



# Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source<sup>1</sup>

This standard is issued under the fixed designation E648; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This fire-test-response standard covers a procedure for measuring the critical radiant flux of horizontally mounted floor-covering systems exposed to a flaming ignition source in a graded radiant heat energy environment in a test chamber. A specimen is mounted over underlayment, a simulated concrete structural floor, bonded to a simulated structural floor, or otherwise mounted in a typical and representative way.

1.2 This fire-test-response standard measures the critical radiant flux at flame-out. It provides a basis for estimating one aspect of fire exposure behavior for floor-covering systems. The imposed radiant flux simulates the thermal radiation levels likely to impinge on the floors of a building whose upper surfaces are heated by flames or hot gases, or both, from a fully developed fire in an adjacent room or compartment. The standard was developed to simulate an important fire exposure component of fires that develop in corridors or exitways of buildings and is not intended for routine use in estimating flame spread behavior of floor covering in building areas other than corridors or exitways. See [Appendix X1](#) for information on proper application and interpretation of experimental results from use of this test.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 The text of this standard references notes and footnotes that provide explanatory information. These notes and footnotes, excluding those in tables and figures, shall not be considered as requirements of this standard.

1.5 *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 materials, products, or assemblies under actual fire conditions.*

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 and health practices and determine the applicability of regulatory limitations prior to use. Specific hazard statements are given in Section 7.*

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:*<sup>2</sup>

[C1186 Specification for Flat Fiber-Cement Sheets](#)

[E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process](#)

[E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C](#)

[E171 Practice for Conditioning and Testing Flexible Barrier Packaging](#)

[E176 Terminology of Fire Standards](#)

## 3. Terminology

3.1 *Definitions*—See Terminology [E176](#) for additional definitions.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *blackbody temperature, n*—the temperature of a perfect radiator—a surface with an emissivity of unity and, therefore, a reflectivity of zero.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.22 on Surface Burning.

Current edition approved April 1, 2017. Published May 2017. Originally approved in 1978. Last previous edition approved in 2015 as E648 –15<sup>ε1</sup>. DOI: 10.1520/E0648-17.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

3.2.2 *corridor, n*—an enclosed space connecting a room or compartment with an exit. The corridor includes normal extensions, such as lobbies and other enlarged spaces, where present.

3.2.3 *critical radiant flux, n*—the level of incident radiant heat energy on the floor covering system at the most distant flame-out point. It is reported as  $W/cm^2$ .

3.2.4 *flame-out, n*—the time at which the last vestige of flame or glow disappears from the surface of the test specimen, frequently accompanied by a final puff of smoke.

3.2.5 *floor covering, n*—an essentially planar material having a relatively small thickness in comparison to its length or width, which is laid on a floor to enhance the beauty, comfort, and utility of the floor.

3.2.6 *floor covering system, n*—a single material, composite or assembly comprised of the floor covering and related installation components (adhesive, cushion, etc.), if any.

3.2.7 *flux profile, n*—the curve relating incident radiant heat energy on the specimen plane to distance from the point of initiation of flaming ignition, that is, 0 cm.

3.2.8 *time zero, n*—the point in time when the chamber door is closed, which needs to occur within 3 s after the specimen has been moved into the chamber (see 12.4).

3.2.9 *total flux meter, n*—the instrument used to measure the level of radiant heat energy incident on the specimen plane at any point.

#### 4. Summary of Test Method

4.1 The basic elements of the test chamber are (1) an air-gas fueled radiant heat energy panel inclined at  $30^\circ$  to and directed at (2) a horizontally mounted floor covering system specimen, Fig. 1. The radiant panel generates a radiant energy flux distribution ranging along the 100-cm length of the test specimen from a nominal maximum of  $1.0 W/cm^2$  to a minimum of  $0.1 W/cm^2$ . The test is initiated by open-flame ignition from a pilot burner. The distance burned to flame-out is converted to watts per square centimetre from the flux profile graph, Fig. 2, and reported as critical radiant flux,  $W/cm^2$ .

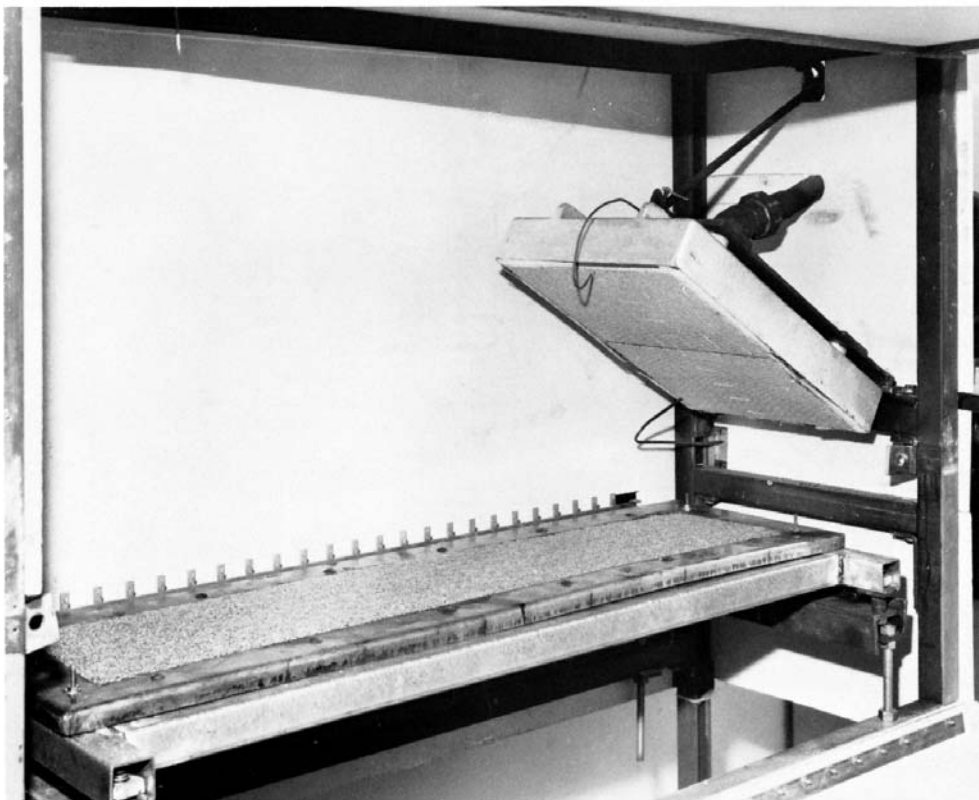
#### 5. Significance and Use

5.1 This fire test response standard is designed to provide a basis for estimating one aspect of the fire exposure behavior of a floor-covering system installed in a building corridor. The test environment is intended to simulate conditions that have been observed and defined in full scale corridor experiments.

5.2 The test is intended to be suitable for regulatory statutes, specification acceptance, design purposes, or development and research.

5.3 The fundamental assumption inherent in the test is that critical radiant flux is one measure of the sensitivity to flame spread of floor-covering systems in a building corridor.

5.4 The test is applicable to floor-covering system specimens that follow or simulate accepted installation practice.



**FIG. 1** Flooring Radiant Panel Test Showing Carpet Specimen and Gas Fueled Panel

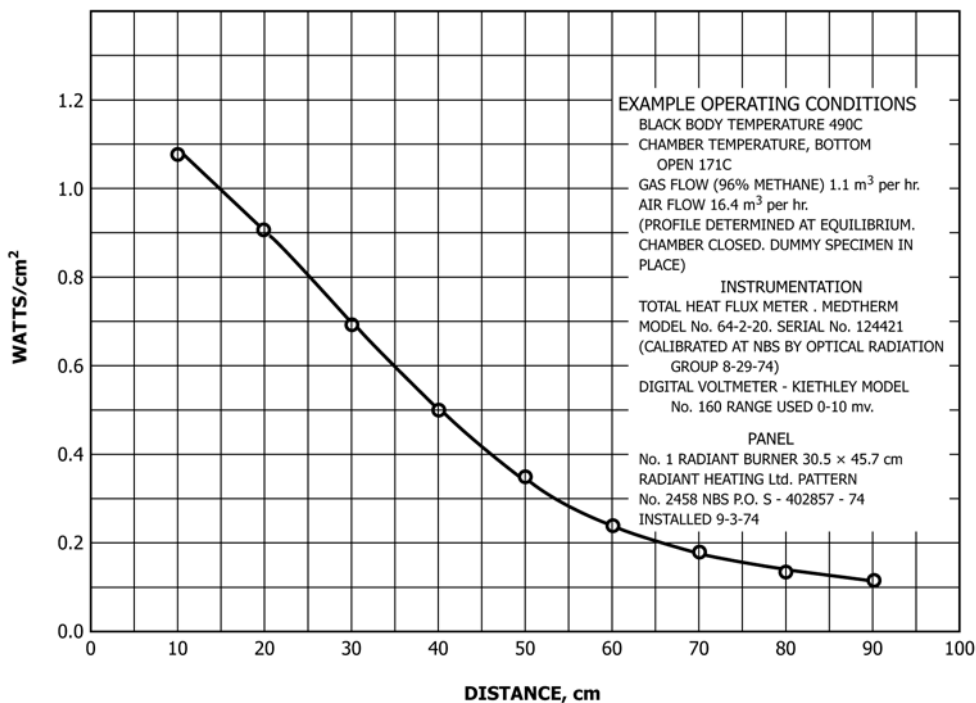


FIG. 2 Standard Radiant Heat Energy Flux Profile

Tests on the individual elements of a floor system are of limited value and not valid for evaluation of the flooring system.

5.5 In this procedure, the specimens are subjected to one or more specific sets of laboratory test conditions. If different test conditions are substituted or the end-use conditions are changed, it is not always possible by or from this test method to predict changes in the fire-test-response characteristics measured. Therefore, the results are valid only for the fire test exposure conditions described in this procedure.

**6. Flooring Radiant Panel Test Chamber—Construction and Instrumentation**

6.1 The flooring radiant panel test chamber employed for this test shall be located in a draft-protected laboratory.

6.1.1 The flooring radiant panel test chamber, Fig. 3 and Fig. 4, shall consist of an enclosure 1400 ± 10 mm long by 500 ± 10 mm deep by 710 ± 10 mm above the test specimen. The sides, ends, and top shall be of 13-mm calcium silicate, 0.74 g/cm nominal density, insulating material with a thermal conductivity at 177°C of 0.128 W/(m·K). One side shall be provided with an approximately 100 by 1100-mm draft-tight fire-resistant glass window so the entire length of the test specimen will be observable from outside the fire test chamber. On the same side and below the observation window is a door that, when open, allows the specimen platform to be moved out for mounting or removal of test specimens. When required for observation, a draft-tight fire-resistant window shall be installed at the low flux end of the chamber.

6.1.2 The bottom of the test chamber shall consist of a sliding steel platform that has provisions for rigidly securing the test specimen holder in a fixed and level position. The free, or air access, area around the platform shall be in the range from 2300 to 3225 cm<sup>2</sup>.

6.1.3 When the rate of flame front advance is to be measured, a metal scale marked with 10-mm intervals shall be installed on the back of the platform or on the back wall of the chamber.

6.1.4 When the extent of flame travel is to be measured after a prescribed burning period, for example, 15 min, the metal scale described in 6.1.3 shall be used.

6.1.5 The top of the chamber shall have an exhaust stack with interior dimensions of 102 ± 3 mm wide by 380 ± 3 mm deep by 318 ± 3 mm high at the opposite end of the chamber from the radiant energy source.

6.2 The radiant heat energy source shall be a panel of porous material mounted in a cast iron or steel frame with a radiation surface of 305 by 457 mm. It shall be capable of operating at temperatures up to 816°C. The panel fuel system shall consist of a venturi-type aspirator for mixing gas<sup>3</sup> and air at approximately atmospheric pressure, a clean, dry air supply capable of providing 28.3 NTP m<sup>3</sup>/h at 76 mm of water, and suitable instrumentation for monitoring and controlling the flow of fuel to the panel.

6.2.1 The radiant heat energy panel is mounted in the chamber at a nominal angle of 30 ± 5° to the horizontal specimen plane. The radiant panel shall be adjusted to obtain the flux profile within the limits specified in 10.6. The horizontal distance from the 0 mark on the specimen fixture to the bottom edge (projected) of the radiating surface of the panel is 89 ± 3 mm. The panel-to-specimen vertical distance is 140 ± 3 mm (see Fig. 3).

<sup>3</sup> Gas used in this test shall be commercial grade propane having a heating value of approximately 83.1 MJ/m<sup>3</sup>, commercial grade methane having a minimum purity of 96 %, or natural gas.