

NFPA® 289

Standard Method of Fire Test for Individual Fuel Packages

2013 Edition



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An International Codes and Standards Organization

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NFPA® 289

Standard

Method of Fire Test for Individual Fuel Packages

2013 Edition

This edition of NFPA 289, *Standard Method of Fire Test for Individual Fuel Packages*, was prepared by the Technical Committee on Fire Tests. It was issued by the Standards Council on November 27, 2012, with an effective date of December 17, 2012, and supersedes all previous editions.

This edition of NFPA 289 was approved as an American National Standard on December 17, 2012.

Origin and Development of NFPA 289

The 2009 edition of NFPA 289 was the first for this standard. It established a fire test method for determining the contribution of individual fuel packages to heat and smoke release when exposed to various ignition sources. Testing protocols were provided for three types of individual fuel packages: single decorative objects such as signs, wall hangings, and mannequins; exhibit booths; and stage sets including backdrops and scenery. NFPA 289 is a standard test method for determining the extent to which these fuel packages contribute to fire growth and the potential for the spread of fire in a controlled environment.

The 2013 edition includes updates to referenced publications, extracted definitions, and annex material. New requirements are added to Chapter 5 on ignition source power levels for specific objects. Also, new provisions for alternative probe locations have been added.



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NFPA 289

Standard

Method of Fire Test for Individual Fuel Packages

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

Chapter 1 Administration

1.1 Scope.

1.1.1* This standard describes a fire test method for determining the fire test response characteristics of individual fuel packages when exposed to various ignition sources.

1.1.2 This fire test method is applicable to individual fuel packages.

1.1.3 This fire test method is not intended to evaluate fire resistance.

1.1.4 This standard contains detailed descriptions of three types of individual fuel packages to be investigated, as follows:

- (1)*Single decorative object
- (2) Exhibit booth
- (3) Stage setting

1.1.5* This test method shall not apply to seating furniture, mattresses, stacking chairs, interior finish, textile wall coverings, or mattress sets.

1.2 Purpose.

1.2.1 This method of test measures certain fire test response characteristics of individual fuel packages under specified fire exposure conditions.

1.2.2 The method of test provides the following data:

- (1) Extent of fire growth
- (2) Rate of heat release by the individual fuel package
- (3) Total heat released by the individual fuel package
- (4) Smoke obscuration, as determined in the exhaust duct
- (5) Production of carbon monoxide, as determined in the exhaust duct
- (6) Emissions of other combustion gases, as determined in the exhaust duct
- (7) Gas temperatures at suitable locations
- (8) Mass loss of single decorative objects

1.2.3* The performance observed in the test is based on the test conditions.

1.2.4 The method of test does not provide the following:

- (1) Full information concerning toxicity of combustion gases
- (2) Fire resistance of systems

1.3 Symbols. The following symbols are used in this standard:

C	= calibration factor for orifice plate or bidirectional probe ($\text{kg}^2 \text{ m}^2 \text{ K}^2$)
C_{est}	= an approximate value of the calibration factor
C_{cor}	= corrected calibration factor
dt	= time (sec)
F_{mb}	= mass of fuel burned (kg)
E	= net heat released per unit mass of oxygen consumed (13.1 MJ/kg)
E_{CO}	= net heat released per unit mass of oxygen consumed, for CO (17.6 MJ/kg)
Ht_{comb}	= heat of combustion of the fuel used (46.5 MJ/kg for propane and 50.0 MJ/kg for methane)
I_0	= light intensity for a beam of parallel light rays, measured in a smoke-free environment, with a detector having the same spectral sensitivity as the human eye and reaching the photodetector
I	= light intensity for a parallel light beam having traversed a certain length of smoky environment and reaching photodetector
k	= smoke extinction coefficient (1/m)
L_p	= light path length of beam through smoky environment, which is equal to the duct diameter (m)
$\dot{m}_e$	= mass flow rate in exhaust duct (kg/sec)
$\dot{m}_{CO}$	= release rate of CO (kg/sec)
$\dot{m}_x$	= release rate of combustion product x (kg/sec)
M_a	= molecular weight of incoming and exhaust air (29 kg/kmol)
M_{CO}	= molecular weight of CO (28 kg/kmol)
M_{O_2}	= molecular weight of oxygen (32 kg/kmol)
MW	= fuel mass loss
OD	= optical density per unit light path length (1/m)



ΔP	= pressure drop across the orifice plate or bidirectional probe (Pa)
$\dot{q}$	= rate of heat release (kW)
RSR	= rate of smoke release (m^2/sec)
Δt	= scan period (sec)
T_e	= gas temperature at the orifice plate or bidirectional probe (K)
test period	= duration of test (sec)
THR	= total heat released (MJ)
TSR	= total smoke released (m^2)
$\dot{V}_s$	= volumetric flow rate at location of smoke meter (value adjusted for smoke measurement calculations) (m^3/sec)
X_{CO}	= measured mole fraction of CO in exhaust flow (nondimensional)
X_{CO_2}	= measured mole fraction of CO_2 in exhaust flow (nondimensional)
$X_{\text{CO}_2}^0$	= measured mole fraction of CO_2 in incoming air (nondimensional)
X_{O_2}	= measured mole fraction of O_2 in exhaust flow (nondimensional)
$X_{\text{O}_2}^0$	= measured mole fraction of O_2 in incoming air (nondimensional)
X_x	= measured mole fraction of combustion gas x in exhaust flow (nondimensional)
α	= combustion expansion factor (nondimensional; use a value of 1.105, unless the value for the test specimen, and not the ignition gas, is known)
ϕ	= oxygen depletion factor (nondimensional)
ρ_0	= density of air at 273.15 K : 1.293 (kg/m^3)

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.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 270, *Standard Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber*, 2013 edition.

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.

3.2.4 Shall. Indicates a mandatory requirement.

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

3.2.6 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 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 *Manual of Style for NFPA Technical Committee Documents*.

3.3 General Definitions.

3.3.1 Fuel Package. A grouping of one or more items whose proximity is sufficiently close that the ignition of one item can be expected to cause the spread of fire to the remaining items in the fuel package.

3.3.2 Individual Fuel Package. An item or a group of items for which the fire test response characteristics are to be measured.

3.3.3 Heat of Combustion.

3.3.3.1 Effective Heat of Combustion. The measured heat release divided by the mass loss for a specified time period.

3.3.3.2 Net Heat of Combustion. The oxygen bomb calorimeter value for the heat of combustion, corrected for the gaseous state of product water.

3.3.4 Heat Release Rate. The heat evolved from the specimen, per unit of time.

3.3.5* Heating Flux. The rate of heat transferred per unit area to a surface, typically expressed in kW/m^2 or $\text{Btu}/\text{s}\cdot\text{ft}^2$.

3.3.6* Initial Test Heat Flux. Amount of heat received by a specimen surface per unit area and unit time at the initiation of a test.

3.3.7 Oxygen Consumption Principle. The expression of the relationship between the mass of oxygen consumed during combustion and the heat released.

3.3.8 Smoke Obscuration. The reduction of light transmission by smoke, as measured by light attenuation. [270, 2013]

Chapter 4 Summary of Method

4.1 General.

4.1.1* The individual fuel package shall be tested by using one of the ignition sources as described in 4.1.7.