



Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter¹

This standard is issued under the fixed designation E2965; 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 standard provides a procedure for measuring the response of materials that emit low levels of heat release when exposed to controlled levels of radiant heating with or without an external igniter.

1.2 This test method differs from Test Method E1354 in that it prescribes a different specific test specimen size, specimen holder, test specimen orientation, a direct connection between the plenum and the top plate of the cone heater assembly to ensure complete collection of all the combustion gases (Fig. 1), and a lower volumetric flow rate for analyses via oxygen consumption calorimetry. It is intended for use on materials and products that contain only small amounts of combustible ingredients or components, such as test specimens that yield a peak heat release of $<200 \text{ kW/m}^2$ and total heat release of $<15 \text{ MJ/m}^2$.

NOTE 1—PMMA is typically used to check the general operation of a Cone Calorimeter. PMMA should not be used with this standard as the heat release rate is too high.

1.3 The rate of heat release is determined by measurement of the oxygen consumption as determined by the oxygen concentration and the flow rate in the exhaust product stream. The effective heat of combustion is determined from a concomitant measurement of test specimen mass loss rate, in combination with the heat release rate. Smoke development (an optional measurement) is measured by obscuration of light by the combustion product stream.

1.4 Test specimens shall be exposed to initial test heat fluxes generated by a conical radiant heater. External ignition, when used, shall be by electric spark. The test specimen testing orientation is horizontal, independent of whether the end-use application involves a horizontal or a vertical orientation.

1.5 Ignitability is determined as a measurement of time from initial exposure to time of sustained flaming.

¹ This test method is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.23 on Combustibility.

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1.6 This test method has been developed for use for material and product evaluations, mathematical modeling, design purposes, and development and research. Examples of material test specimens include portions of an end-use product or the various components used in the end-use product.

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

1.8 *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.*

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

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. For specific hazard statements, see 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:

D5865 Test Method for Gross Calorific Value of Coal and Coke

E176 Terminology of Fire Standards

E603 Guide for Room Fire Experiments

E906 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

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

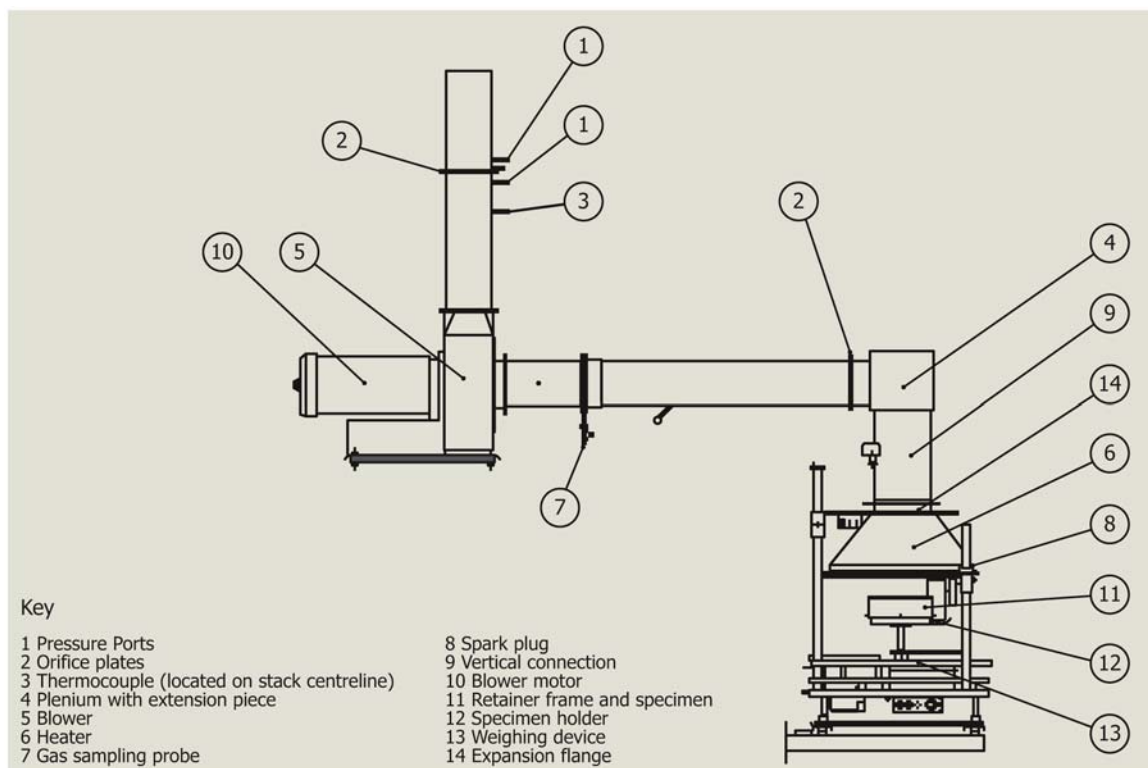


FIG. 1 Modified Cone Calorimeter

Rates for Materials and Products Using an Oxygen Consumption Calorimeter

2.2 ISO Standards

ISO 5657-1986 (E) Fire Tests—Reaction to Fire—Ignitability of Building Materials

ISO 5725-2 (1994) Accuracy (Trueness and Precision) of Measurement Methods and Results—Part 2: Basic Method for the Determination of Repeatability and Reproducibility of a Standard Measurement Method

3. Terminology

3.1 *Definitions:* For definitions of terms used in this test method, refer to Terminology E176.

3.1.1 *effective heat of combustion, n* —the amount of heat generated per unit mass lost by a material, product or assembly, when exposed to specific fire test conditions (contrast *gross heat of combustion*).

3.1.1.1 *Discussion*—The effective heat of combustion depends on the test method, and is determined by dividing the measured heat release by the mass loss during a specified period of time under the specified test conditions. Typically, the specified fire test conditions are provided by the specifications of the fire test standard that cites effective heat of combustion as a quantity to be measured. For certain fire test conditions, involving very high heat and high oxygen concentrations under high pressure, the effective heat of combustion will approximate the gross heat of combustion. More often, the fire test conditions will represent or approximate certain real fire exposure conditions, and the effective heat of combustion is the appropriate measure. Typical units are kJ/g or MJ/kg.

3.1.2 *gross heat of combustion, n* —the maximum amount of heat per unit mass that theoretically can be released by the combustion of a material, product, or assembly; it can be determined experimentally and only under conditions of high pressure and in pure oxygen (contrast *effective heat of combustion*).

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

3.1.3.1 *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 or Test Method E906) 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/m², W/cm², or BTU/(s ft²).

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

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

3.1.5.1 *Discussion*—The initial test heat flux is the heat flux value commonly used when describing or setting test conditions.

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