition temperature or to 120°F (49°C), whichever is lower.

2-8.2 Electrical installations shall be in conformance with NFPA 70, *National Electrical Code®*.

2-9 Smoking.

2-9.1 Smoking shall be prohibited in all storage areas containing oxidizers.

2-9.2 "No Smoking" signs shall be placed conspicuously within and at all entrances to storage areas.

2-10 Maintenance and Repairs.

2-10.1 The performance of maintenance work in an oxidizer storage area shall be subject to prior review and approval by supervisory personnel.

2-10.2 Cutting and welding procedures shall be in conformance with NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*.

2-11 Fire Protection.

2-11.1 Fire hydrants and water supplies shall be provided as required by the authority having jurisdiction. Hydrants shall be installed in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*.

NOTE: Conditions that affect the need for hydrant protection include nearness of the exposures, size and construction of the building, amount and class of the oxidizer stored, and availability of public fire protection.

2-11.2 The need for automatic sprinkler protection shall be determined by the nature of the materials, the manner of storage, and the construction of the buildings under consideration. Where automatic sprinkler systems are required, the

systems shall be installed in conformance with NFPA 13, *Standard for the Installation of Sprinkler Systems.*

NOTE: For certain oxidizers in combustible containers, (e.g., calcium hypochlorite in plastic containers) automatic sprinkler protection is effective only for the control of exposure fires.

2-11.3 Only wet-pipe sprinkler systems shall be employed for protection of buildings or areas containing Class 2 or Class 3 oxidizers.

2-11.4 Fire Protection Water Supplies.

2-11.4.1 Water supplies shall be adequate for the protection of the oxidizer storage by hose streams and automatic sprinklers. The water system shall be capable of providing not less than 750 gpm (2840 Lpm) where protection is by means of hose streams, or 500 gpm (1890 Lpm) for hose streams in excess of the automatic sprinkler water demand.

2-11.4.2 Duration of the water supply shall be a minimum of 2 hr.

2-11.5 Water-based fire protection systems shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*

2-11.6 Manual Fire Fighting. Manual fire-fighting equipment in the form of portable water extinguishers or water hose reel stations shall be provided in accordance with the requirements of NFPA 10, *Standard for Portable Fire Extinguishers,* and NFPA 14, *Standard for the Installation of Standpipe and Hose Systems.*

2-11.6.1* The placement and use of dry chemical extinguishers containing ammonium compounds (Class A:B:C) shall be prohibited in areas where oxidizers that can release chlorine are stored.

2-11.6.2* Halon extinguishers shall not be used in areas where oxidizers are stored.

2-12 Construction. Combustible construction materials that could come into contact with oxidizers shall be protected with a compatible coating to prevent impregnation of the combustible materials by the oxidizers.

NOTE: Impregnation of wood for fire retardancy or to prevent decay does not protect the wood from impregnation by the oxidizer.

2-13 Housekeeping and Waste Disposal.

2-13.1 Accumulation of combustible waste in oxidizer storage areas shall be prohibited.

2-13.2 Spilled oxidizers and leaking or broken containers shall be removed immediately to a safe area to await disposal in conformance with applicable regulations and manufacturer's and processor's instructions. Spilled materials shall be placed in a clean, separate container and shall not be returned to the original container. The disposal of such materials shall not be combined with that of ordinary trash.

2-13.3 Used, empty, combustible containers shall be stored in a detached or sprinklered area.

2-13.4 Operations shall be arranged to prevent excessive fugitive dust accumulation.

2-13.5 Where absorptive combustible packing materials used to contain water-soluble oxidizers have become wet during either fire or nonfire conditions, the oxidizer can impregnate the packing material. This will create a serious fire hazard when the packing material dries. Wooden pallets that are exposed to water solutions of an oxidizer also can exhibit this behavior. Such material shall be relocated to a safe outside area and shall be disposed of properly.

2-14 Dust Collection Systems. Dust collection systems shall be provided in accordance with NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials.* Separate systems shall be provided for incompatible materials.

Chapter 3 Class 1 Oxidizers

3-1 Application. This chapter shall apply to storage of Class 1 oxidizers where stored in quantities in excess of 4000 lb (1814 kg). Chapter 2 also applies to storage of Class 1 oxidizers.

3-2 Storage Arrangements.

3-2.1 The storage of Class 1 oxidizers shall be segregated, cutoff, or detached.

3-2.2 Storage of Class 1 oxidizers shall be in accordance with Tables 3-2.2(a) and (b).

3-2.3 The building limit (tons) shall be permitted to be four times the quantities shown in Table 3-2.2(b) if all of the following conditions are met:

(a) Storage is cutoff or detached;

(b) Storage is located in nonretail occupancies; and

(c) Noncombustible containers are used or buildings are noncombustible.

NOTE: Only the building limit, not the pile limit, height, or width, can be increased by this provision.

3-2.4 Bulk Storage.

3-2.4.1 Bulk storage in combustible buildings shall not come in contact with combustible building members unless the members are protected by a compatible coating to prevent their impregnation by the oxidizer. (*See Section 2-12.*)

3-2.4.2 Bulk storage, either in permanent bins or in piles, shall be separated from all other materials.

3-2.4.3 Bins shall be of noncombustible construction.

Exception: Wooden bins shall be permitted to be protected with a compatible coating to prevent impregnation of the combustible material by the oxidizer.

3-2.4.4 Storage shall be managed to prevent excessive dust accumulation.

3-3 Sprinkler Protection.

3-3.1 Sprinkler protection for Class 1 oxidizers shall be in accordance with NFPA 231, *Standard for General Storage,* or NFPA 231C, *Standard for Rack Storage of Materials,* whichever is applicable.

3-3.2* For the purpose of applying the requirements of NFPA 231, *Standard for General Storage*, or NFPA 231C, *Standard for Rack Storage of Materials*, Class 1 oxidizers in noncombustible or combustible containers (paper bags or noncombustible containers with removable combustible liners) shall be designated as a Class 1 commodity; as a Class 2 commodity where contained in fiber packs or noncombustible containers in combustible packaging; and as a Class 3 commodity where contained in plastic containers.

Table 3-2.2(a) Storage of Class 1 Oxidizers Nonsprinklered Building

	Nonretail Establishment	Retail Establishment*
Building limit (tons)	200 (181 met ton)	15 (13.6 met ton)
Pile limit (tons)	20 (18 met ton)	2 (1.8 met ton)
Pile height (ft)	8 (2.4 m)	6 (1.8 m)
Pile width (ft)	16 (4.9 m)	8 (2.4 m)
Maximum distance from any container to a working aisle (ft)	8 (2.4 m)	4 (1.2 m)
Distance to next pile (ft)	** **	** **
Distance to wall (ft)	4 (1.2 m)	4 (1.2 m)
Distance to incompatible material (ft)	12 (3.7 m)	10 (3 m)

*Totals in this column are for storage in those areas of a retail occupancy not accessible to the public and separated from the sales display area by a minimum of 1-hr fire-resistive construction. For storage in retail sales display areas, see 2-4.4.
**Aisle width equal to pile height.

Table 3-2.2(b) Storage of Class 1 Oxidizers Sprinklered Building*

	Nonretail Establishment	Retail Establishment**
Building limit(tons)	2000 (1814 met ton)	30 (27 met ton)
Pile limit (tons)	200 (181 met ton)	4 (3.6 met ton)
Pile height (ft)	12 (3.7 m)	8 (2.4 m)
Pile width (ft)	24 (7.3 m)	12 (3.7 m)
Maximum distance from any container to a working aisle (ft)	12 (3.7 m)	6 (1.8 m)
Distance to next pile (ft)	*** ***	*** ***
Distance to wall (ft)	2 (0.6 m)	2 (0.6 m)
Distance to incompatible material (ft)	8 (2.4 m)	8 (2.4 m)

*If the storage is to be considered sprinklered, see Section 3-3.
**Totals in this column are for storage in those areas of a retail occupancy not accessible to the public, and separated from the sales display area by a minimum of 1-hr fire-resistive construction. For storage in retail sales display areas, see 2-4.4.
***Aisle width equal to pile height.

3-3.3 Sprinkler protection shall be installed in accordance with NFPA 13, *Standard for Installation of Sprinkler Systems.*

Chapter 4 Class 2 Oxidizers

4-1 Application. This chapter shall apply to Class 2 oxidizers where stored in quantities in excess of 1000 lb (454 kg). Chapter 2 also applies to storage of Class 2 oxidizers.

4-2 Storage Arrangements.

4-2.1 The storage of Class 2 oxidizers shall be segregated, cutoff, or detached.

4-2.2 Cutoff walls shall have a fire resistance rating of at least 1 hr.

4-2.3 Storage of Class 2 oxidizers shall be in accordance with Tables 4-2.3(a) and (b).

4-2.4 The building limit (tons) shall be permitted to be four times the quantities shown in Table 4-2.3(b) if all of the following conditions are met:

(a) Storage is cutoff or detached;

(b) Storage is located in nonretail occupancies; and

(c) Noncombustible containers are used or buildings are noncombustible.

NOTE: Only the building limit, not the pile limit, height, or width, can be increased by this provision.

4-2.5 Storage in glass carboys shall not be more than two carboys high.

4-2.6 Storage in basements shall be prohibited.

Exception: Where the oxidizer is stored in fixed tanks.

4-2.7 Maximum Height of Storage.

4-2.7.1 Maximum storage height for nonsprinklered buildings shall be in accordance with Table 4-2.3(a).

4-2.7.2 Maximum storage height for sprinklered buildings shall be in accordance with Table 4-4.1.

4-3 Building Construction.

4-3.1 Construction materials that are permitted to be in contact with oxidizers, all cutoff partitions, and all construction in stories or basements below storage of liquid oxidizers shall be noncombustible.

4-3.2 Storage areas for oxidizing materials in combustible containers shall be provided with means to vent fumes in a fire emergency.

4-4 Sprinkler Protection.

4-4.1* Sprinkler protection for Class 2 oxidizers shall be designed in accordance with Table 4-4.1.

4-4.2 Sprinkler protection shall be installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems.*

4-4.3 Ceiling sprinklers shall have heads rated at 286°F (141°C).

4-4.4 Storage Protection with In-Rack Sprinklers.

4-4.4.1 In-rack sprinklers shall be heads rated at 165°F (74°C) and shall be designed to provide 30 psi (207 kPa) on the hydraulically most remote six heads on each level.

4-4.4.2 The in-rack sprinklers shall be spaced on 8-ft to 10-ft (2.4-m to 3.0-m) centers at rack uprights.

Table 4-2.3(a) Storage of Class 2 Oxidizers
Nonsprinklered Building

	Segregated Storage		Cutoff Storage		
	Process Plant General Warehouse	Retail* Establishment	Process Plant General Warehouse	Retail* Establishment	Detached Storage
Building limit (tons)	50 (45 met ton)	10 (8.8 met ton)	200 (181 met ton)	15 (13.6 met ton)	300 (272 met ton)
Pile limit (tons)	10 (8.8 met ton)	1 (0.91 met ton)	20 (18.1 met ton)	2 (1.8 met ton)	30 (27.2 met ton)
Pile height (ft)	6 (1.8 m)	4 (1.2 m)	8 (2.4 m)	8 (2.4 m)	8 (2.4 m)
Pile width (ft)	8 (2.4 m)	8 (2.4 m)	12 (3.7 m)	8 (2.4 m)	16 (4.9 m)
Maximum distance from any container to a working aisle (ft)	4 (1.2 m)	4 (1.2 m)	6 (1.8 m)	4 (1.2 m)	8 (2.4 m)
Distance to next pile (ft)	** **	** **	** **	** **	** **
Distance to wall (ft)	4 (1.2 m)	4 (1.2 m)	4 (1.2 m)	4 (1.2 m)	4 (1.2 m)
Distance to incompatible material (ft)	12 (3.7 m)	12 (3.7 m)	*** ***	*** ***	*** ***

*Totals in this column are for storage in those areas of a retail occupancy not accessible to the public and separated from the sales display area by a cutoff wall in accordance with 4-2.2. For storage in retail sales display areas, see 2-4.4.
**Aisle width equal to pile height.
***Not permitted by definition.

Table 4-2.3(b) Storage of Class 2 Oxidizers
Sprinklered Building*

	Segregated Storage		Cutoff Storage		
	Process Plant GeneralWarehouse	Retail** Establishment	Process Plant GeneralWarehouse	Retail** Establishment	Detached Storage
Building limit (tons)	100 (91 met ton)	20 (18.1 met ton)	1000 (907 met ton)	30 (27.2 met ton)	2000 (1814 met ton)
Pile limit (tons)	20 (18.1 met ton)	2 (1.8 met ton)	100 (91 met ton)	5 (4.5 met ton)	200 (181 met ton)
Pile height*** (ft)	*** ***	*** ***	*** ***	*** ***	*** ***
Pile width (ft)	16 (4.9 m)	8 (2.4 m)	25 (7.6 m)	8 (2.4 m)	25 (7.6 m)
Maximum distance from any container to a working aisle (ft)	8 (2.4 m)	4 (1.2 m)	12 (3.7 m)	6 (1.8 m)	12 (3.7 m)
Distance to next pile (ft)	**** ****	**** ****	**** ****	**** ****	**** ****
Distance to wall (ft)	2 (0.6 m)	2 (0.6 m)	2 (0.6 m)	2 (0.6 m)	2 (0.6 m)
Distance to incompatible material (ft)	12 (3.7 m)	12 (3.7 m)	***** *****	***** *****	***** *****

*If the storage is considered to be sprinklered, see Section 4-4.
**Totals in this column are for storage in those areas of a retail occupancy not accessible to the public and separated from the sales display area by a cutoff wall in accordance with 4-2.2. For storage in retail sales display areas see 2-4.4.
***See 4-2.7 and Table 4-4.1.
****Aisle width equal to pile height.
*****Not permitted by definition.

Table 4-4.1 Sprinkler Protection for Class 2 Oxidizers

	Ceiling Sprinklers			
Type of Storage	Storage Height ft (m)	Density gpm/ft² (L/min/m²)	Area of Application ft² (m²)	In-Rack Sprinklers
Palletized or	8 (2.4)	0.20 (8)	3750 (348)	
Bulk	12 (3.7)	0.35 (14)	3750 (348)	
Rack	12 (3.7)	0.20 (8)	3750 (348)	One line above each level of storage except the top level
	16 (4.9)	0.30 (12)	2000 (186)	

4-4.4.3 Where multiple levels are provided, the in-rack sprinklers shall be staggered and shall be provided with water shields.

4-5 Detached Storage.

4-5.1 To be considered detached, a sprinklered building for storage of Class 2 oxidizers shall be a minimum of 35 ft (10.7 m) from other buildings and from a line of property that can be built upon.

4-5.2 To be considered detached, a nonsprinklered building for storage of Class 2 oxidizers shall be located no less than 50 ft (15.2 m) from other buildings or a line of property that can be built upon.

Chapter 5 Class 3 Oxidizers

5-1 Application. This chapter shall apply to Class 3 oxidizers where stored in quantities in excess of 200 lb (91 kg). Chapter 2 also applies to storage of Class 3 oxidizers.

5-2 Storage Arrangements.

5-2.1 The storage of Class 3 oxidizers shall be segregated, cutoff, or detached.

Exception: Storage for sodium chlorate, potassium chlorate, sodium bromate, potassium bromate, and ammonium dichromate shall only be cutoff or detached, not segregated.

5-2.2 Class 3 oxidizer storage shall be located on the ground floor only.

5-2.3 Cutoff walls shall have a fire resistance rating of at least 2 hr.

5-2.4 Storage of Class 3 oxidizers shall be in accordance with Tables 5-2.4(a) and (b).

5-2.5 The building limit (tons) shall be permitted to be twice the quantities shown in Table 5-2.4(b) if all of the following conditions are met:

(a) Storage is cutoff or detached;

(b) Noncombustible containers are used or buildings are noncombustible; and

(c) Storage is located in nonretail occupancies.

NOTE: Only the building limit, not the pile limit, height, or width, can be increased by this provision.

Table 5-2.4(a) Storage of Class 3 Oxidizers
Nonsprinklered Building

	Segregated Storage		Cutoff Storage		
	Process Plant General Warehouse	Retail* Establishment	Process Plant GeneralWarehouse	Retail* Establishment	Detached Storage
Building limit (tons)	20 (18.1 met ton)	10 (8.8 met ton)	100 (91 met ton)	15 (13.6 met ton)	200 (181 met ton)
Pile limit (tons)	5 (4.5 met ton)	1.0 (0.91 met ton)	10 (9.1 met ton)	2 (1.8 met ton)	30 (27.2 met ton)
Pile height (ft)	6 (1.8 m)	4 (1.2 m)	6 (1.8 m)	6 (1.8 m)	6 (1.8 m)
Pile width (ft)	8 (2.4 m)	4 (1.2 m)	12 (3.7 m)	8 (2.4 m)	12 (3.7 m)
Maximum distance from any container to a working aisle (ft)	4 (1.2 m)	4 (1.2 m)	8 (2.4 m)	4 (1.2 m)	8 (2.4 m)
Distance to next pile (ft)	** **	** **	** **	** **	** **
Distance to wall (ft)	4 (1.2 m)	4 (1.2 m)	4 (1.2 m)	4 (1.2 m)	4 (1.2 m)
Distance to incompatible material (ft)	12 (3.7 m)	12 (3.7 m)	*** ***	*** ***	*** ***

*Totals in this column are for storage in those areas of a retail occupancy not accessible to the public and separated from the sales display area by a cutoff wall in accordance with 5-2.3. For storage in retail sales display areas see 2-4.4.
**Aisle width equal to pile height.
***Not permitted by definition.

Table 5-2.4(b) Storage of Class 3 Oxidizers
Sprinklered Building*

	Segregated Storage		Cutoff Storage		
	Process Plant General Warehouse	Retail** Establishment	Process Plant General Warehouse	Retail** Establishment	Detached Storage
Building limit (tons)	50 (45 met ton)	20 (18.1 met ton)	500 (454 met ton)	30 (27.2 met ton)	1500 (1360 met ton)
Pile limit (tons)	10 (8.8 met ton)	2 (1.8 met ton)	30 (27.2 met ton)	4 (3.6 met ton)	100 (91 met ton)
Pile height*** (ft)	*** ***	*** ***	*** ***	*** ***	*** ***
Pile width (ft)	12 (3.7 m)	8 (2.4 m)	16 (4.9 m)	8 (2.4 m)	20 (6.1 m)
Maximum distance from any container to a working aisle (ft)	8 (2.4 m)	4 (1.2 m)	10 (3 m)	6 (1.8 m)	10 (3 m)
Distance to next pile (ft)	**** ****	**** ****	**** ****	**** ****	**** ****
Distance to wall (ft)	2 (0.6 m)	2 (0.6 m)	2 (0.6 m)	2 (0.6 m)	2 (0.6 m)
Distance to incompatible material (ft)	12 (3.7 m)	12 (3.7 m)	***** *****	***** *****	***** *****

*If the storage is considered to be sprinklered, the sprinkler system shall be designed in accordance with the requirements of Section 5-4.
**Totals in this column are for storage in those areas of a retail occupancy not accessible to the public and separated from the sales display area by a cutoff wall in accordance with 5-2.3. For storage in retail sales display areas see 2-4.4.
***See 5-2.8 and Table 5-4.1.
****Aisle width equal to pile height.
*****Not permitted by definition.

5-2.6 Storage in glass carboys shall be one carboy high.

5-2.7 Bulk storage in open bins or piles shall not be permitted.

5-2.8 Maximum Height of Storage.

5-2.8.1 Maximum storage height for nonsprinklered buildings shall be in accordance with Table 5-2.4(a).

5-2.8.2 Maximum storage height for sprinklered buildings shall be in accordance with Table 5-4.1.

5-3 Building Construction.

5-3.1 Buildings used for the storage of liquid Class 3 oxidizers shall not have basements.

5-3.2 Construction materials that can come in contact with oxidizers shall be noncombustible.

5-3.3 Storage areas for oxidizing materials in combustible containers shall be provided with means to vent fumes in a fire emergency.

5-4 Sprinkler Protection.

5-4.1* Sprinkler protection for Class 3 oxidizers shall be designed in accordance with Table 5-4.1.

Table 5-4.1 Sprinkler Protection for Class 3 Oxidizers

Type of Storage	Storage Height ft (m)	Density gpm/ft² (L/min/m²)	Area of Application ft² (m²)	In-Rack Sprinklers
Palletized or	5 (1.5)	0.35 (14)	5000 (465)	
Bulk	10 (3)	0.65 (26)	5000 (465)	
Rack	10 (3)	0.35 (14)	5000 (465)	1 level at midpoint of rack.

5-4.2 Sprinkler protection shall be installed in accordance with NFPA 13, *Standard for Installation of Sprinkler Systems.*

5-4.3 Ceiling sprinklers shall be heads rated at 286°F (141°C).

5-4.4 Storage Protection with In-Rack Sprinklers.

5-4.4.1 In-rack sprinklers shall be heads rated at 165°F (74°C) and shall be designed to provide 30 psi (207 kPa) on the hydraulically most remote six heads on each level.

5-4.4.2 The in-rack sprinklers shall be spaced on 8-ft to 10-ft (2.4-m to 3.0-m) centers at rack uprights.

5-4.4.3 Where multiple levels are provided, the in-rack sprinklers shall be staggered and shall be provided with water shields.

5-5 Detached Storage. To be considered detached, a building for storage of Class 3 oxidizers shall be separated from flammable or combustible liquid storage, flammable gas storage, combustible material in the open, and from any inhabited building, passenger railroad, public highway, or other tanks. The minimum separation distance shall be:

(a) 50 ft (15 m) for a sprinklered building, or

(b) 75 ft (23 m) for an unsprinklered building.

Chapter 6 Class 4 Oxidizers

6-1 Application. This chapter shall apply to Class 4 oxidizers where stored in quantities in excess of 10 lb (4.5 kg). Chapter 2 also applies to storage of Class 4 oxidizers.

6-2 Storage Arrangements.

6-2.1 The storage of Class 4 oxidizers shall be detached.

6-2.2 Storage in glass carboys shall be one carboy high. Storage in drums or in containers or in cases shall not exceed the limits outlined in Table 6-2.2.

Table 6-2.2 Storage of Class 4 Oxidizers in Drums, Containers, Cases

	Nonsprinklered Building	Sprinklered Building
Piles		
Length (ft)	10 (3.0 m)	10 (3.0 m)
Width (ft)	4 (1.2 m)	4 (1.2 m)
Height (ft)	4 (1.2 m)	8 (2.4 m)
Distance to next pile (ft)	6 (1.8 m)	8 (2.4 m)
Quantity Limit per building (tons)	1 (0.9 met tons)	No Limit

6-2.3 Bulk storage in piles or fixed bins shall not be permitted.

6-3 Building Construction and Location.

6-3.1 Buildings shall be constructed as one story without basement. Construction materials that could come in contact with oxidizers shall be noncombustible.

6-3.2 Storage areas shall be provided with means to vent fumes in an emergency.

6-3.3 A storage building or storage tank shall be located not less than the minimum distance provided in Table 6-3.4 from flammable liquid storage, combustible material in the open, and from any inhabited building, passenger railroad, public highway, property line, or tank (other than oxidizer storage).

6-3.4* Where tanks are not separated from each other by 10 percent of the distance specified in Table 6-3.4 for the largest tank, the total contents of all tanks shall be used when using Table 6-3.4.

Table 6-3.4 Separation of Buildings, Tanks Containing Class 4 Oxidizers

Weight of Class 4 Oxidizer (lb)	(kg)	Distance (ft)	(m)
over 10 to 100	(4.5 to 45.4)	75	(23)
101 to 500	(45.8 to 227)	100	(30)
501 to 1,000	(227 to 454)	125	(38)
1,001 to 3,000	(454 to 1361)	200	(61)
3,001 to 5,000	(1361 to 2268)	300	(91)
5,001 to 10,000	(2268 to 4536)	400	(122)
over 10,000	(over 4536)	Subject to approval by the authority having jurisdiction.	

6-4 Sprinkler Protection.

6-4.1 Sprinkler protection for Class 4 oxidizers shall be installed on a deluge sprinkler system to provide water density of 0.35 gal/min/ft^2 (14.4 L/min/m^2) over the entire storage area.

6-4.2 Sprinkler protection shall be installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems.*

Chapter 7 Referenced Publications

7-1 The following documents or portions thereof are referenced within this code and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

7-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1994 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1994 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 1993 edition.

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

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 1995 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 1993 edition.

NFPA 43B, *Code for the Storage of Organic Peroxide Formulations*, 1993 edition.

NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*, 1994 edition.

NFPA 70, *National Electrical Code*, 1996 edition.

NFPA 91, *Standard for the Installation of Systems for Air Conveying of Materials*, 1995 edition.

NFPA 231, *Standard for General Storage*, 1995 edition.

NFPA 231C, *Standard for Rack Storage of Materials*, 1995 edition.

NFPA 490, *Code for the Storage of Ammonium Nitrate*, 1993 edition.

NFPA 495, *Explosive Materials Code*, 1992 edition.

7-1.2 Other Publications.

7-1.2.1 ASTM Publication. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*, 1994.

7-1.2.2 Canadian Government Publication.

Canadian Ministry of Transport Regulations.

7-1.2.3 U.S. Government Publication. U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402.

Title 49, *Code of Federal Regulations*, Parts 100 to end.

Appendix A Explanatory Material

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

A-1-1.1.2 NFPA 49, *Hazardous Chemicals Data*, and NFPA 491M, *Manual of Hazardous Chemical Reactions*, should be used for guidance.

A-1-2 The decomposition of stored commercially available strengths of liquid and solid oxidizers can emit toxic gases. Additionally, the runoff from spills of stored oxidizers or from oxidizers mixed with fire extinguishing agents can contain materials hazardous to the environment.

A-1-5 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 concerned with product evaluations that is in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-5 Authority Having Jurisdiction. The phrase "authority having jurisdiction" 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-1-5 Explosive Reaction. For further information on venting explosive reactions, see NFPA 68, *Guide for Venting of Deflagrations.*

A-1-5 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which 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-1-5 Noncombustible Material. See NFPA 220, *Standard on Types of Building Construction.*

A-1-6.3 The term contamination in this definition means minor contamination that can occur if the material is spilled or placed into improperly cleaned equipment. It does not mean gross contamination with large quantities of combustibles or incompatible materials.

A-1-6.4 The term contamination in this definition means minor contamination that can occur if the material is spilled or placed into improperly cleaned equipment. It does not

mean gross contamination with large quantities of combustibles or incompatible materials.

A-1-7.1 Sills, curbs, or intervening storage of nonhazardous compatible materials and aisles should be used as aids in maintaining separation.

A-2-2.1 The classification system described in Section 1-7 should be 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 Fire Hazards of Materials*. Since the hazard characteristics of oxidizers vary widely depending on the type of oxidizer and its relative concentration, each oxidizer should be rated individually according to the criteria established in NFPA 704.

NFPA 704 is designed to apprise fire fighters or emergency personnel of the inherent hazards related to the manufacture, storage, or use of hazardous materials. It is concerned with the health, fire, reactivity, and other related hazards created by short-term exposure that might be encountered under fire or related emergency conditions.

A-2-4.1.1 Automatic sprinklers should not be relied upon to control all fires involving oxidizers packed in plastic containers.

A-2-4.2 Care should be exercised, since some oxidizers are mutually incompatible. Triazinetriones (chlorinated isocyanurates) and hypochlorites are examples of oxidizers that are incompatible. NFPA 491M, *Manual of Hazardous Chemical Reactions*, lists many oxidizers and other materials that result in hazardous interactions.

A-2-4.4.2 Recommended retail store arrangements for mutually incompatible oxidizers are shown in Figures A-2-4.4.2(a) and (b). These two diagrams illustrate arrangements that minimize the chance of contamination between incompatible materials. Wherever possible, vertical separation should be maintained between incompatible materials.

A-2-5 Example: A sprinklered warehouse containing both Class 2 and Class 3 oxidizers in combustible containers that are cut off from other storage by a 2-hr fire separation is permitted to contain 500 tons (454,000 kg) of Class 2 oxidizers and 250 tons (227,000 kg) of Class 3 oxidizers in accordance with the following ratios:

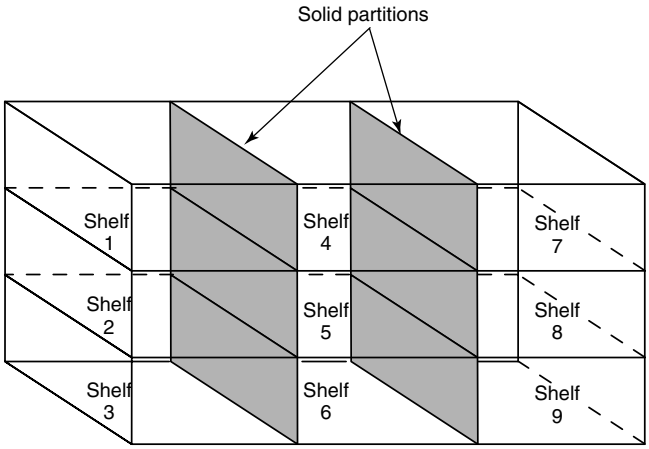
$$\frac{500 \text{ tons}}{1000 \text{ tons (max)}} \times 100 = 50\% \text{ Class 2}$$

$$\frac{250 \text{ tons}}{500 \text{ tons (max)}} \times 100 = 50\% \text{ Class 3}$$

SI units: 1 lb = 0.454kg

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

A-2-11.6.1 A dry chemical fire extinguishing agent containing ammonium compounds (such as some A:B:C agents) should not be used on oxidizers that contain chlorine. The reaction between the oxidizer and the ammonium salts in the fire extinguishing agent can produce an explosive compound (NCl_3). Carbon dioxide or other extinguishing agents that function by a smothering action for effective use are of no value in extinguishing fires involving oxidizers.



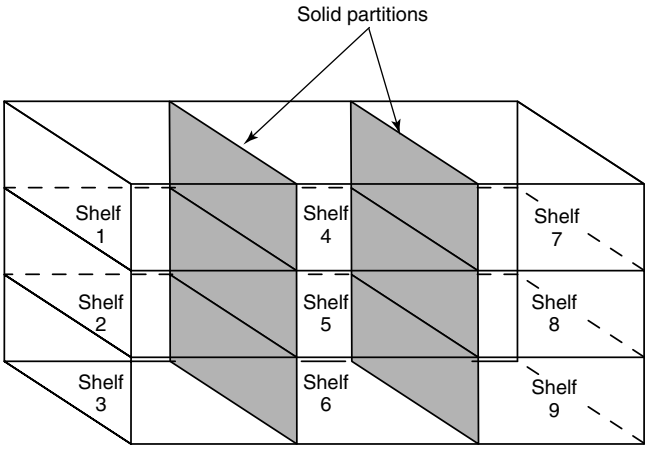
Shelf 1: Oxidizer A — Shelf 4: Oxidizer B — Shelf 7: Oxidizer C

Shelf 2: Oxidizer A — Shelf 5: Oxidizer B — Shelf 8: Oxidizer C

Shelf 3: Oxidizer A — Shelf 6: Oxidizer B — Shelf 9: Oxidizer C

Oxidizers A, B, and C are mutually incompatible.

Figure A-2-4.4.2(a) Recommended retail store arrangement for mutually incompatible oxidizers.



Shelf 1: Oxidizer A — Shelf 4: Oxidizer C — Shelf 7: Oxidizer D

Shelf 2: Inert — Shelf 5: Inert — Shelf 8: Inert

Shelf 3: Oxidizer B — Shelf 6: Incompatible liquid — Shelf 9: Incompatible liquid

Oxidizers A, B, C, and D are mutually incompatible with each other and with the incompatible liquids.

Figure A-2-4.4.2(b) Recommended retail store arrangement for mutually incompatible oxidizers and other incompatible materials.

A-2-11.6.2 Halon extinguishers should not be used on fires involving oxidizers, since they can react with the oxidizer.

A-3-3.2 Commodity refers to the definition in NFPA 231, *Standard for General Storage*, or NFPA 231C, *Standard for Rack Storage of Materials*, as appropriate.

A-4-4.1 For the purposes of Table 4-4.1, the fire hazard potential of Class 2 oxidizers has been considered as approximately equal to Group A plastic (non-expanded), stable cartoned, in