

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

2021



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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

2021 Edition

This edition of 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*, was prepared by the Technical Committee on Electrical Equipment in Chemical Atmospheres. It was issued by the Standards Council on March 15, 2020, with an effective date of April 4, 2020, and supersedes all previous editions.

This edition of NFPA 497 was approved as an American National Standard on April 4, 2020.

Origin and Development of NFPA 497

The Technical Committee on Electrical Equipment in Chemical Atmospheres began the development of this recommended practice in 1973. The committee based the diagrams in the document on various codes and standards of the National Fire Protection Association and on the accepted practices of the chemical process industries and the petroleum refining industry. The first edition of NFPA 497 was adopted by the association at the 1975 Annual Meeting.

The committee began a thorough review of the document in 1980 and completed its work in 1985. The designation was changed to NFPA 497A in anticipation of a similar recommended practice for Class II hazardous (classified) locations. In 1989, the committee recognized a need for editorial revisions to the drawings referenced in Section 3.4. New drawings were included for flammable liquid tank truck loading and unloading and for marine terminal handling of flammable liquids.

In 1993, the committee decided to combine the information on group classifications of flammable liquids, gases, and vapors located in NFPA 497M, *Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations*, with the information in NFPA 497. The expanded version of 497 was renamed *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*. For the 1997 edition, table information was expanded; examples were provided in the appendix; and Class I, Zones 0, 1, and 2 information was incorporated into the text. In 2001, the committee entered NFPA 497 into the November 2003 revision cycle.

The 2004 edition was significantly revised and reorganized for conformance with the 2003 NFPA *Manual of Style*. The organizational and editorial changes enhanced the usability of this recommended practice. In addition, editorial changes were made to the text to harmonize with the text of NFPA 70®, *National Electrical Code*®, and the definitions of combustible liquid and flammable liquid were revised to harmonize with the text of NFPA 30, *Flammable and Combustible Liquids Code*.

The 2008 edition was the culmination of a revision cycle that began in January 2006. NFPA 497 is closely tied to the electrical installation requirements for hazardous (classified) locations contained in NFPA 70. To ensure correlation with revisions to any pertinent requirements in the 2008 NEC, the Technical Committee on Electrical Equipment in Chemical Atmospheres was granted permission by the NFPA Standards Council to enter into a 3 year (Fall 2007) revision cycle.

Significant revisions to the 2008 edition included the following:

- (1) Changes to the scope to specify that explosives, pyrotechnics, and blasting agents have unique hazards that are not addressed by the recommendations of the document
- (2) Recognition of areas as being unclassified where the gas or vapor concentration is insufficient to reach 25 percent of the lower flammable limit (LFL)
- (3) Additions and revisions to Table 4.4.2 on physical properties of selected chemicals, in order to provide information on commonly used materials not previously covered and to resolve

differences that existed between this table and similar information contained in other documents

- (4) Revision to the Annex B example on determining the maximum experimental safe gap and *NEC* group classification for mixtures

For the 2012 edition, the committee revised the references and definitions extracted from other updated NFPA codes, including NFPA 30, *Flammable and Combustible Liquids Code*, and NFPA 70, *National Electrical Code*. The committee added a new definition for unclassified locations to assist in the effective use of the document. A new provision was added for the use of portable electronic products (PEP) in hazardous (classified) locations to meet the provisions of ANSI/ISA RP 12.12.03, *Recommended Practice for Portable Electronic Products Suitable for Use in Class I and II, Division 2, Class I, Zone 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations*. The Chemical Abstract Service (CAS) numbers in Table 4.4.2 and Table 4.4.3 were amended for three materials: n-butane, methyl isobutyl ketone, and process gas > 30 percent H₂. Several diagrams were amended to identify a single-source release condition on all figures that did not previously have a single-source release identified. The committee also revised Annex B, adding an example of a method for determining the *NEC*® Group Classification for a mixture of solvents.

For the 2017 edition, the committee revised the references and definitions extracted from other updated NFPA codes, including NFPA 30, *Flammable and Combustible Liquids Code*; NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*; and NFPA 70, *National Electrical Code*. Text in Chapter 4 dealing with material group was relocated to Chapter 5. The document was also revised to clarify the action to be taken when the maximum experimental safe gap (MESG) and minimum igniting current (MIC) ratio data support different group classifications.

For the 2021 edition, the committee has revised Table 4.4.2 to update chemical physical property data, remove duplicate entries, and correct CAS numbers. Most of the data has been updated based on the Design Institute for Physical Properties (DIPPR) database. Table 4.4.3 has been updated to correlate with Table 4.4.2. Area electrical classifications throughout the document have been updated to correlate with the *NEC* electrical classification.

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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 (1) developing data on the properties of chemicals enabling proper selection of electrical equipment for use in atmospheres containing flammable gases, vapors or dusts; (2) making recommendations for the prevention of fires and explosions through the use of continuously purged, pressurized, explosion-proof, or dust-ignition-proof electrical equipment where installed in such chemical atmospheres.

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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**

2021 Edition

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

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1 Scope.

1.1.1 This recommended practice applies to those locations where flammable gases or vapors, flammable liquids, or combustible liquids are processed or handled; and where their release into the atmosphere could result in their ignition by electrical systems or equipment.

1.1.2 This recommended practice provides information on specific flammable gases and vapors, flammable liquids, and combustible liquids whose relevant combustion properties have been sufficiently identified to allow their classification into the groups established by NFPA 70 (NEC), for proper selection of electrical equipment in hazardous (classified) locations. The tables of selected combustible materials contained in this document are not intended to be all-inclusive.

1.1.3 This recommended practice applies to chemical process areas. As used in this document, a chemical process area could be a large, integrated chemical process plant or it could be a part of such a plant. It could be a part of a manufacturing facility where flammable gases or vapors, flammable liquids, or combustible liquids are produced or used in chemical reactions, or are handled or used in certain unit operations such as mixing, filtration, coating, spraying, and distillation.

1.1.4 This recommended practice does not apply to situations that could involve catastrophic failure of or catastrophic discharge from process vessels, pipelines, tanks, or systems.

1.1.5 This recommended practice does not address the unique hazards associated with explosives, pyrotechnics, blasting agents, pyrophoric materials, or oxygen-enriched atmospheres that might be present.

1.2 Purpose. The purpose of this recommended practice is to provide the user with a basic understanding of the parameters that determine the degree and the extent of the hazardous (classified) location. This recommended practice also provides the user with examples of the applications of these parameters.

1.2.1 Information is provided on specific flammable gases and vapors, flammable liquids, and combustible liquids, whose relevant properties determine their classification into groups. This will assist in the selection of special electrical equipment for hazardous (classified) locations where such electrical equipment is required.

1.2.2 This recommended practice is intended as a guideline and should be applied with sound engineering judgment. Where all factors are properly evaluated, a consistent area classification scheme can be developed.

1.3 Relationship to NFPA Codes and Standards. This recommended practice is not intended to supersede or conflict with NFPA 30, NFPA 33, NFPA 34, NFPA 35, NFPA 36, NFPA 45, NFPA 55, NFPA 58, and NFPA 59A.

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*, 2021 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 2018 edition.

NFPA 34, *Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids*, 2018 edition.

NFPA 35, *Standard for the Manufacture of Organic Coatings*, 2016 edition.

NFPA 36, *Standard for Solvent Extraction Plants*, 2017 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2019 edition.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code*, 2020 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2020 edition.

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*, 2019 edition.

NFPA 70®, *National Electrical Code*®, 2020 edition.

2.3 Other Publications.

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

API RP 500, *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2*, 3rd edition, 2012.

API RP 505, *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2*, 2002, reaffirmed 2013.

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

ASTM D323, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)*, 2008, reaffirmed 2015.

2.3.3 CGA Publications. Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151-2923.

CGA G2.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*, 6th edition, 2014.

2.3.4 IEC Publications. International Electrotechnical Commission, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

ISO/IEC 80079-20-1, *Explosive atmospheres — Part 20-1: Material characteristics for gas and vapor classification — Test methods and data*, 2017.

2.3.5 ISA Publications. The International Society of Automation, 67 T.W. Alexander Drive, P.O. Box 12277, Research Triangle Park, NC 27709.

ISA-RP12.12.03, *Standard for Portable Electronic Products Suitable for Use in Class I and II, Division 2, Class I Zone 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations*, 2011.

2.3.6 IIAR Publications. International Institute of Ammonia Refrigeration, 1001 N. Fairfax Street, Suite 503, Alexandria, VA 22314.

ANSI/IIAR 2 *Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems*, 2014.

2.3.7 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Recommendations Sections.

NFPA 30, *Flammable and Combustible Liquids Code*, 2018 edition.

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*, 2019 edition.

NFPA 70®, *National Electrical Code*®, 2020 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter apply to the terms used in this recommended practice. 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. *Merriam-Webster's*

Collegiate Dictionary, 11th edition, is the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1 Recommended Practice. A document that is 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.

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

3.3 General Definitions.

3.3.1 Adequate Ventilation. A ventilation rate that affords six air changes per hour, 1 cfm per square foot of floor area (0.3 m³/min/m²), or other similar criterion that prevents the accumulation of significant quantities of vapor-air concentrations from exceeding 25 percent of the lower flammable limit (LFL).

3.3.2* Autoignition Temperature (AIT). The minimum temperature required to initiate or cause self-sustained combustion of a solid, liquid, or gas independently of the heating or heated element.

3.3.3 CAS. Chemical Abstract Service.

3.3.4 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 NFPA 30. Combustible liquids are classified in accordance with the following: (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 III Liquid — Any liquid that has a flash point at or above 140°F (60°C); (a) Class IIIA Liquid — Any liquid that has a flash point at or above 140°F (60°C), but below 200°F (93°C); (b) Class IIIB Liquid — Any liquid that has a flash point at or above 200°F (93°C). [30, 2018]

3.3.5 Combustible Material. A generic term used to describe a flammable gas, flammable liquid produced vapor, or combustible liquid produced vapor mixed with air that may burn or explode.

3.3.5.1* Combustible Material (Class I, Division). Class I, Division combustible materials are divided into Groups A, B, C, and D.

3.3.5.1.1 Group A. Acetylene.

3.3.5.1.2 Group B. Flammable gas, flammable liquid produced vapor, or combustible liquid produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value less than or equal to 0.45 mm or a minimum igniting current ratio (MIC ratio) less than or equal to 0.40. Note: A typical Class I, Group B material is hydrogen.

3.3.5.1.3 Group C. Flammable gas, flammable liquid produced vapor, or combustible liquid produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.45 mm and less than or equal to 0.75 mm, or a minimum igniting current (MIC) ratio greater than 0.40 and less than or equal to 0.80. Note: A typical Class I, Group C material is ethylene.