NFPA® 329

Recommended Practice for Handling Releases of Flammable and Combustible Liquids and Gases

2025 Edition

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NFPA® 329

Recommended Practice for

Handling Releases of Flammable and Combustible Liquids and Gases

2025 Edition

This edition of NFPA 329, *Recommended Practice for Handling Releases of Flammable and Combustible Liquids and Gases*, was prepared by the Technical Committee on Tank Leakage and Repair Safeguards. It was issued by the Standards Council on November 16, 2024, with an effective date of December 6, 2024, and supersedes all previous editions.

This edition of NFPA 329 was approved as an American National Standard on December 6, 2024.

Origin and Development of NFPA 329

This recommended practice began as a report (NFPA 30B), which was published until 1950. A manual on this subject was published in 1959. The manual was rewritten as a recommended practice in 1964, with subsequent revisions in 1965, 1972, 1977, 1983, 1987, 1992, and 1999.

The 1999 edition of this recommended practice combined the relevant and updated material in earlier editions of NFPA 329 and of NFPA 328, *Recommended Practice for the Control of Flammable and Combustible Liquids and Gases in Manholes, Sewers, and Similar Underground Structures*, into a single document. NFPA 328 was withdrawn in May 1999.

The 2005 edition of NFPA 329 was the result of a major rewrite to comply with the *Manual of Style for NFPA Technical Committee Documents* and it incorporated amendments to several defined terms that were preferred NFPA definitions.

The 2010 edition of NFPA 329 was amended to ensure that all the referenced documents were listed correctly pertaining to title and edition date. In addition, Figure 5.4.7.1 was revised to show a grounding connection for the air eductor; an annex item was added to Section 9.1 to cross-reference requirements for control of ignition sources as set forth in NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*; and errors in the headings of Table A.4.1.11 were corrected.

In the 2015 edition of NFPA 329, the referenced publications were updated to the most recent editions. In addition, several of the definitions were revised to better describe the terminology used, and, where appropriate, the preferred definition in other NFPA publications was incorporated.

For the 2020 edition, the technical committee made minor editorial revisions, updated the definitions that were extracted from other publications, and revised the references to other publications. The recommended practice for testing aboveground storage tanks (ASTs) was also revised to include newer methods of testing and inspection, and a description of ultrasonic testing was added.

For the 2025 edition, the committee added more guidance on the leakage of flammable gases or vapors. The entries and work conditions for atmospheres where flammable gases or vapors might be present was lowered from below 50 percent lower flammable limit (LFL) to below 10 percent LFL to be consistent with health and safety regulations for general industry, construction, and maritime environments, as well as other NFPA standards. Annex C was revised to further explain light nonaqueous phase liquid (LNAPL) and dense nonaqueous phase liquid (DNAPL).

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

Committee Scope: This Committee shall have primary responsibility for documents on safeguarding against fire, explosion, and health hazards associated with entry, cleaning, and repair of tank systems and methods for detecting, controlling, and investigating releases that could cause these hazards.

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NFPA 329

Recommended Practice for

Handling Releases of Flammable and Combustible Liquids and Gases

2025 Edition

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

Chapter 1 Administration

1.1 Scope.

1.1.1 This recommended practice provides methods for responding to fire and explosion hazards resulting from the release of a flammable or combustible liquid, gas, or vapor that can migrate to a subsurface structure.

1.1.2 Although this recommended practice is intended to address only fire and explosion hazards, other authorities should be consulted regarding the environmental and health impacts and other hazardous conditions of such releases.

1.1.3 This recommended practice outlines options for detecting and investigating the source of a release, for mitigating the fire and explosion hazards resulting from the release, and for tracing the release back to its source.

1.1.4 The options outlined in this recommended practice are not intended to be, nor should they be considered to be, all-inclusive or mandatory in any given situation. If better or more appropriate alternative methods are available, they should be used.

1.1.5* The procedures outlined in this recommended practice can apply to hazardous substances other than flammable and combustible liquids that might have adverse human health effects. However, the physical characteristics of the specific hazardous substance released must be understood before any action is taken. *(See also 1.1.2.)*

1.2 Purpose.

1.2.1 The purpose of this recommended practice is to provide regulatory officials, fire authorities, contractors, and owners of subsurface structures guidance on problems involving flammable and combustible liquids and gases that might be found in subsurface structures and other areas.

1.2.2* The responsibility for correct handling of a suspected release of a flammable or combustible liquid or gas or the potential hazard from such a release will be shared by various individuals, organizations, and regulatory agencies.

1.2.2.1 The successful handling of these problems will depend on the best possible cooperation among those individuals, organizations, and regulatory agencies.

1.2.2.2 This recommended practice is intended for the information of all organizations and persons involved.

1.2.2.3 Owners, operators, or others who become aware of a hazardous condition should notify the fire department, police, or other applicable authority.

1.3 Application. (Reserved)

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

1.4.1 Unless otherwise specified, the provisions of this recommended practice should not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the recommended practice. Where specified, the provisions of this recommended practice should 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 should be permitted to apply retroactively any portion of this recommended practice deemed appropriate.

1.4.3 The retroactive provisions of this recommended practice should 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 recommended practice 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 recommended practice.

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

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

1.6 Units and Formulas. (Reserved)

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this recommended practice and should be considered part of the recommendations of this document.

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

NFPA 30, *Flammable and Combustible Liquids Code,* 2024 edition.

2.3 Other Publications.

2.3.1 API Publications. American Petroleum Institute, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001-5571.

API PBL 1628, *Guide to the Assessment and Remediation of Underground Petroleum Releases*, 3rd edition, 1996.

API PBL 1629, *Guide for Assessing and Remediating Petroleum Hydrocarbons in Soil*, 1st edition, 1993.

Δ **2.3.2 ASTM Publications.** ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D5/D5M, *Standard Test Method for Penetration of Bituminous Materials*, 2020.

ASTM D323, *Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)*, 2020a.

ASTM D4359, *Standard Test Method for Determining Whether a Material is a Liquid or a Solid*, 1990, reapproved 2019.

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2.3.3 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 40, Code of Federal Regulations, Part 112, "Oil Pollution Prevention."

Title 40, Code of Federal Regulations, Part 280.43, "Methods of Release Detection for Tanks."

2.3.4 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

2.4 References for Extracts in Recommendations Sections.

NFPA 30, *Flammable and Combustible Liquids Code,* 2024 edition.

NFPA 77, *Recommended Practice on Static Electricity,* 2024 edition.

NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair,* 2025 edition.

NFPA 921, *Guide for Fire and Explosion Investigations,* 2024 edition.

NFPA 1451, *Standard for a Fire and Emergency Service Vehicle Operations Training Program,* 2018 edition.

Chapter 3 Definitions

Δ **3.1 General.**

N **3.1.1** The definitions contained in this chapter apply to the terms used in this recommended practice.

N **3.1.2** Where terms are not defined in this chapter or within another chapter, they should be defined using their ordinarily accepted meanings within the context in which they are used.

N **3.1.3** *Merriam-Webster's Collegiate Dictionary*, 11th edition, is the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* 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.

3.2.2 Recommended Practice. An NFPA standard similar in content and structure to a code or standard but that contains only nonmandatory provisions using the word "should" to indicate recommendations in the body of the text.

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

3.2.4 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1 Bonding. For the purpose of controlling static electric hazards, the process of connecting two or more conductive objects together by means of a conductor so that they are at the same electrical potential, but not necessarily at the same potential as the earth. [**77,** 2024]

3.3.2 Combustible Gas Indicator. An instrument that samples air to indicate whether there are combustible vapors or gases present and can also indicate the percentage of the lower explosive limit of the vapor or gas mixture.

3.3.3* Combustible Liquid. Any liquid that has a closed-cup flash point at or above 37.8°C (100°F), as determined by the test procedures and apparatus set forth in Section 4.4 of NFPA 30.

3.3.4 Container. For the purpose of handling releases of flammable and combustible liquids and gases, a device that is intended to contain an accumulation of hazardous substances that is too small for human entry or has a capacity that can be effectively and safely cleaned without human entry.

3.3.5* Flammable Liquid. Any liquid that has a closed-cup flash point below 37.8°C (100°F), as determined by the test procedures and apparatus set forth in Section 4.4 of NFPA 30

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and a Reid Vapor pressure that does not exceed an absolute pressure of 276 kPa (40 psi) at 37.8°C (100°F), as determined by ASTM D323, *Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)*.

3.3.6 Hazardous Substance. A substance, including combustible and flammable liquids and flammable gases, that is capable of creating harm to people, the environment, or property due to the dangers that can arise from, but are not limited to, toxicity, reactivity, ignitibility, or corrosivity. [**326,** 2025]

3.3.7 Hot Tapping. The technique of welding and drilling on in-service tanks or containers that contain flammable, combustible, or other hazardous substances. [**326,** 2025]

3.3.8 Hot Work. Any work that is a source of ignition, including open flames, cutting and welding, sparking of electrical equipment, grinding, buffing, drilling, chipping, sawing, or other operations that create hot metal sparks or surfaces from friction or impact. [**326,** 2025]

3.3.9 Inert Gas. For the purpose of handling releases of flammable and combustible liquids and gases, a gas that is nonflammable, chemically inactive, noncontaminating for the use intended, and oxygen-deficient to the extent required.

3.3.10 Inerting. A technique by which the atmosphere in a tank or container is rendered nonignitible or nonreactive by the addition of an inert gas. [**326,** 2025]

Δ **3.3.11 Liquid (Physical State).** Any material that (1) has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D5/D5M, *Standard Test Method for Penetration of Bituminous Materials*, or (2) is a viscous substance for which a specific melting point cannot be determined but that is determined to be a liquid in accordance with ASTM D4359, *Standard Test Method for Determining Whether a Material is a Liquid or a Solid*. [**30,** 2024]

3.3.12* Lower Flammable Limit (LFL). That concentration of a flammable vapor in air below which ignition will not occur. Also known as the lower explosive limit (LEL). [**30,** 2024]

3.3.13 Oxygen Indicator. A device capable of detecting and measuring concentrations of oxygen in the atmosphere.

3.3.14 Purging. For the purpose of handling releases of flammable and combustible liquids and gases, the process of displacing vapors or gases from an enclosure or confined space.

3.3.15 Qualified Person. A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems related to the subject matter, the work, or the project. [**1451,** 2018]

3.3.16 Self-Contained Breathing Apparatus. For the purpose of handling releases of flammable and combustible liquids and gases, a portable respiratory device that (1) is designed to protect the wearer from an oxygen-deficient or other hazardous atmosphere, (2) supplies a respirable atmosphere that is either carried on, in, or generated by the apparatus, and (3) is independent of the ambient environment.

3.3.17 Standby Person. A person who is assigned to remain on the outside of the confined space and to be in communication with those working inside.

3.3.18 Static Electric Discharge. A release of static electricity in the form of a spark, corona discharge, bulking brush discharge, or propagating brush discharge that might be capable of causing ignition of a flammable atmosphere under appropriate circumstances. [**77,** 2024]

3.3.19 Static Electricity. For the purpose of handling releases of flammable and combustible liquids and gases, the electrification of materials through physical contact and separation and the various effects that result from the positive and negative charges so formed.

3.3.20 Subsurface Structure. A structure located belowground, such as a manhole, sewer, utility conduit, observation well, storm drain, vault, water line, fuel gas distribution system, electric light and power conduit, telephone and telegraph communication line, street-lighting conduit, police and fire signal system, traffic signal line, refrigeration service line, steam line, petroleum pipeline, subway, tunnel, or the substructural areas of a building, such as a basement or parking garage.

3.3.21 Tank. A stationary or portable device that is intended to contain an accumulation of hazardous substances.

3.3.22* Toxic Materials, Gases, or Vapors. Any substance whose properties contain the inherent capacity to produce injury to a biological system.

3.3.23 Toxicity. The degree to which a substance is harmful to humans.

3.3.24 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,** 2024]

3.3.25 Vapor. The gas phase of a substance, particularly of those that are normally liquids or solids at ordinary temperatures. [**921,** 2024]

3.3.26 Volatile Liquid. A liquid that evaporates readily at normal temperature and pressure.

3.3.27 Work. Activities performed on tanks and containers in accordance with this document; including, but not limited to, safeguarding, repair, hot work, cleaning, change of service, maintenance, inspection, and transportation.

Chapter 4 Flammable and Combustible Liquids and Gases

4.1 General.

4.1.1 Releases of flammable and combustible liquids and gases can result from leaks in tanks, containers, or pipelines, from surface spills, or from human error.

4.1.2 In most cases, the amount of liquid or gas that is lost is small and can be dissipated by evaporation or otherwise assimilated into the environment.

4.1.3 Because of the physical and chemical characteristics of many flammable and combustible liquids and gases, it is possible that a release can find its way into a subsurface structure, such as a basement, utility conduit, sewer, or well.

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4.1.4 Whether or not an immediate hazard exists depends on a number of factors, such as the amount of liquid or gas released, where it is found, how it is confined, and possible sources of ignition.

4.1.5 Because a flammable or combustible liquid that is unconfined in the subsurface can move from place to place, any indication that such liquids have escaped into the subsurface must be considered as a potential, if not immediate, hazard.

4.1.6 Flammable vapors in subsurface structures can result from a release of a flammable or combustible liquid.

4.1.6.1 Examples of these releases include cleaning solvents and compounds washed down drains by industrial and domestic users or a surface release that enters a sewer or drain.

4.1.6.2 A release can also result from damage to tanks, containers, and pipelines from corrosion, structural failure, excavation in the area, or fire.

4.1.7 If a flammable or combustible liquid or gas is present in the soil, as might be produced by decaying organic matter, there is a likelihood that it will penetrate an adjacent subsurface structure.

N **4.1.8** An underground gas leak could result in the odorant being adsorbed by the soil; therefore, the sense of smell should not be the only method used to identify or locate gas leaks.

4.1.9 Particular attention should be paid to landfill sites. Gas from decomposing material in landfills, primarily methane, might not have an odor.

4.1.10 Flammable gases or vapors can enter conduits, sewers, drains, or basements because subsurface structures constructed of cement, concrete, brick, or vitreous tile typically are not built to be impervious to gases or vapors.

N **4.1.10.1** Gas leaks can travel along the outside of buried pipes, and the leaked gas can migrate along preferential pathways to other locations outside the piping trench.

4.1.11 Gases or vapors can enter the subsurface sections of buildings through cracks or around any underground conduits that penetrate the subsurface walls or floors.

4.1.12* The condition created by the releases of liquids and vapors in subsurface structures can be grouped into the following two classes:

(1) Flammable
(2) Injurious to life

4.1.12.1 The condition of "injurious to life" specified in 4.1.12(2) results from the toxic or suffocating properties of the gases or vapors. Some of these liquids and gases fall into both classes. While this publication deals primarily with the flammable limits associated with liquids and gases, some of which are listed in Table A.4.1.12, additional precautions might be required to protect against health hazards. An example is benzene; its dangerous breathing concentration is only a small fraction of the lower flammable limit (LFL).

4.1.13 Flammable and combustible liquids and gases are commonly stored and handled in locations that are immediately adjacent to structures, facilities, and people.

4.1.14 Flammable and combustible liquids include but are not limited to, chemicals, cleaning fluids, gasoline, alternative fuels, diesel fuel, and heating oil.

4.1.15 Gasoline is the most widely used of these liquids and is commonly stored aboveground and underground at motor fuel dispensing facilities and service stations.

4.1.16 Flammable and combustible gases include, but are not limited to, natural gas, propane, sewage gases, and some refrigerant gases.

4.2 Fires and Explosions.

4.2.1 The probability of an explosion or fire within a subsurface space depends on the following two factors:

(1) The atmosphere must contain a mixture of flammable vapor and air within the flammable range.
(2) There must be a coincident source of ignition.

4.2.2 The severity of an individual explosion or fire and its consequences depend on various other factors and the possibility that any one explosion might result in a major catastrophe is always present.

4.3 Sources of Ignition.

4.3.1 The possibility of ignition of flammable gases or vapors that collect in subsurface structures is limited by the following conditions:

(1) The vapor must be mixed with sufficient air to make a flammable mixture or it must escape into the air at a point where a flammable mixture can be created.
(2) Heat of sufficient intensity to ignite the particular air–vapor mixture involved must be present at the place where the flammable mixture exists.

4.3.2 Flammable mixtures are formed when the concentration of these gases and vapors in air is between the lower and upper flammability limits.

4.3.3 Flammable limits of some gases and vapors that have been found in subsurface structures are listed in Table A.4.1.12.

4.3.4 Potential sources of ignition can be encountered in everyday operations and include open flames, furnace pilot lights, automotive and other internal combustion engines, tar pots, and smoking. Little control can be exerted over these sources of ignition where flammable vapors are escaping from or into subsurface structures.

4.3.5 Static electricity can be a source of ignition when it accumulates to the extent that an ignition-capable spark discharge occurs.

4.3.5.1 The accumulation of a static electric charge is easiest and greatest in an atmosphere of low humidity.

4.3.5.2 Static electricity can be generated when a liquid under pressure escapes at high velocity from a pipe. Particles of dust, scale, or rust or liquid droplets inside the pipe can become heavily charged when blown out by gas or vapor and, if they impinge on an electrically isolated body, that body will accumulate the charge and a spark discharge can occur.

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