



Standard Test Method for Determination of Time to Burn-Through Using the Intermediate Scale Calorimeter (ICAL) Radiant Panel¹

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1. Scope

1.1 This fire-test-response test method assesses the response of materials, products, and assemblies to controlled levels of heat flux with an external igniter.

1.2 The fire-test-response characteristics determined by this test method include the ignitability and time to burn-through of materials, products, and assemblies under well ventilated conditions.

1.3 Heat, smoke, and mass loss rate are not within the scope of this test method, but are addressed by Test Method E1623.

1.3.1 This test method uses the same burner as that described in Test Method E1623. Two burner types are described (Burner A and Burner B).

1.4 Specimens are exposed to a constant heat flux up to 50 kW/m² in a vertical orientation. Hot wires are used to ignite the combustible vapors from the specimen.

1.5 This test method has been developed for evaluations, design, or research and development of materials, products, or assemblies, or for code compliance. The specimen shall be tested in thicknesses and configurations representative of actual end product or system uses.

1.6 Limitations of the test method are listed in 5.7.

1.7 This test method 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.

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

1.9 The values stated in SI units are to be regarded as standard.

1.10 *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 information about hazards is given in Section 7.

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

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

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

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology E176.

3.1.2 *heat flux, n*—heat transfer to a surface per unit area, per unit time (see also *initial test heat flux*).

3.1.2.1 *Discussion*—The heat flux from an energy source, such as a radiant heater, can be measured at the initiation of a test (such as Test Method E1354, E1623, or E906/E906M) and then reported as the incident heat flux, with the understanding that the burning of the test specimen can generate additional heat flux to the specimen surface. The heat flux can also be measured at any time during a fire test, for example as described in Guide E603, on any surface, and with measurement devices responding to radiative and convective fluxes. Typical units are kW/m², kJ/(s m²), W/cm², or BTU/(s ft²).

¹ This test method 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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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.

3.1.3 *initial test heat flux, n*—the heat flux set on the test apparatus at the initiation of the test (see also *heat flux*).

3.1.4 *orientation, n*—the plane in which the exposed face of the specimen is located during testing.

3.1.5 *time to sustained flaming, n*—period of time from start of test to commencement of the first period of flaming lasting long enough to qualify as sustained flaming (see *sustained flaming*).

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *burn-through, n*—occurrence of sustained flaming on the unexposed side of the test specimen.

3.2.2 *ignitability, n*—the propensity to ignition, as measured by the time to sustained flaming, in seconds, at a specified heat flux.

3.2.3 *sustained flaming, n*—existence of flame on or over the specimen surface for periods of at least 5 s.

3.2.3.1 *Discussion*—Flaming of less than 5 s duration is identified as flashing or transitory flaming.

3.2.4 *time to burn-through, n*—time elapsed from the start of the test until burn-through, in seconds.

4. Summary of Test Method

4.1 This is a test method designed to measure the time to burn-through (that is, the time to sustained flaming on the unexposed side) of a 1 m² specimen in a vertical orientation. The specimen is exposed on one side to a uniform heat flux from a gas fired radiant panel of up to 50 kW/m². Tests are conducted with piloted ignition. Piloted ignition results from applying wire igniters at the top and bottom of the test specimen.

4.2 Other measurements can be obtained such as time to sustained flaming on the exposed side, surface temperature, and the specimen's interior temperatures at the user's discretion.

4.3 Each specimen shall be exposed to a uniform heat flux on the exposed face using a radiant panel configuration described in Test Method E1623 with a heat flux of 50 kW/m². The time to burn-through shall be recorded for each specimen. Due to potential edge effects introduced by the specimen holder, where surface flames curl around the specimen edges, or heat transfer from the return edges of the metal holder is higher than in the field of the specimen, flaming within 127 mm (5 in.) of the edges of the unexposed specimen shall be allowed (not considered burn-through). These flames can be extinguished using a suitable means that will not affect the field of the unexposed surface of the specimen.

5. Significance and Use

5.1 This test method is used primarily to determine the time to burn-through and the time to ignition of materials, products, and assemblies.

5.2 Representative joints and other characteristics of an assembly shall be included in a specimen when these details are part of normal design.

5.3 This test method is applicable to end-use products not having an ideally planar external surface. The heat flux shall be

adjusted to be that which is desired at the average distance of the surface from the radiant panel.

5.4 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 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.

5.5 Representative materials and thicknesses shall be included in a specimen when these details are part of normal design.

5.6 This method can also be used for research and development of various material types to be included in larger-scale fire test assemblies (for example, Test Methods E119).

5.7 Test Limitations:

5.7.1 The test results have limited validity if: (a) the specimen melts sufficiently to overflow the drip tray, or (b) explosive spalling occurs.

5.7.2 Report observations of specimens that sag, deform, or delaminate.

6. Apparatus

6.1 *General*—Two burner designs are permitted (Burner A or Burner B). See Test Method E1623 Section 6 Apparatus for a description of the radiant panel system.

6.2 Although heat and smoke release rates are not measured for this procedure, combustion products shall be collected and exhausted for laboratory safety purposes. Construct the exhaust collection system as described in Test Method E1623 except for the instrumentation.

6.2.1 Ensure that the system for exhausting smoke (which includes gaseous combustion products) is designed in such a way that the combustion products leaving the burning specimen are exhausted.

6.3 *Thermocouples*—(not required - optional - see Annex A1):

6.3.1 Specimen temperature measurements are optional. If specimen temperatures are measured, all thermocouples shall comply with Annex A1.

6.4 *Heat Flux Meter*—The total heat flux meter shall be of the Gardon (foil) or Schmidt-Boelter (thermopile) type³, with a design range of about 50 kW/m². The target receiving radiation, and possibly to a small extent convection, shall be flat, circular, approximately 12.5 mm in diameter, and coated with a durable matt-black finish. The target shall be water cooled. Radiation shall not pass through any window before reaching the target. The instrument shall be robust, simple to set up and use, and stable in calibration. The instrument shall have an accuracy of within ±3 % and a repeatability of within ±0.5 %.

³ These apparatus have been found satisfactory for this purpose.