



Standard Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests¹

This standard is issued under the fixed designation E2067; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice deals with methods to construct, calibrate, and use full scale oxygen consumption calorimeters to help minimize testing result discrepancies between laboratories.

1.2 The methodology described herein is used in a number of ASTM test methods, in a variety of unstandardized test methods, and for research purposes. This practice will facilitate coordination of generic requirements, which are not specific to the item under test.

1.3 The principal fire-test-response characteristics obtained from the test methods using this technique are those associated with heat release from the specimens tested, as a function of time. Other fire-test-response characteristics also are determined.

1.4 This practice is intended to apply to the conduction of different types of tests, including both some in which the objective is to assess the comparative fire performance of products releasing low amounts of heat or smoke and some in which the objective is to assess whether flashover will occur.

1.5 This practice does not provide pass/fail criteria that can be used as a regulatory tool, nor does it describe a test method for any material or product.

1.6 For use of the SI system of units in referee decisions, see [IEEE/ASTM SI-10](#). The units given in parentheses are provided for information only.

1.7 This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.

NOTE 1—This is the standard caveat described in section F2.2.2.1 of the Form and Style for ASTM Standards manual for fire-test-response standards. In actual fact, this practice does not provide quantitative measures.

¹ This practice is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.21 on Smoke and Combustion Products.

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1.8 Fire testing of products and materials is inherently hazardous, and adequate safeguards for personnel and property shall be employed in conducting these tests. Fire testing involves hazardous materials, operations, and equipment. See also Section 7.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- [D5424](#) Test Method for Smoke Obscuration of Insulating Materials Contained in Electrical or Optical Fiber Cables When Burning in a Vertical Cable Tray Configuration
- [D5537](#) Test Method for Heat Release, Flame Spread, Smoke Obscuration, and Mass Loss Testing of Insulating Materials Contained in Electrical or Optical Fiber Cables When Burning in a Vertical Cable Tray Configuration
- [D6113](#) Test Method for Using Cone Calorimeter to Determine Fire-Test-Response Characteristics of Insulating Materials Contained in Electrical or Optical Fiber Cables
- [E84](#) Test Method for Surface Burning Characteristics of Building Materials
- [E176](#) Terminology of Fire Standards
- [E603](#) Guide for Room Fire Experiments
- [E906/E906M](#) Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using a Thermopile Method
- [E1354](#) Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

E1474 Test Method for Determining the Heat Release Rate of Upholstered Furniture and Mattress Components or Composites Using a Bench Scale Oxygen Consumption Calorimeter

E1537 Test Method for Fire Testing of Upholstered Furniture

E1590 Test Method for Fire Testing of Mattresses

E1623 Test Method for Determination of Fire and Thermal Parameters of Materials, Products, and Systems Using an Intermediate Scale Calorimeter (ICAL)

E1740 Test Method for Determining the Heat Release Rate and Other Fire-Test-Response Characteristics of Wall Covering or Ceiling Covering Composites Using a Cone Calorimeter

E1822 Test Method for Fire Testing of Stacked Chairs

E2965 Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter

IEEE/ASTM SI-10 International System of Units (SI) The Modernized Metric System

2.2 ISO Standards:³

ISO 13943 Fire Safety-Vocabulary

ISO 5660-1 Fire Tests—Reaction to Fire—Rate of Heat Release from Building Products (Cone Calorimeter Method)

ISO 9705 Fire Tests - Full-Scale Room Test for Surface Products

2.3 California Bureau of Home Furnishings and Thermal Insulation Standards:⁴

CA Technical Bulletin 129 (October 1992), Flammability Test Procedure for Mattresses for Use in Public Buildings

CA Technical Bulletin 133 (January 1991), Flammability Test Procedure for Seating Furniture for Use in Public Occupancies

2.4 NFPA Standards:⁵

NFPA 265 Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Wall Coverings

NFPA 266 Standard Method of Test for Fire Characteristics of Upholstered Furniture Exposed to Flaming Ignition Source – Withdrawn

NFPA 267 Standard Method of Test for Fire Characteristics of Mattresses and Bedding Assemblies Exposed to Flaming Ignition Source – Withdrawn

NFPA 286 Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Wall and Ceiling Interior Finish

NFPA 289 Standard Method of Fire Test for Individual Fuel Packages

2.5 UL Standards:⁶

UL 1685 Standard Vertical Tray Fire Propagation and Smoke Release Test for Electrical and Optical Fiber Cables

UL 1975 Standard Fire Tests for Foamed Plastics Used for Decorative Purposes

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this practice, refer to Terminology **E176** and ISO 13943. In case of conflict, the definitions given in Terminology **E176** shall prevail.

3.1.2 *continuous* (as related to data acquisition in large-scale tests), *adj*—conducted at data collection intervals of 6 s or less. **(E176)**

3.1.3 *heat release rate*, *n*—the heat evolved from the specimen, per unit of time. **(E176)**

3.1.4 *ignition*, *n*—the initiation of combustion. **(E176)**

3.1.4.1 *Discussion*—The combustion may be evidenced by glow, flame, detonation or explosion. The combustion may be sustained or transient.

3.1.5 *oxygen consumption principle*, *n*—the expression of the relationship between the mass of oxygen consumed during combustion and the heat released. **(E176)**

3.1.6 *smoke*, *n*—the airborne solid and liquid particulates and gases evolved when a material undergoes pyrolysis or combustion. **(E176)**

3.1.7 *smoke obscuration*, *n*—reduction of light transmission by smoke, as measured by light attenuation. **(E176)**

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *sample*, *n*—an amount of the material, product, or assembly, to be tested, which is representative of the item as a whole.

3.2.2 *specimen*, *n*—representative piece of the product, which is to be tested together with any substrate or treatment.

4. Significance and Use

4.1 The oxygen consumption principle, used for the measurements described here, is based on the observation that, generally, the net heat of combustion is directly related to the amount of oxygen required for combustion (**1**).⁷ Approximately 13.1 MJ of heat are released per 1 kg of oxygen consumed. Test specimens in the test are burned in ambient air conditions, while being subjected to a prescribed external heating source.

4.1.1 This technique is not appropriate for use on its own when the combustible fuel is an oxidizer or an explosive agent, which release oxygen. Further analysis is required in such cases (see **Appendix X2**).

4.2 The heat release is determined by the measurement of the oxygen consumption, as determined by the oxygen concentration and the flow rate in the combustion product stream, in a full scale environment.

³ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

⁴ Available from California Bureau of Home Furnishings and Thermal Insulation, State of California, Department of Consumer Affairs, 3485 Orange Grove Avenue, North Highlands, CA 95660-5595.

⁵ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

⁶ Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

⁷ The boldface numbers in parentheses refers to the list of references at the end of this standard.