NFPA® 253

Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

2023 Edition

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An International Codes and Standards Organization

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This edition of NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*, was prepared by the Technical Committee on Fire Tests. It was issued by the Standards Council on April 28, 2022, with an effective date of May 18, 2022, and supersedes all previous editions.

This edition of NFPA 253 was approved as an American National Standard on May 18, 2022.

Origin and Development of NFPA 253

Experience suggests that during the early stages of a fire, floor covering systems seldom act as a fire-spread medium. However, in a few fires involving multiple-occupancy buildings, the floor covering materials in corridors were primarily responsible for fire spread over a considerable distance. Those situations caused grave concern and pointed to the need for a realistic test to evaluate the flame spread of floor covering systems.

The inception of the flooring radiant panel test was at the Armstrong Cork Company in 1966. In 1972, conceptualization of critical radiant flux (W/cm2 at extinguishment) as a measure of flame spread hazard was underway at the National Bureau of Standards (NBS). It was determined in the course of NBS work on model corridor fire tests that the radiant energy levels incident on the floor covering had a considerable influence on whether or not flaming combustion would propagate. Accordingly, it was natural to apply the critical radiant flux concept, and, in 1973, the NBS prepared a draft of the flooring radiant panel test.

In 1975, the Technical Committee on Fire Tests began its evaluation of the proposed test methods, which culminated in the adoption of the test as an official NFPA standard in May 1978. The standard was revised in 1984 and 1990.

The 1995 edition included significant improvements based on work conducted by the National Institute of Standards and Technology (NIST) and the carpet industry. Those findings improved the overall application of the standard and provided measured improvement in test precision. Other changes included a new pilot burner and reduction of the variation in the airflow through the chamber, which reduced the variability of data. Revisions also were made to eliminate “permissive” language. The revisions created closer harmony with ASTM E648, *Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.*

The 2000 edition was a reconfirmation of the 1995 edition.

The 2006 edition included a complete editorial rewrite for compliance with the *Manual of Style for NFPA Technical Committee Documents*. Further organizational and editorial changes were made to clarify the requirements of the test method. Provisions regarding safety precautions were moved to the annexes, and additional details were provided on simulating a concrete floor during the test.

The 2011 edition was revised to create uniformity with other fire test standards. Provisions for laminate floor mounting were added to Chapter 5.

In 2015, revisions were made to provide clarity on airflow rates and updated examples of test apparatuses.

The 2019 edition was revised to reference the latest test methods and to address modern materials used for simulated concrete flooring.

The 2023 edition includes terminology clarification and moves the radiation instrumentation calibration information from Annex B to a mandatory section in Chapter 6.

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Committee Scope: This Committee shall have primary responsibility for documents on fire testing procedures, for reviewing existing fire test standards and recommending appropriate action to NFPA, for recommending the application of and advising on the interpretation of acceptable test standards for fire problems of concern to NFPA technical committees and members, and for acting in a liaison capacity between NFPA and the committees of other organizations writing fire test standards. This Committee does not cover fire tests that are used to evaluate extinguishing agents, devices, or systems.

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2023 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex G.

Chapter 1 Administration

1.1 Scope.

1.1.1* This fire test response standard describes a procedure for measuring critical radiant flux behavior of horizontally mounted floor covering systems exposed to a flaming ignition source in a graded, radiant heat energy environment within a test chamber.

1.1.2* This fire test response standard measures the critical radiant flux at flameout and provides a basis for estimating one aspect of fire exposure behavior for floor covering systems.

1.2 Purpose.

1.2.1* The standard was developed to simulate an important fire exposure component in fires that develops in corridors or exit enclosures of buildings and is not intended for routine use in estimating flame spread behavior of floor covering in building areas other than corridors or exit enclosures.

1.2.2 This fire test response standard is designed to provide a basis for estimating one aspect of the fire exposure behavior of a floor covering system installed in a building corridor.

1.2.3 The test environment simulates conditions that have been observed and defined in full-scale corridor experiments.

1.3 Application.

1.3.1 This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions and is not to be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions.

1.3.2 The results of the test are permitted to be used as elements of a fire hazard assessment or a fire risk assessment that takes into account all factors that are pertinent to an assessment of the fire hazard or fire risk of a particular end use.

1.3.3* This standard does not purport to address all safety problems associated with its use.

1.3.4 The user of this standard is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

1.3.5 The fundamental assumption inherent in the test is that critical radiant flux is one measure of the sensitivity to flame spread of floor covering systems located in a building corridor.

1.3.6 The test is suitable for regulatory statutes, specification acceptance, design purposes, or development and research.

1.3.7 The test is applicable to floor covering system specimens that follow or simulate accepted installation practice.

1.3.8 Tests on the individual elements of a floor system are not valid for evaluation of the flooring system.

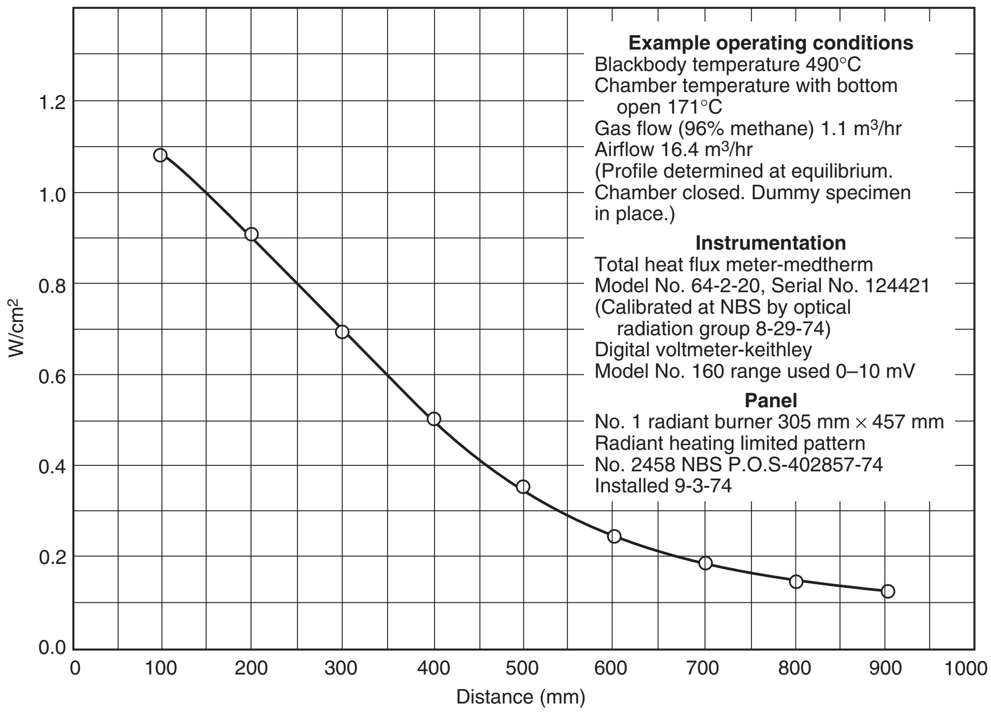
1.4 Summary of Test Method. The basic elements of the test chamber include an air–gas–fueled radiant heat energy panel inclined at 30 degrees to and directed at a horizontally mounted floor covering system specimen.

1.4.1 The radiant panel generates a radiant energy flux distribution along the 1000 mm length of the test specimen from a nominal maximum of 1.0 W/cm^2 to a minimum of 0.1 W/cm^2.

1.4.2 The test is initiated by open-flame ignition from a pilot burner.

1.4.3 The distance burned to flameout is converted to W/cm^2 from the flux profile graph shown in Figure 1.4.3 and is reported as critical radiant flux W/cm^2.

1.4.4 The specimen can be mounted over underlayment or over a simulated concrete structural floor, bonded to a simulated structural floor, or otherwise mounted in a typical and representative way.



Δ **FIGURE 1.4.3 Standard Radiant Heat Energy Flux Profile.**

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. (Reserved)

2.3 Other Publications.

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM C1186, *Standard Specification for Flat Fiber-Cement Sheets*, 2008 (2016).

ASTM C1288, *Standard Specification for Fiber-Cement Interior Substrate Sheets*, 2017.

ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*, 2019a.

2.3.2 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA *101*®, *Life Safety Code*®, 2021 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2 Shall. Indicates a mandatory requirement.

3.2.3 Should. Indicates a recommendation or that which is advised but not required.

3.2.4 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1 Blackbody Temperature. The temperature of a perfect radiator having a surface with an emissivity of unity and, therefore, a reflectivity of zero (0).

3.3.2 Critical Radiant Flux. The level of incident radiant heat energy in units of W/cm^2 on a floor-covering system at the most distant flameout point. [***101***, 2021]

3.3.3* Flameout. The time period measured from the point in time identified as time zero at which the specimen is moved into the chamber and the door is closed to the point in time at which the last vestige of flame or glow disappears from the surface of the test specimen, frequently accompanied by a final puff of smoke.

3.3.4 Floor Covering. An essentially planar material with a small thickness in comparison to its length or width, which is laid on a floor to enhance the beauty, comfort, and utility of the floor.

3.3.5 Floor Covering System. A single material, composite, or assembly composed of the floor covering and related installation components such as adhesive or cushion, if any.

3.3.6 Flooring. A primary floor surface or a final floor surface.

3.3.7 Flux Profile. The curve of incident radiant heat energy on the specimen plane relative to the distance from the point of initiation of flaming ignition (i.e., 0 mm).

3.3.8 Standard Simulated Concrete Subfloor. See 5.2.3.

3.3.9 Total Flux Meter. The instrument used to measure the level of radiant heat energy incident on the specimen plane at any point.

Chapter 4 Test Apparatus

4.1 Radiant Panel Test Apparatus. The apparatus shall be as shown in Figure 4.1(a) and Figure 4.1(b).

4.2 Test Chamber. The flooring radiant panel test chamber employed for this test shall be located in a draft-protected laboratory.

4.2.1 The flooring radiant panel test chamber shall consist of an enclosure 1400 mm ± 10 mm long × 500 mm ± 10 mm wide × 710 mm ± 10 mm high above the test specimen as indicated in Figure 4.2.1(a) and Figure 4.2.1(b).

4.2.1.1 The sides, ends, and top shall be of 13 mm calcium silicate board with a nominal density insulating material of 740 kg/m^3 and shall have a thermal conductivity at 177°C of 0.128 W/(m·K).

4.2.1.2 One side shall be provided with a draft-tight, fire-resistant glass window nominally 100 mm × 1100 mm so that the entire length of the test specimen can be observed from outside the fire test chamber.

4.2.1.3 On the side specified in 4.2.1.2 and below the observation window, a door shall be there that, when open, allows the specimen platform to be moved out for mounting or removal of test specimens.

FIGURE 4.1(a) Flooring Radiant Panel Test Apparatus.

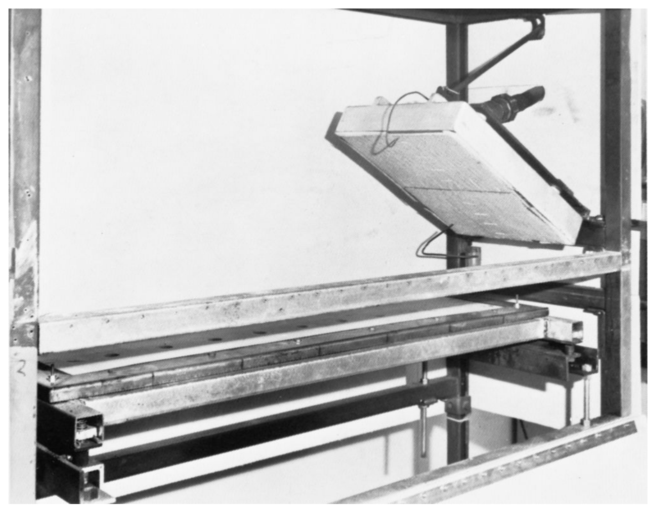


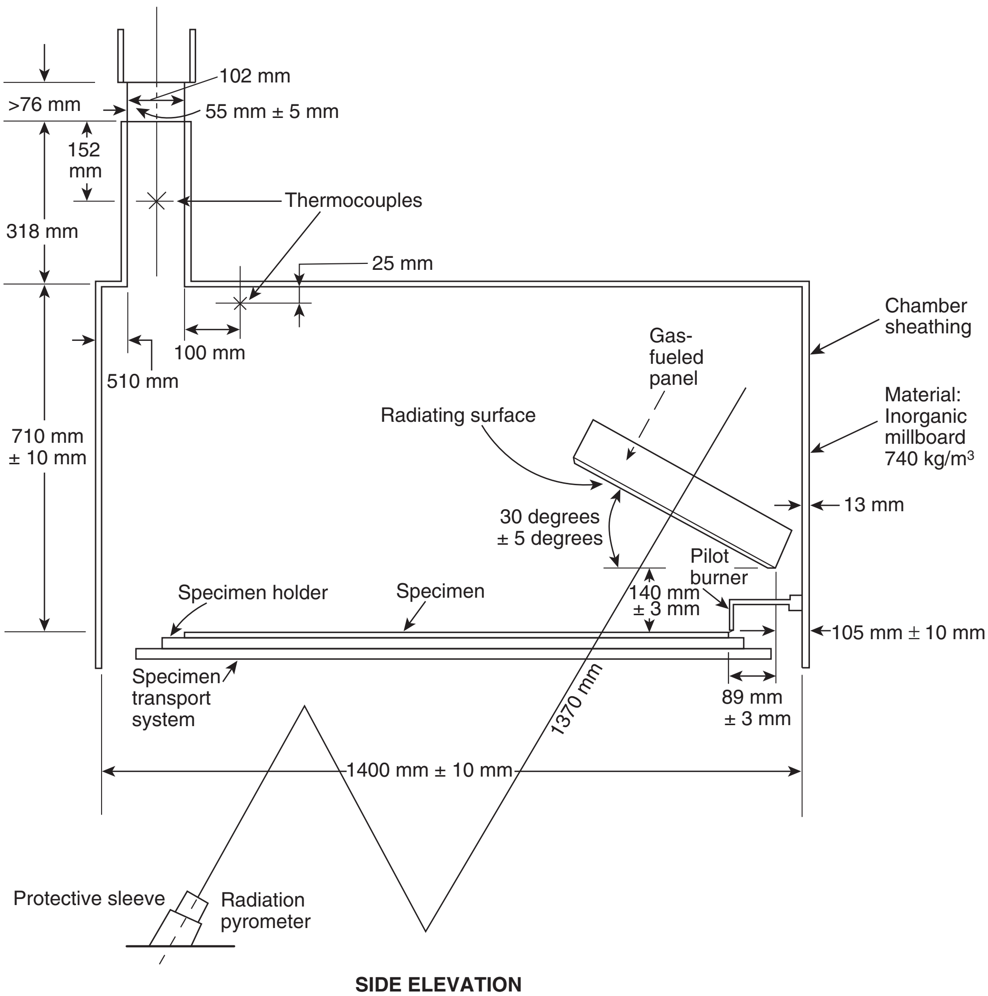
FIGURE 4.1(b) Flooring Radiant Panel Test Apparatus Showing Carpet Specimen and Gas-Fueled Panel.

4.2.1.4 Where necessary for observation, a draft-tight, fire-resistant observation window shall be installed at the low flux end of the chamber.

4.2.2 The bottom of the test chamber shall consist of a sliding steel platform that has provisions for rigidly securing the test specimen holder in a fixed and level position.

4.2.2.1 The test specimen holder shall be level when in place and shall be secured to the specimen mounting platform.

4.2.2.2 The free, or air access, area around the platform shall be in the range from 230,000 mm^2 to 322,500 mm^2.



Δ **FIGURE 4.2.1(a) Side Elevation of Flooring Radiant Panel Tester Schematic.**

4.2.3 The top of the chamber shall have an exhaust stack with interior dimensions of 102 mm ± 3 mm wide × 380 mm ± 3 mm deep × 318 mm ± 3 mm high at the opposite end of the chamber from the radiant panel.

4.3 Radiant Heat Energy Source.

Δ **4.3.1** The radiant heat energy source shall be a panel consisting of a porous material mounted in a cast-iron frame or steel frame and having a radiation surface of 305 mm × 457 mm.

4.3.2 The radiant heat energy source shall be capable of operating at temperatures up to 816°C.

4.3.3 The panel fuel system shall consist of the following:

(1) Venturi-type aspirator for mixing gas and air at atmospheric pressure
(2) Clean, dry air supply capable of providing 28.3 m^3/hr at 76 mm of water column at normal temperature and pressure (NTP)
(3) Instrumentation for monitoring and controlling the flow of fuel to the panel

4.3.4 The radiant heat energy panel shall be fired by propane, methane, or natural gas.

4.3.5 The radiant heat energy panel shall be mounted at an angle of 30 degrees ± 5 degrees to the horizontal specimen plane.

4.3.5.1 The horizontal distance from the zero (0) mark on the specimen fixture to the bottom edge (projected) of the radiating surface of the panel shall be 89 mm ± 0.3 mm.

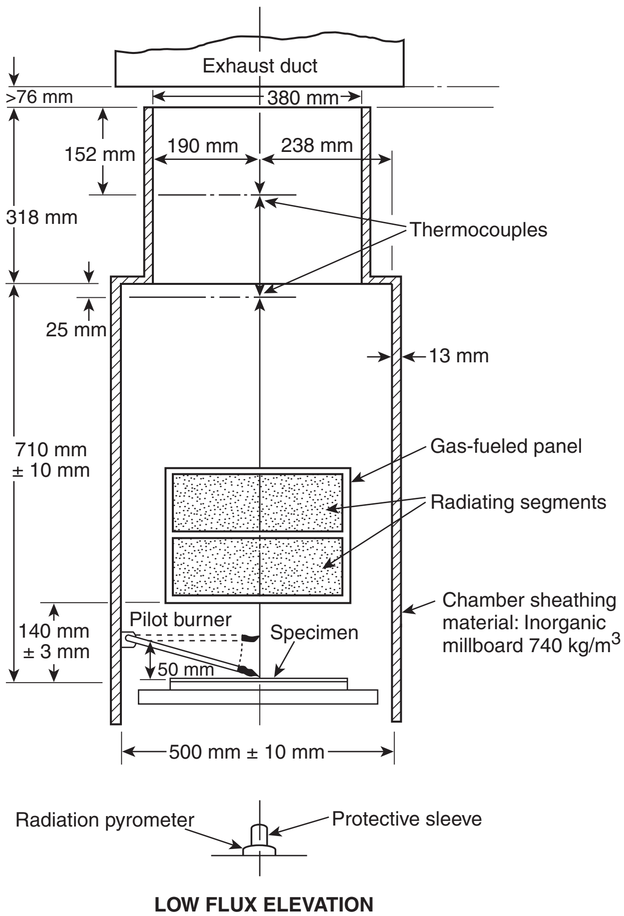
4.3.5.2 The panel-to-specimen vertical distance shall be 140 mm ± 0.3 mm *[see Figure 4.2.1(a) and Figure 4.2.1(b)].*

4.3.5.3 The angle and dimensions specified in 4.3.5 through 4.3.5.2 shall be followed to obtain the required radiant flux profile.

4.3.6 The radiation pyrometer for standardizing the thermal output of the panel shall be capable of viewing a circular area 178 mm to 254 mm in diameter at a nominal distance of 1.37 m.

Δ **4.3.7** The radiation pyrometer shall be calibrated over an operating blackbody temperature range of 490°C to 510°C.

4.3.8 A high impedance voltmeter or potentiometric voltmeter with a millivolt range shall be used to monitor the output of the radiation pyrometer described in 4.3.6.



Δ **FIGURE 4.2.1(b) Low Flux Elevation of Flooring Radiant Panel Tester Schematic.**

4.4* Specimen Holder. The specimen holder shall be constructed from heat-resistant stainless steel having a thickness of 1.98 mm ± 0.2 mm and an overall dimension of 1140 mm × 320 mm ± 20 mm, as illustrated in Figure 4.4, with a specimen opening of 200 mm ± 3 mm × 1000 mm +15 mm/–0 mm.

4.4.1 Six slots shall be cut in the flange on either side of the holder to reduce warping.

4.4.2 The holder shall be fastened to the platform with two stud bolts at each end.

4.5 Pilot Burner. The pilot burner used to ignite the specimen shall be a nominal 6 mm inside diameter, 10 mm outside diameter stainless steel tube line burner having 19 evenly spaced 0.7 mm diameter (No. 70 drill) holes drilled radially along the centerline and 16 evenly spaced 0.7 mm diameter (No. 70 drill) holes drilled radially 60 degrees below the centerline as illustrated in Figure 4.5.

4.5.1 In operation, the gas flow shall be adjusted to a flow rate of 0.085 m^3/hr to 0.100 m^3/hr (air scale).

4.5.2 With the gas flow adjusted in accordance with 4.5.1 and the pilot burner in the test position, the pilot flame shall extend nominally from 63.5 mm ± 10 mm at either end to nominally 127 mm ± 10 mm at the center.

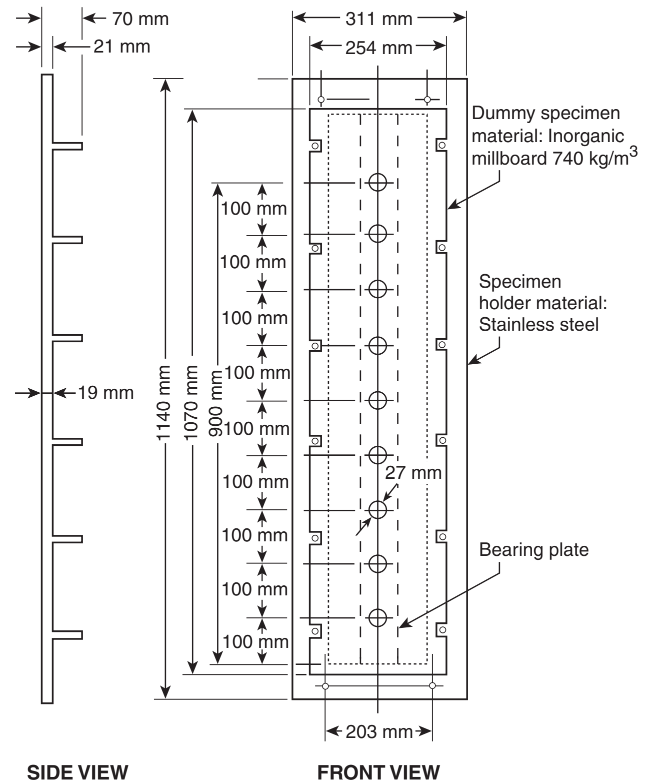
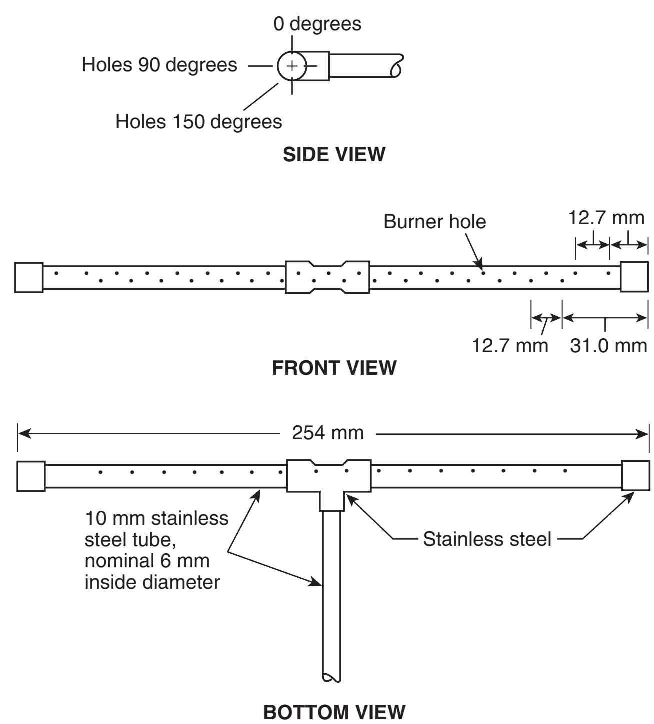


FIGURE 4.4 Dummy Specimen in Specimen Holder.



Notes:
1. All holes No. 70; drill 0.7 mm diameter.
2. All joints silver soldered, heliarced, or otherwise appropriately sealed.

FIGURE 4.5 Pilot Burner.

4.5.3 The pilot burner shall be positioned no more than 5 degrees from the horizontal so that the flame generated impinges on the specimen at the zero (0) distance burned point *[see Figure 4.2.1(a) and Figure 4.2.1(b)]*.

4.5.4 When not being applied to the specimen, the burner shall be capable of being moved at least 50 mm away from the specimen.

4.5.5 The holes in the pilot burner shall be kept clean.

4.5.6 A soft wire brush shall be used to remove surface contaminants.

4.5.7 Nickel–chromium or stainless steel wire or its equivalent with an outside diameter of 0.5 mm shall be used for opening the holes.

4.6 Thermocouples.

4.6.1 A 3.2 mm stainless steel–sheathed, grounded junction, Chromel-Alumel thermocouple shall be located in the flooring radiant panel test chamber. *[See Figure 4.2.1(a) and Figure 4.2.1(b).]*

4.6.1.1 The thermocouple shall be kept clean to ensure the accuracy of the readout.

4.6.1.2 The chamber thermocouple shall be located in the longitudinal central vertical plane of the chamber 25 mm down from the top and 102 mm back from the inside of the exhaust stack.

4.6.2 An indicating potentiometer with a range of 100°C to 500°C shall be used to determine the chamber temperature prior to the test.

4.7* Exhaust Hood.

4.7.1 An exhaust duct meeting the following criteria shall be used to remove combustion products from the chamber:

(1) It shall have a capacity of 28.3 NTP m^3/min to 85 NTP m^3/min, decoupled from the chamber stack by at least 76 mm on all sides.
(2) It shall have an effective canopy area larger than the plane area of the chamber with the specimen platform in the out position.

4.7.2 Prior to igniting the panel, the airflow rate shall be 76.2 m/min ± 15.2 m/min when measured as follows:

(1) A dummy specimen shall be in place.
(2) The temperature of the airflow through the exhaust duct shall be at room temperature.
(3) A hot wire anemometer with an accuracy of ±0.1 m/sec shall be used for this measurement.
(4) The hot wire anemometer shall be inserted into the center of the stack opening at a distance of 152 mm down from the top of the stack opening.
(5) The hot wire anemometer

4.7.3 The hot wire anemometer shall have an accuracy of ±0.1 m/sec.

4.8 Dummy Specimen.

4.8.1 The dummy specimen, which is used in the flux profile determination, shall be made of 19 mm inorganic calcium silicate board with a nominal density of 740 kg/m^3 *(see Figure 4.4).*

4.8.2 The specimen shall measure 250 mm × 1070 mm with 27 mm diameter holes located on the centerline at points ranging from 100 mm to 900 mm, spaced in 100 mm increments, starting at the maximum flux end of the specimen.

4.8.3 To provide proper and consistent seating of the flux meter in the hole openings, a stainless steel or galvanized steel bearing plate shall be mounted and secured firmly to the underside of the calcium silicate board with holes corresponding to those specified in 4.8.1.

4.8.3.1 The bearing plate shall run the length of the dummy specimen and shall have a minimum width of 76 mm.

4.8.3.2 The thickness of the bearing plate shall vary to maintain the flux meter height specified in 6.1.7.1 up to the maximum of 3.2 mm.

Δ **4.8.3.3*** The total heat flux transducer used to determine the flux profile of the chamber in conjunction with the dummy specimen *(see 4.3.8)* shall have a range of 0 W/cm^2 to 1.5 W/cm^2 and shall be calibrated over the operating flux level range of 0.10 W/cm^2 to 1.5 W/cm^2.

4.8.3.4 A source of cooling water 15°C to 25°C shall be provided for the total heat flux transducer.

4.8.3.5 A high impedance voltmeter or potentiometric voltmeter with a range of 0 mV to 10 mV and reading to 0.01 mV shall be used to measure the output of the total heat flux transducer during the flux profile determination.

4.9 Timer. A timer reading to the nearest 0.1 minute shall be used to measure preheating, pilot contact, and flameout times.

Chapter 5 Test Specimens

5.1 Sampling Procedure. The sample selected for testing shall be representative of the product.

5.2* Specimen Size and Mounting.

5.2.1 The test specimen shall be a floor covering system sized to provide for adequate clamping in the mounting frame.

5.2.1.1 The specimen's minimum dimensions shall exceed the frame width (200 mm nominal) and length (1000 mm nominal) by about 50 mm.

5.2.1.2 Holes shall be made in the specimen to accommodate the mounting frame bolts. *(See Figure 4.4.)*

5.2.2 The floor covering system specimen shall simulate actual installation practice.

Δ **5.2.3 Standard Simulated Concrete Floor.** Where a standard simulated concrete floor is used, it shall consist of a fiber cement board with the following specifications:

(1) The board shall be uncoated.
(2) The board shall be nominally 6.3 mm thick.
(3) The board shall have a density of 1442 kg/m^3 ± 160 kg/m^3.
(4) The board shall meet the requirements of either ASTM C1186, *Standard Specification for Flat Fiber-Cement Sheets*, Grade II, or ASTM C1288, *Standard Specification for Fiber-Cement Interior Substrate Sheets.*

(5) The board shall not be required to meet the requirements of ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.*

5.2.4 Carpet.

Δ **5.2.4.1 Simulated Carpet and Cushion Pad Over Concrete.** Carpet specimens shall be cut in the machine direction. The specimen holder shall be inverted on a clean, flat surface and the test specimen then inserted into the holder.

Δ **(A)*** The cushion pad shall be inserted with the pattern side facing the carpet, followed by nominal 6.3 mm thick fiber cement board complying with 5.2.3 and an inorganic millboard a nominal thickness of 13 mm and a nominal density of 0.74 g/cm^3.

(B) The steel bar clamps shall be placed across the assembly and tightened. The test assembly shall be mounted on the specimen transport frame so that the pile lay faces the panel.

5.2.4.2 Simulated Carpet With or Without Integral Cushion Pad Bonded to Concrete. Carpet specimens shall be cut in the machine direction. The adhesive used shall be that recommended by the carpet manufacturer. In the absence of a manufacturer's recommendation, a multipurpose adhesive typical of commercial installation shall be selected by the laboratory.

Δ **(A)** The adhesive shall be applied to the smooth side of the fiber cement board complying with 5.2.3 in accordance with the directions provided by the adhesive manufacturer. In the absence of a manufacturer's recommendation, the adhesive shall be applied with a 3.2 mm V-notched trowel. A nominal 9.1 kg roller with a diameter of 76 mm and a width as close as practical to that of the specimen shall be used to apply the adhesive across the top of the specimen to ensure good contact with the substrate.

Δ **(B)*** Specimens shall be permitted to be stacked under a dead load after bonding specimens to the fiber cement board for no more than 24 hours prior to conditioning. The specimen shall be mounted in the testing frame in accordance with 5.2.4.1 and shall be tested in accordance with standard procedure.

Δ **5.2.4.3 Other Carpet.** The actual subfloor shall be permitted to be substituted for the standard fiber cement board substrate.

5.2.5 Tiles.

5.2.5.1 Samples shall represent the largest dimension tile manufactured.

5.2.5.2 Samples selected from roll or sheet goods prior to cutting into tiles shall be permitted as an alternative to 5.2.5.1. The test results are applicable to identical tiles of smaller dimensions.

5.2.5.3 The specimen shall be mounted so that the first joint is located at the farthest distance from the zero point.

5.2.5.4 Where the tile is not wide enough to cover the width of the specimen holder, the tile shall be mounted to include a longitudinal joint at the center line of the specimen holder.

5.2.5.5 Where the tiles are not glued, the edges of the specimen shall be mechanically secured to the substrate.

5.2.6 Planks, Tiles, Cove, or Base. A flooring material intended for installation in the form of planks, tiles, cove, or base having an overall width greater than the opening in the specimen holder, 200 mm, shall include at least one longitudinal joint located at the approximate centerline of the specimen holder. For materials having a width less than the opening of the specimen holder, 200 mm, the joints shall be located as necessary to complete the specimen assembly.

5.2.7* Resilient Flooring. Commercial installation practice shall be followed or simulated or both.

5.2.7.1 The laminate specimens shall be prepared with a longitudinal seam near the centerline of the specimen holder and shall conform to the following:

(1) The manufacturer recommendations for sealing the seams shall be followed.
(2) The laminate and the proposed cushion shall be conditioned in accordance with Section 5.3 for a minimum of 48 hours.
(3) Laminate specimens shall be mounted by inverting the specimen holder on a clean, flat surface.
(4) Test specimens shall be placed in the specimen holder.
(5) The cushion pad recommended by the manufacturer shall be mounted with the pattern side facing the laminate followed by a fiber-cement board complying with 5.2.3 and inorganic millboard with a nominal 13 mm thickness and a nominal density of 0.58 g/cm^3.
(6) Steel bar clamps shall be placed across the assembly and tightened firmly.
(7) The test assembly shall be mounted on the specimen transport frame so that the laminate decor layer faces the panel.

5.2.7.2 Laminate with an attached cushion shall be mounted without the addition of a separate cushion.

5.2.7.3 Where a specified cushion is absent, a closed-cell foam pad with a thickness of 1.5 to 2.5 mm and a density of 35 ± 5 kg/m^3 shall be used.

5.2.8 Laminate Flooring. Laminate flooring shall be mounted over the proposed cushion or simulated concrete subfloor.

5.2.8.1 The laminate specimens shall be prepared with a longitudinal seam near the centerline of the specimen holder and shall conform to the following:

(1) The manufacturer recommendations for sealing the seams shall be followed.
(2) The laminate and the proposed cushion shall be conditioned in accordance with Section 5.3 for a minimum of 48 hours.
(3) Laminate specimens shall be mounted by inverting the specimen holder on a clean, flat surface.
(4) Test specimens shall be mounted in the specimen holder.
(5) The cushion pad recommended by the manufacturer shall be mounted with the pattern side facing the laminate followed by a fiber-cement board complying with 5.2.3 and inorganic millboard with a nominal 13 mm thickness and a nominal density of 0.58 g/cm^3.
(6) Steel bar clamps shall be placed across the assembly and tightened firmly.
(7) The test assembly shall be mounted on the specimen transport frame so that the laminate decor layer faces the panel.

5.2.8.2 Laminate with an attached cushion shall be mounted without the addition of a separate cushion.

5.2.8.3 Where a specified cushion is absent, a closed-cell foam pad with a thickness of 1.5 to 2.5 mm and a density of 35 ± 5 kg/m^3 shall be used.

5.2.9 Hardwood Flooring. Hardwood floor shall be nailed to a plywood subfloor, sanded, and finished in accordance with standard practice.

5.2.9.1 Commercial installation practice shall be followed or simulated or both.

5.2.9.2 Where a typical system is used, the substrate shall be a 16 mm plywood sheet covered with building paper. The oak flooring strips shall be nailed to the plywood and then sanded, sealed, and waxed.

5.2.9.3 The assembly shall be tested with the moisture content of the oak at 7 percent to 8 percent.

5.2.10 Number of Specimens. A minimum of three specimens per sample shall be tested.

5.3 Specimen Conditioning. Test specimens shall be conditioned at 21°C ± 3°C and a relative humidity of 50 percent ± 5 percent horizontally or vertically in open racks for optimum air circulation for a minimum of 48 hours.

5.3.1 Carpet specimens that have been glued down shall be conditioned for a minimum of 96 hours.

Chapter 6 Radiant Heat Energy Flux Profile Standardization

6.1 Procedure.

6.1.1 In a continuing program of tests, the flux profile shall be determined at least weekly.

6.1.2 Where the time interval between tests is greater than 1 week, the flux profile shall be determined at the start of the test series.

6.1.3 The dummy specimen shall be mounted in the mounting frame, and the assembly shall be attached to the sliding platform.

6.1.4 With the sliding platform outside the chamber, the radiant panel shall be ignited.

6.1.4.1 The unit shall heat for 1½ hours.

6.1.4.2 The pilot burner shall be off during the flux profile determination.

6.1.4.3 The fuel mixture shall be adjusted to provide an air-rich flame.

6.1.4.4 Fuel flow shall be set to bring the panel blackbody temperature to 500°C ± 10°C, and the chamber temperature shall be recorded.

6.1.5 When equilibrium has been established, the specimen platform shall be moved into the chamber and the door shall be closed.

6.1.6 The closed chamber shall be allowed to equilibrate for 30 minutes.

6.1.7 The radiant heat energy flux level shall be measured at the 400 mm point with the total flux meter instrumentation.

6.1.7.1 The measurement specified in 6.1.8 shall be accomplished by inserting the flux meter into the opening so that its detecting plane is 1.6 mm to 3.2 mm above and parallel to the plane of the dummy specimen and then reading its output after 30 seconds ± 10 seconds.

6.1.7.2 If the level is within the limits specified in 6.1.8, the flux profile determination shall be started.

6.1.7.3 If the level is not within the limits specified in 6.1.8, the necessary adjustments in panel fuel flow shall be made.

6.1.7.4 Data shall be recorded in a data log. *(See Annex B.)*

6.1.8 The test shall be run under chamber operating conditions that provide a flux profile as shown in Figure 1.4.3, and the radiant heat energy incident on the dummy specimen shall be as follows:

(1) Between 0.87 W/cm^2 and 0.95 W/cm^2 at the 200 mm point
(2) Between 0.48 W/cm^2 and 0.52 W/cm^2 at the 400 mm point
(3) Between 0.22 W/cm^2 and 0.26 W/cm^2 at the 600 mm point

6.1.9 The flux meter shall be inserted into the 100 mm opening following the procedure outlined in 6.1.7.

6.1.9.1 The millivolt (mV) output shall be read at 30 seconds ± 10 seconds.

6.1.9.2 The procedure outlined in 6.1.9 shall be repeated at the 200 mm point.

6.1.9.3 The 300 mm to 900 mm flux levels shall be determined in the manner specified in 6.1.9.

6.1.9.4 Following the 900 mm measurement, a reading check shall be made at 400 mm to verify that the test chamber is in calibration when it is within the limits set forth in 6.1.8 and the profile determination is completed.

6.1.9.5 If the calibration requirement of 6.1.9.4 cannot be achieved, the fuel flow shall be adjusted, allowing 30 minutes for equilibrium, and the procedure shall be repeated.

6.1.10 The radiant heat energy flux data shall be plotted as a function of distance along the specimen plane.

6.1.10.1 A smooth curve shall be developed by drawing through the data points.

6.1.10.2 The curve developed in 6.1.10.1 shall be designated the flux profile curve.

6.1.11 The open chamber temperature and the radiant panel blackbody temperature identified with the standard flux profile shall be determined by opening the door and moving the specimen platform outside the chamber.

6.1.11.1 The chamber shall be allowed to equilibrate for 30 minutes.

6.1.11.2 The chamber temperature and the optical pyrometer output that indicate the panel blackbody temperature shall be read and recorded in degrees Celsius.

N **6.2 Calibration of Radiation Instrumentation.**

N **6.2.1 Radiation Pyrometer.**

N **6.2.1.1** The radiation pyrometer shall be calibrated by means of a conventional blackbody enclosure placed within a furnace and maintained at the three following uniform temperatures: 490°C (± 2°C), 500°C (± 2°C), and 510°C (± 2°C).

N **6.2.1.2** The blackbody enclosure shall consist of a closed chromel metal cylinder with a small sight hole at one end.

N **6.2.1.3** The radiation pyrometer shall be located on the opposite end of the cylinder where a thermocouple indicates the blackbody temperature, with the thermocouple placed within a drilled hole and in good thermal contact with the blackbody.

N **6.2.1.4** The output of the radiation pyrometer shall be read when the blackbody enclosure has reached the appropriate temperature equilibrium.

N **6.2.1.5** The same procedure shall be used at each of the temperatures indicated in 6.2.1.1.

N **6.2.1.6*** An acceptable alternative to the procedure in 6.2.1.1 through 6.2.1.5 shall be the use of an outside agency accredited by a recognized accreditation body.

N **6.2.2 Total Heat Flux Meter.**

N **6.2.2.1** The total heat flux meter shall be calibrated using transfer calibration methods for comparison with a dedicated calibrated flux meter provided by an outside agency that is accredited by a recognized accreditation body.

N **6.2.2.2** The total heat flux meter calibration shall use the flooring radiant panel test apparatus as the heat source.

N **6.2.2.3** Measurements shall be made at each of the nine dummy specimen positions described in Section 4.8 and the mean value of these results shall constitute the final calibration.

N **6.2.2.4** The laboratory shall maintain a dedicated calibrated reference flux meter to be used exclusively for comparison with any one or more working flux meters when needed.

N **6.2.2.5** The working flux meters shall be calibrated at least annually.

N **6.2.3 Potentiometer.**

N **6.2.3.1** The indicating potentiometer used to measure the output of the radiation pyrometer (in 6.2.1) and the total heat flux meter (in 6.2.2) shall be calibrated at least once per year.

N **6.2.3.2** The potentiometer shall be calibrated using a calibrator with a minimum resolution of 0.01 mV.

N **6.2.3.3** The calibrator in 6.2.3.2 shall be traceable to an outside agency accredited by a recognized accreditation body.

N **6.2.3.4*** An acceptable alternative to the procedure in 6.2.3.1 through 6.2.3.3 shall be the use of an outside agency accredited by a recognized accreditation body.

Chapter 7 Test Procedure

7.1 Pretest Heating. With the sliding platform outside the chamber, the radiant panel shall be ignited.

7.1.1 The unit shall be allowed to heat for 1½ hours.

7.1.2 A sheet of inorganic millboard, such as calcium silicate or the equivalent, shall be used to cover the opening when the hinged portion of the front panel is open and the specimen platform is moved out of the chamber.

7.1.3 The millboard specified in 7.1.2 shall be used to prevent heating of the specimen and to protect the operator.

7.1.4 The panel blackbody temperature and the chamber temperature shall be read.

7.1.5 If the temperature readings specified in 7.1.4 are within ±5°C of those determined in accordance with 6.1.11, the chamber shall be considered ready for use.

7.2 Sample Mounting. The sample holder shall be inverted on a workbench, and the flooring system shall be inserted.

7.2.1 The steel bar clamps shall be placed across the back of the assembly, and the nuts shall be tightened firmly.

7.2.2 The sample holder shall be returned to its upright position, the test surface shall be cleaned with a vacuum, and the sample holder shall be mounted on the specimen platform.

7.2.3 Carpet specimens shall be brushed to raise the pile to its normal position.

7.3 Ignition of Pilot Burner. The following steps shall be taken:

(1) The pilot burner shall be ignited and kept at least 50 mm away from the specimen.
(2) The specimen shall be moved into the chamber and within 3 seconds the door shall be closed and the timer started. This is time zero.

7.3.1 The timer shall be started.

7.3.2 After 5 minutes, the chamber shall be considered to be preheated.

7.3.3 With the pilot burner on and at least 50 mm away from the specimen, the pilot burner flame shall be brought into contact with the specimen at the zero (0) mm mark.

7.3.4 The pilot burner flame shall remain in contact with the specimen for 5 minutes.

7.3.5 The pilot burner then shall be removed to a position at least 50 mm away from the specimen, and the pilot burner flame shall be extinguished.

7.4 Flame Propagation of Specimen. If the specimen does not propagate flame within 5 minutes following pilot burner flame application, the test shall be terminated.

7.4.1 For specimens that do propagate flame, the test shall be continued until the flame goes out or until the flame front advances the full length of the specimen.

7.4.2 Significant phenomena such as melting, blistering, and penetration of flame to the substrate shall be observed and recorded.

7.5 Completion of Test.

7.5.1 When the test is completed, the door shall be opened and the specimen platform shall be pulled out.

7.5.2 The protective inorganic millboard sheet shall be put in place.

7.6 Data Collection and Recording. The distance burned shall be measured (i.e., the point of farthest advance of the flame front to the nearest 1 mm).

7.6.1 The distance to W/cm^2 critical radiant heat flux at flameout shall be converted from the flux profile curve.

7.6.2 Data shall be recorded in a data log. *(See Annex B.)*

7.7 Removal of Specimen. The specimen and its mounting frame shall be removed from the movable platform.

7.8 Subsequent Testing.

7.8.1 The subsequent test shall be started as soon as the panel blackbody temperature and the chamber temperature are verified *(see 6.1.11)*.

7.8.2 The test assembly shall be at room temperature prior to startup.

7.9 Extent of Flame Travel After a Prescribed Period.

7.9.1 Where the extent of flame travel after a prescribed burning period (e.g., 15 minutes) is measured for fire hazard assessment purposes, it shall be performed using the metal scale in accordance with 7.9.2.

7.9.2 A metal scale marked at 10 mm intervals shall be installed on the back of the platform or on the back wall of the chamber.

7.9.3 The distance measured in 7.9.1 shall be converted into a radiant flux.

Chapter 8 Calculations

8.1 General.

8.1.1 Results obtained from all specimens tested shall be reported.

8.1.2 Three specimens for the calculations shall be selected, and an explanation of why they were chosen shall be provided.

8.1.3 The mean, the standard deviation, and the coefficient of variation of the critical radiant flux test data on all specimens shall be calculated.

8.2 Formulas. The following formulas shall be used:

[8.2]

$$S = \sqrt{\frac{\left(\sum X^2 - n\bar{X}^2\right)}{n-1}} \text{ and } V = \frac{S}{\bar{X}} \times 100$$

where:
S = estimated standard deviation
X = value of single observation
n = number of observations
$\bar{X}$ = arithmetic mean of the set of observations
V = coefficient of variation

Chapter 9 Report

9.1 Required Information. The report shall include the following:

(1) Description of the floor covering system tested, including its elements
(2) Description of the procedure used to assemble the floor covering system specimen
(3) Number of specimens tested
(4) Individual values of critical radiant flux
(5) Average critical radiant flux, standard deviation, and coefficient of variation
(6) Observations of the burning characteristics of the specimen during the testing exposure, such as premature ignition during the initial 5-minute heating period, delamination, melting, sagging, and shrinking
(7) For tiles, the finished dimensions of the tile tested and a statement that test results are applicable to tiles of smaller dimensions
(8) The extent of flame travel and radiant flux after a prescribed period, if measured

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1.1 This test method is technically similar to ASTM E648, *Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source*, and test results obtained with this test method should be considered equivalent to test results obtained using ASTM E648. Multiple codes and standards, including NFPA *101* and *NFPA 5000*, reference both test methods in the same section.

A.1.1.2 The imposed radiant flux simulates the thermal radiation levels likely to impinge on the floors of a building whose upper surfaces are heated by flames, hot gases, or both from a fully developed fire in an adjacent room or compartment.

A.1.2.1 Annex D provides information on the proper application and interpretation of the results of this test.

A.1.3.3 Specific safety precautions are provided in Annex E.

Δ **A.3.2.1 Approved.** The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment, or materials, the "authority having jurisdiction" may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The "authority having jurisdiction" may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.3.3 Flameout. See Section 7.6.

A.4.4 An acceptable heat-resistant stainless steel is AISI Type 300 (UNA-NO8 330) or equivalent. This reference is provided for informational purposes only and has not been independently verified, certified, or endorsed by NFPA or any of its technical committees.

A.4.7 An acceptable anemometer is an Omega HH-615 HT hot-wired anemometer manufactured by Omega Engineering Inc., Stamford, CT. This reference is provided for informational purposes only and has not been independently verified, certified, or endorsed by NFPA or any of its technical committees.

A.4.8.3.3 An acceptable heat flux transducer is a Schmidt-Boelter–type Medtherm 64-2-20 manufactured by Medtherm Corporation, Huntsville, AL. This reference is provided for informational purposes only and has not been independently verified, certified, or endorsed by NFPA or any of its technical committees.

A.5.2 Typical examples of floor covering systems are as follows:

(1) Hardwood floor nailed to a plywood subfloor that is sanded and finished according to standard practice
(2) Carpet with or without integral cushion pad bonded to a high-density inorganic sheet simulating a concrete subfloor
(3) Carpet mounted over the actual cushion pad or carpet mounted over the actual subfloor to be used in the installation
(4) Resilient floor bonded to a high-density inorganic sheet simulating a concrete subfloor
(5) Laminate floor mounted over the proposed cushion or simulated concrete floor

Δ **A.5.2.4.1(A)** It should be noted that fiber cement board could spall during a test. This can be avoided by heating the board for 12 hours at 163°C.

A.5.2.4.2(B) See Section 5.3 for conditioning requirements.

Δ **A.5.2.7** In most instances, this type of installation practice necessitates bonding to the standard fiber cement substrate.

N **A.6.2.1.6** Examples of recognized accreditation bodies include the National Institute of Standards and Technology (NIST) and calibration laboratories accredited to ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, by an accreditation body complying with ISO/IEC 17011, *Conformity assessment — Requirements for accreditation bodies accrediting conformity assessment bodies*. Calibration laboratories should be accredited by an accreditation body recognized by the International Laboratory Accreditation Cooperation (ILAC).

N **A.6.2.3.4** Examples of recognized accreditation bodies are the National Institute of Standards and Technology (NIST) and calibration laboratories accredited to ISO/IEC Standard 17025, *General requirements for the competence of testing and calibration laboratories*, by an accreditation body complying with ISO/IEC Standard 17011, *Conformity assessment — Requirements for accreditation bodies accrediting conformity assessment bodies*. Calibration laboratories should be accredited by an accreditation body recognized by the International Laboratory Accreditation Cooperation (ILAC).

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Annex B Sample Data Logs

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Data Logs. Sample data logs for a radiant flux profile and a flooring radiant panel test are provided in Figure B.1(a) and Figure B.1(b).

RADIANT FLUX PROFILE DATA LOG

Date ____________________

Blackbody temperature __________ mV __________ °C

Gas flow __________ NTP m^3/hr

Airflow __________ NTP m^3/hr

Room temperature __________ °C

Pressure: Air __________ cm of H_2O; gas __________ cm of H_2O

Flux meter No. __________

Conversion factor from calibration on __________

Distance (cm)	mV	W/cm^2
10		
20		
30		
40		
60		
70		
80		
90		

Signed ____________________

Δ **FIGURE B.1(a) Sample Data Log for Radiant Flux Profile.**

FLOORING RADIANT PANEL TEST DATA LOG

Test No. __________ Date __________ Time __________

Laboratory ____________________

Specimen identification/code No. ____________________

Test Assembly

Panel: Angle __________ degrees; temperature __________ °C

Flow: Gas __________ NTP m^3/hr; air __________ NTP m^3/hr

Pressure, Initial

Air __________ cm of H_2O; gas __________ cm of H_2O

Chamber Temperature

Initial __________ °C; maximum __________ °C

Room temperature __________ °C

Hood draft __________ cm of H_2O

Flame Front Advance

Distance (cm)	Time (minutes)				

Total burn length __________ cm

Critical radiant flux __________ W/cm^2

Flame front out __________ minutes; flux profile reference __________

All flame out __________ minutes

Observations ____________________

Signed ____________________

Δ **FIGURE B.1(b) Sample Data Log for Flooring Radiant Panel Test.**

Annex C Commentary on Critical Radiant Flux Test

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1 Introduction.

C.1.1 The development and behavior of fires in buildings and rooms or compartments are complex phenomena and are not well understood. As a result, efforts to establish safety requirements must, for the present, be based on the selection and use of those components of the fire system that could become involved and that can be regulated. These efforts, together with experienced engineering rationale, must serve until a more valid technical basis for fire engineering design has been determined.

C.1.2 When fire develops in a building, experience suggests that traditional floor covering systems seldom serve as a medium for fire spread during the early stages of a fire. During several fires in the early 1970s, floor covering materials in corridors became involved for considerable distances. The test method described in this standard has been recommended as a means to control potential fire spread in floor covering systems.

C.1.3 Because the quantity and nature of room furnishing items cannot, at present, be controlled with regard to fire involvement of the full room, it is necessary to assume that floor involvement can and will, on occasion, occur. It is appropriate to recommend the application of only those floor covering systems that meet high levels of resistance to fire involvement based on critical radiant flux for use in corridors. Building codes cover interior finish in general, and it appears that only in corridors do the requirements for floor covering systems need to be more restrictive.

C.1.4 This annex is intended to provide information on the technical relevance of the test method to the problem of fires. It is intended to provide both the technical audience and the lay public with a basis for interpreting the significance and limitations of the data resulting from the test.

C.2 Nature of the Test.

C.2.1 Convective heat flow cannot serve as a major feedback mechanism in most cases of fires that involve floor covering systems, because of the buoyancy of the flames and hot gases. Therefore, the horizontal surfaces of building finishes seldom have been recognized as primary hazards in the spread of flames. However, corridor fire tests conducted at the National Institute of Standards and Technology (NIST), together with building fire incidents, indicate that fire spread can occur in corridors exposed to burnout conditions in adjacent rooms. [1, 2]

C.2.1.1 Fires were observed to propagate the full length of the corridor where little, if any, combustible material other than the floor covering system was involved in the corridor finish. Analysis of the measurements made during such tests has made clear the importance of radiant heat transfer from upper corridor surfaces, flame, smoke, and gases in serving a fire support role. Therefore, the sensitivity of a floor covering system to the radiant support of combustion is recommended as a basis for ranking floor covering systems with respect to fire behavior. [3, 4]

C.2.1.2 Critical radiant flux, the heat flux level below which surface flame spread will not occur, was selected as the fire property of controlling importance for a floor covering system. If a room fire does not impose a radiant flux that exceeds this critical level on a corridor floor covering system, flame spread will not occur.

C.2.2 Critical radiant flux does not provide information on the irradiance level to which the flooring is exposed when fire occurs. Irradiance level is influenced largely by other variables, which include the following:

(1) Nature, quantity, and arrangement of the fire load in the compartment where ignition occurs
(2) Ventilation conditions in the portion of the building that becomes exposed to fire
(3) Geometry of the compartment and ventilation passages
(4) Heat release rate of the fire load and the floor covering system
(5) Heat capacity of the enclosing walls, ceiling, and floor

C.3 Experimental Studies of Relevance.

C.3.1 One important fire property of floor covering systems has been identified that, if the effective irradiance level can be predicted when fire occurs, can provide information on the extent of fire spread possibility. The use of this property alone, at least in some cases, is inadequate for the prediction of fire spread under severe exposure conditions. An example follows in C.3.1.1.

Δ **C.3.1.1** Figure C.3.1.1 shows a plot of the maximum heat flux to the floor surface of the NIST full-scale corridor with four 18 kg cribs in the burn room and with no combustible floor covering system or other interior finish present in the corridor. These data were obtained with a fire load in the adjoining room of 10.7 kg/m^2 with a measured burning rate (maximum) of 80 g/sec. The two curves show the envelope resulting from two series of experiments.

C.3.1.2 The data plotted as circles on Figure C.3.1.1 represent the critical radiant flux of 12 floor covering systems versus the extent of flame propagation in the corridor as tested using the full-scale tests. [5] In all cases, the heat flux to the floor covering system at the doorway between the room and the corridor was higher than the critical radiant flux for the material.

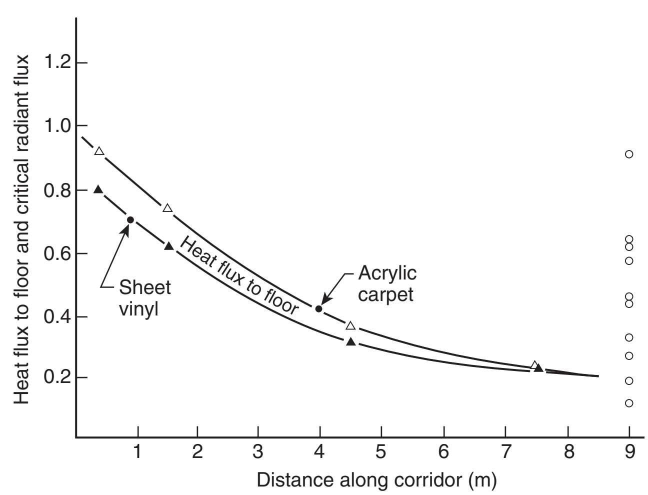

FIGURE C.3.1.1 Critical Radiant Flux of Various Floor Covering Systems Versus the Extent of Flame Propagation in the Corridor.

Therefore, flame spread should be expected to include involvement of the corridor, and that was observed.

C.3.2 It is evident that only two of the 12 floor covering systems stopped burning at distances corresponding to their critical radiant flux as shown on the flux-distance curve for the corridor without combustible linings. The reason for this difference in behavior is that, apparently, the flux to the floor surface was sufficiently augmented by the heat release from the flooring itself after rapid flame spread commenced. This usually followed a period of relatively slow flame spread away from the doorway.

C.3.2.1 In addition, it seems likely that changes in ventilation of the compartment fire could have modified the location at which pyrolysis gases burn (i.e., in the corridor above the floor) and influenced the flame height of the floor fire. These effects greatly increased the radiant flux incident on the floor.

C.3.2.2 To date, the effects noted in C.3.2 and C.2.1 are not well understood, and no firm guidance can be provided on the way they should be introduced to predict the overall behavior of such a fire system.

C.3.3 Other data are available to illustrate the merit of the test under less severe exposure. These data are the result of a series of experiments involving crib or furniture item fires in a room 2.4 m in height with an open door measuring 3.4 m × 2.7 m that had been fitted with floor covering assemblies of known critical radiant flux characteristics. In these tests, the crib or furniture and the floor covering assembly were the only combustibles in the room.

C.3.4 The results of this study have been published, and Figure C.3.4 shows some of the data developed. [6] The curve shown in Figure C.3.4 illustrates the extent of fire propagation from the source as a function of critical radiant flux.

C.3.4.1 The four floor covering systems used were carpets that all qualified as having passed the pill test. The data are interesting, because they show that, under the conditions of the experiments, the distance of fire propagation is inversely related to critical radiant flux.

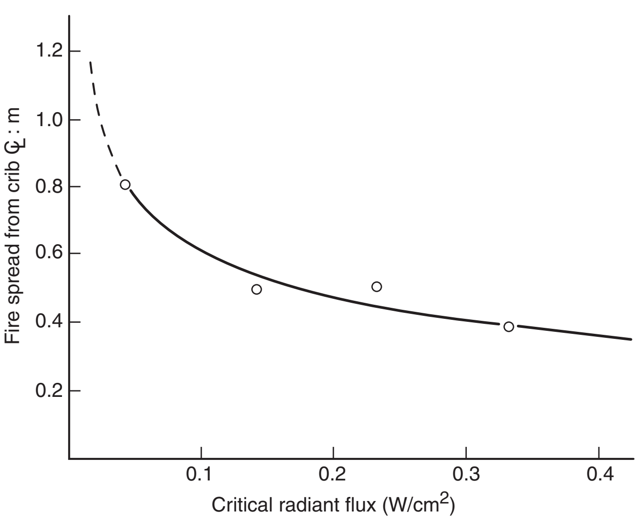

FIGURE C.3.4 Room Burn Tests — Fire Spread from 6.4 kg Cribs.

C.3.4.2 In addition, while not demonstrated by this curve, the data show that the burning ceased at positions on the floor covering system somewhat below those at which flux measurement during the test corresponded to the critical radiant flux of the floor covering system being studied. Therefore, in this situation, which did not involve room flashover, critical radiant flux appears to provide a method of ranking the fire spread behavior of the carpets.

C.3.5 The current version of this test procedure is a result of a recent study conducted at NIST. [7] The purpose of this work was to resolve a perceived problem with ignitability of and continued flame propagation across some carpet specimens and to reduce the variability of test results obtained by different laboratories. As a result, the following three significant changes were made in the standard:

(1) New provisions on specimen preparation and conditioning
(2) Tighter control of the airflow through the chamber during calibration and conduct of the test
(3) Replacement of the propane torch pilot burner with a propane line burner

C.3.5.1 The ignitability and flame propagation issues appear to have been resolved with the use of the new line burner. The variability of test results among different laboratories has been shown to be markedly improved by the aforementioned changes in the standard, at least for one carpet fabric.

C.3.5.2 Previous proficiency rounds performed by the National Voluntary Laboratory Accreditation Program resulted in coefficients of variation ranging from 18 percent to 35 percent; the coefficient of variation obtained using the revised standard was less than 12 percent. A complete discussion of the research conducted by NIST can be found in the report referenced in C.3.5.

C.4 Summary.

C.4.1 It should be recognized that the critical radiant flux test method provides a useful way of ranking floor covering systems on the basis of this important fire property. However, critical radiant flux is only one of several parameters that determine the fire behavior of floor covering systems.

C.4.1.1 Critical radiant flux indicates the threshold above which flame spread occurs. To use this property in fire safety estimates, the probable heat flux exposure to the floor from the initiating fire needs to be judged. Such estimates must, for the present, depend on judgment or on data from prototype experiments.

C.4.1.2 Once a fire is initiated in a corridor, other parameters such as critical radiant flux for ignition and rate of flame spread, as well as corridor configuration and the presence of combustibles such as ceiling and wall linings, can be important in determining the ultimate spread of fire.

C.4.2 Because many parameters are involved in determining fire behavior, establishment of criteria for critical radiant flux of floor covering systems can be expected to reduce, but not to eliminate, the incidence of extensive flame spread of floor covering systems.

C.4.3 In this procedure, the specimens are subjected to one or more specific sets of laboratory fire test exposure conditions. If different test conditions are substituted or the anticipated end-use conditions are changed, it might not be possible to predict