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**STANDARD METHOD OF TEST FOR FIRE GROWTH OF
INSULATED BUILDING PANELS IN A FULL-SCALE ROOM
CONFIGURATION**

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Approved by:



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CETTE NORME NATIONALE DU CANADA EST DISPONIBLE EN VERSIONS FRANÇAISE ET ANGLAISE

STANDARD METHOD OF TEST FOR FIRE GROWTH OF INSULATED
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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

- Standard Terminology of Fire Standards, ASTM E 176-05 a
 - Standard Guide for Measurement of Gases Present or Generated During Fires, ASTM E 800-06
-

Documents Published by the International Organisation for Standardization (ISO)
1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland
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www.iso.ch

- International Organization for Standardization, Fire Tests - Full-Scale Room Test for Surface Products, ISO 9705: 1993(E)
-

Documents Published by Underwriters' Laboratories of Canada (ULC)
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- Standard Method of Test for Determination of Noncombustibility in Building Materials, CAN/ULC-S114-05
 - Standard Method of Test for Fire Spread Under Roof-Deck Assemblies, CAN/ULC-S126-M86
-

STANDARD METHOD OF TEST FOR FIRE GROWTH OF INSULATED BUILDING PANELS IN A FULL-SCALE ROOM CONFIGURATION

PREFACE

This is the Reaffirmation of the First Edition of the Standard Method of Test for Fire Growth of Insulated Building Panels in a Full-Scale Room Configuration, CAN/ULC-S138.

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.

Appendix A, identified as Informative, is 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 First Edition of this National Standard of Canada has been reaffirmed.

Attention is drawn to the possibility that some of the elements of this Canadian standard may be the subject of patent rights. ULC Standards shall not be held responsible for identifying any or all such patent 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 is a fire test response Standard. This document describes the test method used to determine the contribution to fire growth provided by a *non-loadbearing* insulated building panel installed in a sprinklered or unsprinklered room configuration (see Appendix A).

1.2 The insulated building panels investigated by this test method are of the factory-assembled type and intended for use as exterior or interior walls, ceilings or roofs. This Standard presumes that these panels are not backed by other materials or constructions in typical installation practice.

Note: Where the panels are designed to be installed in a backed condition, the *test specimen* should be installed and evaluated in accordance with its intended use.

1.3 This test method measures the time to flashover under specified test conditions. Provisions are made to measure ignitability, smoke obscuration, rate of fire growth and rate of heat release of the test panels.

1.4 This test method is not intended to determine the fire resistance rating of insulated building panels. In addition, this test method does not investigate the toxic hazard posed by the products of combustion.

1.5 The exposure tests, as described herein, are not intended to be representative of all fire conditions. It is likely that conditions will vary with changes in the amount, nature and distribution of fire loading, ventilation, size and configuration of the *assembly* installed. These requirements provide a relative measure of the fire performance of comparable *assemblies* under these specified fire exposure conditions.

1.6 This Standard shall be used to measure and describe the response of materials, products or *assemblies* to heat and flame under controlled conditions.

2. GLOSSARY

NOTE: Terms used in this Standard that are in *italic* print are defined as follows:

2.1 In addition to the definitions below, for the purposes of this document, the definitions contained in the Standards ASTM E 176 and ISO 9705 will also apply:

ASSEMBLY – A unit or structure composed of a combination of materials or products, or both.

Note: The fabrication of the *assembly* shall be representative of the manufactured item. An *assembly* may include an air gap.

DEAD LOAD – the weight of all permanent structural and non-structural component(s) of a building.

LOADBEARING – Subjected to or designed to carry loads in addition to its own *dead load*, excepting a wall element subjected only to wind or earthquake loads in addition to its own *dead load*.

NONCOMBUSTIBLE – A material that meets the acceptance criteria of CAN/ULC-S114 “Standard Method of Test for Determination of Noncombustibility in Building Materials”.

NON-LOADBEARING – Building elements that are not *loadbearing*.

RESPONSE TIME INDEX (RTI) – A measure of the sensitivity of a sprinkler’s thermal element.

TEST SPECIMEN – An *assembly* representing the end-use construction.

3. TEST SPECIMEN PREPARATION

3.1 TEST SPECIMEN

3.1.1 The test *assembly* shall be as representative as possible of actual field installation with respect to panel support, fastening, backing and joint configuration. Panels shall be mounted directly on the *noncombustible* floor, in accordance with the manufacturer’s installation instructions. The use of interior masonry curbs, however, is not permitted even when specified in the installation instructions. The normal width, length and thickness of panels shall be used wherever possible.

3.1.2 Samples shall be conditioned at a temperature of $23 \pm 2^{\circ}\text{C}$ and $50 \pm 5\%$ relative humidity to constant mass.

3.1.3 If the panels are intended for use in a sprinklered environment, the test room described in Clause 3.2 shall incorporate the type of sprinkler to be used in practice and installed in accordance with the requirements in the National Building Code of Canada.

3.2 TEST ROOM

3.2.1 The fire test room shall be constructed, from the insulated building panels under investigation. The interior dimensions of the room shall be a width of 2.4 m by a length of 3.6 m and a height of 2.4 m (see Figure 1).

3.2.2 Three walls or three walls and the ceiling or roof shall be fabricated from the building panels. The 2.4 m by 2.4 m wall containing the doorway shall be fabricated from the *noncombustible* materials as described in Clause 3.2.6.

3.2.3 In addition to any corner joint, one vertical panel joint shall be located adjacent to and in contact with the ignition burner (see Figures 3 and 4).

3.2.4 Where the panels are not used for ceiling or roof applications, the test ceiling or roof *assembly* shall be constructed of a *noncombustible* metal deck, insulated with a *noncombustible* insulation having a thermal resistance at least equivalent to the wall panel thermal resistance or R30, whichever is greater.

Note: Alternative ceilings that meet the performance requirements of CAN/ULC-S126 may also be used.

3.2.5 The panels forming the walls or walls, roofs and ceilings of the test room shall be butted as closely as possible to the wall containing the doorway. The gap between the wall containing the doorway and the adjacent walls shall be filled with *noncombustible* insulation material to a level sufficient to prevent the passage of flames or hot gases outside the test room.

3.2.6 The wall containing the doorway shall be constructed from steel studs and inorganic reinforced cement boards. The studs shall be 64 mm wide by 35 mm deep, installed at 600 mm OC, into 64 mm wide by 32 mm deep floor and ceiling tracks. The studs and tracks shall be fabricated from 0.5 mm thick galvanized steel. The perimeter studs and ceiling track shall be attached to the panels forming the adjacent walls or walls and ceilings, in accordance with the building panel manufacturer's instructions. The inorganic reinforced cement boards shall be 6 mm thick by 1220 mm wide by 2440 mm long, and shall be fastened vertically on both sides of the studs and track with 25 mm long Type S drywall screws spaced 150 mm OC.

3.2.7 When conducting a sprinklered room test, one automatically actuated sprinkler shall be installed in the fire test room. The sprinkler head shall be located 2 m from the 2.4 m by 2.4 m wall, 1.2 m from the 2.4 m by 3.6 m wall adjacent to the main burner and 75 mm below the ceiling (see Figure 5). The choice of the sprinkler head type and water flow rate shall be at the discretion of the submitter, but shall be consistent with the general practices for the intended application of the panels.

4. TEST APPARATUS & CALIBRATION

4.1 PRIMARY IGNITION SOURCE

4.1.1 The primary ignition source shall consist of a burner made from mild steel having a nominal 305 mm by 305 mm porous top surface of silica sand. The height of the burner shall be adjusted such that the top surface of the silica sand is 305 mm above the floor and shall be horizontal (see Figures 2 and 3).

4.1.2 The burner shall be supplied with a heat source having a minimum calorific value of 37 MJ/m³. The gas flow to the burner shall be measured with an accuracy of at least $\pm 3\%$. The heat output to the burner shall be controlled within $\pm 5\%$ of the prescribed value.

Note: The gas supply used may be either propane or natural gas.

4.1.3 The calibration of the burner for the test shall be performed with the burner heat outputs (see Table 1) with the burner positioned directly under the hood. Measurements shall be taken at least every 6 s and shall be started 1 min prior to ignition of the burner. At steady

state conditions, the difference between the mean rate of heat release over 1 min calculated from the metered gas input shall not exceed 5% for each level of output.

4.1.4 The time delay for a stepwise change of the heat output from the burner, when placed centrally 1 m below the hood, shall not exceed 20 s and shall be corrected for in test data. The time delay shall be determined by measuring the time taken to reach agreement to within 10% of the final measured heat release value, when going through the stepwise procedure given in Table 1, taking measurements at least every 6 s.

4.2 SECONDARY IGNITION SOURCE

4.2.1 The secondary ignition source shall be an “L” shaped burner pointed down (at a 90° angle to the floor of the test chamber), and placed within 25 mm above the floor to provide a ground level ignition source for melted combustibles. The flame shall be long enough to impinge on the floor. The supplementary burner will be placed 150 mm away from the walls, directly beneath the main burner (see Figure 3).

4.2.2 The heat output of the secondary ignition source shall be 10 kW. The sum of the heat release rates from the main burner and the supplementary “L” shaped burner shall constitute the total burner heat release rate (see Appendix A3.6). The burner shall be supplied with a heat source described in Clause 4.1.2

4.3 HEPTANE IGNITION SOURCE

4.3.1 When conducting the sprinklered room test, a 300 kW heptane ignition source described in Clause 4.3.2 shall be used in lieu of the Primary and Secondary Ignition Burners described in Clauses 4.1 and 4.2 (see Figure 3).

4.3.2 The heptane fuel shall be poured into a galvanized steel pan measuring 400 mm by 400 mm, and containing a minimum of 13 mm of water (see Figure 4). Sufficient heptane shall be transferred to the pan to provide a minimum heat output of 300 kW $\pm$ 5% for a period of 15 min. Appropriate precautions shall be taken to prevent the possible overflow of fuel from the pan. The depth of the pan shall be sufficient to contain the initial heptane amount, plus the subsequent volume of water that will be discharged by the sprinkler during the fire test.

Note: It is necessary to take appropriate precautions to prevent potential run-off or leakage of heptane during the test. Adjustments may be needed to increase the depth of the pan to compensate for water collection.

4.4 HEAT FLUX INSTRUMENTATION

4.4.1 Heat Flux Meter

4.4.1.1 The heat flux meter¹ shall be of the foil or the thermopile type with a design range of 50 kW/m². The target area shall be a flat black surface having a view angle of 180 degrees. The target shall be contained within a water-cooled body in which the front face shall be of

¹ Heat flux meters found to be acceptable for this purpose are the Gardon (foil) or the Schmidt-Rohr (thermopile).

highly polished metal, flat, coinciding with the plane of the target, and circular, with a diameter of not more than $50 \text{ mm} \pm 2 \text{ mm}$. The heat flux gauge shall have an accuracy of at least ± 3 percent and repeatability within 0.5 percent. In operation, the heat flux gauge shall be maintained above the dew point, by water supplied at a temperature of $50^\circ\text{C} - 65^\circ\text{C}$.

4.4.1.2 The heat flux meter shall be mounted such that the top surface is at a height of $25 \text{ mm} \pm 1.5 \text{ mm}$ above the floor, facing upward, in the geometric center of the fire test room.

4.4.1.3 The calibration of the heat flux meter shall be checked whenever required, by comparison with two instruments held as reference standards and not used for any other purpose. One of the reference standards shall be fully calibrated at yearly intervals.

4.5 HOOD AND EXHAUST DUCT

4.5.1 The hood and exhaust duct system for collecting the combustion products shall have a sufficient capacity and be designed so that all of the combustion products leaving the fire room through the doorway during a test are collected. The system shall not disturb the fire-induced flow in the doorway. The exhaust capacity shall be at least $3.5 \text{ m}^3\cdot\text{s}^{-1}$ at normal pressure and a temperature of 25°C .

Note: See Figures 7 & 8 for an example of a hood and exhaust duct design and gas collection schematic. Refer to Appendix A1.1 for additional information.

4.6 GAS COLLECTION SYSTEM

4.6.1 The gas exhaust collection system shall be constructed with the following minimal requirements: a blower, steel hood, duct, bi-directional probe, thermocouple(s), oxygen measurement system, smoke obscuration measurement system (white light photocell lamp/detector or laser), and combustion gas sampling and analysis system. The gas exhaust collection system shall be constructed (see Figure 7).

4.6.2 Ensure that the system for collecting the smoke (which includes gaseous combustion products) has sufficient exhaust capacity and is designed in such a way that all of the combustion products leaving the burning *test specimen* through the doorway are collected. Design the capacity of the evacuation system such that it will exhaust, minimally, all combustion gases leaving the *test specimen* (see Appendix A1.1.6).

4.6.3 Place probes for the sampling of combustion gas and measurement of flow rate (see Appendix A2). The flow rate in the exhaust duct shall be measured by a bi-directional probe, or an equivalent measuring system, with an accuracy of at least $\pm 6\%$. The response time to a stepwise change of the duct flow rate shall not exceed 5 s to reach 90 % of the final value.

4.6.4 Make all measurements of smoke obscuration, gas concentrations, or flow rates at a position in the exhaust duct where the exhaust is mixed uniformly so that there is a nearly uniform velocity across the duct section. To ensure uniform mixing of the exhaust, provide a straight section of duct before the measuring system having a length equal to at least eight times the inside diameter of the duct. If a measuring system is positioned at a distance of less than 8 diameters, demonstrate the achievement of equivalent results.