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An American National Standard

Standard Test Method for Determination of Time to Burn-Through Using the Intermediate Scale Calorimeter (ICAL) Radiant Panel[1]

This standard is issued under the fixed designation E3048; 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 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~~ 50 kW ~~kW/m~~/m^2 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.

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[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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***A Summary of Changes section appears at the end of this 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific information about hazards is given in Section 7.

1.11 *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
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 initial test 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/m^2, W/cm^2, or BTU/(s ft^2).

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

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

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

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

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

3.2.3 *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

[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.

side) of a 1 m^2 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/m^2. 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 up to ~~50~~ 50 kW ~~kW/m~~/m^2. The time to burn-through shall be recorded for each 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) type[3], with a design range of about 50 kW/m^2. 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 %.

7. Hazards

7.1 The test procedures involve high temperatures and combustion processes. Therefore the potential exists for burns, ignition of extraneous objects or clothing, and for inhalation of combustion products. The operator shall use protective gloves and clothes while removing the specimen shield and while moving the specimen trolley toward or away from the radiant panels. The construction of a viewing wall with windows is recommended for laboratories with small spaces where the operator and viewers cannot move far enough away from the area of the radiant panel.

7.2 The water cooled shield placed in front of the radiant panel assembly dramatically lowers the heating of the laboratory space and lowers the potential for harm to operators working in the area.

8. Test Specimens

8.1 *Size and Preparation:*

8.1.1 Test specimen's dimensions shall be 1000 mm by 1000 mm and up to 152 mm in thickness. Use the specimen holder as described in Test Method E1623. If specimens of thickness greater than 152 mm are to be tested, a specimen holder shall be constructed to accommodate the desired specimen thickness. They shall be representative of the construction of the end-use product. Test materials and assemblies of normal thickness, 152 mm or less, using their full thickness.

8.1.2 If a product is designed to normally have joints in a field application, then that specimen shall incorporate the joint detail. Center the joint in the specimen's vertical or horizontal centerline as appropriate. Also test the specimen without a joint detail if the design does not include a joint.

8.1.3 Cover the edges of the specimen with 12 mm ceramic wool blanket to eliminate the gap between the holder and the specimen.

8.2 *Conditioning*—The test specimen shall be conditioned to a constant weight at a temperature of 23 °C ± 2.8 °C (73.4 °F ± 5 °F) and at a relative humidity of 50 ± 5 %.

9. Calibration

9.1 Use calibrated instruments. The instruments required to be calibrated or verified include the infrared pyrometer, heat flux meter, computerized data acquisition system, and thermocouples.

9.2 *Heat Flux/Distance Relationship:*

9.2.1 Ignite the radiant panel and allow it to come to equilibrium as indicated by its constant heat flux and surface temperature.

9.2.1.1 Use the calibration panel specimen described in Test Method E1623.

9.2.2 Generate a curve of average heat flux measurements over the calibration panel surface versus distance from the radiant panel. Place the calibration panel in the same position as a specimen and insert the flux meter from the unexposed face through the holes. The target face of the flux meter shall extend 15 mm toward the radiant panel from the exposed surface of the calibration panel to minimize the convective heat transfer contribution. After the heat flux has come to equilibrium, make the heat flux measurements with the target face of the heat flux meter at the following distance away from the radiant panel: 300, 400, 600, 800, 1000, and 2000 mm. If lower heat fluxes than the one corresponding to a 2 m distance are used, continue calibrating until past the needed distance.

[3] These apparatus have been found satisfactory for this purpose.

9.2.3 No individual heat flux measurement shall deviate from the average at each of the distances by more than ±6 %. The average heat flux measurements in the bottom row of the calibration panel shall not deviate from that in any of the heat flux values used by more than ±5 %.

9.2.4 Use the curve generated in 9.2.2 to determine the distance from the radiant panel for a desired radiant heat flux exposure.

9.2.5 Perform calibration every three months or more frequently if any significant changes to equipment are made or if calibration is suspect. Check the calibration at the desired target heat flux the day of the test.

9.3 *Heat Flux Meter*—Check the calibration of the heat flux meter whenever a recalibration of the apparatus is carried out by comparison with an instrument (of the same type as the working heat flux meter and of similar range) held as a reference standard and not used for any other purpose. Fully calibrate the reference standard at a standardizing laboratory at yearly intervals.

10. Procedure

10.1 *Preparation:*

10.1.1 Open the water valve to the steel tubing that support the radiant panel and adjust the water flow sufficiently high such that water exiting the frame will not exceed 100 °C in temperature.

10.1.2 Position the specimen holder assembly remote to the desired test location.

10.1.3 Place the water cooled shield in front of the radiant panel assembly and adjust the water flow sufficiently high such that water exiting the shield will not exceed 100 °C in temperature.

10.1.4 Turn on the flow of gas to each of the radiant panels and ignite them.

10.1.5 Allow the burners to operate for 30 min prior to testing.

10.1.6 Adjust the water flow to the frame and shield as required in 10.1.1 and 10.1.3.

10.1.7 Turn on all sampling and recording devices.

10.1.8 Insert the specimen into the specimen holder. Place the specimen in the specimen holder by removing the top specimen holder cap section, inserting the specimen and replacing the top cap.

10.1.9 Turn on the wire igniters.

10.1.10 If heat flow through the specimen is to be monitored, attach the thermocouples as described in 6.3.

10.2 *Test Procedure:*

10.2.1 Place the specimen trolley at the location previously calibrated to correspond to a 50 kW/m^2 heat flux exposure to the surface of the specimen.

10.2.2 For R&D purposes, place the specimen trolley at the location previously calibrated to correspond to the desired heat flux exposure to the surface of the specimen.

10.2.3 Remove the water cooled specimen shield in not more than 2 s and start the timer marking the beginning of the test.

10.2.4 Record the times when flashing or transitory flaming occurs. When sustained flaming occurs, record the time and turn off the igniters. If the flame extinguishes after turning off the igniters, turn on the igniters again within 5 s and do not turn the igniters off until the entire test is completed. Report these events in the test report.

10.2.5 If the collection hood is used to exhaust combustion gases from the test room, then adjust the duct flow to a sufficient value as necessary to collect all combustion gases.