

NFPA® 269

Standard Test Method for Developing Toxic Potency Data for Use in Fire Hazard Modeling

2012 Edition



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Developing Toxic Potency Data for Use in Fire Hazard Modeling

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This edition of NFPA 269, *Standard Test Method for Developing Toxic Potency Data for Use in Fire Hazard Modeling*, was prepared by the Technical Committee on Fire Tests. It was issued by the Standards Council on December 13, 2011, with an effective date of January 2, 2012, and supersedes all previous editions.

This edition of NFPA 269 was approved as an American National Standard on January 2, 2012.

Origin and Development of NFPA 269

The first edition of NFPA 269 was published in 1996. It was desirable to establish a standard test method for the development of data for use in toxic hazard modeling. The basis of this standard was derived from work completed by the National Institute of Standards and Technology. The 2000 edition was a reconfirmation of the earlier edition. The 2007 edition was a complete revision for compliance with the *Manual of Style for NFPA Technical Committee Documents*.

The 2012 edition has been revised to contain new scope statements for testing lethal toxic potency values and new requirements for testing reports.

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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.

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.

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

Chapter 1 Administration

1.1* Scope.

1.1.1 This test method is intended to provide a means for assessing the lethal toxic potency of combustion products produced from a material or product ignited when exposed to a radiant flux.

1.1.2 This test method has been designed to generate toxic potency data on materials and products (including composites) for use in fire hazard analysis. It is also permitted to be used to assist in the research and development of materials and products.

1.1.3 Lethal Toxic Potency Values.

1.1.3.1 Lethal toxic potency values associated with 30-minute exposures are predicted using calculations that employ combustion atmospheric analytical data for carbon monoxide, carbon dioxide, oxygen (vitiation), and, if present, hydrogen cyanide, hydrogen chloride, and hydrogen bromide.

1.1.3.2 These predictive equations are therefore limited to those materials and products whose smoke toxicity can be attributed to these toxicants.

1.1.3.3 The confirmation of the predicted lethal toxic potency values by means of an animal check will serve to determine the extent to which additional toxicants contribute to the lethal toxic potency of the smoke.

1.1.3.4 Where an animal check test result does not confirm the predicted lethal toxic potency values, the presence of one or more additional toxicants or toxicological antagonists is indicated by the degree of disagreement between the two results, and indicates the importance of the unmeasured factors.

1.1.4 Specimens are exposed to a radiant heating flux with an electric spark ignition.

1.1.5 Specimens tested are representative of finished products, including composite and combination systems.

1.1.6 This standard is not intended to address all safety issues associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations (especially with regard to the institutional care and use of experimental test animals) prior to use. (For specific hazard requirements, see Section 6.1.)

1.2 Purpose.

1.2.1 This test method is intended to provide data for the mathematical modeling of fire hazard as a means for the evaluation of materials and products.

1.2.2 This test method shall be used to predict, and subsequently confirm, the lethal toxic potency of smoke produced upon exposure of a material or product to specific fire test conditions. Confirmation determines whether certain major gaseous toxicants account for the observed toxic effects as well as the lethal toxic potency. If a predicted lethal toxic potency value is not adequately confirmed, indicating the potential for unusual or unexplained toxicity due to other components, the lethal toxic potency shall be investigated using other methodology, such as conducting an experimental determination of the LC_{50} using the apparatus described. (See B.3.1 and B.3.2.)

1.2.3 This test method produces lethal toxic potency data that shall be considered appropriate for use in modeling the hazard of both preflashover and postflashover fires. Most fire deaths due to smoke inhalation in the United States occur in areas other than the room of fire origin and are caused by fires that have proceeded beyond the room of fire origin. It is assumed that these fires typically are flashover fires. Therefore, the principal emphasis is placed on evaluating toxic hazard under these conditions. In postflashover fires, large concentrations of carbon monoxide result from a reduced air supply to the fire plume. Because bench-scale tests do not have the capability to simulate this phenomenon, the lethal toxic potencies determined in this test method shall require adjustment for use in modeling the hazard from postflashover conditions (see 11.2.3). For preflashover conditions, the LC_{50} values derived from this method shall be permitted to be used as toxic potency data without adjustment.

1.2.4 Lethal toxic potency values determined in this test method exhibit a degree of uncertainty where used to predict real-scale toxic potencies. (See B.4.2.)

1.2.5 Tests shall be conducted on small-sized specimens representative of the materials, products, or composites in their intended end use.

1.2.6 This test method does not attempt to address the toxicological significance of changes in particulate or aerosol size, smoke transport, distribution, or deposition or of changes in the concentration of any smoke constituent as a function of time that occurs in an actual fire.

1.2.7 The propensity for smoke from any material, when tested for its effects on a rat, to have the same effects on a human in fire situations shall be inferred only to the extent that a rat can be correlated with a human biologically. (See B.2.5.)



1.2.8 This test method shall not be used to assess incapacitation. Incapacitation shall be inferred from lethal toxic potency values.

1.2.9 The effects of sensory irritation are not addressed by this test method.

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 document.

2.2 NFPA Publications. (Reserved)

2.3 Other Publications.

Guide for the Care and Use of Laboratory Animals, Institute of Laboratory Animal Research, Commission on Life Sciences, National Research Council, ISBN: 0-309-05377-3, 1996.

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

2.4 References for Extracts in Mandatory Sections. (Reserved)

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 Shall. Indicates a mandatory requirement.

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

3.2.3 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Carboxyhemoglobin Saturation. The percent of blood hemoglobin converted to carboxyhemoglobin due to reaction with inhaled carbon monoxide.

3.3.2 Concentration–Time Curve. A plot of the concentration of a gaseous toxicant ($\mu\text{L}/\text{L}$) or of fire effluent ($\text{g}\cdot\text{m}^{-3}$) as a function of time.

3.3.3 Ct Product. The concentration–time product ($\mu\text{L}/\text{L}/\text{min}$) obtained by the integration of the area under a concentration–time curve.

3.3.4* Fractional Effective Dose (FED). The ratio of the Ct product for a gaseous toxicant produced in a given test to that Ct product of the toxicant that has been statistically determined from independent experimental data to pro-

duce lethality in 50 percent of test animals within a specified exposure and postexposure time.

3.3.5 LC_{50} . A measure of lethal toxic potency measured in units of $\text{g}\cdot\text{m}^{-3}$; the concentration of gas or fire effluent statistically calculated from concentration response data to produce lethality in 50 percent of test animals within a specified exposure and postexposure time.

3.3.6 Mass Loss Concentration. The mass loss of a test specimen consumed during combustion per unit exposure chamber volume ($\text{g}\cdot\text{m}^{-3}$).

3.3.7 Postflashover. The stage of a room fire during which average air temperature in the upper half of the room exceeds 600°C .

Chapter 4 Test Method

4.1 Summary of Test Method.

4.1.1 This method shall subject a test specimen of surface area $76\text{ mm} \times 127\text{ mm}$ or smaller and thickness of 50 mm or less to ignition while exposed to $50\text{ kW}/\text{m}^2$ of radiant heat for 15 minutes.

4.1.2 The effluent produced shall be collected for 30 minutes within a 200 L chamber to which the combustion assembly is joined through a connecting chimney.

4.1.3 Concentrations of the major gaseous toxicants shall be monitored over the 30-minute period, with Ct products for each determined from the integration of the areas under the respective concentration–time plots.

4.1.4 The Ct product data, along with the mass loss of the test specimen during the test, then shall be used in calculations to predict the 30-minute LC_{50} of the test specimen.

4.1.5 The predicted LC_{50} then shall be confirmed in comparable tests by exposing six rats, restrained for head-only exposure, for 30 minutes to the smoke produced from that mass of the test specimen whose mass loss concentration during the 30-minute period is approximately equivalent to 70 percent $\pm$ 10 percent and equivalent to 130 percent of its estimated LC_{50} .

4.1.6* If no more than one rat dies during the 30-minute exposure, or within 14 days postexposure, to the mass loss concentration corresponding to 70 percent of the LC_{50} , and at least five rats die during the 30-minute exposure, or within 14 days postexposure, to the mass loss concentration corresponding to 130 percent of the LC_{50} , the predicted LC_{50} shall be considered to be validated.

4.1.7 For data representing postflashover fires, a correction shall be made for the excess CO generated by ventilation-limited fires.

4.1.8 Although the normal radiant heat flux is $50\text{ kW}/\text{m}^2$, other levels of flux shall be permitted to be used for specific evaluations of other fire scenarios, provided the variation is recorded and reported.

4.1.9 The test method shall also allow for measurements of the time to ignition and the rate of mass loss of the test specimens.