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(Reaffirmed 2016)**

**STANDARD TEST METHOD FOR THE DETERMINATION OF
COMBUSTIBILITY PARAMETERS OF BUILDING MATERIALS
USING AN OXYGEN CONSUMPTION CALORIMETER (CONE
CALORIMETER)**

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STANDARD TEST METHOD FOR THE DETERMINATION OF
COMBUSTIBILITY PARAMETERS OF BUILDING MATERIALS USING
AN OXYGEN CONSUMPTION CALORIMETER (CONE CALORIMETER)

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AMENDMENT NOTICE

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STANDARD TEST METHOD FOR THE DETERMINATION OF COMBUSTIBILITY PARAMETERS OF BUILDING MATERIALS USING AN OXYGEN CONSUMPTION CALORIMETER (CONE CALORIMETER)	ULC-S135-04
AMENDMENT 1	DATE OF AMENDMENT: AUGUST 2006

The following amendments are being incorporated into ULC-S135-04:

1. Revised Clause 6.1.5
2. Note added to Clause 6.1.6
3. Note added to Clause 8.2.8.1

NOTICE

PLEASE NOTE THAT THIS STANDARD INCLUDES AMENDMENT(S). THE CURRENT EDITION OF THIS STANDARD IS NOT VALID UNLESS USED TOGETHER WITH THE AMENDMENT(S).

IT IS POSSIBLE, HOWEVER, THAT CERTAIN CODES WILL REFER TO THE SUPERSEDED EDITION OF THIS STANDARD, WITHOUT THE AMENDMENT(S). IN THOSE INSTANCES, THE COMPILATION OF THIS DOCUMENT ALLOWS FOR REFERENCE TO BE MADE TO THE STANDARD PRIOR TO THE INCLUSION OF THE AMENDMENT(S).

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6.1.5 When the test specimen is a material or composite that would normally be attached to a well-defined substrate, it shall be tested in conjunction with that substrate using the recommended fixing technique, and bonded with the appropriate adhesive or mechanically attached.

6.1.6 The composite material or assembly shall be prepared as specified in 6.1.1 through 6.1.3 and exposed in a manner typical of end use conditions. The influence of the underlying layers shall be understood and care taken to ensure that the test result obtained is relevant to its use in practice.

Note: If a composite material referenced in Clauses 6.1.5 and 6.1.6 consists of discrete layers and testing reveals that the surface layer or layers protect the underlying layers such that complete combustion of the underlying layers does not occur, the National Building Code 2005 requires the outer layers be removed sequentially until all layers have been exposed during testing, or until complete combustion occurs.

8.2.8.1 The total *heat release* per unit area as determined by clause 10.2.5.2 shall be compared for the three specimens. If any of these readings differ by more than 10% from the average of the three readings, then a further set of three specimens shall be tested. In such cases, report the averages for peak *heat release rate*, total *heat release* and total *smoke extinction area* using the set of six readings.

Note: For composite materials tested as described in Clause 6.1.6, the heat release and smoke extinction area shall be determined from the cumulative emissions from all layers.

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REFERENCE PUBLICATIONS

The documents shown below are referenced in the text of this Standard. Unless otherwise stated elsewhere in this Standard such reference shall be considered to indicate the edition and/or revisions of the document available at the date on which the Committee approved this ULC Standard.

Documents Published by the American Society for Testing and Materials (ASTM)
100 Barr Harbour Drive, PO Box C700, West Conshohocken, PA 19428-2959 U.S.A.
Telephone: (610) 832-9585
www.astm.org

- ASTM E906-99, Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products
- ASTM E1354-03, Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

Documents Published by the International Organisation for Standardization (ISO)
1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 749 01 11
www.iso.ch

- ISO 5657:1997, Reaction to fire tests – Ignitability of building products using a radiant heat source
- ISO 5660-1:2002, Reaction to fire tests – Heat release rate (cone calorimeter method)
- ISO 5660-2:2002, Reaction to fire tests -*Smoke Production rate* (dynamic measurement)

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- CAN/ULC-S114-05 Standard Method of Test for Determination of Non-combustibility in Building Materials
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STANDARD TEST METHOD FOR THE DETERMINATION OF COMBUSTIBILITY PARAMETERS OF BUILDING MATERIALS USING AN OXYGEN CONSUMPTION CALORIMETER (CONE CALORIMETER)

PREFACE

This is the Reaffirmation of the Second Edition of the Standard Test Method for the Determination of Combustibility Parameters of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter), ULC-S135.

This Edition of the Standard has been formally approved by the ULC Standards Committee on Fire Tests.

This Standard has been developed in compliance with the requirements of SCC for accreditation of a Standards Development Organization.

Only metric SI units of measurement are used in this Standard. If a value for measurement is followed by a value in other units in parentheses, the second value may be approximate. The first stated value is the requirement.

Appendices A, B and C, identified as Informative, are for information purposes only.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

The Second Edition of this ULC Standard has been reaffirmed.

Attention is drawn to the possibility that some of the elements of this Canadian standard may be the subject of patents rights. ULC Standards shall not be held responsible for identifying any or all such patents rights.

Requests for interpretation of this Standard should be sent to ULC Standards. The requests should be worded in such a manner as to permit a "yes" or "no" answer based on the literal text of the requirement concerned.

The review and action to revise or reaffirm this Standard will not exceed 5 years from the date of publication, unless the Standard is identified as fitting within a stabilized category, whereby the review will commence within the appropriate time frame set out by ULC Standards.

This Standard is intended to be used for conformity assessment.

1. SCOPE

1.1 This test method determines combustibility parameters for the assessment of degree of combustibility of building materials by measuring the *heat release* and smoke production from specimens exposed to radiant heat using the test apparatus, specimen configurations and procedures described.

1.2 This test method determines the amount of heat and smoke that may be contributed to a fire involving products made from the same material as that of the test specimen.

1.3 This test method provides for radiant thermal exposure of a specimen. An external source of ignition is provided by an electric spark.

1.4 This test method is based on the observation that generally, the net heat of combustion of a material is directly related to the quantity of oxygen required for its combustion. This relationship is such that approximately 13.1×10^3 kJ of heat are released per 1.0 kg of oxygen consumed.

1.5 *Heat release* is measured from the moment the specimen is subjected to the radiant thermal exposure of a conical heater.

1.6 The primary measurements are oxygen concentration, light obscuration and exhaust flow rate. Provision is also made for measurement of mass-loss rate and time to *sustained flaming*.

1.7 Smoke development is measured by obscuration of light in the combustion product stream.

1.8 This test method is used to evaluate specimens in a horizontal *orientation* under an external *heating flux* exposure of 50 kW/m^2 . The specimen, once ignited, is also heated by its own flame.

Note: The test apparatus has provision for testing specimens in a vertical *orientation*. Discussion on such testing may be found in Appendix C.

2. SIGNIFICANCE

2.1 This test method provides a description of the behaviour of specimens under a specified fire exposure.

2.2 The data, obtained for a specific test, describes the *heat release rate* and *smoke production rate* of the specimen when exposed to the specific environmental conditions and procedures.

2.3 The *heat release rate* is calculated per square metre of effective exposed surface area. If a specimen swells, sags, delaminates, or otherwise deforms so that the exposed surface area changes, the calculated *heat release rate* corresponds to the effective exposed area, not to the new surface area.

2.4 The *smoke production rate* is determined by measuring the volumetric flow rate of smoke and the *extinction coefficient* of the smoke at the point of measurement.

2.5 The applicability of data from this test method to products in actual use is dependent on test specimens being representative of that product.

2.6 This test method may not be applicable to end-use products that do not have planar, or nearly planar external surfaces.

3. TERMINOLOGY

3.1 GLOSSARY

Note: Terms used in this standard appearing in *italic* print are defined as follows:

- 3.1.1 *EXTINCTION COEFFICIENT* – natural logarithm of the ratio of incident light intensity to transmitted light intensity, per unit path length.
- 3.1.2 *HEATING FLUX* - the incident flux imposed externally from the heater on the specimen at the initiation of the test. The specimen, once ignited, is also heated by its own flame.
- 3.1.3 *HEAT RELEASE* - the thermal energy which is released by the specimen under specified conditions.
- 3.1.4 *HEAT RELEASE RATE* - the thermal energy which is released by the specimen under specified conditions, per unit of time.
- 3.1.5 *IGNITIBILITY* - the propensity to ignite, as measured by the time to *sustained flaming*, in seconds, at the specified *heating flux*.
- 3.1.6 *ORIENTATION* - the plane in which the exposed face of the specimen is located during testing. For this test method, it is always horizontal facing up.
- 3.1.7 *OXYGEN CONSUMPTION PRINCIPLE* - the expression of the relationship between the mass of oxygen consumed during combustion and the heat released.
- 3.1.8 *SMOKE EXTINCTION AREA* – integral of the *smoke obscuration* curve over the time interval being considered.
- 3.1.9 *SMOKE OBSCURATION* – reduction, shall be expressed as a percentage, in intensity of light due to its passage through smoke.
- 3.1.10 *SMOKE PRODUCTION RATE* – product of the volumetric flow rate of smoke and the extinction coefficient of the smoke at the point of measurement.

- 3.1.11 *SUSTAINED FLAMING* - existence of flame on or over the specimen surface for periods of at least 4 s. Flaming of less than 4 s duration is identified as flashing or transitory flaming.

3.2 SYMBOLS

- 3.2.1 A_s – effective exposed area of the specimen, 0.0081 m^2 .
- 3.2.2 C – calibration constant for oxygen consumption analysis, $\text{m}^{1/2} - \text{kg}^{1/2} - \text{K}^{1/2}$.
- 3.2.3 Δh_c – net heat of combustion, kJ/kg .
- 3.2.4 ρ – density, kg/m^3 .
- 3.2.5 σ – specific extinction area, m^2/kg .
- 3.2.6 I_0/I – ratio of incident light intensity to transmitted light intensity.
- 3.2.7 k – linear absorption coefficient (commonly called *extinction coefficient*), m^{-1} .
- 3.2.8 k_1 – measured calibration *extinction coefficient*, m^{-1} .
- 3.2.9 k_2 – calculated calibration *extinction coefficient*, m^{-1} .
- 3.2.10 k_m – measured *extinction coefficient*, m^{-1} .
- 3.2.11 L – light path length through smoke, m .
- 3.2.12 M_a – molecular weight of air, kg/kmol .
- 3.2.13 M_e – molecular weight of the combustion products, kg/kmol .
- 3.2.14 m – specimen mass, kg .
- 3.2.15 $\dot{m}$ – specimen mass loss rate, kg/s .
- 3.2.16 $\dot{m}_e$ – exhaust duct mass flow rate, kg/s .
- 3.2.17 m_f – final specimen mass, kg .
- 3.2.18 m_i – initial specimen mass, kg .