NFPA 35

Standard for the

Manufacture of Organic Coatings

2005 Edition

This edition of NFPA 35, *Standard for the Manufacture of Organic Coatings*, was prepared by the Technical Committee on Manufacture of Organic Coatings and acted on by NFPA at its November Association Technical Meeting held November 13–17, 2004, in Miami Beach, FL. It was issued by the Standards Council on January 14, 2005, with an effective date of February 7, 2005, and supersedes all previous editions.

This edition of NFPA 35 was approved as an American National Standard on February 7, 2005.

Origin and Development of NFPA 35

The first edition of NFPA 35 was developed by the NFPA Manufacturing Hazards Council and published in 1938 as *Suggestions for the Fire Protection of Lacquer Manufacturing Plants*. A second edition of this document was published in 1946. The Manufacturing Hazards Council was subsequently disbanded and responsibility for NFPA 35 transferred to the new Sectional Committee on Coating Manufacture, which operated under the NFPA Committee on Flammable Liquids. This Sectional Committee undertook a major revision of NFPA 35, expanding its scope to the manufacture of all organic coatings. A new NFPA 35 was published as a Tentative Recommended Practice in 1961. This Recommended Practice was officially adopted by the Association in 1964. The Sectional Committee subsequently rewrote NFPA 35 as a mandatory standard, which was adopted by the Association in 1970. Revisions to this standard were adopted in 1971, 1976, 1982, and 1987.

In 1993, NFPA's Flammable Liquids Project was reorganized and the former Technical (Sectional) Committee became an independent committee. The new Technical Committee on Manufacture of Organic Coatings processed a 1995 edition of NFPA 35, which incorporated a significant revision to the requirements for deflagration (explosion) venting, as a consequence of a major fire and explosion incident at a coatings manufacturing plant.

After adoption of the 1995 edition of NFPA 35, the Technical Committee on Manufacture of Organic Coatings immediately began a major rewrite of NFPA 35, culminating in the 1999

edition, which included the following amendments:

(1) Editorial revision and reorganization to effect editorial improvement and simplification of the text, making it more easily understood and interpreted

(2) New building construction requirements to address the hazards of liquid spill fires and their impact on load-bearing building supports

(3) Improved requirements for deflagration venting

(4) Improvements to the requirements for transfer of flammable and combustible liquids within operating areas

(5) Deletion of text relating to open-fire resin cooking processes, which are no longer used

(6) Guidance on pressure transfer of liquids by air and inert gas

(7) Revision and simplification of requirements for special hazards, specifically nitrocellulose, monomers, and organic peroxide formulations, including appendix text on handling procedures for nitrocellulose

(8) A new Chapter 7 on fire protection to address control of ignition sources, with particular attention to static electricity hazards and bonding and grounding requirements

(9) Addition of a chapter on management of fire hazards

The 2005 edition of NFPA 35 incorporates the following amendments and improvements:

(1) Editorial revisions to comply with the *Manual of Style for NFPA Technical Committee Documents*

(2) Adoption of preferred definitions from other NFPA technical documents, where such adoption does not conflict with the intent and context of NFPA 35

(3) Clarification of the requirements for process building heating

(4) Requirements for "hot box" installations and drum heaters that are used to heat containers of viscous liquids

(5) Improved requirements for proper handling of nitrocellulose, including guidance on safe movement using hand trucks and powered industrial trucks

(6) A requirement that all fires must be investigated to determine their cause

(7) A new Table A.5.6.3 to provide guidance for electrical area classification that is specific to equipment and processes that manufacture organic coatings

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

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 the fire and explosion hazards associated with the design, construction, and operation of organic coating manufacturing process and facilities.

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important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading "Important Notices and Disclaimers Concerning NFPA Documents." They can also be obtained on request from NFPA or viewed at www.nfpa.org/disclaimers.

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

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

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for mandatory extracts are given in Chapter 2 and those for nonmandatory extracts are given in Annex C. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall apply to facilities that use flammable and combustible liquids, as herein defined, to manufacture organic coatings for automotive, industrial, institutional, household, marine, printing, transportation, and other applications.

1.1.2 This standard shall not apply to the following:

(1)* Operations involving the use or application of coating materials

(2)* Storage of organic coatings in locations other than the manufacturing facility

1.2* Purpose.

The purpose of this standard shall be to provide minimum requirements for safety to life and property from fire and explosion in facilities and processes that manufacture organic coatings.

1.3 Application. (Reserved)

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.

1.4.1 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.

1.4.2 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.

1.4.3 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 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.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.6 Units and Formulas. (Reserved)

1.7 Code Adoption Requirements. (Reserved)

Chapter 2 Referenced Publications

2.1 General.

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

2.2 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 10, *Standard for Portable Fire Extinguishers,* 2002 edition.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam,* 2005 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2002 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2003 edition.

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

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems,* 2003 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances,* 2002 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems,* 2002 edition.

NFPA 30, *Flammable and Combustible Liquids Code,* 2003 edition.

NFPA 70, *National Electrical Code®,* 2005 edition.

NFPA *101®*, *Life Safety Code®,* 2003 edition.

NFPA 432, *Code for the Storage of Organic Peroxide Formulations,* 2002 edition.

NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment,* 2003 edition.

NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations,* 2002 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems,* 2004 edition.

2.3 Other Publications.

2.3.1 ASTM Publications.

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

ASTM D 5, *Standard Test Method for Penetration of Bituminous Materials,* 2000.

ASTM D 56, *Standard Method of Test for Flash Point by the Tag Closed Cup Tester,* 1998.

ASTM D 86, *Standard Test Method for Distillation of Petroleum Products,* 2000.

ASTM D 92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup,* 1998.

ASTM D 93, *Standard Test Methods for Flash Point by the Pensky-Martens Closed Cup Tester,* 1999.

ASTM D 323, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method),* 1999.

ASTM D 3278, *Standard Methods of Tests for Flash Point of Liquids by Setaflash ClosedTester,* 1996.

ASTM D 3828, *Standard Test Method for Flash Point by Small Scale Closed Tester,* 1998.

2.3.2 U.S. Government Publications.

U.S. Government Printing Office, Washington, DC 20402.

Title 29, Code of Federal Regulations, Part 1910.146, "Permit-Required Confined Spaces."

Title 29, Code of Federal Regulations, Part 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)."

Chapter 3 Definitions

3.1 General.

The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* **Approved.** Acceptable to the authority having jurisdiction.

3.2.2* **Authority Having Jurisdiction (AHJ).** An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

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

3.3 General Definitions.

3.3.1 Antistatic. For the purpose of this standard, having a surface resistivity less than 1.0×10^{11} ohms per square or having a charge decay rate from 5000 volts to 500 volts of less than 0.5 second when tested at 23°C (73°F) and 30 percent relative humidity.

3.3.2 Basement. For the purpose of this standard, a story of a building or structure having one-half or more of its height below ground level and to which access for fire-fighting purposes is unduly restricted. [**30**, 2003]

3.3.3 Boiling Point. See 3.4.2.1.

3.3.4 Building. A three-dimensional space that is enclosed by a roof and a wall or walls that cover more than one-half of the possible area of the sides of the space, is of sufficient size to allow entry by personnel, will likely limit the dissipation of heat or dispersion of vapors, and restricts access for fire fighting.

3.3.5 Combustible Liquid. See 3.4.3.2.

3.3.6 Container. Any vessel of 450 L (119 gal) or less capacity used for transporting or

storing liquids. [**30**, 2003]

3.3.7 Fire Point. See 3.4.2.2.

3.3.8 Flammable Liquid. See 3.4.3.1.

3.3.9 Flash Point. See 3.4.2.3.

3.3.10 Hot Box. For the purpose of this standard, an enclosure or room used to raise and maintain the temperature of a container and its contents above ambient.

3.3.11* Important Building. A building that is considered not expendable in an exposure fire. [**30,** 2003]

3.3.12 Inert Gas. For purposes of tank entry, cleaning, or repair, a gas that is nonflammable, chemically inactive, noncontaminating for the use intended, and oxygen-deficient to the extent required. [**326**, 2005]

3.3.13* Inerting. A technique by which a combustible mixture is rendered nonignitible by the addition of an inert gas.

3.3.14 Liquid. See 3.4.2.4.

3.3.15 Mix Tank. A portable or fixed agitated vessel in which intermediate or finished products are manufactured, adjusted, and held pending disposition.

3.3.16* Monomer. An unsaturated organic compound whose molecules contain reactive groups that polymerize with each other or with other monomer molecules to produce polymers.

3.3.17 Nitrocellulose. A nitrated cellulose (cotton linters or wood pulp) with a nitrogen content ranging from 10.5 percent to 12.6 percent by weight.

3.3.17.1 *Dry Nitrocellulose.* Nitrocellulose containing less than the minimum wetting agents described in *Solvent-Wet Nitrocellulose.*

3.3.17.2 *Plasticized Nitrocellulose.* A colloided, chip-like, flake-like, or particle-type nitrocellulose plasticized with not less than 18 percent by weight plasticizer, such as dibutyl phthalate or dioctyl phthalate.

3.3.17.3 *Solvent-Wet Nitrocellulose.* A fibrous, granular, cubed, or flake-like nitrocellulose wetted with not less than 25 percent by weight alcohol, toluene, or other organic liquid having a flash point not lower than –4°C (25°F).

3.3.17.4 *Water-Wet Nitrocellulose.* A fibrous, granular, cubed, or flake-like nitrocellulose wetted with not less than 25 percent by weight water.

3.3.18 Nonconductive Liquid. A liquid that has an electrical conductivity less than 50 picosiemens per meter.

3.3.19 Organic Coating. A liquid mixture of film-forming binder resins, such as those based on alkyd, nitrocellulose, acrylic, polyester, or other chemistry, and flammable or combustible solvents, such as hydrocarbons, esters, ketones, and alcohols, that convert to a protective, decorative, or utilitarian finish.

3.3.20* **Organic Peroxide.** A reactive organic compound that consists of an active double oxygen group (–O–O–) combined with an organic radical. Organic peroxides are derived from hydrogen peroxide in which one or both hydrogen atoms are replaced by a hydrocarbon or heterocyclic or acid radical.

3.3.21 Portable Tank. Any closed vessel having a liquid capacity over 230 L (60 gal) and not intended for fixed installation. This includes intermediate bulk containers (IBCs) as defined and regulated by the U.S. Department of Transportation.

3.3.22 Protection for Exposures. Fire protection for structures on property adjacent to an organic coatings manufacturing facility that is provided by (1) a public fire department or (2) a private fire brigade maintained on the property adjacent to the liquid storage that is capable of providing cooling water streams to protect the property adjacent to the liquid storage.

3.3.23 Safety Can. A listed container, of not more than 20 L (5.3 gal) capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure. [**30**, 2003]

3.3.24 Stable Liquid. Any liquid not defined as unstable. [**30**, 2003]

3.3.25 Storage Tank. Any vessel having a liquid capacity that exceeds 230 L (60 gal), is intended for fixed installation, and is not used for processing. [**30**, 2003]

3.3.26* **Unstable Liquid.** A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerize, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure, or temperature. [**30**, 2003]

3.3.27 Vapor Pressure. See 3.4.2.5.

3.3.28* **Ventilation.** As specified in this standard, movement of air that is provided for the prevention of fire and explosion. [**30**, 2003]

3.4* Definition and Classification of Liquids.

[**30:**1.7]

3.4.1* **Scope.** This section shall establish a uniform system of defining and classifying flammable and combustible liquids for the purpose of proper application of this standard. This section shall apply to any liquid within the scope of and subject to the requirements of this standard. [**30:**1.7.1] This section shall not apply to mists, sprays, or foams. [**30:**1.7.1.1] This section shall not apply to liquids that do not have flash points but are capable of burning under certain conditions, such as certain halogenated hydrocarbons and certain mixtures of flammable or combustible liquids and halogenated hydrocarbons. [**30:**1.7.1.2]

3.4.2 Definitions. For the purpose of this standard, the following terms shall be defined as shown in this subsection. [**30:**1.7.2]

3.4.2.1* ***Boiling Point.*** The temperature at which the vapor pressure of a liquid equals the surrounding atmospheric pressure. For purposes of defining the boiling point, atmospheric pressure shall be considered to be 14.7 psia (760 mm Hg). For mixtures that do not have a constant boiling point, the 20 percent evaporated point of a distillation performed in

accordance with ASTM D 86, *Standard Test Method for Distillation of Petroleum Products,* shall be considered to be the boiling point. [**30:**1.7.2.1]

3.4.2.2* ***Fire Point.*** The lowest temperature at which a liquid will ignite and achieve sustained burning when exposed to a test flame in accordance with ASTM D 92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup.* [**30**, 2003]

3.4.2.3* ***Flash Point.*** The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitible mixture with air near the surface of the liquid or within the vessel used, as determined by the appropriate test procedure and apparatus specified in 3.4.4.

3.4.2.4 ***Liquid.*** Any material that has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D 5, *Standard Test Method for Penetration of Bituminous Materials.* [**30,** 2003]

3.4.2.5* ***Vapor Pressure.*** The pressure, measured in pounds per square inch absolute (psia), exerted by a liquid, as determined by ASTM D 323, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method).* [**30,** 2003]

3.4.3 Classification and Definition of Liquids. Any liquid within the scope of this standard and subject to the requirements of this standard shall be known generally as either a flammable liquid or a combustible liquid and shall be defined and classified in accordance with this subsection. [**30:**1.7.3]

3.4.3.1 ***Flammable Liquid.*** Any liquid that has a closed-cup flash point below 100°F (37.8°C), as determined by the test procedures and apparatus set forth in 3.4.4. Flammable liquids are classified as Class I as follows: *Class I Liquid:* any liquid that has a closed-cup flash point below 100°F (37.8°C) and a Reid vapor pressure not exceeding 40 psia (2068.6 mm Hg) at 100°F (37.8°C), as determined by ASTM D 323, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method).* Class I liquids are further classified as follows: (1) Class IA liquids — those liquids that have flash points below 73°F (22.8°C) and boiling points below 100°F (37.8°C). (2) Class IB liquids — those liquids that have flash points below 73°F (22.8°C) and boiling points at or above 100°F (37.8°C). (3) Class IC liquids — those liquids that have flash points at or above 73°F (22.8°C) but below 100°F (37.8°C). [**30:**1.7.3.2)

3.4.3.2 ***Combustible Liquid.*** Any liquid that has a closed-cup flash point at or above 100°F (37.8°C), as determined by the test procedures and apparatus set forth in 3.4.4. Combustible liquids are classified as Class II or Class III as follows: (1) *Class II Liquid* — any liquid that has a flash point at or above 100°F (37.8°C) and below 140°F (60°C); (2) *Class IIIA Liquid* — any liquid that has a flash point at or above 140°F (60°C) but below 200°F (93°C); (3) *Class IIIB Liquid* — any liquid that has a flash point at or above 200°F (93°C). [**30:**1.7.3.1]

3.4.4 Determination of Flash Point. The flash point of a liquid shall be determined according to the methods specified in this subsection. [**30:**1.7.4]

3.4.4.1 The flash point of a liquid having a viscosity below 5.5 centistokes at 104°F (40°C) or below 9.5 centistokes at 77°F (25°C) shall be determined in accordance with ASTM D 56, *Standard Method of Test for Flash Point by the Tag Closed Cup Tester*. Exception: Cut-back asphalts, liquids that tend to form a surface film, and liquids that contain suspended

solids shall not be tested in accordance with ASTM D 56, even if they otherwise meet the viscosity criteria. [**30:**1.7.4.1]

3.4.4.2 The flash point of a liquid having a viscosity of 5.5 centistokes or more at 104°F (40°C) or 9.5 centistokes or more at 77°F (25°C) or a flash point of 200°F (93.4°C) or higher shall be determined in accordance with ASTM D 93, *Standard Test Methods for Flash Point by the Pensky-Martens Closed Tester*. [**30:**1.7.4.2]

3.4.4.3 As an alternative, ASTM D 3278, *Standard Method of Tests for Flash Point of Liquids by Setaflash Closed Tester*, shall be permitted to be used for paints, enamels, lacquers, varnishes, and related products and their components that have flash points between 32°F (0°C) and 230°F (110°C) and viscosities below 150 stokes at 77°F (25°C). [**30:**1.7.4.3]

3.4.4.4 As an alternative, ASTM D 3828, *Standard Test Methods for Flash Point by Small Scale Closed Tester*, shall be permitted to be used for materials other than those for which ASTM D 3278 is specifically required. [**30:**1.7.4.4]

Chapter 4 Location of Plants and Buildings

4.1 Location.

4.1.1 Organic coatings manufacturing operations shall not be located in the same building with other occupancies.

4.1.1.1 Operations incidental to or connected with organic coatings manufacturing shall not be classed as "other operations or occupancies."

4.1.2 Organic coatings manufacturing operations and processes shall be located so that they are accessible from at least two sides to provide access for fire fighting and other emergency operations.

4.1.3 Where topographical conditions will allow an accidental release of flammable and combustible liquids to flow from organic coatings manufacturing operations and processes so as to present a fire hazard to other facilities, drainage shall be provided in accordance with Section 5.2.

4.2 General Layout and Design.

4.2.1 Organic coatings manufacturing operations shall be provided with means of egress that meet the following requirements:

(1) Means of egress shall be arranged to prevent occupants from being trapped in the event of a fire.

(2) Means of egress shall not be exposed by drainage facilities required by Section 5.2.

(3) Aisles shall be provided to allow unobstructed movement of personnel and fire protection equipment.

4.2.2 Laboratories, offices, and storage areas that are located in the same building as organic

coatings manufacturing operations shall be separated from the manufacturing operations by a wall that meets both of the following requirements:

(1) The wall shall have a minimum 2-hour fire resistance rating.

(2) Openings in the wall between these areas and the manufacturing area shall be protected by fire doors having a minimum 1½-hour fire protection rating.

4.2.3 Areas where unstable liquids are handled or processed shall be separated from all adjacent areas by walls that meet both of the following requirements:

(1) The wall shall have a minimum 2-hour fire resistance rating.

(2) Openings in the walls between these areas and all adjacent areas shall be protected by fire doors having a minimum 1½-hour fire protection rating.

4.2.4 Process Vessels.

4.2.4.1 Process vessels shall be located in accordance with Table 4.2.4.1(a) and Table 4.2.4.1(b).

Table 4.2.4.1(a) Location of Process Vessels

Process Vessels Having Emergency Relief Venting to Permit Pressure (psig)	Stable Liquids	Unstable Liquids
≤2.5	Table 4.2.4.1(b)	2.5 times Table 4.2.4.1(b)
>2.5	1.5 times Table 4.2.4.1(b)	4 times Table 4.2.4.1(b)

For SI units, 2.5 psig = gauge pressure of 17.2 kPa.

Table 4.2.4.1(b) Reference for Table 4.2.4.1(a)

	Minimum Distance	
Capacity of Vessel (gal)	From Property Line That is or can be Built Upon, Including the Opposite Side of a Public Way (ft)	From Nearest Side of any Public Way or From Nearest Important Building on Same Property (ft)
≤275	5	5
276–750	10	5

Table 4.2.4.1(b) Reference for Table 4.2.4.1(a)

Capacity of Vessel (gal)	Minimum Distance	
	From Property Line That is or can be Built Upon, Including the Opposite Side of a Public Way (ft)	From Nearest Side of any Public Way or From Nearest Important Building on Same Property (ft)
751–12,000	15	5
12,001–30,000	20	5
30,001–50,000	30	10

For SI units, 1 gal = 3.8 L; 1 ft = 0.3 m.

Exception: As provided for in 4.2.4.3.

4.2.4.2 Where unstable liquids are processed and protection for exposures, as defined in 3.3.22, is not provided, the distance required by 4.2.4.1 shall be doubled.

4.2.4.3 The distances required in 4.2.4.1 shall be permitted to be waived where both of the following criteria are met:

(1) The vessels are housed within a building.

(2) The exterior wall of the building facing the line of adjoining property that can be built upon is a blank wall having a minimum 2-hour fire resistance rating.

4.2.4.4 Where Class IA or unstable liquids are handled, the blank wall specified in 4.2.4.3(2) shall be designed to provide resistance to damage from an explosion originating inside the building and the building shall meet all applicable requirements of Section 5.5.

Chapter 5 Building Construction

5.1 General Construction.

Buildings that house organic coatings manufacturing operations shall meet the requirements of this section.

5.1.1 The buildings shall be of fire-resistive or noncombustible construction without basements.

5.1.2 The first floor of the buildings shall be at or above the grade to provide water drainage and vapor diffusion.

5.1.3 Flammable raw materials and finished stock storage shall be stored in a detached

building or in an area that is separated from manufacturing areas by a wall that meets both of the following requirements:

(1) The wall shall have a minimum 2-hour fire resistance rating.

(2) Openings in the wall shall be protected by fire doors having a minimum 1½-hour fire protection rating.

5.1.4 Internal partitions shall not interfere with ventilation or with means of egress and shall be of noncombustible construction.

5.1.5 In multistory buildings, stairways and elevators shall be enclosed by walls that meet both of the following requirements:

(1) The walls shall have a minimum 2-hour fire resistance rating.

(2) Openings in the walls shall be protected by fire doors having a minimum 1½-hour fire protection rating.

5.1.6 Each manufacturing area shall have at least two means of egress arranged to prevent occupants from being trapped in the event of a fire. The means of egress shall meet all of the following requirements:

(1) They shall be well separated.

(2) They shall lead to the outside or to another safe area.

(3) They shall meet the requirements of NFPA *101*, *Life Safety Code*.

(4) Access to all exits shall be kept unobstructed.

(5) Exit doors shall open in the direction of exit travel.

5.1.7 Load-bearing supports for vessels and equipment capable of releasing enough liquid to result in a fire of sufficient intensity and duration to cause structural damage shall be protected by one or more of the following:

(1) Drainage to prevent accumulation of burning liquid under vessels or equipment

(2) Fire-resistive construction

(3) Fire-resistant protective coatings or systems

(4) Water spray systems designed and installed in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*

(5) Other alternate means that are acceptable to the authority having jurisdiction

5.2 Drainage.

5.2.1 Emergency drainage systems for leaks of flammable or combustible liquids and for fire protection system discharge shall be provided and shall meet the requirements of 7.3.5 of NFPA 30, *Flammable and Combustible Liquids Code*.

5.2.2 If an emergency drainage system either is connected to a public sewer system or

discharges into public waterways, it shall be equipped with traps or separators.

5.3 Building Heating.

If building heating is provided in areas handling Class I liquids, it shall be provided by indirect means such as water, steam, or warm air, or the heating equipment shall be listed and approved for use within the electrically classified area where it is installed.

5.4 Ventilation.

5.4.1 Open Containers and Equipment. Enclosed buildings in which Class I liquids are processed or handled in open containers and equipment shall be continuously ventilated at a rate not less than 1 $ft^3/min/ft^2$ (0.3 $m^3/min/m^2$) of solid floor area during operation of any equipment.

5.4.1.1 Continuous ventilation shall be accomplished by natural ventilation or by exhaust fans taking suction at floor level and discharging to a safe location outside the building.

5.4.1.2 Where there is a potential for vapor emission due to evaporation of Class I liquids, ventilation shall be provided during shutdown periods at a rate sufficient to maintain a safe atmosphere.

5.4.1.3* If additional local ventilation is needed for control of health hazards, such ventilation shall be permitted to be utilized for up to 75 percent of the ventilation recommended in 5.4.1.

5.4.1.4 Ventilation shall be designed to include all pits or other low points where flammable vapors can collect.

5.4.2 Closed Containers and Equipment. Enclosed buildings in which Class I liquids are processed or handled in closed containers and equipment shall be equipped with point-of-use and point-of-emission local exhaust ventilation systems designed to prevent accumulation of flammable vapors during the operation of the equipment.

5.4.2.1 Ventilation shall be accomplished by exhaust fans taking suction at all potential points of flammable vapor release from the equipment.

5.4.2.2 During a shutdown period, when equipment is open and there is a potential for vapor emission, ventilation shall be provided at a rate sufficient to maintain a safe atmosphere.

5.4.2.3* Additional floor-level ventilation shall be required in stagnant areas, such as sumps, pits, and other low points where flammable vapors can collect.

5.5* Deflagration (Explosion) Venting.

Deflagration venting shall be provided for buildings and structures in which a deflagration hazard exists.

5.6 Electrical Equipment.

5.6.1 All electrical wiring and equipment shall be installed and maintained in accordance

with NFPA 70, *National Electrical Code*.

5.6.2 Where Class I liquids are exposed to the air or where Class II or Class III liquids are exposed to the air at temperatures at or above their flash points, the equipment used in the building and the ventilation of the building shall be designed so that flammable vapor–air mixtures are confined, under normal operating conditions, to the inside of the equipment and to a zone that extends not more than 5 ft (1.5 m) from the equipment.

5.6.3* Table A.5.6.3 of this standard and Chapter 8, Electrical Equipment and Installations, of NFPA 30, *Flammable and Combustible Liquids Code*, shall be used to determine the extent of hazardous (classified) locations for purposes of installation of electrical equipment and wiring.

5.6.4 In establishing the extent of hazardous (classified) locations, such locations shall not extend beyond floors, walls, roofs, or other solid partitions that have no communicating openings into the hazardous (classified) locations.

5.6.5 Where the provisions of this section require the installation of Class I, Division 1 or Class I, Division 2 electrical equipment, ordinary electrical equipment, including switch gear, shall be permitted to be used if the following requirements are met:

(1) The electrical equipment shall be installed in a room or enclosure that is maintained under positive pressure with respect to the classified area in accordance with NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*.

(2) Ventilation makeup air shall not be contaminated.

(3) Pressurized rooms and enclosures in classified areas shall be designed to prevent the flow of liquids into the rooms or enclosures.

Chapter 6 Process Equipment and Operations

6.1 Transfer of Flammable and Combustible Liquids.

6.1.1* Transfer of Class I, Class II, and Class III liquids from storage tanks to process areas shall be through a closed piping system by means of gravity flow or by pumps.

6.1.1.1 Where liquid transfer is by gravity flow, one or more fail-closed, remotely actuated valves shall be provided at suitable locations in the piping to stop the flow of liquids in an emergency. Operation of these valves shall be by means of emergency shut-offs located near each point of use and at the storage tanks.

Exception: Emergency shut-offs are not required at the storage tanks if the remotely actuated valves are closed automatically by a fire detection, fire suppression, or fire alarm system.

6.1.1.2* Where liquid transfer is by pumps, one or more emergency switches shall be provided to shut down all pumps and to stop the flow of liquids in an emergency. The emergency switches shall be located at exits from the process areas, at other safe locations outside the process areas, and at the pumps.

Exception: Emergency switches are not required at the pumps if the pumps are shut off automatically by a fire detection, fire suppression, or fire alarm system.

6.1.2 Transfer of liquids to and from vessels, containers, tanks, and piping systems by means of air or inert gas pressure shall be permitted only where all of the following requirements are met:

(1) Vessels, containers, tanks, and piping systems shall be designed for such pressurized transfer and shall be capable of withstanding the anticipated operating pressure.

(2) Safety and operating controls, including pressure relief devices, shall be provided to prevent overpressure of any part of the system.

(3) Where necessary, fail-closed, remotely actuated valves shall be provided at suitable locations in the piping.

(4) Only inert gas shall be used to transfer Class I liquids.

(5) Inert gas shall be used to transfer Class II and Class III liquids that are heated above their flash points.

6.1.3 Positive displacement pumps shall be provided with pressure relief discharging back to the supply tank or vessel, the pump suction, or another suitable location or shall be provided with interlocks to prevent overpressure.

6.1.4 Dispensing of the following liquids from large containers to smaller containers shall be by means of an approved drum pump or by gravity using an approved self-closing valve:

(1) Class I liquids

(2) Class II or Class III liquids heated to temperatures at or above their flash points

6.1.5 Containers and mix tanks that contain Class I, Class II, or Class III liquids shall be covered with rigid lids to prevent spills whenever they are moved or transported from one location to another.

6.2 Piping, Valves, and Fittings.

Piping, valves, and fittings shall be designed and installed in accordance with Chapter 5 of NFPA 30, *Flammable and Combustible Liquids Code*, and in accordance with the requirements of 6.2.1 through 6.2.11.

6.2.1 All piping, valves, and fittings in flammable or combustible liquid service shall be designed for the working pressures and structural stresses to which they will be subjected.

6.2.2 Piping, valves, and fittings shall be of steel or other material approved for the service intended. Cast-iron valves, fittings, and pipe shall not be used.

6.2.3 Valves shall be of types that indicate whether they are open or closed (e.g., a rising stem, plug, or ball valve). Valves shall be mounted in a manner so that vibration will not cause them to open.

6.2.4 Terminal valves on remote pumping systems shall be of the spring-loaded, self-closing

type and shall be permitted to be held open manually or by a fusible link.

6.2.5 Pumps of remote pumping systems shall be controlled by valves, or by operation of a meter, or shall be automatically shut off by a fire detection, fire suppression, or fire alarm system.

6.2.6 Piping for Class I, Class II, and Class III liquids shall meet the following requirements:

(1) Piping shall not be routed through enclosed exits.

(2) Piping having flanged connections, valves, checks, meters, or other joints or devices that can leak shall not be run through tunnels, stair towers, elevator towers or other areas where personnel could be confined, or in concealed spaces or in trenches with solid covers.

6.2.7 Piping systems shall be provided with a means of relieving trapped liquids, such as relief valves or drainage.

6.2.8 Listed flexible connectors shall be permitted to be used where vibration exists or where frequent movement is necessary.

6.2.9 Approved hose shall be permitted to be used at dispensing stations and transfer stations.

6.2.10 Solvent piping that enters equipment such as mixers and kettles shall be bonded to the equipment and shall be designed to minimize generation of static electricity due to free fall or excessive agitation.

6.2.11 Before being placed in service, all piping shall be hydrostatically tested to not less than 1½ times the expected working pressure for a minimum of 30 minutes to determine whether the piping is free of leaks.

6.3 Kettles, Reactors, and Vessels.

6.3.1 Closed Reactors and Thin-Down Tanks.

6.3.1.1 Reactor systems shall be designed to safely manufacture the products assigned to them. Design factors shall include, but not be limited to, materials of construction, pressure rating, emergency vent system, cooling and heating capacity, condenser capacity, instrumentation, and other design features.

6.3.1.2 The following safeguards shall be provided for all reactors:

(1) Furnace room ventilation shall be maintained with a high-level exit and a low-level entry.

(2) Gas furnaces shall be provided with an accessible, identified external gas shutoff valve for emergency use.

(3) Reactors shall be provided with emergency pressure relief systems sized and located using an approved design method.

(4) Discharge piping from pressure relief systems shall be directed to a blow-down tank or catch tank that is sized and located using an approved design method or to a safe

location.

6.3.1.3 The following additional safeguards shall be provided for direct-fired heaters:

(1)* The fire box shall be instrumented to shut down fuel in case of flameout to prevent explosions within.

(2) The external area under the kettle where the fire box or furnace is located shall be completely sealed from the process area, particularly the operating floor, to prevent any spills from being ignited.

(3) The furnace air intake shall be remotely located from the process area.

(4) The exhaust from the fire box shall be piped or ducted away from the process area to prevent its igniting flammable materials due to spills or upsets during processing.

(5) Combustible materials shall not be stored in the furnace room, nor shall the furnace room contain any piping of flammable materials except those connected to the kettle or fire box as part of the process.

(6) The reactor shall be provided with a high-temperature limit switch that will automatically shut down heating and, if desired, initiate automatic cooling.

6.3.1.4* Reactors and thin-down tanks shall be designed and procedures shall be established to prevent violent foaming when materials are added to hot reactor contents.

6.4 Dispersion Equipment.

6.4.1 Two-roll mills or other mills operating with close clearances and that are used for the processing of flammable and heat-sensitive materials, such as nitrocellulose, shall be located in a detached building or in a noncombustible structure without other occupancy.

6.4.1.1 The amount of nitrocellulose or other flammable material brought into the area shall be no more than that required for a single batch.

6.4.1.2 A remote, manually operated water spray system, designed in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, shall be provided to protect mills.

6.4.2 Installations that consist of a single disperser and drive that can be used in more than one fixed mix tank shall be equipped with a device to lock the disperser and drive's agitator in place to prevent contact between the agitator blades and the walls of the mix tank.

6.4.2.1 The agitator shall be bonded to the tank when in use.

6.4.2.2 Each tank shall be provided with a cover.

6.5 Ball Mills and Pebble Mills.

6.5.1 Ball mills and pebble mills shall be grounded.

6.5.2 Metal chutes or funnels used for adding flammable or combustible liquids to mills shall be extended into the mill as far as possible to minimize free fall. They shall be bonded to the mill or to ground so that static electric charges can dissipate.

6.5.3 Where it is necessary to pressure-unload a ball mill or pebble mill, inert gas shall be used. Air shall not be used.

6.5.4 Each mill shall be provided with a relief valve to protect it from overpressure. The pressure relief valve shall be set no higher than the design pressure of the vessel.

6.6 Mixers and Mixing Tanks.

6.6.1 Tanks and other vessels needed for processing and manufacturing of organic coatings shall be permitted in the process area, but shall not be considered storage tanks for purposes of application of this standard.

6.6.2 Mixers used for flammable or combustible products shall be equipped with rigid covers.

6.6.2.1 Covers shall be permitted to have slots or openings to accommodate mixer shafts or other operational needs.

6.6.3 Where gravity flow is used, a shutoff valve shall be installed as close as practical to the vessel being unloaded and a control valve shall be provided near the end of the discharge pipe.

6.6.3.1 Discharging piping shall be bonded to the receiving container so that static electric charges can dissipate.

6.6.4 Mixing tanks shall be designed to safely manufacture the products assigned to them.

6.6.5 Portable process mixing tanks and containers shall be secured to prevent the tank from moving to prevent contact between the mixing blade and the tank/container.

Chapter 7 Material Storage and Handling

7.1 Tank Car and Tank Vehicle Unloading and Loading.

Tank car and tank vehicle unloading and loading facilities shall be designed and operated in accordance with Section 7.6 of NFPA 30, *Flammable and Combustible Liquids Code*.

7.2 Flammable and Combustible Liquid Storage.

7.2.1 The storage of Class I, Class II, and Class III liquids, as defined in Section 3.4, shall meet the requirements of Chapters 4 and 6 of NFPA 30, *Flammable and Combustible Liquids Code*.

7.2.2 Where liquids cannot be stored in outside aboveground tanks or in underground tanks because of temperature or production considerations, tanks shall be permitted to be installed inside of buildings or structures, provided the installation meets the requirements of 4.3.4 of NFPA 30, *Flammable and Combustible Liquids Code*.

7.2.3 Storage tanks inside buildings shall be permitted only in areas that meet the following requirements:

(1) The areas shall be at or above grade.

(2) The areas shall have drainage.

(3) The areas shall be separated from process areas by construction having a minimum 2-hour fire resistance rating.

(4) Openings to other rooms or buildings shall be provided with noncombustible, liquidtight raised sills or ramps at least 4 in. (100 mm) in height, or the floor in the storage area shall be at least 4 in. (100 mm) below the surrounding floor. A permissible alternative is an open-grated trench inside of the room that drains to a safe location.

(5) Openings to other rooms or buildings shall be provided with fire doors having a minimum 1½-hour fire protection rating.

(6) The areas shall be liquidtight where the walls join the floor.

7.2.4 Hot box installations shall include the following controls:

(1)* Unless the area is provided with adequate containment, the hot box shall have containment for at least the volume of the largest container or portable tank.

(2) Containers shall be sealed.

(3) If there is the potential for overheating, the system shall be designed with high temperature limits to actuate audible alarms and shut down the heating source.

(4) When electrical equipment is provided, all electrical wiring and utilization equipment shall be suitable for Class I, Division 2 locations if the enclosed liquids are either Class I or are Class II or Class III heated up to or above their flash points.

7.2.5 Portable drum heaters shall be designed for the hazardous locations in which they are used and shall be maintained in accordance with the manufacturer's specifications.

7.3 Storage of Finished Products.

7.3.1 Finished products in containers, intermediate bulk containers, and portable tanks that are Class I, Class II, or Class III liquids shall be stored outdoors, in a separate building, or in a room separated from the process area by a wall or partition having a minimum 2-hour fire resistance rating.

7.3.1.1 Openings in such walls shall be protected by fire doors having a minimum 1½-hour fire protection rating.

7.3.2 Storage shall meet applicable requirements of Chapter 6 of NFPA 30, *Flammable and Combustible Liquids Code*.

7.4 Outdoor Storage.

Outdoor storage of liquids in containers, intermediate bulk containers, and portable tanks shall meet the requirements of Section 6.7 of NFPA 30, *Flammable and Combustible Liquids Code*.

7.5 In-Plant Transportation and Storage of Portable Shipping Tanks.

The storage of portable shipping tanks shall be in accordance with NFPA 30, *Flammable and Combustible Liquids Code*.

7.5.1 Full or partially full portable shipping tanks shall be permitted to be stacked two high, provided they are of the nesting design.

7.5.2 All materials-handling equipment used for transporting or lifting portable shipping tanks shall be of ample capacity to lift or transport the full load safely and shall meet the requirements of NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*.

7.5.3 Floors of buildings and shipping docks shall be structurally able to carry the wheel loads resulting from transporting full portable shipping tanks by means of materials-handling equipment.

7.5.4 Portable shipping tanks shall be permitted to be emptied by any of the following three methods:

(1) Contents shall be permitted to be pumped from the top. The pump, pipelines, hose, or other containers or tanks shall be bonded and grounded.

(2) Contents shall be permitted to be pumped from a valve at the bottom of the portable shipping tank. The pump, pipelines, hose, or other containers or tanks shall be bonded and grounded.

(3) Contents shall be permitted to be discharged by gravity from a valve at the bottom of the portable shipping tank. The portable shipping tank, pipelines, hose, and receiving vessel shall be bonded and grounded.

7.5.5 Portable shipping tanks shall not be pressure-unloaded unless done in accordance with 6.1.2 of this standard.

7.5.6 Filling Portable Shipping Tanks. Portable shipping tanks shall be filled by gravity or pump. Where filling through an open manhole, the fill pipe shall be bonded to the portable shipping tank.

7.6 Power-Operated Industrial Trucks.

7.6.1* Only those power-operated industrial trucks that are approved and designated as Type DX or EX, as defined in NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, shall be permitted to be used in areas where ignitible vapors exist under normal operating conditions.

7.6.2 Power-operated industrial trucks that are approved and designated as Type DX, EX, EE, or DY shall be permitted to be used in areas where Class I liquids and their vapors are normally within a closed system or container from which the liquid or vapor can escape only in the event of accidental rupture or breakdown of such equipment (Class I, Division 2, Group D electrical classification).

7.6.3* Power-operated industrial trucks that are approved and designated as Type CNS, GS, LPS, DS, ES, GS/CNS, or GS/LPS shall be permitted to be used in areas where Class I liquids are stored in sealed containers if permitted by the authority having jurisdiction.

7.6.4 Only those power-operated industrial trucks that are approved and designated as Type DX or EX shall be permitted to be used in areas where combustible dusts are or can be in suspension in the air continuously, intermittently, or periodically under normal operating conditions in quantities that can produce ignitible mixtures (i.e., Class II, Division 1, Group G electrical classification).

7.6.5 Power-operated industrial trucks that are approved and designated as Type DX, EE, EX, or DY shall be permitted to be used in areas where combustible dusts are present but not normally in suspension in the air and where dusts will not be thrown into suspension in the air by the normal operation of equipment in quantities that can produce ignitible mixtures, but where deposits of such dusts can be ignited by arcs or sparks originating in the truck (i.e., Class II, Division 2, Group G electrical classification).

Chapter 8 Special Hazards

8.1* Nitrocellulose.

8.1.1 Handling.

8.1.1.1* Handling of containers of nitrocellulose shall be done in a manner that prevents generation of frictional heat.

8.1.1.2 The following precautions shall be taken when moving containers of nitrocellulose:

(1) When containers are moved using a wheeled hand truck, the hand truck shall be fitted with a "grab" to hold the top of the container.

(2)* When power-driven industrial trucks are used, the containers shall be held in place on the transportation pallet, if used, or held in place by a properly designed drum-holding device to ensure the container is secure during movement.

8.1.1.3 Containers shall not be dropped. If containers must be lowered from one elevation to another, handling equipment shall be used and the containers kept under control at all times.

8.1.2 Storage.

8.1.2.1 Rooms used to store nitrocellulose shall meet the following requirements:

(1) The room shall be separated from the production area by construction having a minimum 2-hour fire resistance rating.

(2) Openings into the room shall be protected by fire doors having a minimum 1½-hour fire protection rating.

(3)* The room shall be protected by an automatic sprinkler system, either wet-pipe, preaction, or deluge, that provides a density of 0.35 gpm/ft² (14.3 L/min · m²) over

the entire storage area.

(4) The electrical area classification of a cutoff room or an attached building shall be determined based on the classification of the adjacent process area.

8.1.2.2 Outside storage of nitrocellulose shall meet the following requirements:

(1) Storage shall be on a detached pad or in a detached noncombustible structure such as a roofed shed that is located in accordance with Table 8.1.2.2.

(2) Where storage is protected by a sprinkler system that provides a density of 0.35 gpm/ft^2 (14.3 L/ min · m^2) over the entire storage area, the distances in Table 8.1.2.2 shall be permitted to be reduced by 50 percent.

(3) Detached storage areas shall not be classified for purposes of electrical installations, and general-purpose electrical equipment and wiring methods shall be permitted.

Table 8.1.2.2 Separation Distances for Nitrocellulose Storage

Wet Nitrocellulose (Dry Weight) (lb)	Distance to Property Line or Nearest Important Building (ft)
≤1,000	50
1,000–5,000	75
5,000–10,000	100
10,000–25,000	125
25,000–50,000	150
>50,000	As approved by authority having jurisdiction

For SI units, 1 lb = 0.454 kg; 1 ft = 0.3 m.

8.1.2.3 Storage of other commodities in the same area as nitrocellulose shall be limited to inert materials and noncombustible materials that are chemically compatible with the nitrocellulose. Such materials shall be separated from the nitrocellulose by a minimum distance of 20 ft (6 m).

8.1.2.4 Storage of flammable liquids shall not be permitted in the same storage area as nitrocellulose.

8.1.2.5 Nitrocellulose shall be stored only in its original shipping container or a container that is approved for storing nitrocellulose.

8.1.2.6 Containers of nitrocellulose shall not be opened in the main storage area but only at the point of use or at a location set aside for the purpose.

8.1.2.7 Containers of nitrocellulose shall be stored in an upright position with the lid up and shall not be stacked more than two high.

8.1.2.8* Nitrocellulose shall be stored in such a manner that the stock will be rotated to

ensure that the oldest material is used first and that nitrocellulose is not stored for more than two years.

8.1.2.9* Where building heat is necessary, it shall be provided by indirect means, such as low-pressure steam, hot water, or warm air. Heating units, radiators, steam and hot water pipes, and warm air outlets shall be located so that containers of nitrocellulose do not come in contact with them.

8.1.2.10 The storage area shall be marked with a sign that states NITROCELLULOSE — FLAMMABLE SOLID — KEEP HEAT, SPARKS, AND FLAME AWAY, or equivalent wording.

8.1.3 Use in Process Area.

8.1.3.1 The amount of nitrocellulose brought into the operating area at any one time shall not exceed the amount required for a single shift.

8.1.3.2 Containers shall remain closed until ready for use.

8.1.3.3* Where only part of a container is used, the lid and closure shall be replaced immediately and the closure securely fastened.

8.1.3.4 If it is necessary to fork or scoop nitrocellulose out of a container, a spark-resistant scoop shall be used.

8.1.3.5 Spilled nitrocellulose shall be cleaned up immediately. Clean-up procedures shall include the following:

(1) Material that has dried or is suspected of having dried shall be wet with water or solvent and placed in a covered metal container.

(2) The material shall be removed at the end of the day or shift and disposed of properly.

8.1.3.6 After containers of nitrocellulose are emptied, the covers shall be replaced and the closure securely fastened.

8.1.3.7 Used nitrocellulose shall be placed in a covered waste container, wet down with water, and removed at the end of the day or shift and disposed of daily.

8.1.3.8 Containers, rim rings of fiber containers, and vessels shall be bonded and grounded during transfer operations.

8.1.4* Waste Disposal. Sweepings and other small quantities of nitrocellulose that cannot be used shall be wet down with water or solvent and placed in a covered metal container. The waste material shall be disposed of in accordance with applicable regulations.

8.2* Monomers.

Monomers shall be stored, handled, and used in accordance with manufacturers' instructions.

8.2.1 Bulk Storage of Liquid Monomers.

8.2.1.1 Storage tanks for liquid monomers shall meet all applicable requirements of Chapter 4 of NFPA 30, *Flammable and Combustible Liquids Code*.

8.2.1.2 Storage tanks for liquid monomers shall not be located in the same diked area as or in the drainage path of any storage tank that holds a material that is incompatible with the monomer.

8.2.1.3 Storage tanks for liquid monomers shall be provided with separate normal vents that meet the requirements of 4.2.5 of NFPA 30, *Flammable and Combustible Liquids Code*.

8.2.1.4 Storage tanks for liquid monomers shall be provided with emergency vents that meet the following requirements:

(1) The emergency vents shall be capable of relieving the excess internal pressure and evolution of gas, liquid, or vapor resulting from polymerization or runaway reaction.

(2) The emergency vents shall be designed in accordance with methods that are appropriate for the specific monomer.

8.2.2* Storage of Solid Monomers. Solid monomers shall be stored, handled, and used in accordance with the manufacturers' instructions.

8.2.3 Waste Disposal. Waste monomers or material contaminated with monomers shall be disposed of according to applicable government regulations regarding hazardous waste.

8.3* Organic Peroxide Formulations.

Organic peroxide formulations shall be stored in accordance with NFPA 432, *Code for the Storage of Organic Peroxide Formulations*, and shall be handled and used in accordance with the manufacturers' instructions.

Chapter 9 Control of Ignition Sources

9.1 Ignition Sources.

Precautions shall be taken to prevent the ignition of flammable materials in organic coatings manufacturing facilities by sources including, but not limited to, the following:

(1) Open flames

(2) Lightning

(3) Hot surfaces

(4) Radiant heat

(5) Smoking

(6) Hot work

(7) Spontaneous ignition

(8) Frictional heat or sparks

(9) Static electricity

(10) Electrical sparks

(11) Stray currents

(12) Ovens, furnaces, and heating equipment

9.2 Smoking.

Smoking shall be limited to designated areas that are identified and provided with disposal containers.

9.3* Hot Work.

9.3.1 Hot work shall not be permitted until a written permit authorizing such work has been issued.

9.3.2 The permit shall be issued by a person in authority following his or her inspection of the area to ensure that precautions have been taken and will be followed until the job is completed.

9.4 Repair of Electrical Equipment.

Where electrical equipment is repaired or replaced, the integrity of the area's electrical classification shall be maintained in accordance with Section 5.6.

9.5* Static Electricity Hazards.

9.5.1* Bonding and Grounding. All equipment such as tanks, machinery, and piping, where a flammable mixture might be present, shall be bonded and connected to a ground.

9.5.1.1 The bond or ground, or both, shall be physically applied or shall be inherently present by the nature of the installation.

9.5.1.2 For purposes of dissipating static electric charges, the resistance to ground of a metallic grounding path shall not exceed 25 ohms and the resistance to ground of a nonconductive or semiconductive grounding path shall not exceed 1 million ohms (1 megohm).

9.5.1.3 Electrically isolated sections of metallic piping or equipment shall be bonded to the other portions of the system or grounded to prevent external ignition hazards.

9.5.1.4* Where flammable liquids are transferred to or from portable containers greater than 1 gal (3.785 L) in size, all metallic elements, including the containers, shall be bonded together, and one element shall be grounded.

9.5.1.5 A bond or ground connection shall meet the following requirements:

(1) All materials shall be electrically conductive.

(2) Materials used shall have sufficient mechanical strength, corrosion resistance, and flexibility for the service intended.

(3) If wire is used, it shall be no smaller than No. 10 AWG wire, preferably uninsulated.

(4) Permanent connections shall be made with electrical cable lugs or bolted clamps or by brazing, welding, or other suitable means.

9.5.1.6* Bonding clamps for portable equipment shall be of the opposed-point type and shall be attached so that metal-to-metal contact with bonded equipment is assured.

Exception: Other types of clamps that provide secure metal-to-metal contact shall be permitted to be used.

9.5.1.7* Rubber or leather belts used to transmit power shall be made of conductive material or treated with a conductive belt dressing. Such dressings shall be checked periodically to ensure reliability.

9.5.1.8* When adding powders to Class I liquids, it shall be done in a manner that minimizes the generation of static electricity.

9.5.2 Plastic Piping. Powders shall not be conveyed through solid plastic piping that is not antistatic.

9.5.3* Fill Pipes. Fill pipes or side diverters shall be used to transfer nonconductive Class I liquids in quantities greater than 60 gal (227 L) at a time.

9.5.4 Stretch Wrap. Plastic packaging film, including stretch wrap and shrink wrap, shall not be applied or removed in any area that is designated as a hazardous (classified) location.

9.6 Lightning Protection.

Where required by the authority having jurisdiction, lightning protection systems meeting the requirements of NFPA 780, *Standard for the Installation of Lightning Protection Systems*, shall be provided.

Chapter 10 Management of Fire Hazards

10.1 Scope.

This chapter shall apply to the management methodology used to identify, evaluate, and control the fire and explosion hazards involved in manufacturing organic coatings.

10.2 Basic Requirements.

Organic coatings manufacturing operations that involve the use of flammable and combustible liquids shall be reviewed to ensure that fire and explosion hazards resulting from loss of containment of liquids are provided with corresponding fire prevention and emergency action plans.

Exception: Operations that involve only the use of Class II or Class III liquids handled at temperatures below their flash points and that do not involve the use of Class I liquids need not undergo this review.

10.3 Evaluation of Hazards.

The extent of fire prevention and control that is provided shall be determined by means of an engineering evaluation of the operation and application of fire protection and process engineering principles.

10.3.1 The hazard evaluation shall include, but not be limited to, the following:

(1) Analysis of the fire and explosion hazards of the operation

(2) Analysis of hazardous materials and chemicals and hazardous reactions used in the operation and the safeguards taken to control them

(3) Analysis of the applicable facility design requirements in this standard

(4) Analysis of the applicable operation and protection requirements in this standard

(5) Analysis of local conditions, such as exposure to and from adjacent properties and exposure to floods, earthquakes, and windstorms

(6) Analysis of the emergency response capabilities of the local emergency services

10.4 Emergency Action Plans.

A written emergency action plan that is consistent with available resources and personnel shall be established to respond to fires and related emergencies.

10.4.1 The emergency action plan shall include, but not be limited to, the following:

(1) Procedures to be followed in case of fire, such as sounding the alarm, notifying the fire department, evacuating personnel, and controlling and extinguishing the fire.

(2) Procedures and schedules for conducting drills of these procedures.

(3) Appointment and training of personnel to carry out assigned duties. These duties shall be reviewed at the time of initial assignment, as responsibilities or response actions change, and whenever anticipated duties change.

(4) Maintenance of fire protection equipment.

(5) Procedures for shutting down or isolating equipment to reduce the release of liquid. This shall include assigning personnel responsible for maintaining critical plant functions or the shutdown of plant processes.

10.5 Management of Change.

The fire hazards management review conducted in accordance with Section 10.3 shall be repeated whenever the fire or explosion hazards change significantly. Conditions that might require repeating a review include, but are not limited to, the following:

(1) Changes in the materials in process

(2) Changes in process equipment

(3) Changes in process controls

(4) Changes in operating procedures or assignments

10.6* Fire Investigation.

All fires shall be investigated.

Chapter 11 Fire Protection

11.1* Scope.

This chapter shall apply to the commonly recognized management control systems and methods used to prevent or minimize the loss from fire or explosion in organic coatings manufacturing facilities.

11.2 Automatic Sprinkler Protection.

11.2.1* Important manufacturing and storage buildings shall be protected by sprinkler systems installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

11.2.2 An automatic sprinkler system shall be permitted to be equipped with fire-fighting foam that is compatible with the materials protected. Such systems shall be designed in accordance with one of the following:

(1) NFPA 13, *Standard for the Installation of Sprinkler Systems*

(2) NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*

(3) NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*

11.2.3* Water supplies for fire protection systems shall be capable of providing the pressure and capacity needed to meet the highest flow demand in any one fire, with ample reserve for necessary hose demand.

11.2.4 Drainage facilities shall be provided for water from sprinkler systems. *(See Section 5.2.)*

11.3 Fire Hydrants.

Where public hydrants and water mains are not available or are inadequate, private hydrants and water mains shall be provided in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*.

11.4 Fire Alarm Systems.

An approved means for prompt notification of fire to those within the plant and to the available public or private fire department shall be provided.

11.5 Portable Fire Control Equipment.

11.5.1 Portable Fire Extinguishers. Listed portable fire extinguishers shall be provided in

accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

11.5.2 Standpipe and Hose Systems. When the need is indicated in accordance with Section 10.3, standpipe and hose systems shall be installed in accordance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*. Only combination nozzles or spray nozzles shall be used.

11.5.3 Hose Connections. When the need is indicated in accordance with Section 10.3, 1½ in. hose connections shall be installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. Only combination nozzles or spray nozzles shall be used.

11.6* Fixed Local Application Extinguishing Systems.

When the need is indicated in accordance with Section 10.3, manufacturing equipment and tanks shall be permitted to be protected by foam, inert gas, or dry chemical extinguishing systems.

Chapter 12 Training and Emergency Planning

12.1 Basic Training Requirements.

12.1.1 Personnel responsible for the use and operation of portable fire control equipment shall be trained in the use of that equipment. Refresher training shall be conducted at least annually.

12.1.2 Personnel shall be trained in the methods of manually actuating fixed extinguishing systems and of notifying public or private fire departments and emergency organizations.

12.1.3 All personnel shall be made aware of special hazards and shall be instructed as to the identity and potential dangers of hazardous materials.

12.1.4 Personnel shall be trained in proper procedures for safe operation of processes, as well as emergency shutdown procedures.

12.2 Emergency Planning.

12.2.1 Planning for fire control measures shall be coordinated with local emergency response agencies.

12.2.2 Procedures shall be established to provide for safe shutdown of operations under emergency conditions.

12.2.3 Provisions shall be made for training, inspection, and testing of associated alarms, interlocks, and controls.

Exception: Where shutdown of an operation would increase the hazard, other emergency procedures shall be permitted to be established.

12.2.4 The emergency procedure shall be kept readily available and up to date.

Chapter 13 Inspection and Maintenance

13.1 General.

13.1.1 Fire protection equipment shall be tested and maintained in accordance with applicable NFPA standards.

13.1.2 Inspection and testing of fire protection equipment shall be performed in accordance with recommendations of the equipment manufacturer.

13.1.3 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*.

13.1.4 Procedures shall be established to control leakage and prevent spillage of liquids during maintenance operations.

13.1.5 Combustible waste material and residues in operating areas shall be kept to a minimum, stored in covered metal containers, and disposed of daily.

13.1.6 Outside storage areas shall be kept free of weeds, trash, or other unnecessary combustible materials.

13.1.7 Aisles established for movement of personnel shall be maintained clear of obstructions to permit orderly evacuation and ready access for manual fire-fighting activities.

13.2 Confined Space Entry.

Where it is necessary for an employee to enter a tank, a pit, a manhole, or any other confined space, such entry shall be authorized by the individual in charge. If it is a permit-required confined space, as defined in 29 CFR 1910.146, all the requirements of 29 CFR 1910.146 shall be met.

13.3* Cleaning Tanks and Vessels.

Cleaning of storage tanks and process vessels shall be done in a manner and with controls to prevent fires. If permit-required confined space entry is necessary as defined in 29 CFR 1910.146, “Permit-Required Confined Space Entry,” all applicable requirements of these rules and of 29 CFR 1910.147, “Control of Hazardous Energy,” shall be met.

13.4* Floor Cleaning.

Floor cleaning shall be done in a manner that minimizes fire hazards.

Annex A Explanatory Material

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

correspond with the applicable text paragraphs.

A.1.1.2(1) See NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*; NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*; and Chapter 7 of NFPA 30, *Flammable and Combustible Liquids Code*, for information on the use and application of these coatings.

A.1.1.2(2) See Chapter 6 of NFPA 30, *Flammable and Combustible Liquids Code*, for information on storage of these coatings at other locations.

A.1.2 This standard provides a means by which plant management and supervisory personnel can evaluate the hazards of operations under their jurisdiction. It also provides a guide for design engineers, architects, and others in planning new installations.

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

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

A.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.11 Important Building. Examples include, but are not limited to, occupied buildings, control buildings, or buildings that contain high-value contents or critical equipment or supplies.

A.3.3.13 Inerting. See NFPA 69, *Standard on Explosion Prevention Systems*, for additional information on this subject.

A.3.3.16 Monomer. Monomers can be liquids (styrene, ethyl acrylate), gases (butadiene, vinyl chloride), or solids (acrylamide) and exhibit the same flammability characteristics that

would be expected of any organic compound with their physical constants. Monomers represent an additional hazard because of the exothermic heat that is evolved when uncontrolled polymerization occurs.

A.3.3.20 Organic Peroxide. Some organic peroxides are heat and shock sensitive and are potentially explosive. Examples of such peroxides are benzoyl peroxide and methyl ethyl ketone peroxide.

A.3.3.26 Unstable Liquid. This term does not include liquids whose only hazard is combustibility.

A.3.3.28 Ventilation. Ventilation can be achieved by introduction of fresh air to dilute contaminated air or by local exhaust of contaminated air. Ventilation is considered adequate if it is sufficient to prevent accumulation of significant quantities of vapor–air mixtures in concentrations over 25 percent of the lower flammable limit.

A.3.4 The information in Section 3.4, including related explanatory text that follows in this annex, is extracted from Section 1.7 of NFPA 30, *Flammable and Combustible Liquids Code*.

A.3.4.1 Scope. Certain mixtures of flammable or combustible liquids and 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 halogenated hydrocarbon 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. For systems such as open process tanks or spills in open air, an open-cup test method might be more appropriate for estimating the fire hazard.

A.3.4.2.1 Boiling Point. At the boiling point, the surrounding atmospheric pressure can no longer hold the liquid in the liquid state and the liquid boils. A low boiling point is indicative of a high vapor pressure and a high rate of evaporation.

A.3.4.2.2 Fire Point. Related to the flash point is the fire point. The fire point of a liquid is the temperature at which ignition of vapors will result in continued burning. As the term *flash point* suggests, the vapors generated at that temperature will flash but will not necessarily continue to burn. The difference between flash point and fire point has some significance when conducting flash point tests. *(See ASTM D 92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup, and "Method of Testing for Sustained Combustibility" in 49 CFR, 173.)* However, a closed-cup flash point is used to classify the liquid and characterize its hazard.

A.3.4.2.3 Flash Point. Flash point is a direct measure of a liquid's volatility, its tendency to vaporize. The lower the flash point, the greater the volatility and the greater the risk of fire. Flash point is determined using one of several different test procedures and apparatus that are specified in 3.4.4. A liquid that has a flash point at or below ambient temperature is easy to ignite and will burn quickly. On ignition, the spread of flame over the surface of such a

liquid will be rapid, because it is not necessary for the fire to expend energy heating the liquid to generate more vapor. Gasoline is a familiar example. A liquid with a flash point above ambient temperature presents less risk because it must be heated to generate enough vapor to become ignitible; it is more difficult to ignite and presents less potential for the generation and spread of vapor. A common example is home heating oil (Fuel Oil No. 2). Home heating oil must be atomized to a fine mist in order to be easily ignited.

The volatility of liquids is increased by heating. Where Class II or Class III liquids are heated above their flash points, ventilation and electrical classification might be necessary in the immediate area. However, the vapors from such heated liquids cool rapidly in the air, limiting concern to the area of that space in which the temperature of the vapors remains above the flash point of the liquid.

Certain solutions of liquids in water exhibit a flash point using the standard closed-cup test procedures but will not burn and might even extinguish a fire. To assist identifying such solutions, the following standards are helpful: ASTM D 4206, *Standard Test Method for Sustained Burning of Liquid Mixtures Using the Small Scale Open-Cup Apparatus,* and ASTM D 4207, *Standard Test Method for Sustained Burning of Low-Viscosity Liquid Mixtures by the Wick Test.* Liquid mixtures that do not sustain combustion for a specified time at a specified temperature are considered to be noncombustible. These tests provide additional data for determining proper storage and handling of such mixtures. In a confined space, such mixtures might still create an ignitible vapor–air mixture, depending on the amount of flammable liquid in the mixture and the quantity of the spill.

For more information, see ASTM E 502, *Standard Test Method for Selection and Use of ASTM Standards for the Determination of Flash Point of Chemicals by Closed Cup Methods,* and the ASTM *Manual on Flash Point Standards and Their Use.*

A.3.4.2.5 Vapor Pressure. Vapor pressure is a measure of the pressure that the liquid exerts against the atmosphere above it. Just as the atmosphere exerts pressure on the surface of the liquid, the liquid pushes back. Vapor pressure is normally less than atmospheric pressure and is a measure of the liquid's tendency to evaporate, to move from the liquid to the gaseous state. This tendency is also referred to as volatility, thus the use of the term *volatile* to describe liquids that evaporate very easily. The higher the vapor pressure, the greater the rate of evaporation and the lower the boiling point. Simply put, this means more vapors and increased fire risk.

A.5.4.1.3 See NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, for information on this subject.

A.5.4.2.3 As stated in 5.4.2, the requirements apply to situations where containers and equipment are closed during routine operations and are fitted with point-of-use ventilation to capture vapors when they are opened. Normally installed floor-level ventilation is only required where there is the potential for flammable vapor accumulation.

A.5.5 A deflagration hazard can exist where one or more of the following conditions exist:

(1) Flammable gases are present in the operation.

(2) Class IA liquids are processed in open equipment.

(3) Class I liquids are processed in closed equipment at temperatures that exceed the boiling points of the liquids.

(4) Class I, Class II, or Class III liquids can be liberated as a mist as a result of a leak from equipment operating at a pressure above atmospheric.

(5) Combustible dusts can create a dust explosion potential as a result of operations or malfunction of equipment. See NFPA 68, *Guide for Venting of Deflagrations*, for information on the design and installation of deflagration vents. See NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, if applicable.

Deflagration venting can be provided by one or a combination of the following methods:

(1) Open-air construction

(2) Lightweight wall and roof construction

(3) Lightweight wall and roof panels, held in place by low-pressure-relieving fasteners

(4) Windows capable of relieving the deflagration

A.5.6.3 Examples of such equipment are dispensing stations, sand mills, open centrifuges, plate-and-frame filter presses, open vacuum filters, and the surfaces of open equipment. The classifications listed in Chapter 8, Electrical Equipment and Installations, of NFPA 30, *Flammable and Combustible Liquids Code*, are based on the premise that the installation meets all applicable requirements of NFPA 30 and NFPA 70, *National Electrical Code*. If this is not the case, the authority having jurisdiction has the authority to determine the extent of hazardous (classified) locations.

For additional information, see NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*.

Table A.5.6.3 presents guidance for classifying areas around equipment and processes specific to the manufacture of organic coatings.

Table A.5.6.3 Electrical Area Classification Specific to Organic Coatings Manufa

Location	*NEC* Class I		Extent of Classifie
	Division	Zone	

Table A.5.6.3 Electrical Area Classification Specific to Organic Coatings Manufa

Location	*NEC* Class I		Extent of Classifie
	Division	Zone	
Indoor open head mills installed in areas provided with ventilation in accordance with Section 5.4 where flammable vapor–air mixtures can exist under normal operation	1	0	The entire area associated v equipment where flammabl vapors are present continuc periods of time
	1	1	Area within 5 ft of any edg equipment, extending in al
	2	2	Area between 5 ft and 8 ft (such equipment, extending directions; also, space up tc floor or grade level within : horizontally from any edge equipment
Indoor closed head mills installed in areas with ventilation in accordance with Section 5.4 where flammable vapor–air mixtures are contained within the mill and within connected tanks, resulting in small vapor loss	1	0	The immediate area of the supporting tanks where flar or vapors are present contir long periods of time
	1	1	Area within 5 ft of any edg equipment, extending in al
	2	2	Area between 5 ft and 8 ft (such equipment, extending directions; also, space up tc floor or grade level within : horizontally from any edge equipment
Indoor open mixing equipment installed in areas provided with ventilation in accordance with Section 5.4 where flammable vapor–air mixtures can exist under normal operation	1	0	The entire area associated v equipment where flammabl vapors are present continuc periods of time
	1	1	Area within 5 ft of any edg equipment, extending in al
	2	2	Area between 5 ft and 8 ft (such equipment, extending directions; also, space up tc floor or grade level within : horizontally from any edge equipment

Table A.5.6.3 Electrical Area Classification Specific to Organic Coatings Manufa

Location	*NEC* Class I		Extent of Classifie
	Division	Zone	
Indoor closed mixing equipment installed areas provided with ventilation in accordance with Section 5.4 where flammable vapor–air mixtures can exist inside the mixing tank under normal operation	1	0	The entire area associated v equipment where flammabl vapors are present continuc periods of time
	1	1	Area within 5 ft of any edg equipment, extending in al
	2	2	Area between 5 ft and 8 ft (such equipment, extending directions; also, space up tc floor or grade level within horizontally from any edge equipment
Indoor sealed mixing equipment installed in areas provided with ventilation in accordance with Section 5.4 where flammable vapor–air mixtures can exist inside the mixing tank under normal operation and the only emissions are through the vents opening to the outside of the building	1	0	The interior of the mining flammable gases or vapors continuously or for long pe
	1	1	Area within 3 ft of any edg equipment, extending in al
	2	2	Area between 5 ft and 8 ft (such equipment, extending
Indoor resin plate and frame filter press equipment installed with no local ventilation where flammable vapor–air mixtures can exist under normal operation	1	0	The entire area associated v equipment where flammabl vapors are present continuc periods of time
	1	1	Area within 5 ft of any edg equipment, extending in al
	2	2	Area between 5 ft and 8 ft (such equipment, extending directions; also, space up tc floor or grade level within horizontally from any edge equipment
Indoor resin plate and frame filter press equipment installed with surrounding local ventilation where flammable vapor–air mixtures can exist under normal operation only within the ventilation enclosure	1	0	The entire area associated v equipment where flammabl vapors are present continuc periods of time
	1	1	Area within 5 ft of any edg equipment, extending in al
	2	2	Area between 5 ft and 8 ft (such equipment, extending directions; also, space up tc floor or grade level within horizontally from any edge equipment

For SI units, 1 ft = 0.3 m.

A.6.1.1 To the extent practicable, processes involving the use of flammable and combustible liquids should be carried out in closed systems of equipment, containers, and piping.

A.6.1.1.2 The switches can deactivate pumps, close valves, or initiate other emergency actions to prevent additional fuel from being added to the fire.

A.6.3.1.3(1) See NFPA 86, *Standard for Ovens and Furnaces*, for additional information.

A.6.3.1.4 Violent foaming in a reactor or thin-down tank can be caused by rapid boiling, outgassing, or chemical reaction when relatively cold liquid or solid ingredients are added to the hot contents of the reactor or tank. This is particularly hazardous when the ingredients are added through an open manway or hatch because the contents can be ejected from the vessel directly at the operator, resulting in a severe personnel hazard and a potential fire hazard. This situation can be prevented or minimized by adding ingredients through a closed device, such as a screw feeder or a rotary valve, with the operator away from the area immediately in front of the vessel.

A.7.2.4(1) See 6.4.2.5 of NFPA 30, *Flammable and Combustible Liquids Code*.

A.7.6.1 See NFPA 70, *National Electrical Code*, for additional information on the interpretation of the electrical classifications referred to herein and NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, for an explanation of the designations of industrial trucks.

A.7.6.3 Subsection 4.2.3.2 of NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, states "In locations used for the storage of liquids in sealed containers or liquefied or compressed flammable gases in containers, approved power-operated industrial trucks designated as Types CNS, DS, ES, GS/CNS, or GS/LPS may be used if permitted for such locations by the authority having jurisdiction." Compared to the above types, industrial trucks that are designated Types DY and EE have significantly less potential for igniting flammable vapors (such as might result from a spill of Class I liquid) and should be used in inside liquid storage areas where conditions warrant.

A.8.1 Nitrocellulose is a flammable material whose burning rate varies depending on its wetting agent and its degree of dryness.

Solvent-wet nitrocellulose is nitrocellulose that is wet with a flammable liquid such as alcohol. Its hazard and rate of burning are the same as that of the wetting agent alone.

Water-wet nitrocellulose is nitrocellulose that is wet with water. It is difficult to ignite and, once ignited, is slower burning than solvent-wet nitrocellulose.

Plasticized nitrocellulose is nitrocellulose that is compounded with a plasticizer. It burns very intensely and is a more serious fire hazard than solvent wet nitrocellulose.

Dry nitrocellulose burns rapidly and with intense heat. It is to be avoided in all operations.

When nitrocellulose of any type burns, toxic gases such as oxides of nitrogen and carbon monoxide are produced. Personnel must avoid exposure to these gases. Incipient responders

and fire fighters should avoid breathing the products of combustion given off by burning nitrocellulose. Responders should position themselves in such a way as to minimize exposure to these products of combustion or should wear self-contained breathing apparatus if their duties require that they enter an atmosphere of burning nitrocellulose.

Water is the most effective fire extinguishing medium for nitrocellulose and should be used in large quantities. Exposure of containers of nitrocellulose to a fire or high heat causes vaporization of the wetting medium, resulting in an increase in pressure that causes release of the lid of the container.

A.8.1.1.1 Dragging or pushing a container of nitrocellulose across a hard surface, such as pavement or steel decking, can generate enough frictional heat to ignite the nitrocellulose. Drums can, however, be rolled on their lower chime in an upright position.

A.8.1.1.2(2) Non-sparking devices are not required when handling closed containers of nitrocellulose.

A.8.1.2.1(3) Although the sprinkler system can be either a wet-pipe, preaction, or deluge system, deluge systems are preferred.

A.8.1.2.8 Any nitrocellulose stored for more than two years should be tested for the proper amount of wetting agent before use. The manufacturer should be contacted for guidance for proper procedures for handling inadequately wetted or degraded material.

A.8.1.2.9 Overheating of containers of nitrocellulose, either by direct contact with a hot surface or by storage in an overheated environment, can lead to pressure buildup in the container and release of the lid.

A.8.1.3.3 If the nitrocellulose is contained inside a plastic bag within the drum, the plastic bag should be closed before securing the lid on the metal or fiber drum.

A.8.1.4 When solvent solutions containing nitrocellulose are evaporated for solvent recovery, the nitrocellulose might decompose or ignite if proper precautions are not taken. Toxic gases from decomposing nitrocellulose can overpressure recovery units. Due to the many varied ingredients used in making products that contain nitrocellulose, no single method for preventing decomposition of the nitrocellulose can be provided. Two approaches for minimizing decomposition, the effectiveness of which must be verified by the user by laboratory testing and engineering controls, are as follows:

(1) Denitrate the nitrocellulose in an excess amount of a 5 percent aqueous sodium hydroxide solution. The amount of sodium hydroxide solution required must be determined by the user, based on laboratory tests. The amount of nitrocellulose and other chemicals that might compete for the sodium hydroxide might vary between batches of solvent.

(2) Do not allow nitrocellulose or other solids to dry in the evaporation unit. Adding a high boiling point liquid, such as mineral oil, might help keep the material wet. Regularly clean out the wet solids and dispose of them in accordance with applicable government regulations. Distillation solids should be kept wet and allowed to cool to a temperature below 140°C (284°F) before being removed from the distillation unit. The wet solids should also be kept well below 140°C (284°F) to prevent

decomposition.

A.8.2 Monomers are reactive chemicals that present special hazards. They are usually flammable and their vapors, which are normally heavier than air, can form explosive vapor–air mixtures. They will typically contain inhibitors to prevent self-polymerization, but the effectiveness of the inhibitor decreases with increasing temperatures. If exposed to the heat of a fire, polymerization can take place. If this occurs in a closed container, a violent rupture can occur.

Suppliers should be contacted for advice concerning the storage, handling, and use of specific monomers.

Some measures that might be appropriate include the following:

(1) Individually piping monomers to prevent contamination that could promote polymerization.

(2) Providing storage tanks for monomers that are sensitive to extremes of temperature with means to control the temperature, such as water spray, cooling coils, reflective paints, overhead cover, or insulation.

(3) Checking the strength of inhibitors periodically to make certain they are at a safe level, since some inhibitors, (e.g., hydroquinone in styrene) lose their effectiveness under certain time and temperature conditions.

A.8.2.2 Normally, solid monomers are not subject to self-polymerization unless they are liquefied or are subjected to elevated temperatures.

A.8.3 Some organic peroxide formulations are unstable and can present a serious problem in safe handling. A few are powerful oxidizing agents and can react violently with reducing agents. Most will react to exposure to heat or shock. The manufacturer or supplier should be consulted wherever these materials are to be used.

In general, organic peroxide formulations must be stored in a cool location. In very hot weather, artificial cooling might be necessary to prevent decomposition of the peroxide. In cold climates, artificial heat might be necessary to prevent the formation of shock-sensitive crystals.

A.9.3 Hot work includes, but is not limited to, welding, cutting, grinding, and the use of nonrated electrical equipment in hazardous (classified) locations. See NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, for additional guidance.

A.9.5 See NFPA 77, *Recommended Practice on Static Electricity*, for information on this subject.

A.9.5.1 Personnel who add materials to or take samples from a vessel that contains or might contain an ignitible atmosphere or who approach a location that contains an ignitible atmosphere should be grounded. Skin-to-ground resistance should not exceed 10^8 ohms (100 megohms). The preferred method of providing this ground is by means of conductive footwear and conductive flooring. As an alternate means, personnel grounding devices can be worn.

Powered industrial trucks that are moved into an area designated as a Class I, Division 1 hazardous (classified) location should have a resistance to ground through the floor of less than 10^8 ohms. Powered industrial trucks that have conductive tires that meet ANSI/UL 583, *Standard for Safety for Electric Battery-Powered Industrial Trucks*, and that operate on a clean, unpainted concrete floor can meet this specification. Alternatively, the trucks can be grounded by means of grounding cables.

A.9.5.1.4 Portable plastic containers and rigid plastic container liners can create an ignition hazard by sparks from a contained conductive flammable liquid if the container has been charged by rubbing.

A.9.5.1.6 The physical condition of bonding cables and clamps should be visually checked before each use. Points on bonding clamps should be capable of penetrating the nonconductive coating of enameled drums so that metal-to-metal contact is ensured and should be replaced when they are no longer sharp. Bonding clamps should be attached to designated, unpainted, metallic surfaces that are kept clean. These bonding locations should be at least 1 ft (0.3 m) above the floor but not at the upper rim of an open-top vessel that contains or might contain a flammable liquid.

A.9.5.1.7 Ordinary rubber or leather flat belts generate static.

A.9.5.1.8 Powders should not be added to a mixing vessel or a high-speed disperser that contains a Class I liquid unless either the liquid has a conductivity greater than 1000 picosiemens per meter or the entire vapor space of the vessel is inerted. If no powder or other second phase is present during mixing and the vessel is not inerted, the conductivity should be at least 50 picosiemens per meter. Regardless of the conductivity of the liquid, the entire vapor space of the vessel should be inerted if the mixing blades break the surface of the liquid. Manual dumping of powders or particulate solids directly into a vessel that contains an ignitible atmosphere should be avoided. *(See* NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, for additional guidance.)*

Solid materials should not be added directly to a vessel that contains a Class I liquid either from plastic bags that are not antistatic or from rigid plastic containers that are not antistatic. As defined in this standard, antistatic means "having a surface resistivity less than 1.0×10^{11} ohms per square or having a charge decay rate from 5000 volts to 500 volts of less than 0.5 second, when tested at 23°C (73°F) and 20 percent relative humidity." The latter criteria are taken from Method 4046 of Federal Test Method Standard 101C. Likewise, solid materials should not be added directly to a vessel that contains a Class I liquid from standard flexible intermediate bulk containers (FIBCs or "bulk bags") or from FIBCs that have plastic liners that are not antistatic. Antistatic plastic bags should be marked "ANTISTATIC" by the vendor, who should also certify that the bags meet the above-referenced specifications.

Certain types of FIBCs have been demonstrated, in full-scale dumping tests, not to cause incendive static electric discharges. These types include the "groundable" type (if grounded) and the "static dissipative," nongroundable type, which is designed to dissipate static charges from the bag to a safe level by nonincendive corona discharge. Standard FIBCs or FIBCs with a plastic liner should be dumped into a hopper/feed screw, a hopper/rotary valve, or an

equivalent system that isolates the FIBC from any ignitible vapor and limits the flow rate from the FIBC to less than 0.5 ft^3/sec (0.014 m^3/sec). A groundable FIBC should have a resistance to its grounding tab of less than 10^8 ohms, using a 50-mm diameter electrode, from any point on its surface.

A.9.5.3 Where flammable and combustible liquids are allowed to fall an appreciable distance through space, a static charge can be generated due to their breaking up into a spray or droplets. A method used to reduce this hazard is to extend the fill pipe to the bottom of the equipment or container or to divert the flow to the side of the equipment or container. This will help to keep the flow in a solid stream and reduce splashing.

Grounded fill pipes can be used to ground liquids that are being transferred into a nonconductive container or vessel. For this purpose, the fill pipe should contact the bottom of the container or vessel; for example, with a 45 degree cut or with a "tee" connector at its lower end.

A.10.6 All fires, regardless of size, should be investigated to determine cause and to develop means to prevent future occurrences. NFPA 921, *Guide for Fire and Explosion Investigations*, provides guidance on fire investigations.

A.11.1 The wide range in size, design, and location of organic coatings manufacturing facilities precludes the inclusion of detailed fire prevention and control systems and methods applicable to all such facilities. Qualified engineering judgment should be exercised.

A.11.2.1 The sprinkler system should be designed to protect the most severe hazard present in the area. Specifics of the system design, including design densities and areas of application, should be taken from the appropriate code or standard. Typical occupancies found in an organic coatings manufacturing facility and the appropriate code or standard for them are as follows:

(1) Offices, manufacturing areas, finished product container filling, storage of ordinary commodities to no more than 12 ft high: NFPA 13, *Standard for the Installation of Sprinkler Systems*

(2) Laboratories: NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*

(3) Storage of ordinary commodities greater than 12 ft: NFPA 13, *Standard for the Installation of Sprinkler Systems*, and NFPA 230, *Standard for the Fire Protection of Storage*

(4) Storage of flammable and combustible liquids: NFPA 30, *Flammable and Combustible Liquids Code*

(5) Storage of aerosol products: NFPA 30B, *Code for the Manufacture and Storage of Aerosol Products*

Due to the potential for fast growing fires in areas where large quantities of flammable liquids are handled or stored, the use of wet pipe or deluge type sprinkler systems is preferred.

A.11.2.3 Although fires involving some solvents might not be extinguished by water, water

from sprinklers can control the flames and help keep the structure, equipment, and the supports cool, thereby preventing collapses.

A.11.6 For further information, see NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*; NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*; NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*; and NFPA 17, *Standard for Dry Chemical Extinguishing Systems*.

A.13.3 The procedures and safeguards required to clean a tank or vessel will depend on the formulation of the prior contents, the configuration of the tank or vessel, and applicable environmental regulations. They should be chosen to provide fire prevention for the personnel engaged in the work. Cleaning a tank or vessel might involve simply rinsing with some of the raw materials of the prior contents, then storing the rinse liquid for use in a subsequent batch.

The preferred method of cleaning portable process tanks, intermediate bulk containers, and similar vessels or containers is by means of a mechanical washer specifically manufactured for the purpose. The preferred method of cleaning fixed tanks or vessels is by means of a closed-top circulating system specifically manufactured for the purpose. Tanks and vessels should be grounded and their interior should be inerted to prevent accumulation and subsequent discharge of static electricity.

Tanks and vessels can be cleaned by rinsing, and vapor-freeing can be accomplished by purging the tank or vessel with air. A safe atmosphere should be maintained by continued ventilation. Where a fixed ventilation system is not provided, an air mover can be attached to the tank or vessel, so that clean air is drawn into it and discharged through the air mover to a safe location. The air mover should be approved for the location in which it is to be used.

During the purge process, the concentration of vapor in the tank or vessel will usually pass through the flammable range before a safe atmosphere is attained. Precautions should be taken to ensure that the air mover is bonded to the tank or vessel or to other equipment to minimize accumulation of static electricity. By first purging the system with an inert gas and then ventilating with air, the hazards of passing through the flammable range are minimized.

A.13.4 When possible, floor cleaning should be done with the least practical amounts of flammable or combustible liquids. The material to be removed should be evaluated to determine its fire and health hazards before cleaning begins. Suitable fire protection and personal protective equipment should be provided and used during floor cleaning. Residues and cleaning equipment (mops, rags, etc.) should be disposed of in a safe manner.

Annex B Operational Practices

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

B.1 Safety Work Permit.

Where repair work is to be performed in a restricted area by plant or outside personnel, a work permit authorized by the individual in charge should be issued after an inspection has

been made to ensure safe procedures for the work specified. This permit should be restricted as to date and time for each specified job, with additional copies as needed. *(See Figure B.1.)*

SAFETY WORK PERMIT

To: _____ Department: _____

For: (a) _____ All repair work done by outside departments.

(b) _____ Hot work: Welding (gas or electric), burning, or any work requiring or producing heat, flame, sparks, or electric current.

(c) _____ Entering a vessel.

Good for: Date: _____ Time: _____ A.M. P.M.

To Date: _____ Time: _____ A.M. P.M.

Area: _____

Describe work to be done: _____

NOTE: Write in "yes" or "no." If question does not apply, check it off, indicating that it has been given consideration.

1. Can the equipment be removed from the building? ..... _____
2. Can this work be done other than by the use of flame? ..... _____
3. Have all process materials (solids, liquids, gases) been removed from the equipment? ..... _____
4. Can sparks ignite material in vicinity or on lower floors or levels? ..... _____
5. Have connections been blanked off? ..... _____
6. Have valves been tagged and/or locked closed? ..... _____
7. Have switches been tagged open (safety locks on push buttons not sufficient)? ..... _____
8. Has equipment and all attached piping been cleaned? ..... _____
   With: ❑ Water ❑ Steam ❑ Inert Gas
9. Has equipment been ventilated? ..... _____
10. Have trenches and sewer openings been covered and steam turned on? ..... _____
11. Has gas test been made? ..... _____
12. Is adjacent equipment safe? ..... _____
13. Has worker been given proper instructions? ..... _____

NOTE: Equipment or material to be removed for repair or disposal must be approved by Department Supervisor as free from dangerous materials.

Are there any special precautions to be observed? _____

Operating Superintendent **Safety Fire Inspector**

Maintenance Supervisor

FIGURE B.1 Sample Safety Work Permit.

B.2 Tank or Confined Space Safety Permit.

Before any person is permitted to enter a tank or other confined space, someone with responsible authority should review in detail with those entering the enclosure the hazards of the product and the precautions that should be taken before work is started. The procedure should be completed in detail before any person enters the confined space. *(See Figure B.2.)*

During the time personnel are in a tank or confined space, they should wear an approved safety harness with a line outside the tank that is held by a person outside the tank. The persons involved should be in visual and voice communication. At least one other person should be within calling distance. Portable compressed gas and manually operated horn units to assist in attracting the attention of personnel can be used for rescue operations.

APPROVAL SHEET FOR WORK IN TANKS OR CONFINED SPACES

Location: _____ **Equipment:** _____ **Material in Tank or Area:** _____ **Date** _____

Preparation of Tank or Area	**Check (✓)**	**Explain if Not Checked**
Tank steamed for _____ hours	_____	
Flushed with water	_____	
Atmosphere tested and approved by Safety Dept. Representative or Supervisor	_____	
All lines disconnected or blanked off close to tank	_____	
Ventilated with blower	_____	
Blower checked by Electrical Department	_____	
Proper tools provided	_____	
Revolving tanks or tanks with stirrers or agitators are locked out	_____	
Fire Permit issued _____ No Fire Permit issued	_____	
Lifeline checked and ready for use	_____	
Air mask ready for use	_____	
Extra worker present to be on hand entire time worker is in tank or confined area	_____	
Ladder to climb out of tank or area available	_____	
Other work in area that might create hazard to worker in tank or area investigated and, if necessary, stopped	_____	
Reasons for safety measures explained to worker about to enter tank	_____	
Proper fire equipment on site	_____	
What provisions have been made to handle the residue of the tank?		

Additional Remarks:

I understand the hazards present and the precautions to be observed as checked above.

Operating Dept. Supervisor

Engineering Dept. Supervisor

Safety Dept. Supervisor

FIGURE B.2 Sample Approval Sheet for Work in Tanks or Confined Spaces.

B.3 Preventive Maintenance.

In most plants, a plan of regularly scheduled shutdowns is followed. During these periods, repair work is undertaken that cannot be done safely or effectively while the plant is operating. This affords an excellent opportunity for detailed inspection of the equipment in order to detect and correct conditions that might be the cause of unnecessary hazards developing and untimely and costly interruptions in plant operations.

Annex C Informational References

C.1 Referenced Publications.

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

C.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2005 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2005 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2002 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2003 edition.

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 2002 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2003 edition.

NFPA 30B, *Code for the Manufacture and Storage of Aerosol Products*, 2002 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 2003 edition.

NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*, 2003 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2004 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2003 edition.

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

NFPA 69, *Standard on Explosion Prevention Systems*, 2002 edition.

NFPA 70, *National Electrical Code®*, 2005 edition.

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

NFPA 86, *Standard for Ovens and Furnaces*, 2003 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 2004 edition.

NFPA 230, *Standard for the Fire Protection of Storage*, 2003 edition.

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2004 edition.

NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, 2002 edition.

NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2000 edition.

NFPA 921, *Guide for Fire and Explosion Investigations*, 2004 edition.

C.1.2 Other Publications.

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

ASTM D 92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup*, 1998.

ASTM D 4206, *Standard Test Method for Sustained Burning of Liquid Mixtures Using the Small Scale Open-Cup Apparatus*, 2001.

ASTM D 4207, *Standard Test Method for Sustained Burning of Low-Viscosity Liquid Mixtures by the Wick Test*, 1991.

ASTM E 502, *Standard Test Method for Selection and Use of ASTM Standards for the Determination of Flash Point of Chemicals by Closed Cup Methods*, 1984.

ASTM *Manual on Flash Point Standards and Their Use*.

C.1.2.2 UL Publication. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 583, *Standard for Safety for Electric Battery-Powered Industrial Trucks*, 9th edition, 1996.

C.1.2.3 U.S. Government Publication. U.S. Government Printing Office, Washington, DC 20420.

Title 49, Code of Federal Regulations, Part 173, Appendix H, "Method of Testing for Sustained Combustibility."

C.1.2.4 Other Publication. *Merriam-Webster's Collegiate Dictionary,* 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

C.2 Informational References. (Reserved)

C.3 References for Extracts.

The following documents are listed here to provide reference information, including title and edition, for extracts given throughout the nonmandatory sections of this standard as indicated by a reference in brackets [ ] following a section or paragraph. These documents are not a part of the requirements of this document unless also listed in Chapter 2 for other reasons.

NFPA 30, *Flammable and Combustible Liquids Code*, 2003 edition.

NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*, 2005 edition.