

NFPA 32

Standard for Drycleaning Plants

2000 Edition



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An International Codes and Standards Organization

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NFPA 32

Standard for

Drycleaning Plants

2000 Edition

This edition of NFPA 32, *Standard for Drycleaning Plants*, was prepared by the Technical Committee on Textile and Garment Care Processes and acted on by the National Fire Protection Association, Inc., at its World Fire Safety Congress and Exposition™ held May 14–17, 2000, in Denver, CO. It was issued by the Standards Council on July 20, 2000, with an effective date of August 18, 2000, and supersedes all previous editions.

This edition of NFPA 32 was approved as an American National Standard on August 18, 2000.

Origin and Development of NFPA 32

This standard was originally prepared by the Committee on Flammable Liquids in 1924 and 1925 in cooperation with the National Association of Dryers and Cleaners. The first edition was adopted in 1925. Amendments were adopted in 1927; complete revised editions were issued in 1936, 1944, and 1956; amendments were adopted in 1964; a completely revised edition was issued in 1970; amendments were adopted in 1972; and completely revised editions were issued in 1974 and 1979. There was a minor amendment in the 1985 edition, which was reconfirmed in 1990. One minor change was adopted for the 1996 edition.

For the 2000 edition, as in previous editions, requirements are outlined in chapters by type of plant, which is determined by the solvent in use. In the revision, general requirements for all plants, regardless of solvent in use, were moved to the front of the standard. Changes for the 2000 edition also include requirements considering up-to-date practices and technology. The Technical Committee on Textile and Garment Care Processes better correlated the requirements for each plant type with the relative hazards potentially present. Various protection requirements were made less stringent in cases where the plant has reduced quantities of solvent in combination with various redundant safety systems for the equipment. Requirements were added to address machine conversion to allow the machine to use another solvent, as is commonly occurring in the industry.

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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 concerned with the fire and explosion hazards of drycleaning using combustible and noncombustible solvents, and the fire hazards of laundries and other textile care processes.

Contents

<p>Chapter 1 Administrative Provisions 32- 4</p> <p>1.1 Purpose 32- 4</p> <p>1.2 Scope 32- 4</p> <p>1.3 Equivalency 32- 4</p> <p>1.4 Retroactivity 32- 4</p> <p>1.5 Approval 32- 4</p> <p>1.6 Definitions 32- 4</p> <p>1.7 Systems 32- 5</p> <p>Chapter 2 General Plant Requirements 32- 5</p> <p>2.1 General 32- 5</p> <p>2.2 Operating Requirements 32- 5</p> <p>2.3 Maintenance and Housekeeping 32- 5</p> <p>2.4 Construction 32- 6</p> <p>2.5 Building Services 32- 6</p> <p>2.6 Fire Protection 32- 6</p> <p>Chapter 3 Spotting 32- 6</p> <p>3.1 Solvents 32- 6</p> <p>3.2 Spotting Table Surface 32- 6</p> <p>3.3 Waste Streams 32- 6</p> <p>3.4 Spotting Table Grounding 32- 6</p> <p>Chapter 4 General Equipment Requirements 32- 7</p> <p>4.1 General 32- 7</p> <p>4.2 Pumps and Piping 32- 7</p> <p>4.3 Filters 32- 7</p>	<p>4.4 Drycleaning Machines 32- 7</p> <p>4.5 Stills 32- 8</p> <p>4.6 Automatic Fire Extinguishing Systems 32- 8</p> <p>Chapter 5 Type II Drycleaning Plants 32- 8</p> <p>5.1 Application 32- 8</p> <p>5.2 Location and Construction 32- 8</p> <p>5.3 Building Services 32- 8</p> <p>5.4 Processes and Equipment 32- 8</p> <p>Chapter 6 Type III Drycleaning Plants 32-10</p> <p>6.1 Type IIIA Drycleaning Plants 32-10</p> <p>6.2 Type IIIB Drycleaning Plants 32-11</p> <p>Chapter 7 Type IV Drycleaning Plants 32-11</p> <p>7.1 Application 32-11</p> <p>7.2 Building Services 32-11</p> <p>7.3 Processes and Equipment 32-12</p> <p>Chapter 8 Referenced Publications 32-12</p> <p>Appendix A Explanatory Material 32-12</p> <p>Appendix B Referenced Publications 32-13</p> <p>Index 32-14</p>
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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 8 and Appendix B.

Chapter 1 Administrative Provisions

1.1 Purpose. This standard prescribes safeguards intended to prevent fires and explosions involving drycleaning processes and to minimize the personal injury and property damage consequences of such incidents. This standard does not include requirements for disposal of any hazardous chemicals or materials. Requirements not specifically mentioned or referred to herein are not part of this standard.

1.2 Scope. This standard shall apply to establishments hereinafter defined as drycleaning plants.

1.3 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.5 Approval.

1.5.1 Before any drycleaning plant is established or constructed, the class of solvent is changed, or an existing plant is remodeled, plans and specifications shall be submitted to the authority having jurisdiction for examination and approval.

1.5.2 Plans shall be drawn to an indicated scale showing the relative location of the drycleaning building; boiler room; finishing building or departments; items such as storage tanks for

solvents, pumps, washers, drying tumblers, filters, stills, processing tanks, and interconnecting piping; and the sectional elevation of the buildings, including the lowest floors, pits, tanks and the fittings, and other services.

1.6 Definitions. For the purposes of this standard, the following terms shall be defined as follows.

1.6.1* Approved. Acceptable to the authority having jurisdiction.

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

1.6.3 Bonding. The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

1.6.4* Drycleaning. The process of removing dirt, grease, paints, and other stains from such items as wearing apparel, textiles, fabrics, and rugs by the use of nonaqueous liquids (solvents, nonwater based).

1.6.5 Drycleaning Machines. Any equipment in which textiles are immersed or agitated in solvent or in which drycleaning solvent is extracted from textiles and/or dried.

1.6.6 Drycleaning Plant. A plant in which drycleaning and associated operations are conducted, including the office, receiving area, and storage rooms.

1.6.7 Drycleaning Room. A room in which the drycleaning operations are conducted, including all additional areas containing solvent or solvent-handling equipment.

1.6.8 Dual-Phase Processing. A process in which a drycleaning operation precedes or follows a laundering operation in the same equipment.

1.6.9* Flash Point. The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with the air near the surface of the liquid or within the vessel used.

1.6.10 Gallon. U.S. Standard. 1 U.S. gal = 0.833 Imperial gal = 231 in.³ = 3.785 L.

1.6.11 Grounded. Connected to earth or to some conducting body that serves in place of the earth.

1.6.12 Intrinsically Safe. As applied to equipment and wiring, equipment and wiring that are incapable of releasing sufficient electrical energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture.

1.6.13 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.

1.6.14* 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.

1.6.15 Shall. Indicates a mandatory requirement.

1.6.16 Solvents.

1.6.16.1 Class I Solvents. Liquids having a flash point below 100°F (37.8°C).

1.6.16.2 Class II Solvents. Liquids having a flash point at or above 100°F (38°C) and below 140°F (60°C).

1.6.16.3 Class IIIA Solvents. Liquids having a flash point at or above 140°F (60°C) and below 200°F (93.4°C).

1.6.16.4 Class IIIB Solvents. Liquids having a flash point at or above 200°F (93.4°C).

1.6.16.5 Class IV Solvents. Liquids classified as nonflammable.

1.6.17 Spotting (Prespotting). The local application of a solvent to spots of dirt, grease, paint, tar, and other stains for removal of same.

1.6.18 Tank.

1.6.18.1 Process Tank. A tank containing solvent that is an integral part of the drycleaning machine.

1.6.18.2 Storage Tank. A tank used for the storage of new or distilled solvent.

1.6.18.3 Treatment Tank. A tank used for settling, filtering, caustic treatment, or other operating purposes.

1.6.19 Trunnion Shaft (Spider and Trunnion). A shaft that supports the rotating cylinder.

1.6.20 Tumbler.

1.6.20.1 Drying Tumbler. Any equipment in which solvent-cleaned textiles are tumbled, agitated, and dried or deodorized while heated air circulates through the load to remove the solvent.

1.6.20.2 Reclaiming Tumbler. A drying tumbler, which, in addition, reclaims the solvent from vapors.

1.6.21 Working Pressure. The maximum filter pump discharge pressure.

1.7 Systems. For the purpose of this standard, drycleaning plants or systems shall be classified as follows:

(a) *Type I.* Systems employing Class I solvents are prohibited by this standard per 2.2.1.1 [e.g., 50°F (10°C) flash point naphtha].

(b) *Type II.* Systems employing Class II solvents and complying with the requirements of Chapters 2, 3, 4, and 5 (e.g., Stoddard solvent).

(c) *Type IIIA.* Systems employing Class IIIA solvents and complying with the requirements of Chapters 2, 3, 4, and 6 [e.g., 140°F (60°C) solvent].

(d) *Type IIIB.* Systems employing Class IIIB liquids and complying with the requirements of Chapters 2, 3, 4, and 6 (e.g., specially compounded oils).

(e) *Type IV.* Systems employing Class IV solvents and complying with the requirements of Chapters 2, 3, 4, and 7.

Chapter 2 General Plant Requirements

2.1 General. Drycleaning operations, including the design, operation, and maintenance of buildings and premises, shall conform with the provisions of Chapter 2.

2.1.1 Classification. The provisions of this chapter shall apply to drycleaning operations using all classes of solvents.

Plants employing more than one class of solvent for drycleaning shall comply with the requirements for the numerically lowest class of solvent employed. In addition to the provisions of this chapter, drycleaning operations shall conform with the specific requirements of Chapters 5 through 7 applicable to the class of solvent used.

2.1.2 Change of Solvent Class. When a change in solvent classification is proposed for use with existing equipment, the provisions of Chapters 5 through 7 applicable to the new solvent class shall be met.

2.2 Operating Requirements.

2.2.1 Prohibited Activities.

2.2.1.1 Type I Systems Prohibited. Type I drycleaning plants or systems shall be prohibited.

2.2.1.2 Open Systems Prohibited. Drycleaning by immersion and agitation in open vessels shall be prohibited.

2.2.1.3 Smoking Prohibited. Smoking in a drycleaning room shall be strictly prohibited.

2.2.1.4 General Public Operation Prohibited. Drycleaning conducted by the general public shall be prohibited.

Exception: Type IV drycleaning operations.

2.2.2 Preparation. All materials to be drycleaned shall be searched thoroughly in the receiving room and all foreign materials, especially matches and metallic substances, shall be removed.

2.2.3* Employee Training. All employees shall be informed of the hazards of the solvents and processes employed in the plant and shall be trained in the proper storage, handling, use, and disposal of materials and wastes.

2.3 Maintenance and Housekeeping.

2.3.1 Extinguishing System Inspection. In order to ensure the reliable operation of steam or other extinguishing systems, periodic inspection of all valves and piping shall be made.

2.3.2 Lint and Refuse Removal. The lint and refuse shall be removed from all traps after the close of the day's work, deposited in approved waste cans, removed from the premises, and disposed of safely. At all other times, the trap covers shall remain securely in place.

2.3.3 Spill and Leak Prevention. Proper maintenance and operating practices that help prevent leakage or unintentional escape of solvent or solvent vapors shall be followed. Where solvent-saturated materials must be manually transferred from one piece of equipment to another, operating practices shall be designed to minimize the amount of solvent dripping on the floor.

2.3.4 Floor Cleaning. Flammable and combustible liquids shall not be used for cleaning floors. Spilled solvent or solvent drippings from transferred garments shall be cleaned up immediately.

2.3.5 Tank Repair and Cleaning. The repairing and cleaning of tanks shall be performed in accordance with NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair.*

2.4 Construction.

2.4.1 General.

2.4.1.1 Noncombustible Construction. Walls shall be of masonry or noncombustible construction, and wall finish shall be plain or plastered without furring or concealed spaces.

2.4.1.2 Fire-Resistant Construction. The floor or roof and ceiling construction above a drycleaning room shall have a fire resistance rating of not less than 1 hour.

2.4.2 Location.

2.4.2.1 Fire Department Vehicle Access. The drycleaning building shall be located so that it is accessible from at least one side for fire-fighting and fire control purposes. The drycleaning building shall be located not closer than 10 ft (3 m) from the line of adjoining property.

Exception: The 10-ft (3-m) distance shall be permitted to be waived if the wall facing the line of adjoining property is a blank wall having a fire resistance rating of not less than 2 hours.

2.4.2.2 Tank Storage. Drycleaning and tank storage rooms shall be restricted to the lowest floor level of a building. Such rooms shall not be located below grade or above any other story.

2.4.3 Boilers.

2.4.3.1 Boilers shall be located, where possible, in a detached building. Where located in the same building and in a room adjoining the drycleaning room, the boiler room shall be separated by fire partitions, without openings, having a fire resistance rating of not less than 2 hours.

2.4.3.2 Openings into the boiler room shall be at least 10 ft (3 m) from any openings into the drycleaning room.

2.4.4 Means of Egress. Means of egress shall conform with the provisions of NFPA 101®, *Life Safety Code*®.

2.5 Building Services.

2.5.1 Electrical Wiring and Equipment. The electrical wiring and equipment of drycleaning plants shall conform with the requirements of NFPA 70, *National Electrical Code*®.

2.5.2 Ventilation. Ventilation of all types of drycleaning plants shall be adequate to protect employees and the public in accordance with applicable government regulations.

2.5.3 Floors. The floors of a drycleaning room shall be of fire-resistive construction with a wearing surface of noncombustible and solvent-resistant material.

2.5.4* Drainage. A drycleaning room shall be designed with an emergency drainage system to direct solvent leakage and fire protection water to a safe location. Where necessary to control the migration of the solvent, curbs, scuppers, or a special drainage system to control the spread of fire shall be provided.

Exception: Type III and Type IV plants if they have containment pans under the machine.

2.5.5 Sewer Connections. Drycleaning rooms shall be designed to prevent the normal discharge of solvents to public waterways, public sewers, or adjoining property.

2.6 Fire Protection.

2.6.1 General. In order to ensure the reliable operation of fire extinguishing systems and equipment required by this standard, such systems and equipment shall be installed, inspected, tested, and maintained in accordance with Section 2.6.

2.6.2 Automatic Sprinkler Systems. Where required by this standard, automatic sprinkler systems shall be installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, and periodically inspected, tested and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*.

2.6.3 Automatic Fire Extinguishing Systems. Where required by this standard, automatic fire extinguishing systems, including, but not limited to, water mist, clean agent, and carbon dioxide systems, shall be installed in accordance with the applicable reference standard. Automatic fire extinguishing systems shall be periodically inspected, tested, and maintained in accordance with the applicable reference standard and the manufacturers' operation and maintenance procedures.

Exception: Approved steam injection extinguishing systems.

2.6.3.1 Carbon Dioxide Fire Extinguishing Systems. Carbon dioxide fire extinguishing systems shall conform with NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*.

2.6.3.2 Clean Agent Fire Extinguishing Systems. Clean agent fire extinguishing systems shall conform with NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*.

2.6.3.3 Water Mist Fire Extinguishing Systems. Water mist fire extinguishing systems shall conform with NFPA 750, *Standard on Water Mist Fire Protection Systems*.

2.6.4 Portable Fire Extinguishers. Suitable numbers and types of portable fire extinguishers shall be installed and maintained throughout the drycleaning plant in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

Chapter 3 Spotting

3.1 Solvents. Spotting or prespotting shall be conducted only with Class II, Class III, or Class IV liquids or solvents stored in and dispensed from approved containers as defined in NFPA 30, *Flammable and Combustible Liquids Code*.

Exception: These operations shall be permitted to be conducted with Class I solvents if they are stored in and dispensed from approved safety cans or in sealed DOT-approved metal shipping containers of not more than 1-gal (3.8-L) capacity. Class I solvents can be dispensed for spotting from plastic containers not to exceed 1 pint (0.5 L).

3.2 Spotting Table Surface. The spotting table shall have a nonabsorbent surface.

3.3 Waste Streams. Waste streams from spotting operations shall be disposed of in a manner consistent with all applicable regulations.

3.4 Spotting Table Grounding. Spotting tables shall be permanently and effectively grounded.

Chapter 4 General Equipment Requirements

4.1 General.

4.1.1 All drycleaning machines and converted drycleaning equipment shall comply with the provisions of and be listed to comply with this standard.

4.1.2 Equipment shall be designed for the intended class of solvent used. When a change in solvent classification is proposed for use with existing equipment, the specific requirements of Chapters 5 through 7 applicable to the new solvent class shall be met.

4.1.3 All drycleaning machines and conversion equipment shall be furnished with one or more suitably placed nameplates indicating all the following, as applicable:

- (1) Minimum allowable solvent flash point classification
- (2) Maximum rated cylinder speed
- (3) Warnings that the machine shall not be operated with a solvent having a flash point less than that stated
- (4) Warnings that the machine shall not be operated in excess of its rated cylinder speed
- (5) Date of manufacture or conversion

4.1.4 Manufacturers shall provide written instructions covering the proper installation and the safe operation and use of equipment and solvent to the buyer.

4.1.5 Drycleaning machine wiring shall conform with the requirements of NFPA 79, *Electrical Standard for Industrial Machinery*.

4.1.6 All solvent-handling equipment shall be constructed and maintained so as to prevent leakage.

4.2 Pumps and Piping.

4.2.1 The transfer of solvent shall be through closed circuit pipes.

4.2.2 Pipes, tubing, valves, and sight glasses shall be constructed of materials suitable for use with the solvent and shall be tested for a minimum pressure of 50 percent in excess of the maximum operating pressure.

4.2.3 Flow and level sight glasses shall be protected reliably against physical damage.

4.2.4 All pumps shall be designed for the solvent being used and shall be provided with replaceable mechanical seals proven to be leakproof in solvent operation. Positive displacement pumps for solvent service shall be fitted with relief valves or bypasses to prevent pressure in excess of the working pressure of the system.

4.2.5 Pump motors shall be designed or selected for compatibility with the solvent being used and the pump specifications.

4.3 Filters.

4.3.1 Filters operating above atmospheric pressure shall be constructed to withstand, without bursting, a pressure of 5 times the maximum allowable working pressure or to withstand, without yielding, a pressure of $2\frac{1}{2}$ times the maximum allowable working pressure.

4.3.2 Pressure-type filters shall be equipped with a reliable pressure gauge that shall be checked regularly for accuracy.

Filters shall not be operated at pressures exceeding those recommended by the manufacturers.

4.3.3 Pressure vessels shall be provided with an air-bleeding valve and line connected to discharge into the washer or into the storage tank vent line. Such air-bleeding lines shall not discharge into the room.

4.3.4 Filters shall be equipped with a pressure relief device that prevents the pressure within the filter from rising more than 10 percent above the working pressure of the filter. The relief device shall not be smaller than $\frac{3}{4}$ -in. (20-mm) pipe size and shall discharge into an underground tank or above-ground base tank of a drycleaning unit without a shutoff valve in the line.

4.4 Drycleaning Machines.

4.4.1 Drycleaning machines shall be of substantial construction to prevent distortion of their components and to minimize vibration that can cause damage to equipment or harm to personnel while the machines are in normal operation. The units shall be securely attached to the floor or, if necessary, to special foundations to minimize transmission of vibration to surrounding areas.

4.4.2 Drycleaning machines shall be provided with doors or covers that prevent solvent from splashing onto the floor.

4.4.3 Cylinder access door(s) shall be interlocked as follows:

- (1) Opening of the door(s) while there is solvent in the cylinder
- (2) Opening of the door(s) while the cylinder is rotating
- (3) Rotation of the cylinder or basket while the door(s) are open

Exception: Machines that require inching of the cylinder with the door open shall be permitted, provided that the solvent has been drained from the cylinder.

4.4.4 A manual push button to stop the machine shall be provided in front of the machine if the drycleaning machine is equipped with automatic controls.

4.4.5 Drycleaning machines shall be equipped with brakes or other means to stop the machine and avoid generation of sparks or excessive heat.

4.4.6 Drycleaning machines shall be provided with a device that will shut off all inlet supply valves to the machine in the event the solvent level in the machine reaches the bottom of the trunnion shaft, unless an overflow means below the bottom of the trunnion and connected to a storage or process tank by a pipe at least one size larger than the solvent inlet pipe to the machine and without a shutoff valve has been provided.

4.4.7 Individual button or lint traps shall be provided with drycleaning machines and shall be located between the machine drain and the storage and process tanks.

4.4.8 The solvent inlet pipe into a drycleaning machine shall be arranged to deflect the solvent stream away from the door opening.

4.4.9 Drycleaning machines shall be constructed with clearance between the cylinder or basket and the outer casing to prevent striking or rubbing of parts of the rotating cylinder against the outer casing.

4.5 Stills.

4.5.1 A check valve shall be installed in the steam line between the boiler and the still.

4.5.2 Water separators shall be provided on stills to reduce the amount of water entrapped with the distilled solvent.

4.6 Automatic Fire Extinguishing Systems. The installation of automatic fire extinguishing systems for the protection of drycleaning equipment shall conform with Section 2.6.

Chapter 5 Type II Drycleaning Plants

5.1 Application. This chapter shall apply to drycleaning plants or systems utilizing Class II solvents.

5.2 Location and Construction.

5.2.1 Separation. Type II drycleaning plants located in buildings with other occupancies shall be separated vertically and horizontally from other occupancies in accordance with Section 5.2.

5.2.1.1 Type II drycleaning plants shall be separated from assembly, educational, health care, detention and correction, and residential occupancies by a fire barrier having a minimum fire resistance rating of 4 hours. Openings in such fire barriers shall be equipped with self-closing or automatic-closing opening protection having a minimum 3-hour fire protection rating.

Exception: The required fire barrier shall be permitted to be a 2-hour resistance rating with self-closing or automatic-closing opening protection having a 1¹/₂-hour fire protection rating in drycleaning plants where the quantity of Class II solvent in drycleaning machines and storage does not exceed 150 gal (568 L) and drycleaning machines are equipped with instrumentation, equipment, or controls that provide any one of the following:

(a) Features that limit oxygen concentrations to less than 8 percent by volume

(b) Features that limit solvent vapor concentration to less than 25 percent of the lower explosive limit (LEL)

(c) Features that incorporate an integral automatic fire extinguishing system in accordance with Section 4.6

5.2.1.2 Type II drycleaning plants shall be separated from business, factory/industrial, mercantile, storage, and other similar occupancies by a fire barrier having a minimum fire resistance rating of 2 hours. Openings in such fire barriers shall be equipped with self-closing or automatic-closing opening protection having a minimum 1¹/₂-hour fire protection rating.

Exception: The required fire barrier shall be permitted to be a 1-hour resistance rating with self-closing or automatic-closing opening protection having a 3/4-hour fire protection rating in drycleaning plants where the quantity of Class II solvent in drycleaning machines and storage does not exceed 150 gal (568 L) and drycleaning machines are equipped with instrumentation, equipment, or controls that provide any one of the following:

(a) Features that limit oxygen concentrations to less than 8 percent by volume

(b) Features that limit solvent vapor concentration to less than 25 percent of the LEL

(c) Features that incorporate an integral automatic fire extinguishing system in accordance with Section 4.6

5.2.2 Automatic Sprinklers. A building housing a drycleaning plant shall be protected throughout by an approved automatic sprinkler system in accordance with 2.6.2.

Exception: Automatic sprinklers are not required in drycleaning plants where the quantity of Class II solvent in drycleaning machines and storage does not exceed 150 gal (568 L) and drycleaning machines are equipped with instrumentation, equipment, or controls that provide any one of the following:

(a) Features that limit oxygen concentrations to less than 8 percent by volume

(b) Features that limit solvent vapor concentration to less than 25 percent of the LEL

(c) Features that incorporate an integral automatic fire extinguishing system conforming with Section 4.6.

5.2.3 Where the quantity of solvent in drycleaning machines and storage exceeds 150 gal (568 L), the drycleaning room shall be separated from the rest of the drycleaning plant by a fire barrier having a fire resistance rating of not less than 2 hours. Openings in such fire barriers shall be equipped with self-closing or automatic-closing opening protectives having a minimum of 1¹/₂-hour fire protection rating.

5.3 Building Services.

5.3.1 Heating, Ventilation, and Air Conditioning.

5.3.1.1 Heating shall be by steam, hot water, or hot oil only.

5.3.1.2 A mechanical system of ventilation with means for remote control shall be installed in drycleaning rooms in accordance with NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, and NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*. A system serving a drycleaning room shall serve no other room. The ventilation system shall have sufficient capacity to exhaust 1 ft³/min/ft² (0.3 m³/min/m²) of floor area from the drycleaning room to a safe outdoor location.

5.3.1.3 The blades or running rings of exhaust fans shall be of nonferrous metal, and motors for fans shall not be installed in ducts.

5.3.2 Electrical Installations. Electrical equipment and wiring in a Type II drycleaning room shall comply with the provisions of NFPA 70, *National Electrical Code*, for use in Class I, Division 2 hazardous locations.

5.4 Processes and Equipment.

5.4.1 Storage and Treatment Tanks.

5.4.1.1 Tanks shall be constructed and installed in accordance with Section 5.4 and NFPA 30, *Flammable and Combustible Liquids Code*, Chapter 2.

5.4.1.2 Tank Vents.

5.4.1.2.1 Storage tanks and atmospheric treatment tanks installed aboveground shall be provided with emergency relief venting to relieve excessive internal pressure caused by exposure fire.

5.4.1.2.2 The total capacity of an emergency venting device, including the capacity of any normal vent, shall not be less than that derived from Table 5.4.1.2.2.

Exception: The airflows specified in Table 5.4.1.2.2 shall be permitted to be multiplied by 0.3 for tanks installed in sprinklered drycleaning rooms.

Table 5.4.1.2.2 Wetted Area Versus ft³/hr (m³/hr) Free Air at 14.7 psia (101.3 kPa absolute) and 60°F (15.6°C)

ft ²	m ²	ft ³ /hr	m ³ /hr
20	1.9	21,100	598
30	2.8	31,600	895
40	3.7	42,100	1192
50	4.6	52,700	1492
60	5.6	63,200	1790
70	6.5	73,700	2087
80	7.4	84,200	2385
90	8.4	94,800	2685
100	9.3	105,000	2974
120	11.1	126,000	3568
140	13.0	147,000	4163
160	14.9	168,000	4758
180	16.7	190,000	5380
200	18.6	211,000	5976

Note: Interpolate for intermediate values.

5.4.1.2.3 The wetted area of a tank or container shall be calculated on the basis of 100 percent of the surface area of the tank.

5.4.1.2.4 Atmospheric tanks shall be limited to pressures not exceeding 2.5 psi (17.2 kPa) under emergency venting conditions.

5.4.1.2.5 In no case shall a vent be less than 1/4-in. (30-mm) pipe size. The vent of a tank installed inside a building shall terminate outside the building.

5.4.1.3 An inside storage or treatment tank shall be equipped with a gauging device designed and installed so that solvent or vapors cannot be discharged into the building during normal service. A gauge glass or sight glass that allows the escape of solvent from the tank when broken shall not be used.

5.4.1.4 Storage tanks installed underground or outside aboveground shall be constructed and installed in accordance with NFPA 30, *Flammable and Combustible Liquids Code*.

5.4.1.5 Storage and treatment tanks installed inside aboveground shall not exceed an individual capacity of 1500 gal (5677.5 L). Total tank capacity inside shall not exceed 3000 gal (11,345 L). Tanks shall be permitted to be located aboveground, inside a drycleaning room, conforming with the requirements of Section 5.2 and shall be provided with approved secondary containment in accordance with 2.3.2.3 of NFPA 30, *Flammable and Combustible Liquids Code*.

Exception No. 1: Quantities not exceeding 5500 gal (20,820 L) shall be permitted inside sprinklered cutoff rooms conforming with Section 4.4 of NFPA 30, Flammable and Combustible Liquids Code.

Exception No. 2: Tanks inside detached storage buildings conforming with 2.3.4 of NFPA 30, Flammable and Combustible Liquids Code.

5.4.1.6 An inside storage tank shall be provided with a fill pipe originating outside the building. Fill pipes shall have approved connections and permanent identification of applicable solvent.

5.4.1.7 Inside aboveground storage tanks shall be located as close as practicable to the drycleaning unit(s) to which they are connected.

5.4.1.8 Treatment tanks shall not be used for the storage of new or distilled solvents.

5.4.1.9 Treatment tanks subject to greater than atmospheric pressure shall be designed for a working pressure not less than 15 psi [(1 atm) (103 kPa)] and shall be built in accordance with the principles of the ASME *Boiler and Pressure Vessel Code*, Section VIII, "Pressure Vessels," Division 1. Such tanks shall be equipped with a pressure relief device that prevents the pressure in the tank from rising more than 10 percent above the working pressure of the tank. The relief device shall not be smaller than 3/4-in. (20-mm) pipe size and shall discharge into an underground tank or aboveground base tank of a drycleaning unit without a shutoff valve in the line.

5.4.2 Pumps, Piping, and Solvent Coolers.

5.4.2.1 Aboveground Piping, Valves, and Fittings.

5.4.2.1.1 The aboveground transfer of solvent between any tank or equipment shall flow through closed circuits of iron or steel piping.

Exception: Valves or fittings composed of brass or bronze.

5.4.2.1.2 Flexible hose suitable for the solvent shall be permitted as necessary for connections between vibrating and stationary equipment. Such flexible hose shall have a rating of 50 percent above the maximum operating pressure but not less than 5 psig [(0.3 atm) (34 kPa)].

5.4.2.1.3 If a flow sight glass could, if damaged, allow the escape of flammable liquids, then it shall be of a type not damaged by heat and shall be protected against physical damage.

5.4.2.2 Underground Piping, Valves, and Fittings. Underground piping, valves, and fittings shall be installed and tested in accordance with NFPA 30, *Flammable and Combustible Liquids Code*.

5.4.2.3 Pumps.

5.4.2.3.1 Service pumps shall be provided to remove sludge from underground tanks. The suction pipe shall be carried to the tank bottom, and the pump shall discharge to a suitable container. In no case shall the discharge be into a sewer.

5.4.2.3.2 All pumps handling solvent shall be designed for use with flammable liquids. Pumps of the positive displacement type shall be fitted with a relief valve or bypass, set to prevent pressures in excess of the working pressure of the system.

5.4.2.3.3 Solvent Coolers. Where a continuous solvent flow circulation is maintained by means of a circulating pump, solvent coolers shall be provided to maintain a solvent temperature not exceeding 90°F (32.2°C). Visual and audible alarm devices shall be provided to warn the operator when the solvent temperature exceeds 90°F (32.2°C).

5.4.3 Drycleaning Machines, Stills, Drying Cabinets, and Tumblers.

5.4.3.1 General. Only steam, hot water, or hot oil shall be used as a source of heat for equipment.

5.4.3.2 Equipment Requirements.

5.4.3.2.1 Drycleaning machines with drying capabilities and reclaiming tumblers shall be equipped with automatic extinguishing systems installed and maintained in accordance with Section 2.6, and shall be provided with self-closing explosion hatches, arranged to open away from the operator, having an area equal to at least 1 ft²/15 ft³ (0.22 m²/m³) of cylinder volume.

Exception: Automatic extinguishing systems are not required if the equipment contains instrumentation, equipment, or controls that provide any one of the following:

(a) Features that limit oxygen concentration to less than 8 percent by volume

(b) Features that limit solvent vapors to less than 25 percent of the LEL

5.4.3.2.2 The fan shall be properly housed and interlocked to ensure operation while the equipment is in use. The fan, blades, or running rings shall be constructed of nonferrous metal.

5.4.3.3 Stills.

5.4.3.3.1 If steam is used as the source for heat, a pressure-regulating valve shall be installed in the steam supply line to the still.

5.4.3.3.2 Stills shall be liquidtight and gastight.

5.4.3.3.3 Stills shall be designed for operation based on the vacuum principle.

5.4.3.3.4 If a relief valve is provided, it shall be equipped with a vent line extending to the outside.

5.4.3.3.5 Each still shall be provided with a combination vacuum and pressure gauge.

5.4.3.3.6 Each still shall be equipped with an automatic valve to maintain the solvent level in the still at the proper height.

5.4.4 Static Electricity.

5.4.4.1* Storage tanks, treatment tanks, filters, pumps, piping, ductwork, drycleaning units, stills, drying cabinets, tumblers, and other equipment in the drycleaning room shall be bonded together and grounded. Isolated units of equipment shall be grounded.

5.4.4.2* Special consideration shall be given to the generation and accumulation of static electricity where loading fabrics into or removing fabrics from drycleaning units. Where fabrics are transferred from one piece of equipment to another, the two pieces of equipment shall be electrically bonded together.

Chapter 6 Type III Drycleaning Plants

6.1 Type IIIA Drycleaning Plants.

6.1.1 Application. The provisions of this chapter shall apply to Type IIIA drycleaning plants and systems located in buildings with or without other occupancies.

6.1.2 Special Provisions.

6.1.2.1 Separation. Type IIIA drycleaning plants located in buildings with other occupancies shall be separated from other occupancies by a fire barrier having a minimum 2-hour fire resistance rating. Openings in such fire barriers shall be equipped with self-closing or automatic-closing opening protection having a minimum 1¹/₂-hour fire protection rating.

Exception No. 1: The required fire barrier shall be permitted to be a 1-hour resistance rating with self-closing or automatic-closing opening protection having a ³/₄-hour fire protection rating in drycleaning plants located in buildings protected throughout by an automatic sprinkler system installed in accordance with 2.6.2.

Exception No. 2: The required fire barrier shall be permitted to be a 1-hour resistance rating with self-closing or automatic-closing opening protection having a ³/₄-hour fire protection rating in drycleaning plants where the quantity of Class IIIA solvent in drycleaning machines and storage does not exceed 330 gal (1250 L) and drycleaning machines are equipped with instrumentation, equipment, or controls that provide any one of the following:

(a) Features that limit oxygen concentrations to less than 8 percent by volume

(b) Features that limit solvent temperatures to less than 30°F (16.7°C) below their flash point

(c) Features that limit solvent vapor concentration to less than 25 percent of the LEL

(d) Features that incorporate equipment approved for use in Class I, Division 2 hazardous locations

(e) Features that incorporate an integral automatic fire extinguishing system conforming with Section 2.6

6.1.2.2 Automatic Sprinklers. Type IIIA drycleaning plants shall be protected throughout by approved automatic sprinkler systems installed in accordance with 2.6.2.

Exception: Automatic sprinkler systems are not required in drycleaning plants where the quantity of Class IIIA solvent in drycleaning machines and storage does not exceed 330 gal (1250 L) and drycleaning machines are equipped with instrumentation, equipment, or controls that provide any one of the following:

(a) Features that limit oxygen concentrations to less than 8 percent by volume

(b) Features that limit solvent temperatures to less than 30°F (16.7°C) below their flash point

(c) Features that limit solvent vapor concentration to less than 25 percent of the LEL

(d) Features that incorporate equipment approved for use in Class I, Division 2 hazardous locations

(e) Features that incorporate an integral automatic fire extinguishing system conforming with Section 2.6

6.1.3 Equipment Requirements.

6.1.3.1 The electrical equipment and wiring of a Type IIIA drycleaning system shall be in accordance with NFPA 70, *National Electrical Code*, for ordinary locations.

6.1.3.2 For stills, drycleaning machines, or reclaiming tumblers in which solvent is ordinarily heated to greater than 30°F (16.7°C) below the flash point, the electrical components and wiring on such equipment shall be in accordance with NFPA 70, *National Electrical Code*, Class I, Division 2.

Exception No. 1: The electrical equipment and wiring on reclaiming tumblers or drycleaning machines without stills shall be in accordance

with NFPA 70, National Electrical Code, for ordinary locations when they contain instrumentation, equipment, or controls that provide any of the following:

(a) Features that limit oxygen concentrations to less than 8 percent by volume

(b) Features that limit solvent temperatures to less than 30°F (16.7°C) below their flash point

(c) Features that limit solvent vapor concentration to less than 25 percent of the LEL

Exception No. 2: The electrical equipment and wiring on stills or drycleaning machines with stills shall be in accordance with NFPA 70, National Electrical Code, for ordinary locations provided that they are equipped with instrumentation, equipment, or controls that provide for automatic de-energization of equipment and wiring when both the following apply:

(a) Integrity of the still has been compromised

(b) Solvent or vapor at temperatures greater than 30°F (16.7°C) below the flash point are released

6.1.3.3 Drycleaning machines with drying capabilities and reclaiming tumblers shall be equipped with automatic extinguishing systems installed and maintained in accordance with Section 2.3, and shall be provided with self-closing explosion hatches, arranged to open away from the operator, having an area equal to at least 1 ft²/15 ft³ (0.22 m²/m³) of cylinder volume.

Exception: Automatic extinguishing systems and self-closing hatches are not required if the equipment contains instrumentation, equipment, or controls that independently provide any one of the following:

(a) Features that limit oxygen concentrations to less than 8 percent by volume

(b) Features that limit solvent temperatures to less than 30°F (16.7°C) below their flash point

(c) Features that limit solvent vapor concentrations to less than 25 percent of the LEL

6.1.4 Storage Tanks, Treatment Tanks, and Filters. Storage tanks, treatment tanks, and filters shall comply with the requirements of Section 5.4.

Exception: In drycleaning plants located in buildings with other occupancies or without sprinklers, each aboveground tank shall have a capacity of not more than 330 gal (1250 L), and the total solvent capacity of such plant, including inside aboveground and underground storage tanks, shall not exceed 1320 gal (4996 L).

6.1.5 Electrical Installations. Electrical equipment and wiring in a Type IIIA drycleaning room shall be in accordance with NFPA 70, National Electrical Code, for ordinary locations.

6.2 Type IIIB Drycleaning Plants.

6.2.1 Application. Section 6.2 shall apply to drycleaning plants or systems utilizing Class IIIB liquids.

6.2.2 General Restriction. When Class IIIB solvents are heated in excess of 30°F (16.7°C) below their flash point, the provisions of 6.1.2 and 6.1.3 shall apply.

6.2.3 Requirements.

6.2.3.1 Separation. Type IIIB drycleaning plants located in buildings with other occupancies shall be separated from other occupancies by a fire barrier having a minimum 1-hour fire resistance rating. Openings in such fire barriers shall be

equipped with self-closing or automatic-closing opening protection having a minimum ³/₄-hour fire protection rating.

Exception: Openings in fire barriers separating drycleaning plants from exit access corridors shall be equipped with opening protection having a minimum 20-minute fire protection rating.

6.2.3.2 Automatic Sprinklers. Type IIIB drycleaning plants shall be protected throughout by approved automatic sprinkler systems installed in accordance with 2.6.2.

Exception: Drycleaning plants where the quantity of Class IIIB solvent in drycleaning machines and storage does not exceed 3300 gal (12,490 L).

6.2.4 Equipment Requirements.

6.2.4.1 Electrical equipment and wiring in a Type IIIB plant or system shall comply with the provisions of NFPA 70, National Electrical Code, for ordinary locations.

6.2.4.2 Storage tanks, treatment tanks, and filters shall comply with the requirements of Section 5.4.

Exception: The capacity of any inside aboveground tank shall not exceed 2500 gal (9463 L), and the aggregate capacity of all inside aboveground storage and treatment tanks in an unenclosed area shall not exceed 7500 gal (28,391 L). Capacities in excess of 7500 gal (28,391 L) shall be located in a separate room as permitted by Exception No. 1 to 5.4.1.5.

Chapter 7 Type IV Drycleaning Plants

7.1 Application.

7.1.1 This chapter shall apply to drycleaning plants or systems utilizing Class IV solvents.

7.1.2 The provisions of this chapter shall apply to Type IV drycleaning plants and systems located in buildings with or without other occupancies in which the drycleaning is not conducted by the public.

7.2 Building Services.

7.2.1 Ventilation, Heating, and Air Conditioning.

7.2.1.1 Manually operated emergency ventilation for spills or leaks shall be installed to provide an air change every 5 minutes within 15 ft (4.57 m) of equipment using Class IV solvents. The switch for this ventilation equipment shall be readily accessible and clearly identified.

7.2.1.2 Air for combustion for gas-fired and oil-fired devices, where such devices are located in the drycleaning rooms, shall come through ducts from a clean source of air outside the building.

7.2.1.3 Apparatus with open flames or with exposed electric heating elements shall be protected from any equipment using Class IV solvents by providing the following:

- (1) Exterior intakes for combustion air
- (2) If present, exhaust vents from the drycleaning equipment, located remotely from the air intakes

Exception: Apparatus located in a separate, enclosed room or cabinet that is independently ventilated to prevent the air from the drycleaning system from being drawn toward the apparatus.

7.2.1.4 The exhaust ventilation outlets shall be located no closer than 25 ft (7.63 m) from any openings in other occupancies.

7.2.2 Electrical Installations. All electrical equipment, devices, and wiring for light and power shall be installed in accordance with the requirements of NFPA 70, *National Electrical Code*, for general-purpose use.

7.3 Processes and Equipment.

7.3.1 General.

7.3.1.1 Solvent storage and treatment tanks and all interior steel surfaces that tend to corrode when exposed during ordinary operation to solvent and to air alternately shall be protected against corrosion. Pumps, filters, or any closed containers that ordinarily are completely filled with solvent, or steam coils or chests that are immersed in solvent or that ordinarily do not tend to corrode, shall be permitted to be constructed of carbon steel without corrosion protection.

7.3.1.2 Exhaust ventilation ducts from equipment shall be sealed, taped, or soldered, and the discharge shall extend above the roofline unless leading directly into a solvent recovery system.

7.3.2 Pumps and Piping. Pumps shall be permitted to be used for the transfer of solvent.

7.3.3 Drycleaning Units and Stills.

7.3.3.1 Drycleaning units shall comply with the requirements of Section 4.4.

7.3.3.2 Atmospheric solvent stills shall be constructed to prevent hot solvent vapor from escaping into the room where operated under normal conditions and at rated capacity.

Chapter 8 Referenced Publications

8.1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix B.

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

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

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2000 edition.

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

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 1998 edition.

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

NFPA 70, *National Electrical Code*[®], 1999 edition.

NFPA 79, *Electrical Standard for Industrial Machinery*, 1997 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 1999 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 1999 edition.

NFPA 101[®], *Life Safety Code*[®], 2000 edition.

NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*, 1999 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2000 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2000 edition.

8.1.2 Other Publication.

8.1.2.1 ASME Publication. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ASME *Boiler and Pressure Vessel Code*, Section VIII, "Pressure Vessels," Division 1, 1998.

Appendix A Explanatory Material

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

A.1.6.1 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.1.6.2 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.1.6.4 Drycleaning. Methods of drycleaning include the following: immersion and agitation with the solvent in closed machines; spotting with cleaning solvents; dual-phase processing.

A.1.6.9 Flash Point. The appropriate test procedure and apparatus are as follows:

The flash point of liquids having a viscosity less than 45 SUS at 100°F (37.8°C) and a flash point below 200°F (93.4°C) is determined in accordance with ASTM D 56, *Test Method for Flash Point by Tag Closed Tester*.

The flash point of liquids having a viscosity of 45 SUS or more at 100°F (37.8°C) or a flash point of 200°F (93.4°C) or

higher is determined in accordance with ASTM D 93, *Standard Test Methods for Flash Point by Pensky–Martens Closed Cup Tester*.

Certain mixtures of flammable or combustible liquids and other substances, such as halogenated hydrocarbons, either do not exhibit a flash point using the standard closed-cup test methods or will exhibit elevated flash points. However, if the other substance is the more volatile component, preferential evaporation of this component can result in a liquid that does have a flash point or has a flash point that is lower than the original mixture. In order to evaluate the fire hazard of such mixtures, flash point tests should be conducted after fractional evaporation of 10, 20, 40, 60, or even 90 percent of the original sample or other fractions representative of the conditions of use. In the event that the flammable or combustible liquid is a blend of substances having differing flash points, the flash point of each component of the blend needs to be reported if there is a potential for the components to separate during normal operation.

A.1.6.14 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.2.2.3 The content, frequency, and documentation of employee right-to-know training should conform with the applicable requirements of OSHA 29 *CFR* 1910.1200, “Hazard Communication.” Fire prevention and fire safety training conforming with OSHA 29 *CFR* 1910.38, “Employee Emergency Plans and Fire Prevention Plans,” and 1910.156, “Fire Brigades,” can also be required. Where employees are required to wear personal protective equipment, they should be thoroughly trained in the use and maintenance of this equipment.

A.2.5.4 Appendix A of NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, provides information on such protection.

A.5.4.4.1 For further information, see NFPA 77, *Recommended Practice on Static Electricity*.

A.5.4.4.2 For further information, see NFPA 77, *Recommended Practice on Static Electricity*.

Appendix B Referenced Publications

B.1 The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not considered part of the requirements of this standard unless also listed in Chapter 8. The edition indicated here for each reference is the current edition as of the date of the NFPA issuance of this standard.

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

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 1996 edition.

NFPA 77, *Recommended Practice on Static Electricity*, 2000 edition.

B.1.2 Other Publications.

B.1.2.1 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 56, *Test Method for Flash Point by Tag Closed Tester*, 1997.

ASTM D 93, *Standard Test Methods for Flash Point by Pensky–Martens Closed Cup Tester*, 1997.

B.1.2.2 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 29, *Code of Federal Regulations*, Part 1910.38, “Employee Emergency Plans and Fire Prevention Plans,” Occupational Safety and Health Administration, 1998.

Title 29, *Code of Federal Regulations*, Part 1910.156, “Fire Brigades,” Occupational Safety and Health Administration, 1998.

Title 29, *Code of Federal Regulations*, Part 1910.1200, “Hazard Communication,” Occupational Safety and Health Administration, 1998.

Index

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- A-**
- Access, fire department vehicle** 2.4.2.1
 - Air conditioning systems** 5.3.1.2 to 5.3.1.3, 7.2.1
 - Air-bleeding valves** 4.3.3
 - Approved** 1.5
 - Definition 1.6.1, A.1.6.1
 - Authority having jurisdiction**
 - Definition 1.6.2, A.1.6.2
 - Plans submitted to 1.5.1
- B-**
- Boilers** 2.4.3
 - Bonding** 5.4.4.1 to 5.4.4.2, A.5.4.4.1 to A.5.4.4.2
 - Definition 1.6.3
 - Building services** 2.5, A.2.5.4
 - Type II drycleaning plants/systems 5.3
 - Type IV drycleaning plants/systems 7.2
- C-**
- Carbon dioxide extinguishing systems** 2.6.3.1
 - Clean agent extinguishing systems** 2.6.3.2
 - Construction** 2.4
 - Drycleaning machines 4.4
 - Type II drycleaning plants/systems 5.2
 - Type IIIA drycleaning plants/systems 6.1.2.1
 - Type IIIB drycleaning plants/systems 6.2.3.1
 - Containment, solvent** 2.5.4, A.2.5.4
- D-**
- Definitions** 1.6
 - Drainage, solvent** 2.5.4, A.2.5.4
 - Drycleaning (definition)** 1.6.4, A.1.6.4
 - Drycleaning equipment** Chap. 4, *see also* Drycleaning machines
 - Extinguishing systems 4.6
 - Filters 4.3
 - Instructions 4.1.4
 - Leakage prevention 4.1.6
 - Nameplates 4.1.3
 - Pumps and piping 4.2
 - Stills 4.5
 - Type II drycleaning plants/systems 5.4.4.1, A.5.4.4.1
 - Drycleaning machines**
 - Construction and design of 4.4
 - Controls 4.4.3 to 4.4.6
 - Type II plants 5.2.1.1 Ex., 5.2.1.2 Ex., 5.2.2 Ex.
 - Type IIIA plants 6.1.2.1 Ex. 2, 6.1.2.2 Ex., 6.1.3.2 Ex., 6.1.3.3 Ex.
 - Definition 1.6.5
 - Doors 4.4.2 to 4.4.3, 4.4.8
 - Nameplates 4.1.3
 - Type II drycleaning plants/systems 5.4.3, 5.4.4.1, A.5.4.4.1
 - Type IIIA drycleaning plants/systems 6.1.3.2 to 6.1.3.3
 - Type IV drycleaning plants/systems 7.3.3
 - Wiring 4.1.5
 - Drycleaning operations** Chap. 2, A.2
 - Classification 2.1.1
 - Employee training 2.2.3, A.2.2.3
 - Maintenance and housekeeping 2.3
 - Operating requirements 2.2, A.2.2.3
 - Preparation of materials for 2.2.2, A.2.2.3
 - Prohibited activities 2.2.1
 - Public operation 2.2.1.4
 - Drycleaning plants/systems**
 - Building services 2.5, A.2.5.4
 - Construction 2.4
 - Definition 1.6.6
 - Location 2.4.2
 - Open systems, prohibition of 2.2.1.2
 - Plans 1.5.1 to 1.5.2
 - Type I 1.7(a), 2.2.1.1
 - Type II *see* Type II drycleaning plants/systems
 - Type IIIA 1.7(c), 6.1
 - Type IIIB 1.7(d), 6.2
 - Type IV 1.7(e), 2.2.1.4 Ex., Chap. 7
 - Drycleaning rooms**
 - Construction 2.4
 - Definition 1.6.7
 - Electrical wiring and equipment 5.3.2, 6.1.5
 - Location 2.4.2.2
 - Openings 2.4.3.2, 5.2.3
 - Separation 5.2.3
 - Smoking prohibition 2.2.1.3
 - Spill control, drainage, and containment 2.5.4, A.2.5.4
 - Sprinkler systems 5.2.2
 - Static electricity in 5.4.4.1, A.5.4.4.1
 - Ventilation 5.3.1.2 to 5.3.1.3
 - Drying tumblers** 1.5.2
 - Definition 1.6.20.1
 - Type II drycleaning plants/systems 5.4.3.2.1, 5.4.4.1, A.5.4.4.1
 - Type IIIA drycleaning plants/systems 6.1.3.2 to 6.1.3.3
 - Dual-phase processing (definition)** 1.6.8
- E-**
- Egress, means of** 2.4.4
 - Electrical wiring and equipment** 2.5.1
 - Drycleaning machines 4.1.5
 - Type II drycleaning plants/systems 5.3.2
 - Type IIIA drycleaning plants/systems 6.1.3.1 to 6.1.3.2, 6.1.5
 - Type IIIB drycleaning plants/systems 6.2.4.1
 - Type IV drycleaning plants/systems 7.2.2
 - Employee training** 2.2.3, A.2.2.3
 - Equivalency to standard** 1.3
 - Explosion hatches, self-closing** 6.1.3.3
 - Extinguishers, portable fire** 2.6.4
 - Extinguishing systems** 2.6, *see also* Sprinkler systems
 - Drycleaning machines 4.6, 5.4.3.2.1, 6.1.3.3
 - Inspection 2.3.1