NFPA 268
Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source

1996 Edition

NFPA®

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

IMPORTANT NOTICE ABOUT THIS DOCUMENT

NFPA codes, standards, recommended practices, and guides, of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its codes and standards.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this document available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the NFPA list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

NOTICES

All questions or other communications relating to this document and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

Users of this document should be aware that this document may be amended from time to time through the issuance of Tentative Interim Amendments, and that an official NFPA document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments then in effect. In order to determine whether this document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments, consult appropriate NFPA publications such as the *National Fire Codes®* Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed above.

A statement, written or oral, that is not processed in accordance with Section 5 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

The NFPA does not take any position with respect to the validity of any patent rights asserted in connection with any items which are mentioned in or are the subject of this document, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on this document. Users of this document are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Users of this document should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of this document, intend to urge action that is not in compliance with applicable laws, and this document may not be construed as doing so.

Licensing Policy

NFPA 268

Standard Test Method for

Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source

1996 Edition

This edition of NFPA 268, *Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source*, was prepared by the Technical Committee on Fire Tests and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 13-15, 1995, in Chicago, IL. It was issued by the Standards Council on January 12, 1996, with an effective date of February 2, 1996, and supersedes all previous editions.

This edition of NFPA 268 was approved as an American National Standard on February 2, 1996.

Origin and Development of NFPA 268

The 1996 edition represents the first edition for a standard that addresses the determination of ignitibility characteristics of exterior wall assemblies. This test method incorporates a radiant heat energy source. Currently there are no standardized test methods available within the standard writing organizations, and this document will complement the fire test methods available within the NFPA standards. The results of this test can be used to measure and describe properties of materials in controlled laboratory conditions and also can be used as an element of a fire risk assessment.

Technical Committee on Fire Tests

Jesse J. Beitel, *Chair*
Hughes Assoc. Inc., MD

April L. Berkol, ITT Sheraton Corp., MA
Rep. American Hotel & Motel Assn.
John A. Blair, The DuPont Company, DE
Rep. Society of the Plastics Industry Inc.
William P. Chien, State of New York Dept. of Fire Prevention & Control, NY
William E. Fitch, Omega Point Laboratories Inc., TX
Thomas W. Fritz Armstrong World Industries Inc., PA
Jeffrey E. Gould, Factory Mutual Research Corp., MA
Alfred J. Hogan, Reedy Creek Improvement District, FL
Rep. Fire Marshals Assn. of North America
Wayne D. Holmes, HSB Professional Loss Control Inc., PA
Karl D. Houser, Gypsum Assn., Washington, DC
Marc L. Janssens, American Forest & Paper Assn., DC
James R. Lawson, U.S. Nat'l Inst. of Standards and Technology, MD
Gerald E. Lingenfelter, American Insurance Services Group Inc., NY
William S. Metes, Underwriters Laboratories Inc., IL
George E. Meyer, Warnock Hersey Int'l Inc., CA
John W. Michener, Milliken Research Corp., SC
Rep. American Textile Mfrs. Inst. Inc.
James A. Milke, University of Maryland, MD
James C. Norris, Union Carbide, PA
Sivon C. Reznikoff, Arizona State University, AZ
John Roberts, Underwriters Laboratories of Canada, ON
Herman Stone, General Foam, PA
T. Hugh Talley, Hugh Talley Co., TN
Rep. Upholstered Furniture Action Council
Richard P. Thornberry, The Code Consortium, Inc., CA
Robert J. Wills, American Iron & Steel Inst., AL
Peter J. Gore Willse, Industrial Risk Insurers, CT
Rep. Industrial Risk Insurers

Alternates

Peter H. Billing, American Forest & Paper Assn., FL
(Alt. to M. L. Janssens)
Delbert F. Boring, American Iron & Steel Inst., OH
(Alt. to R. J. Wills)
Tony Crimi, Underwriters Laboratories of Canada, ON
(Alt. to J. Roberts)
Philip J. DiNenno, Hughes Assoc. Inc., MD
(Alt. to J. J. Beitel)
Richard D. Gottwald, Society of the Plastics Industry Inc., DC
(Alt. to J. A. Blair)
Arthur J. Parker, Southwest Research Inst., TX
(Vot. Alt. to SwRI Rep.)
R. Joseph Pearson, Inchcape Testing Services, NY
(Alt. to G. E. Meyer)
William A. Thornberg, Industrial Risk Insurers, CT
(Alt. to P. J. G. Willse)
James J. Urban, Underwriters Laboratories Inc., IL
(Alt. to W. S. Metes)
Kay M. Villa, American Textile Mfrs. Inst. Inc., DC
(Alt. to J. W. Michener)
Joe Ziolkowski, American Furniture Mfrs. Assn., NC
(Alt. to T. H. Talley)

Nonvoting

A. J. Bartosic, Rohm & Haas Co., PA
Tod L. Jilg, Hoechst Celanese, NC
Herman H. Spaeth, Novato, CA
(Member Emeritus)

Walter P. Sterling, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in membership may have occurred. A key to classifications is found at the back of this document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on fire testing procedures when such standards are not available; 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.

Contents

NFPA 268

Standard Test Method for

Determining Ignitibility of Exterior Wall Assemblies Using A Radiant Heat Energy Source

1996 Edition

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

Information on referenced publications can be found in Chapter 14 and Appendix C.

Chapter 1 General

1-1 Scope.

1-1.1 This fire test response standard describes a method for determining the propensity of ignition of exterior wall assemblies from exposure to 12.5 kW/m^2 (1.10 Btu/ft^2-sec) radiant heat in the presence of a pilot ignition source.

1-1.2 This test method evaluates the propensity of ignition of an exterior wall assembly where subjected to a minimum radiant heat flux of 12.5 kW/m^2 (1.10 Btu/ft^2-sec). This method determines whether ignition of an exterior wall assembly occurs when the wall is exposed to a specified radiant heat flux, in the presence of a pilot ignition source, during a 20-minute period.

1-1.3 This test method applies to exterior wall assemblies having planar, or nearly planar, external surfaces.

1-1.4 This test shall be used for code and other regulatory purposes, for specification and design purposes, and for research and development activities. (*See Section B-1.*)

1-1.5 This method shall not be used to evaluate the fire endurance of wall assemblies, nor shall it be used to evaluate the effect of fires originating within the building or within the exterior wall assemblies. This method shall not be used to evaluate surface flamespread, nor shall it be used to evaluate the influence of openings for their propensity of ignition.

1-2 Significance and Use.

1-2.1 This fire test response standard measures and describes the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and shall not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test shall be permitted to be used as an element of a fire risk assessment that takes into account all factors that are pertinent to an assessment of the fire hazard of a particular end-use.

1-2.2 This fire test response standard involves hazardous materials, operations, and equipment. This standard does not address all of the safety problems associated with its applications. It is the responsibility of the user of the standard to establish appropriate safety and health practices and to determine the applicability of the regulatory limitations of the standard prior to use. Safety requirements for specific hazards are provided in Chapter 9.

1-2.3 Ignitibility is the propensity of an assembly to ignite and burn with a sustained flame for at least 5 seconds and is further qualified by considering the length of time from time of initial exposure to occurrence of the sustained flaming.

1-2.4 The values stated in SI units shall be considered the required values. The values in parentheses are for information only.

1-2.5 In this procedure, the specimens are subjected to one or more specific sets of laboratory test conditions. If different test conditions are substituted or the end-use conditions are changed, it is not possible for this test to predict all changes in the fire test response characteristics measured. Therefore, the results are valid only for the fire test exposure conditions described in this procedure.

Chapter 2 Terminology and Definitions

2-1 Terminology. ASTM E 176, *Standard Terminology of Fire Standards*, shall be referenced for definitions of terms used in this test method.

2-2 Definitions. The terms that follow are defined for the purposes of this standard.

Heat Flux. The incident flux imposed externally on the surface of the specimen by the radiant panel.

Heat Flux Meter. The instrument used to measure the level of radiant heat energy incident on the plane of the specimen surface as specified in this standard.

Ignitibility. The propensity of ignition as measured by the time to sustained flaming.

Shall. Indicates a mandatory requirement.

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

Sustained Flaming. The visual confirmation of the uninterrupted existence of flame on, or near, the surface of the specimen for at least 5 seconds.

Chapter 3 Summary of Method

3-1 Test Panel Orientation. This test method utilizes a gas-fired radiant panel to apply a radiant heat flux of 12.5 kW/m^2 (1.10 Btu/ft^2-sec) to a representative sample of an exterior wall assembly while the test specimen is exposed simultaneously to a pilot ignition source. The radiant panel and the test specimen are oriented in a parallel plane configuration, with the geometric centers of the radiant panel and the test specimen concurrent along a line perpendicular to their surfaces. (*See Figure 3-1.*)

3-2 Test Setup. This method utilizes a 0.91-m × 0.91-m (3-ft × 3-ft) propane-fired radiant panel and a minimum 1.22-m (4-ft) wide × 2.44-m (8-ft) high test specimen. A spark igniter mounted on the vertical centerline of the test specimen at a point 460 mm (18 in.) above its horizontal centerline and 15.9 mm ($^5/_8$) from its surface serves as the pilot ignition source. A radiation shield isolates the test specimen from the radiant source prior to the start of the test, during which the radiant panel is ignited and brought to a specified steady-state temperature of 871°C ± 27.8°C (1600°F ± 50°F).The specified heat flux value is controlled by the spacing between the radiant panel and the test specimen. The test specimen is exposed to a "square-wave" radiant heat versus time exposure for 20 minutes.

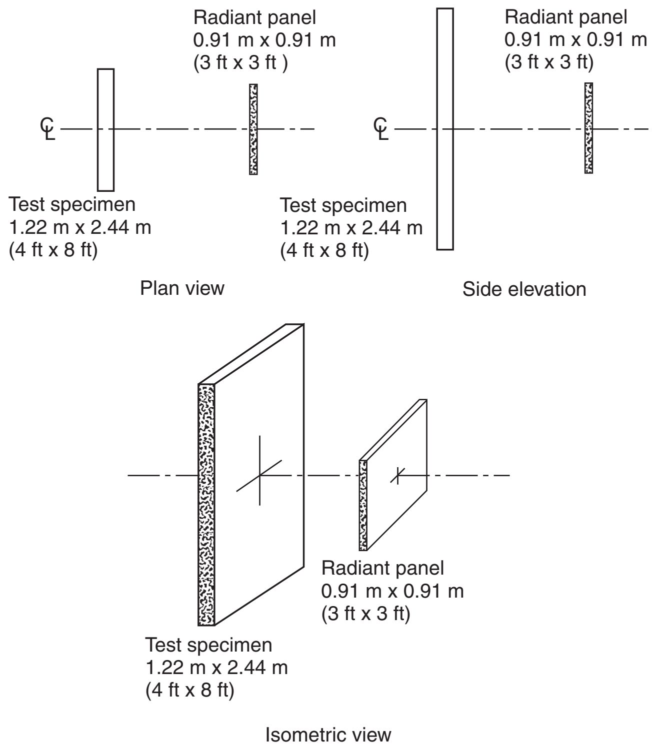

Figure 3-1 Spatial relationship between the test specimen and the radiant panel

The method determines whether the test specimen ignites during the 20-minute test period. When sustained flaming for longer than 5 seconds is observed on, or near, the surface of the test specimen, ignition has occurred.

Chapter 4 Radiant Panel Apparatus and Specimen Mounting System

4-1* Radiant Panel. The radiant panel shall have minimum face dimensions of 0.91 m × 0.91 m (3 ft × 3 ft) and shall consist of an array of individual burner heads, each measuring not less than 152.4 mm × 152.4 mm (6 in. × 6 in.). The individual burner heads shall consist of a porous ceramic plate covered by an Inconel mesh, or equivalent, radiant panel burners. The burner heads shall be fired by a premixed propane-air fuel mixture. The gas supply to the burner heads shall be separated into three zones. Each zone shall consist of two horizontal rows of six burner heads. The zone arrangement shall allow the surface of the 0.91 m × 0.91 m (3 ft × 3 ft) radiator to be controlled to produce a relatively uniform temperature. The temperature of each zone of burner heads shall be established by controlling the propane-air fuel mixture pressure supplied to each zone. Automatic controls shall be provided to ignite the radiant panel and to shut off the propane gas fuel flow in the event of a misfire. The burner heads and the associated propane and air plumbing and control equipment shall be mounted on a steel platform. [*See Figures 4-1(a) and (b).*]

Exception: Alternate radiant panels shall be permitted, provided the calibration criteria of 7-3(a) and (b) are met.

4-2 Test Specimen. A minimum 1.22-m (4-ft) wide × 2.44-m (8-ft) high test specimen shall be mounted on a steel frame trolley assembly (*see Figure 4-2*) or equivalent support system. The mounting frame shall hold the test specimen securely in a vertical orientation and shall allow for the spacing between the test specimen and the radiant panel to be adjusted. The specimen trolley shall consist of a 1.22-m × 1.22-m (4-ft × 4-ft) steel base mounted on steel V-groove wheels or an equivalent arrangement. The V-groove wheels shall travel on angle-iron tracks that are mounted securely to the laboratory floor and that incorporate leveling adjusters. A means shall be provided to prevent the trolley from overturning.

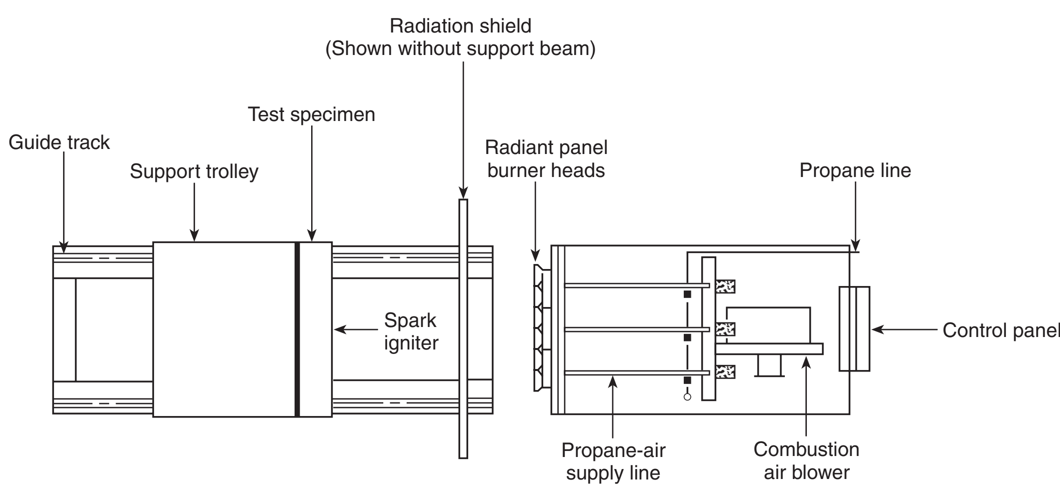

Figure 4-1(a) Plan view of the test apparatus.

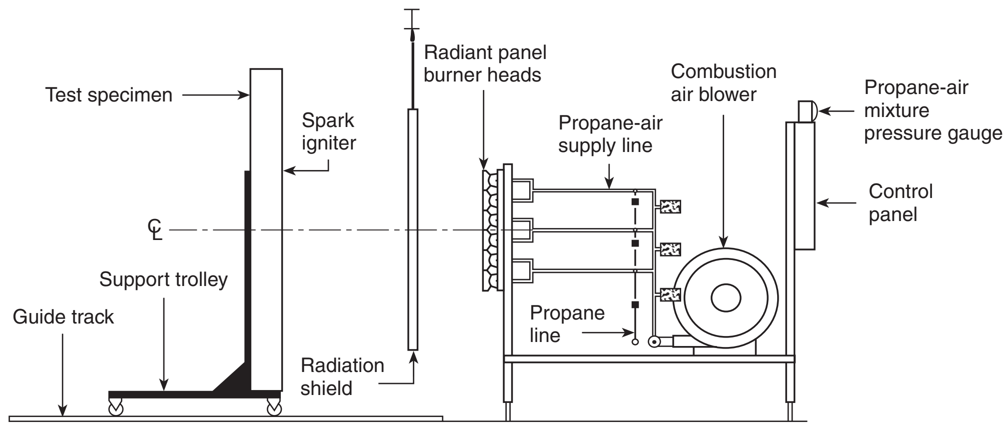

Figure 4-1(b) Side elevation of the test apparatus.

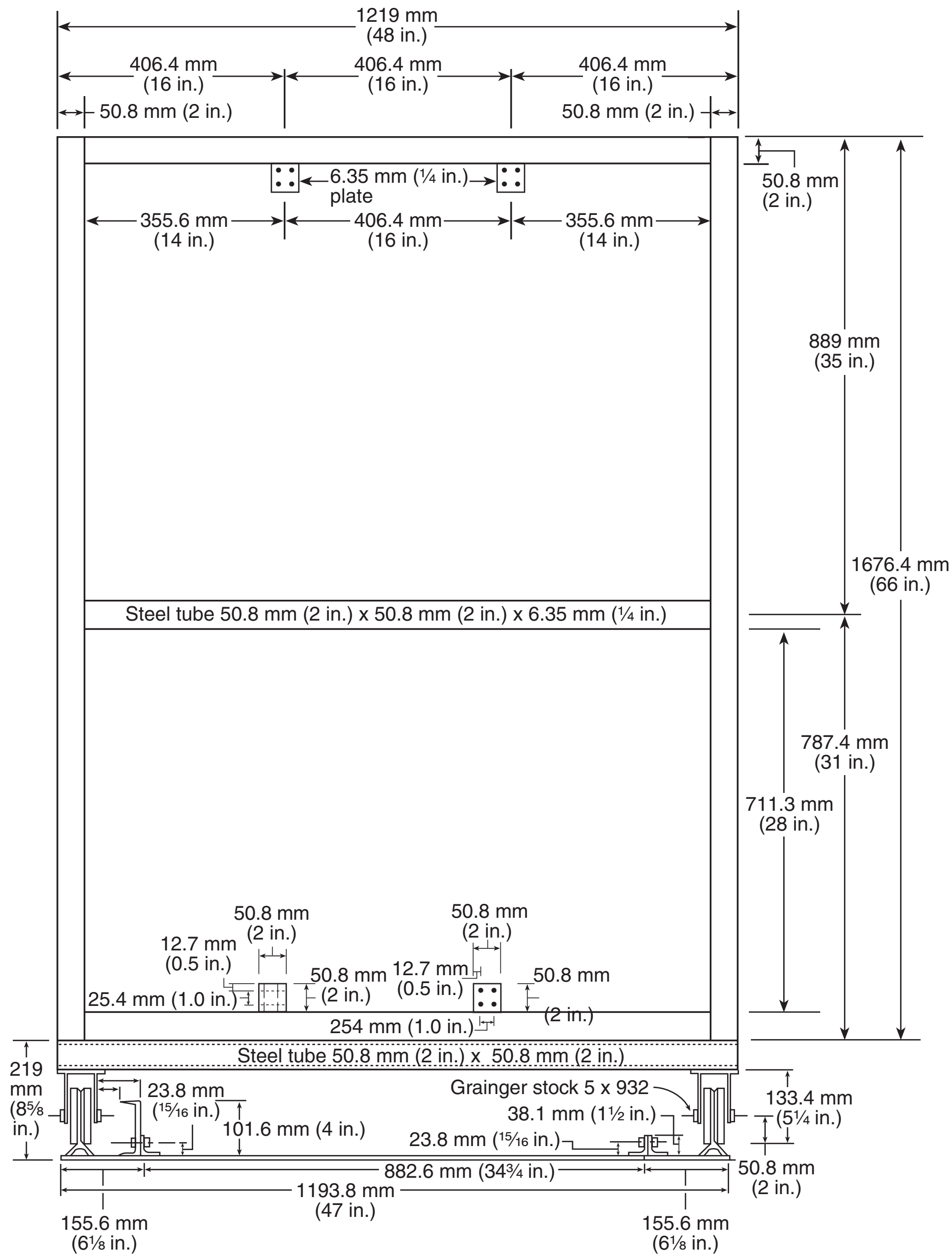

Figure 4-2 Front elevation of the specimen trolley and frame.

4-3 Radiation Shield.

4-3.1 A radiation shield shall be used to isolate the test specimen from the radiant panel both before and after the test period. The radiation shield shall consist of a water-cooled panel (*see Figure 4-3.1 for one possible arrangement*) or other construction that has been shown to have no effect on the specimen or radiator.

4-3.2 Where a water-cooled shield is used, dual waterflow connections shall supply coolant water to the bottom of the radiation shield. The coolant water shall exit along the top edge of the radiation shield. The water coolant flow shall be either a closed loop or open loop system, depending on the conditions and preference of the individual laboratory. The radiation shield shall be fitted with a pressure gauge and, in closed loop systems, a pressure relief valve. The outlet of the pressure relief valve shall be piped to an area that prevents injury to test personnel in the event of the release of coolant or steam. A thermocouple shall be mounted in the coolant discharge to monitor temperature increase in the coolant during tests. Increases in coolant temperature during tests shall not exceed 56°C (100°F).

4-3.3 The radiation shield shall be mounted so that it can be removed quickly or inserted (*see Figure 4-3.3 for one possible arrangement*). Prior to the start of the test, the radiation shield shall be inserted between the radiant panel and the test specimen to prevent exposure of the test specimen until the start of the 20-minute exposure. Once the radiant panel has attained its specified steady-state temperature, the radiation shield shall be removed in order to begin the radiant heat exposure period.

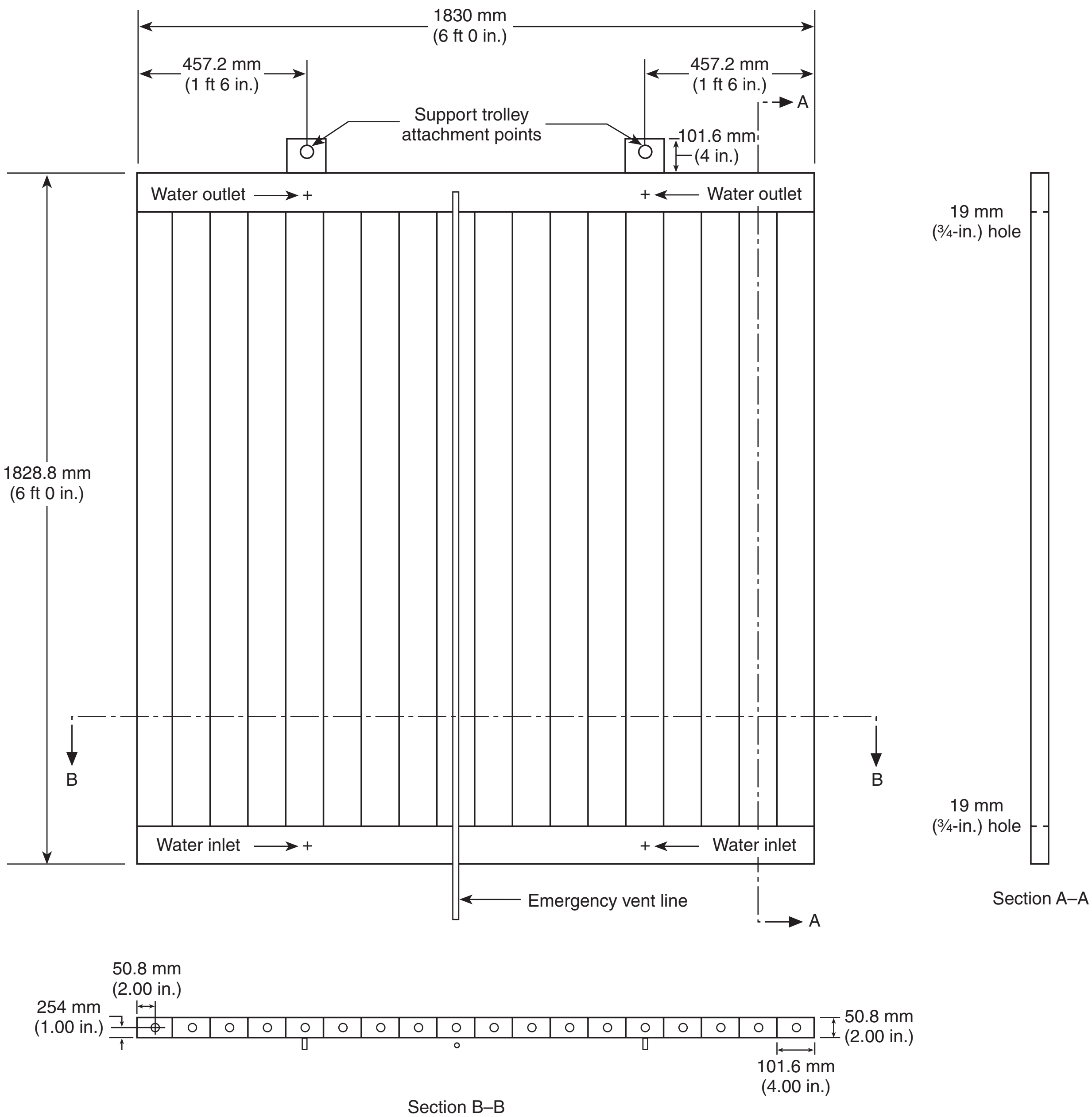

Figure 4-3.1 Radiation shield.

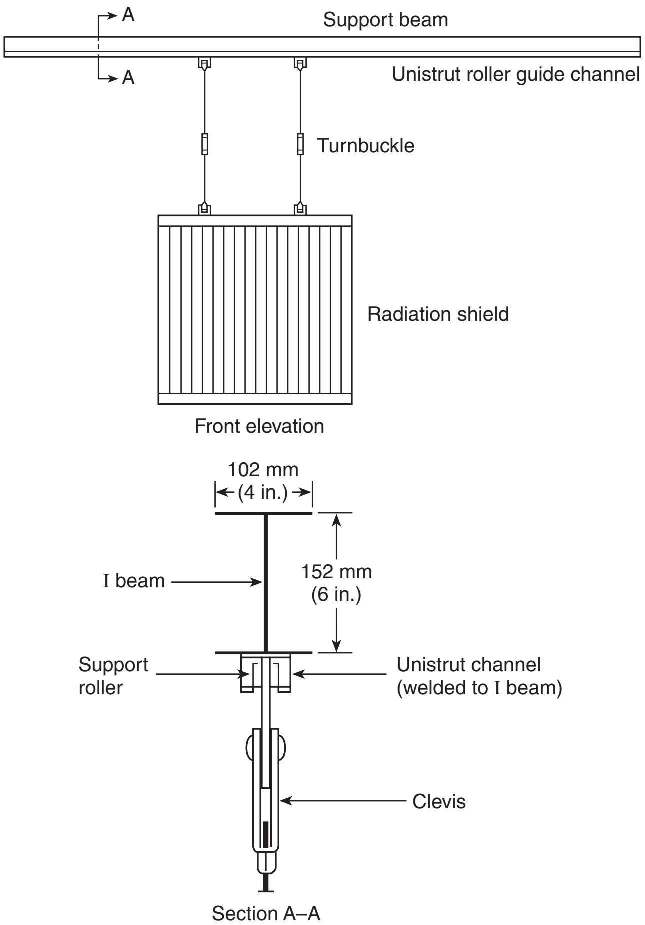

Figure 4-3.3 Radiation shield support trolley.

4-4 Spark Igniter. The spark igniter shall consist of two electrodes connected to a nominal 6000-volt energy source. The spark igniter electrodes shall extend horizontally from the edge of the test specimen and shall be positioned so that the center of the spark gap is located along the vertical centerline of the test specimen at a location 460 mm ± 3.2 mm (18 in. ± $^1/_8$ in.) above the horizontal centerline of the test specimen [*see Figures 4-4(a) and (b)*.] The center of the spark gap also shall be located 15.9 mm ± 1.6 mm ($^5/_8$ in. ± $^1/_{16}$ in.) away from the surface of the test specimen.

The spark igniter electrodes shall be designed and mounted so that the 15.9-mm ± 1.6 mm ($^5/_8$-in. ± $^1/_{16}$ in.) spacing is maintained throughout the test period by a spring tensioner or equivalent arrangement. The spacing shall be maintained even if the test specimen surface deforms. The spark igniter electrodes and support structure shall be designed so that the entire cross-sectional area of the design is contained within a 9.5-mm ($^3/_8$-in.) projected width.

The spark igniter shall be operated so that the duration of the "off" portion of the cycle is no greater than 2 seconds, and the duration of the "on" portion of the cycle is at least 5 seconds.

4-5 Ambient Conditions.

4-5.1 The test shall be conducted within a building vented to discharge combustion products and to intake fresh air so that oxygen-deficient air is not introduced during a test.

4-5.2 Ambient air temperature at the start of the ignitibility test and the calibration test shall be 10°C to 32°C (50°F to 90°F).

4-5.3 The radiant panel apparatus shall be located in a draft-free environment so that volatiles evolving during the course of a test rise vertically adjacent to the surface of the test specimen.

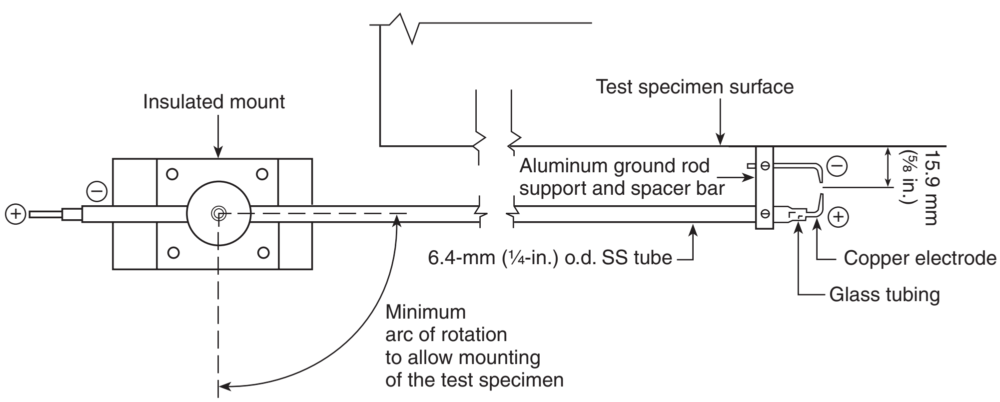

Figure 4-4(a) Plan view of the spark igniter.

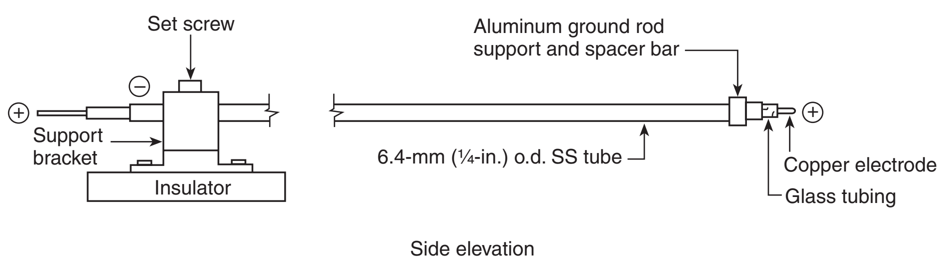

Figure 4-4(b) Side elevation of the spark igniter.

Chapter 5 Instrumentation and Documentation

5-1 Heat Flux Meter.

5-1.1 Locations During Calibration and Product Tests. A heat flux meter for reference use shall be located within 127 mm (5 in.) of the vertical edge of the test specimen on a line along the horizontal centerline of the test specimen (*see Figure 5-1.1*). The exact distance of the heat flux meter from the vertical edge of the test specimen shall be the same as that used for the calibration test. The front face of the heat flux meter shall be in the same plane as the exposed face of the test specimen and shall be parallel to the face of the radiant panel.

5-1.2 Heat flux meters shall be located in the calibration panel at the five locations specified in Figure 5-1.2.

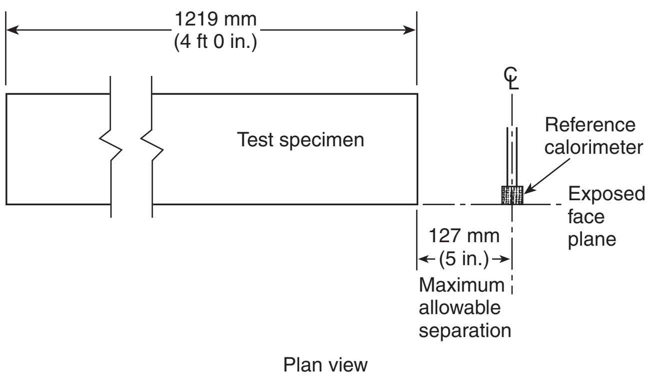

Figure 5-1.1 Reference calorimeter location.

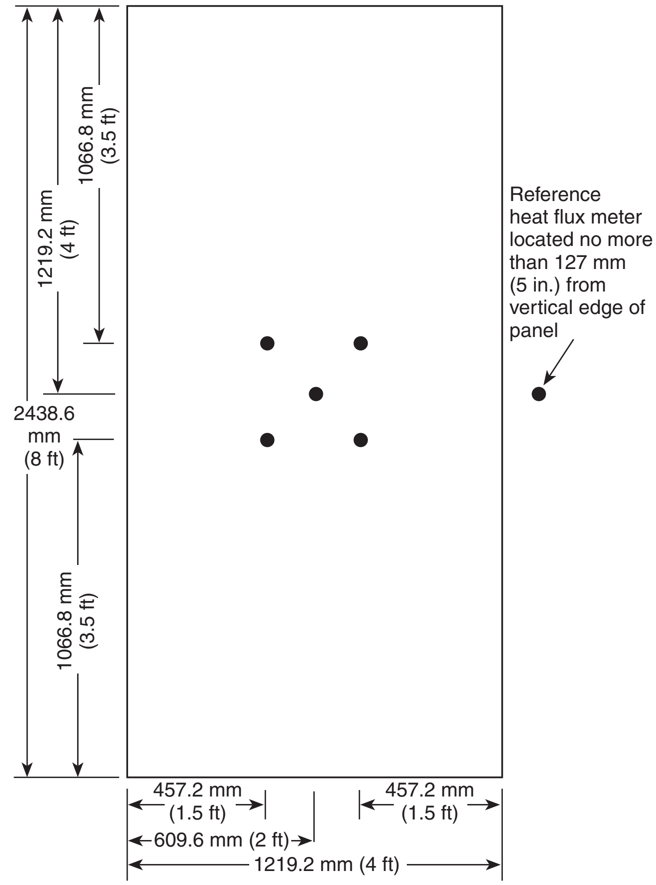

Figure 5-1.2 Calibration panel heat flux meter locations.

5-1.3 Specification. The heat flux meters shall be of the Gardon or Schmidt-Boelter type with a flat black surface and a nominal 180-degree view angle. The heat flux meters shall be operated at the manufacturer's recommended coolant temperature, and the flow rate for the flux levels shall be measured in accordance with ASTM E 511, *Standard Test Method for Measuring Heat Flux Using a Copper-Constantan, Circular Foil, Heat-Flux Gage*. For Schmidt-Boelter heat flux meters, the zero off-set of the heat flux meters at ambient temperature, due to the temperature of the coolant water, shall be added to or subtracted from the heat flux data collected during the calibration tests and the product tests before calculations are made to determine compliance with this test method.

5-2 Thermocouples.

5-2.1 Locations. A minimum of eight thermocouples shall be installed on the face of the radiant panel with the termination bead of each thermocouple mounted so that the bead is in contact with the burner screen at the locations specified in Figure 5-2.1.

5-2.2 Specifications. The thermocouples shall be Type K, no smaller than No. 24 AWG, and no larger than No. 14 AWG. The thermocouples shall be insulated and capable of continuous operation at a temperature of at least 982°C (1800°F.)

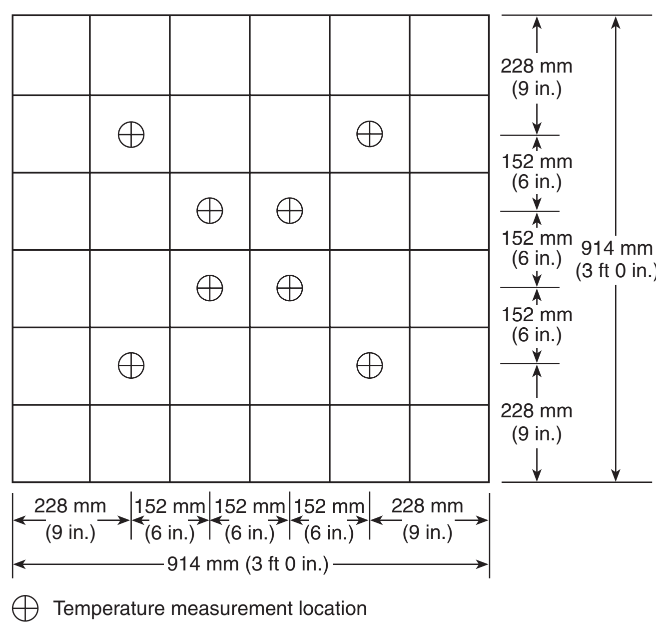

Figure 5-2.1 Temperature measurement locations on the face of the radiant panel.

5-3 Photographic Documentation. Photographic or video equipment shall be used to record the performance of the test specimen throughout the test period. The exterior surface of the test specimen shall be marked clearly with a 0.3-m × 0.3-m (1-ft × 1-ft) grid using a contrasting color. A clock or other suitable timing device shall be used for photographic records. This clock or timing device shall be synchronized accurately with all other measurements, or other provision shall be made to correlate the photo record with time. Color photographs shall be taken at regular intervals for the duration of the test, or a continuous video or film recording shall be made. The camera view area shall include the entire 1.22-m × 2.44-m (4-ft × 8-ft) specimen.

Chapter 6 Test Specimen and Mounting

6-1 Specimen Detail. Test specimens shall be a minimum of 1.22 m × 2.44 m (4 ft × 8 ft) and shall be representative of the overall wall system construction, including finish details, joints, if any, attachments, and support structure.

6-2 Mounting. Test specimens shall be mounted securely on the trolley assembly with their 2.44-m (8-ft) dimension in a vertical orientation. The exterior face of the test specimen shall be parallel to the face of the radiant panel and the geometric center of the test specimen, and the geometric center of the radiant panel shall be concurrent with respect to a line drawn perpendicular to the faces of the test specimen and the radiant panel.

Chapter 7 Calibration of the Test Equipment

7-1* Calibration. A successful calibration test shall have been performed prior to and within 30 days of any ignitibility test. The calibration test shall last for 20 minutes and shall use the radiant panel to expose a standard calibration panel as detailed in Figure 5-1.2. The calibration panel shall consist of two layers having a total thickness of 31.8 mm ($1^1/_4$ in.). A 12.7-mm ($^1/_2$-in.) low density, rigid thermal insulation board (fiberfrax Duraboard or equivalent) having a nominal density of 0.23 g/cm^3 to 0.28 g/cm^3 (15 lb/ft^3 to 18 lb/ft^3) shall be mounted to the test frame and covered with one layer of 19.1-mm ($^3/_4$-in.), 0.74-g/cm^3 (44-lb/ft^3) nominal density calcium silicate insulating material with a thermal conductivity at 177°C (350°F) of 0.128 W/m•K (0.89 Btu•in./h•ft^2•°F). The data specified in Section 7-1(a) through (d) shall be recorded at intervals no greater than 15 seconds as follows:

(a) The heat flux versus the time curve at each of the five specified heat flux meter locations on the calibration panel surface and the reference heat flux meter at the side-mounted locations (*see Figure 5-1.2*);

(b) The heat flux versus the time curve obtained by averaging the four heat flux meters located at the corners of the central square foot of the calibration panel;

(c) The temperatures versus the time on the surface of the radiant panel at the specified locations (*see Figure 5-2.1*);

(d) The average of the temperatures on the surface of the radiant panel at each of the specified locations.

7-2 Spacing. The spacing between the exposed face of the calibration panel and the face of the radiant panel shall be recorded.

7-3 Validation. The calibration test shall be considered valid, provided the values specified in Section 7-3(a) through (c) are as follows:

(a) The heat flux obtained by averaging the four heat flux meters located at the corners of the central square foot of the calibration panel shall be 12.5 kW/m^2 ± 5 percent (1.10 Btu/ft^2-sec ± 5 percent).

(b) The heat flux at the center of the calibration panel shall not exceed 15/kW/m^2(1.32 Btu/ft^2-sec) or shall not be less than 12.5 kW/m^2 (1.10 Btu/ft^2-sec).

(c) The average surface temperature of the radiant panel shall be 871°C ± 27.8°C (1600°F ± 50°F) for each thermocouple.

Chapter 8 Test Specimen Conditioning

8-1 Conditioning. Specimens shall be conditioned to a constant weight at 21.1°C ± 5.6°C (70°F ± 10°F) and a relative humidity of 50 percent ± 10 percent. The constant weight shall be considered to have been achieved where less than a 0.1 percent change in the measured weight of the test specimen undergoing conditioning is recorded for each of three successive measurements taken three days apart, prior to testing.

Chapter 9 Safety Precautions

9-1 Gas Hazard. The possibility of a gas-air fuel explosion in the test apparatus shall be recognized. Suitable safeguards consistent with sound engineering practice shall be installed in the panel fuel supply system. These safeguards shall include one or more of the following, as appropriate:

(a) A gas feed cutoff that activates when the air supply fails;

(b) A fire sensor directed at the panel surface that stops fuel flow when the panel flame goes out;

(c) A commercial gas water heater or gas-fired furnace pilot burner control thermostatic shutoff that activates when the gas supply fails, or other suitable and approved device;

(d) A manual reset for any safeguard system used.

9-2 High Temperature and Pressure. The possibility of excess pressure and high temperatures involving the fluid (water) of the heat exchanger used as a radiation shield (*see Section 4-3*) shall be recognized. Pressure relief valves piped to a safe location shall be provided. The design and operation of the radiation shield shall be consistent with sound engineering practice.

9-3 Products of Combustion. In view of the potential hazard from products of combustion, other laboratory equipment shall be protected from smoke and gas. Laboratory operators shall be instructed to minimize exposure to combustion products by following sound safety practice (e.g., wearing appropriate protective clothing, using insulated gloves).

Chapter 10 Test Procedure

10-1 Conditioning. The specimen shall be tested within 1 hour from the time the specimen is removed from the conditioning room.

10-2 Specimen and Test Equipment. Prior to the start of the test, the status of the following items shall be verified:

(a) The test specimen shall be mounted securely to the trolley assembly and properly oriented with respect to the radiant panel.

(b) The trolley assembly shall be moved to the proper location to provide the required separation distance between the face of the test specimen and the face of the radiant panel, as determined from the most recent calibration test.

(c) The side-mounted reference heat flux meter shall be mounted in its proper orientation and shall be operated at the manufacturer's recommended coolant temperature and flow rate for the flux levels shall be measured in accordance with ASTM E 511, *Standard Test Method for Measuring Heat Flux Using a Copper-Constantan, Circular Foil, Heat-Flux Gage.* The coolant temperature shall be set high enough to prevent condensation on the sensor prior to the start of the test.

(d) The spark igniter shall be in place and operational.

(e) The radiation shield shall be in place and shall be operated at the proper waterflow rate.

(f) The propane gas supply to the radiant panel shall be of sufficient quantity for the test duration and shall be connected properly.

10-3 Radiant Panel Preheat. Ten minutes prior to the start of the test period, the radiant panel shall be ignited. During the 10-minute warm-up period, the radiant panel shall function properly, and its average surface temperature shall be 871°C ± 27.8°C (1600°F ± 50°F). Data shall be recorded for the surface temperature of the radiant panel and the reference heat flux meter beginning 1 minute prior to the start of the test and shall be continued until the end of the test period. Thirty seconds prior to the test, the spark igniter shall be turned on and videotaping or photographing of the test assembly shall commence and continue for the test period.

10-4 Specimen Exposure. At time zero, the radiation shield shall be removed and the radiant heat exposure of the test specimen shall begin. The test shall be continued for 20 minutes unless sustained flaming (ignition) of the test specimen occurs. If sustained flaming (ignition) of the test specimen occurs, the test shall be terminated by inserting the radiation shield between the radiant panel and the test specimen, turning off the spark igniter, extinguishing the test specimen, and interrupting the flow of gas to the radiant panel. If the specimen does not ignite, the test shall be terminated after 20 minutes by inserting the radiant shield between the radiant panel and the test specimen, turning off the spark igniter, and interrupting the flow of gas to the radiant panel.

10-5 Heat Flux Variation. During a test, if the heat flux measured by the reference heat flux meter varies more than ± 2.5 percent from the average value recorded during the most recent calibration test, the results shall be invalid.

Chapter 11 Report

11-1 Information. The report shall include the information specified in Section 11-1(a) through (k) as follows:

(a) The name, thickness, density, and size of all materials used in the wall construction, along with any other identifying characteristics or labels that are significant in order to identify the construction completely;

(b) The construction of the full wall assembly, including finish details, joints, if any, attachments, support structure, and any other details necessary to fully describe the test assembly;

(c) A description of the material conditioning;

(d) The relative humidity and temperature of the test building prior to and during both the test and the most recent calibration test;

(e) The time histories of the eight individual thermocouples mounted on the surface of the radiant panel and the average of the eight thermocouples;

(f) The time history of the reference heat flux meter;

(g) The distance from the edge of the test specimen to the centerline of the side-mounted reference heat flux meter during both the test and the most recent calibration test;

(h) The separation distance between the exposed face of the test specimen and the face of the radiant panel both in the calibration test and the product test;

(i) A transcript of the visual observations recorded during the test;

(j) A statement regarding flaming or ignition of the specimen, or both, that includes the following:

1. The time to sustained flaming, if any;

2. Observations and the time of occurrence of any transient flaming on or near the surface of the specimen; and

3. If appropriate, a statement indicating that no ignition (sustained flaming) occurred during the 20-minute test period.

(k) The average heat flux value recorded at the reference heat flux meter during both the test and the most recent calibration test.

Chapter 12 Precision and Bias

12-1* Applicability. This standard does not address either the precision or bias of this test method.

Chapter 13 Calibration

13-1 Heat Flux Meters.

13-1.1* Heat flux meters shall be calibrated at least annually by a method that is traceable to NIST.

13-1.2 Each laboratory shall be permitted to use a dedicated calibrated reference heat flux meter for the calibration of heat flux meters.

Chapter 14 Referenced Publications

14-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

14-1.1 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E 176, *Standard Terminology of Fire Standards*, 1993.

ASTM E 511, *Standard Test Method for Measuring Heat Flux Using a Copper-Constantan, Circular Foil, Heat-Flux Gage*, 1989.

Appendix A Explanatory Material

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

A-4-1 Eclipse Infra-Glo or equivalent radiant panel burners manufactured by Eclipse Combustion, Rockford, IL, are considered to be satisfactory.

A-7-1 Fiberflax Duraboard or equivalent can be considered acceptable for low density rigid thermal insulation board.

A-12-1 Due to the fact that results are not being expressed numerically, a precision and bias statement is not applicable.

A-13-1.1 For additional information, see ASTM E 511, *Standard Test Method for Measuring Heat Flux Using a Copper-Constantan Circular Foil, Heat Flux Gage.*

Appendix B Commentary on Radiant Ignition Test

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

B-1 Introduction.

B-1.1 Historically, the exterior walls of buildings of large area or multistory buildings have been constructed using noncombustible materials. In recent years, the model building codes of the United States have been revised to recognize the use of limited quantities of combustible materials in the exterior walls of buildings traditionally required to use noncombustible materials. The use of combustible materials in exterior walls has raised concerns regarding the possibility of fire spreading from building to building by radiant heat transfer and ignition of the exterior facades.

B-1.2 Model codes contain fire resistance ratings and opening limitations for the exterior walls of buildings, based upon the concept of limiting radiant heat transfer to adjacent buildings. The commonly accepted threshold for piloted ignition of wood is 12.5 kW/m^2 (1.10 Btu/ft^2-sec). The exterior walls of a building should be designed to limit the radiant heat transfer to adjacent structures to 12.5 kW/m^2 (1.10 Btu/ft^2-sec) or less. The basis of the concept is that radiant heat transfer should be limited to values that do not ignite combustible architectural trim, veneer, or exterior facades on adjacent buildings.

B-2 U.S. Model Building Codes. The BOCA *National Building Code* and the SBCCI *Standard Building Code* regulate building facades based on ignitibility characteristics. Exterior facades are regulated as a function of the distance to the property line and on the basis of the radiant heat flux necessary to cause ignition of the facade under "piloted" conditions.

Both the *Standard Building Code* and the *National Building Code* provide summarized descriptions for conducting ignitibility evaluations for exterior wall assemblies. However, no standardized test method for the determination of the ignitibility characteristics of exterior building facades under radiant heat exposure currently exists within the model building codes or ASTM.

B-3 Ignitibility Research.

B-3.1 A research project, sponsored by the Exterior Insulation Manufacturers Association, was conducted to develop a laboratory-scale, radiant heat ignitibility test procedure. The research program consisted of two phases. In the first phase, large-scale tests were run at the Southwest Research Institute to develop a database to be used to judge the reliability of data from laboratory-scale tests of similar specimens.

Large-scale tests used 2.44-m × 3.66-m (8-ft × 12-ft) exterior wall panels that were exposed to radiant heat from a 1.83-m × 2.44-m (6-ft × 8-ft) radiant panel. The radiator and product sizes are believed to be adequate to predict product behavior in actual fires. However, large-scale testing can be needlessly expensive if laboratory-scale or bench-scale tests are shown to be capable of producing data that correlate with large-scale testing.

Specimens similar to those tested in the large-scale apparatus were tested in a laboratory-scale procedure at the University of California at Richmond Field Test Station by Fisher Research and Development, Inc. Specimens for the laboratory-scale tests measured 1.22 m × 2.44 m (4 ft × 8 ft) and were exposed to a 0.91-m × 0.91-m (3-ft × 3-ft) gas-fired radiant panel. To achieve an exposure of 12.5 kW/m^2 (1.10 Btu/ft^2-sec), the specimen was separated from the radiant panel by a distance of 1.08 m to 1.10 m (43 in. to 44 in.). The data from the laboratory-scale tests and the large-scale tests are provided in Table B-3.1. The laboratory-scale test procedure developed by Fisher Research and Development, Inc., has been used as the basis for the NFPA 268 standard.

B-3.2 Table B-3.1 shows that the performance of exterior wall systems tested in accordance with the NFPA 268 standard correlates well with full-scale test results. The 0.91-m × 0.91-m (3-ft × 3-ft) radiant panel and 1.22-m × 2.44-m (4-ft × 8-ft) specimen are sufficient to reproduce full-scale behavior.

[1]Beitel, Jesse J., "Large-Scale Radiant Heat Exposure Tests of Exterior Insulated Finish Systems," Final Report SwRI Project No. O1-3528, June 1991.

[2]Fisher, P. E., Fred L. and Fleishmann, Charles M., "Radiant Heat Exposure of Exterior Walls," Final Report, Project No. FRD8933, October 1992.

Table B-3.1 Summary of the Radiant Heat Exposure Test Results

Description of the Wall Construction	Exposure Heat Flux (kW/m2)	Time to Ignition (sec) Cone Calorimeter	Lab Scale	Full Scale
EIFS (thin coat, mineral wool core)	12.5	No	322	No
EIFS (thin coat, mineral wool core)	20	199	150	163
EIFS (thin coat, 2 in. expanded P.S.)	12.5	No	No	No
EIFS (thin coat, 2 in. expanded P.S.)	20	140	134	139
EIFS (thin coat, 2 in. expanded P.S.)	12.5	No test	No	No
EIFS (thin coat, 2 in. expanded P.S.)	12.5	No test	No	270
EIFS (thin coat, 2 in. expanded P.S.)	20	No test	117	135
EIFS (thin coat, 2 in. expanded P.S.)	12.5	No	235	280
EIFS (thin coat, 2 in. expanded P.S.)	20	218	83	85
EIFS (thin coat, 1 in. expanded P.S.)	12.5	No	No	No
EIFS (thin coat, 1 in. expanded P.S.)	20	209	185	140
EIFS (thin coat, 1 in. expanded P.S.)	12.5	No	No	No
EIFS (thin coat, 1 in. expanded P.S.)	20	186	130	116
EIFS (thick coat, 2 in. extruded P.S.)	12.5	No	No	No
EIFS (thick coat, 2 in. extruded P.S.)	20	No	No	771
EIFS (thick coat, 2 in. extruded P.S.)	12.5	No	No	No
EIFS (thick coat, 2 in. extruded P.S.)	20	No	Malfunc.	570
EIFS (thin coat, 4 in. expanded P.S.)	12.5	No	250	No
EIFS (thin coat, 4 in. expanded P.S.)	20	158	89	86
EIFS (thin coat, 1 in. isocyanurate)	12.5	355	200	222
EIFS (thin coat, 1 in. isocyanurate)	20	138	Ramped	105
EIFS (thin coat, no insulation)	12.5	No	No	No
EIFS (thin coat, no insulation)	20	137	80	99
$^5/_8$-in. × 4-in. thick exterior gypsum board	12.5	No	No	No
$^5/_8$-in. × 4-in. thick exterior gypsum board	20	No test	No test	1336
$^5/_8$-in. × 4-in. thick T1-11 plywood	12.5	No	1100	819
$^5/_8$-in. × 4-in. thick T1-11 plywood	20	197	333	191

For SI units: 1 in. = 25.4 mm; 1 kW/m^2 = 5.28 Btu/ft^2-sec

B-3.3 The NFPA 268 standard uses a conservative approach by evaluating the ignitibility of specimens under "piloted" conditions. A spark igniter is located at the upper boundary of the specimen area that is subjected to the specified radiant heat exposure. The spark is located in the flow of volatiles that travel up the face of the specimen in the region where the greatest concentration of volatiles has been observed.

B-3.4 This method prescribes the testing of full assemblies. Tests of individual wall components might not be indicative of the behavior of the final assembly.

B-3.5 Use of a bench-scale apparatus might not produce results that correlate with the full-scale behavior of wall assemblies because of "scale effects." For example, many insulated exterior wall systems use expanded polystyrene (thermoplastic) foam insulation. Thermoplastic insulation can shrink away from the fire exposure, thereby changing test geometry and exposure conditions. Changes in exposure conditions can be magnified in bench-scale tests, as compared to full-scale tests. Furthermore, there could be a minimum test specimen area (larger than bench scale) that needs to be exposed in order for some specimens to produce sufficient volatiles to reach a flammable mixture with air.

B-3.6 This test method carefully prescribes radiant panel size and operating conditions. Radiant panel specifications are set to standardize the "flux map" on the face of test specimens. This method could be used for regulatory purposes, and, consequently, it is important that exposure conditions from apparatus to apparatus be standardized. Significantly changing the size or shape of the radiant panel, for example, results in a different flux profile over the face of the test specimen and can produce varying results. Similarly, a change in the operating temperature of the radiant panel, which, in turn, would necessitate a change in the separation of the radiant panel and the test specimen, results in a change in the configuration factor. The change in configuration factor produces a different flux profile.

B-3.7 To respond to the needs of the U.S. model building codes, this apparatus has been standardized to operate at a single exposure condition: 12.5 kW/m^2 (1.10 Btu/ft^2-sec). The apparatus could be recalibrated for different exposure conditions. However, such changes would necessitate additional research. For example, an apparatus has been developed to evaluate the performance of wall assemblies under radiant heat exposure. Sufficient separation of the radiant panel and the test specimen need to be maintained to avoid convective heat transfer. Avoidance of convective heat transfer establishes a limit for exposures in this apparatus. The limits of the exposure conditions possible with this apparatus have not been determined.

[3]Grand, Ph.D., Arthur F. and Valys, Anthony J., "Report on Cone Calorimeter Time to Ignition Test," Final Report, SwRI Project No. 01-3782-022, September 20, 1991.