Designation: E2748 – 23

An American National Standard

Standard Guide for Fire-Resistance Experiments[1]

This standard is issued under the fixed designation E2748; 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.

INTRODUCTION

This guide provides a means for ensuring comparability of findings among different researchers conducting fire-resistance experiments employing innovative and creative variations to standard test methods. This guide is intended to bring uniformity and consistency to tests and reports covering fire-resistance research that is generally conducted as a variation of Test Methods E119. Its provisions are voluntary and users are free to pick and choose from the provisions herein provided. The overriding goal is to make it possible to begin to provide data that ultimately can be used in fire safety engineering and fire-resistance modeling as those fields evolve. When the purpose of the research is to study the effect of changing specific individual variables on the outcome of Test Methods E119 fire-resistance tests, sound research practices dictate that only one variable should be changed at a time.

1. Scope*

1.1 This guide covers the conduct of fire-resistance tests using conditions different than those addressed in Test Methods E119. This guide also addresses the reporting of data derived from those tests.

1.2 This guide does not provide or generate fire-resistance ratings suitable for determining compliance with code or regulatory requirements comparable to those resulting from tests conducted in accordance with Test Methods E119.

1.3 The values stated in SI units are to be regarded as standard. The values in parentheses are for information only.

1.4 *This guide 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.*

1.5 *Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.*

1.6 *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.*

1.7 *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]

E119 Test Methods for Fire Tests of Building Construction and Materials

E176 Terminology of Fire Standards

E603 Guide for Room Fire Experiments

E3057 Test Method for Measuring Heat Flux Using Directional Flame Thermometers with Advanced Data Analysis Techniques

2.2 *Other Standards:*

ISO 834-1 Fire Resistance Tests – Elements of Building Construction – Part 1: General Requirements[3]

UL 263 Fire Tests of Building Construction and Materials[4]

3. Terminology

3.1 For definitions of terms used in this guide, refer to Terminology E176.

[1] This guide is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.11 on Fire Resistance.

Current edition approved March 1, 2023. Published March 2023. Originally approved in 2010. Last previous edition approved in 2017 as E2748 – 12a(2017). DOI: 10.1520/E2748-23.

[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.

[3] Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, https://www.iso.org.

[4] Available from UL, Comm 2000, 151 Eastern Avenue, Bensenville, IL 60106.

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

4. Significance and Use

4.1 The methods and procedures set forth in this guide relate to the conduct and reporting of fire-resistance tests obtained from particular fire-resistance tested specimens tested using conditions different than those addressed by Test Methods E119.

4.2 Data derived from fire tests conducted and reported under this guide are useful for general fire research and as potential input data for use in fire models.

4.3 It is necessary that users of this guide have knowledge and understanding of the provisions of Test Methods E119, including those pertaining to conditions of acceptance in order to understand how the alternative test conditions relate to those specified in Test Methods E119.

4.4 Users of this guide should be aware that tests conducted using exposure conditions different than those specified in Test Methods E119 do not provide or generate fire resistance ratings suitable for determining compliance with code or regulatory requirements.

4.4.1 In Test Methods E119, standard test specimens are subjected to specific exposure conditions. Substitution of different exposure conditions can change the measured fire-test-response characteristics of a test specimen. Therefore, the data are valid for only the alternative exposure conditions used.

5. General Principles

5.1 Except as specifically modified herein, fire-resistance tests should be conducted using the test furnaces, exposure conditions, test specimens, instrumentation, and acceptance criteria set forth in Test Methods E119.

5.2 Although it is possible to vary many variables at one time, and it may be desirable to do so when evaluating the response of a specimen to specific design fire conditions, it is usually desirable to vary only one parameter at a time when comparing results from two or more tests or when evaluating the effect on fire resistance of changing a specific variable.

5.3 *Limitations*—The test data is valid for only the specimen and parameters used in the test.

6. Alternative Time-Temperature Curves

6.1 The provisions in this section are applicable to the use of alternative time-temperature curves that are different from the time-temperature curve specified in Test Methods E119.

6.1.1 When the time-temperature curve specified in Test Methods E119 is used, it should be so stated in the report.

NOTE 1—There are a number of recognized time-temperature curves in use in fire-resistance test standards around the world.

6.2 When a recognized or published time-temperature curve is used, the reference in which the curve is described should be cited and the time-temperature curve should be reported.

6.3 Fire safety engineering and computer modeling are methods whereby non-standard time-temperature curves can be derived to represent specific design conditions.

6.3.1 When these design fires are used as the basis of a time-temperature curve, a table or equation representing the curve should be reported.

7. Alternative Pressure Differentials

7.1 The provisions in this section are applicable to the use of specific furnace pressure differentials.

NOTE 2—There are a number of recognized or published furnace pressure differentials in use in fire test standards around the world.

7.2 When a recognized or published furnace pressure differential is used, the reference in which the pressure differential is described should be cited and the pressures should be reported.

7.3 When other pressure differentials are used for exploratory research or to replicate actual fire conditions, or for any other reason, they should be described and should be reported.

7.4 Furnace pressure differentials should be measured as described in UL 263.

8. Alternative Test Specimens

8.1 The provisions in this section are applicable to the use of alternative test specimens that are different from the test specimens specified in Test Methods E119.

8.2 Test specimen dimensions, that is, height and width for walls, length and width for horizontal specimens, or lengths for columns or beams, should be reported and the method used to modify the furnace opening to accommodate the specimen size should be reported.

8.3 When test specimens having exposed and unexposed surfaces that are not parallel to each other or that are not flat (planar) are tested, their maximum and minimum thicknesses, and radii, if curved, should be reported.

8.4 When test specimens having one or more designed protrusions or indentations (pilasters, alcoves, etc.) either on the fire side, the unexposed side, or both, are tested, the size, shape, location, and dimensions of each protrusion or indentation should be described and reported.

8.5 When test specimens exceeding the depth of the specimen mounting frame are tested, the method(s) of protecting the portion of the test specimen extending beyond the frame should be described and reported.

9. Alternative Instrumentation – Furnace Environment

9.1 When alternative instrumentation is used in addition to the standard instrumentation specified in Test Methods E119, the alternative instrumentation should be spaced and mounted so as to not interfere with the standard instrumentation.

9.2 *Furnace Temperature Measurement:*

9.2.1 When the furnace control temperature measurement method (that is, shielded thermocouples) specified in Test Methods E119 is used it should be so stated in the report.

9.2.2 When Directional Flame Thermometers or plate thermometers are used they should be spaced as described in 9.2.2.1 through 9.2.2.2.

NOTE 3—Directional Flame Thermometers are described in Test Method E3057. Specifications for plate thermometers are provided in ISO 834-1.

9.2.2.1 There should be nine plate thermometers equally distributed across the test specimen surface.

9.2.2.2 Directional Flame Thermometers and Plate thermometers should be located 4 ± 0.2 in. (100 ± 5 mm) from the exposed surface of the test specimen at the beginning of the test.

9.2.3 Other methods, sensors, or measurement devices for monitoring the furnace temperature should be described and reported.

9.2.4 Any special mounting methods used for plate thermometers or other temperature measuring devices should be described and reported.

9.2.5 The locations of furnace temperature measuring devices should be reported.

9.3 *Heat Flux Measurement:*

9.3.1 When heat flux measurements are taken in addition to furnace temperature control measurements, the methods, instrumentation, and heat flux profile should be described and reported.

9.3.1.1 Any special mounting methods should be described and reported.

9.3.2 The locations of heat flux measurement devices should be reported.

9.4 *Pressure Measurement:*

9.4.1 When furnace pressures are measured or controlled, the methods, instrumentation, and pressure differentials should be reported.

9.4.2 Furnace pressure should be measured using the tube sensor described in ISO 834-1 and UL 263.

9.4.2.1 In a vertical furnace, pressure should be measured at a minimum of two locations. The measuring locations should be separated by a minimum of ⅓ the test specimen height.

9.4.2.2 In a horizontal furnace, pressure should be measured at a single location a nominal 4 ± 0.2 in. (100 ± 5 mm) below the exposed surface of the test specimen at the beginning of the test.

9.4.3 Any special mounting methods should be described and reported.

9.4.4 The locations of pressure measurement devices should be reported.

9.5 *Furnace Oxygen Concentration:*

9.5.1 When furnace oxygen concentration is being monitored, it should be measured in the furnace stack.

9.5.1.1 Oxygen concentration should be measured using a paramagnetic-type oxygen analyzer.

9.5.1.2 The sampling probe should be similar to the sampling probe used in duct measurements of hood calorimeters described in Guide .

9.5.1.3 Gas samples should be continuously drawn out of the stack through a sampling line.

9.5.2 The oxygen concentration profile should be reported.

9.6 *Other Measurement Instrumentation:*

9.6.1 Additional instrumentation such as load cells, additional thermocouples, moisture content measurement devices, motion sensors, or other instrumentation not described or specified in Test Methods E119 should be fully described and reported.

10. Alternative Instrumentation – Specimen

10.1 When alternative instrumentation is used in addition to the standard instrumentation specified in Test Methods E119, the alternative instrumentation should be spaced and mounted so as to not interfere with the standard instrumentation.

10.2 *Unexposed Surface Temperature Measurement for Walls and Floor/Ceilings:*

10.2.1 When the unexposed surface temperature measurement methods specified in Test Methods E119 are used, it should be so stated in the report.

10.2.2 Other methods, sensors, or measurement devices used for monitoring the unexposed surface temperature should be described and reported.

10.2.2.1 Any special mounting methods should be described and reported.

10.2.3 The locations of temperature measuring devices should be reported.

10.3 *Heat Flux Off the Unexposed Surface of Walls and Floor/Ceilings:*

10.3.1 When total heat flux off the unexposed surface is measured, it should be measured as described in 10.3.1.1 through 10.3.1.3.

10.3.1.1 Total heat flux coming off the unexposed surface should be measured using a Schmidt-Boetler-type water-cooled total heat flux gauge.

10.3.1.2 The heat flux gauge should be placed near the center of the unexposed surface of the specimen and as close to the specimen surface as practical.

10.3.1.3 When the test specimen contains a transparent element, an additional heat flux gauge should be placed near the center of the transparent element and as close as practical to the surface of the transparent element.

10.4 *Temperature Profile Through Test Specimens:*

10.4.1 When the temperature profile of test specimens is monitored, it should be monitored as described in 10.4.1.1 through 10.4.1.4.

10.4.1.1 Temperatures should be measured through the thickness of the test specimen at not less than two locations representative of each major heat-transfer path within the specimen.

10.4.1.2 The surface temperature on the exposed side should be measured with a 24-gauge, Type K bare bead thermocouple placed in contact with the exposed surface of the test specimen.

10.4.1.3 The surface temperature on the unexposed side should be measured using an optical pyrometer suitable for measuring temperatures on the unexposed side.

10.4.1.4 Internal temperatures should be measured using Inconel-sheathed Type K thermocouples with a sheath diameter of 0.04 in. (1.0 mm).

10.5 *Gas Temperature Measurement:*

10.5.1 When gas temperatures are measured they should be measured as described in 10.5.1.1 through 10.5.1.3.

10.5.1.1 Gas temperatures should be measured using aspirated thermocouples.

NOTE 4—Aspirated thermocouples are described in Guide E603.