# NFPA® 285

# Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components

## 2023 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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**NFPA® 285**

# Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components

**2023 Edition**

This edition of NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components*, was prepared by the Technical Committee on Fire Tests and acted on by the NFPA membership during the 2022 NFPA Technical Meeting held June 8-9. It was issued by the Standards Council on August 12, 2022, with an effective date of September 1, 2022, and supersedes all previous editions.

This edition of NFPA 285 was approved as an American National Standard on September 1, 2022.

## Origin and Development of NFPA 285

The 1998 edition was the first for this standard. It established a test method, developed through a consensus process, for determining the flammability characteristics of exterior non-load-bearing wall assemblies or panels. The Committee's intention was to establish a standard that could be adopted or referenced by other applicable documents, such as the model building codes. The standard was introduced to regulate and address the introduction of combustible materials into exterior walls of all construction types.

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 improve the application of the test method, and the scope and purpose of the document were revised to clarify the document's intent. Technical changes addressed details about the test specimen, documentation of the fire test, and testing instrumentation. Historical information describing the development of NFPA 285 was also added as annex material.

The 2012 edition included organizational, editorial, and technical changes that addressed clarifications and corrections of both requirements and figures. The changes provided consistency throughout the document and updated the standard to reflect current construction and testing practices. Technical changes included new requirements, acceptance criteria, and diagrams for thermocouple locations for new types of wall systems.

The 2019 edition included many substantial changes. The document was revised to include both load-bearing and non-load-bearing assemblies. Additionally, the scope was expanded to apply to buildings of any construction type. New sections were also added in Chapter 5 to address joint and seam locations and window header construction.

The 2023 edition includes a revised document scope to make it clearer that this is an assembly test method. Additional changes include new limits on wall projections and details on sealing the tops and sides of walls. This edition also includes a new Annex B on the extension of results from assemblies that meet NFPA 285 test requirements.

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NFPA 285

# Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components

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 C.

## Chapter 1 Administration

### 1.1* Scope.

Δ **1.1.1*** This standard provides a test method for determining the fire propagation characteristics of exterior wall assemblies that are constructed using combustible materials or that incorporate combustible components.

**1.1.2*** The fire propagation characteristics are determined for post-flashover fires of interior origin.

Δ **1.2 Purpose.** The purpose of this standard is to provide a standardized fire test procedure for evaluating the suitability of exterior wall assemblies that are constructed using combustible materials or that incorporate combustible components for installation on buildings.

### 1.3 Application.

**1.3.1** This standard shall be used to evaluate the fire propagation characteristics of exterior wall assemblies and panels used as components of curtain wall assemblies that are constructed using combustible materials or that incorporate combustible components within the wall assemblies as specified in the following:

(1) The ability of the wall assembly to resist flame propagation over the exterior face of the wall assembly
(2) The ability of the wall assembly to resist vertical flame propagation within the combustible components from one story to the next
(3) The ability of the wall assembly to resist vertical flame propagation over the interior surface of the wall assembly from one story to the next
(4) The ability of the wall assembly to resist lateral flame propagation from the compartment of fire origin to adjacent compartments or spaces

**1.3.2** The application of this standard to actual field installations of exterior wall assemblies and panels used as components of curtain wall assemblies shall not limit the use of the methods and materials employed to seal the gap between the edge of the second floor slab and the interior surface of the test specimen during the test, provided approved sealing methods and materials are used in the field.

**1.3.3** This standard requires both visual observations made by laboratory personnel conducting the test and temperature data recorded during the test.

## 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.** National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials,* 2018 edition.

**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 C1396/C1396M, *Specification for Gypsum Board*, 2017.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2020.

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

ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C*, 2018.

ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2017.

Δ **2.3.2 UL Publications.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 723, *Test for Surface Burning Characteristics of Building Materials*, 2018.

**2.3.3 Other Publications.**

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

**2.4 References for Extracts in Mandatory Sections.**

*NFPA 5000®, Building Construction and 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* Authority Having Jurisdiction (AHJ).** An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

**3.2.3 Labeled.** Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**3.2.4 Shall.** Indicates a mandatory requirement.

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

**3.2.6 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 phrase "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.**

*N* **3.3.1 Air Cavity.** A void space between two layers of material intentionally included within a wall assembly for the movement of air or water.

*N* **3.3.2 Base Wall.** A load-bearing or non-load-bearing exterior wall that is used as an enclosing wall for a building and that provides a base for the attachment of other wall system components.

**3.3.3 Combustible Insulation.** Combustible material used as insulation.

**3.3.4 Combustible (Material).** A material that, in the form in which it is used and under the conditions anticipated, will ignite and burn; a material that does not meet the definition of noncombustible or limited-combustible. [**5000,** 2021]

*N* **3.3.5 Engineering Decision.** A documented decision based on a successful NFPA 285 test that provides component substitutions or installation deviations from the tested assembly or component based on a comparative assessment.

*N* **3.3.6* Exterior Cladding.** A material or assembly of materials applied on the exterior side of exterior walls.

*N* **3.3.7 Exterior Insulation.** A material or system installed on the exterior side of a base wall that provides thermal insulation.

**3.3.8* Exterior Wallcovering.** A material or assembly of materials applied on the exterior side of exterior walls for the purpose of providing a weather-resisting barrier or insulation or for aesthetics.

**3.3.9 Limited-Combustible (Material).** See Section 4.2.

**3.3.10 Noncombustible Material.** See Section 4.1.

*N* **3.3.11 Stud Cavity.** The space formed by vertical and/or horizontal steel or wood studs that are used to frame a wall.

**3.3.12 Test Specimen.** The exterior wall assembly to be tested in accordance with this fire test method.

## Chapter 4 Test Facility and Apparatus

**4.1 Noncombustible Material.** A material that complies with any one of the following shall be considered a noncombustible material:

(1) The material, in the form in which it is used, and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.
(2) The material is reported as passing ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.*
(3) The material is reported as complying with the pass/fail criteria of ASTM E136 when tested in accordance with the test method and procedure in ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C.* [**5000:**7.1.4.1.1]

**4.2 Limited-Combustible Material.** A material shall be considered a limited-combustible material where both of the following conditions of 4.2(1) and 4.2(2), and the conditions of either 4.2.1 or 4.2.2 are met:

(1) The material does not comply with the requirements for a noncombustible material in accordance with Section 4.1.
(2) The material, in the form in which it is used, exhibits a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg), when tested in accordance with NFPA 259. [**5000:**7.1.4.2]

Δ **4.2.1** The material shall have a structural base of noncombustible material with a surfacing not exceeding a thickness of ⅛ in. (3.2 mm) where the surfacing exhibits a flame spread index not greater than 50 when tested in accordance with ASTM E84,

*Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Test for Surface Burning Characteristics of Building Materials*. [**5000:**7.1.4.2.1]

**4.2.2** The material shall be composed of materials that in the form and thickness used, neither exhibit a flame spread index greater than 25 nor evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723 and are of such composition that all surfaces that would be exposed by cutting through the material on any plane would neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723. [**5000:** 7.1.4.2.2]

**4.2.3** Materials shall be considered limited-combustible materials where tested in accordance with ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter,* at an incident heat flux of 75 kW/m$^2$ for a 20-minute exposure, and both the following conditions are met:

(1) The peak heat release rate shall not exceed 150 kW/m$^2$ for longer than 10 seconds.
(2) The total heat released shall not exceed 8 MJ/m$^2$.

[**5000:**7.1.4.2.3]

**4.3 Test Facility.**

**4.3.1** The test apparatus described in Section 4.4 shall be located inside a test facility.

**4.3.2** The test facility shall have minimum dimensions of 30 ft wide × 30 ft deep × 23 ft high (9.1 m × 9.1 m × 7.0 m).

**4.3.3** The test facility shall have provisions for supplying combustion makeup air taken from the outside during the test.

**4.3.4** The test facility shall be constructed to allow for the exhaust of the combustion by-products during the test while not inducing an airflow on the exterior face of the test specimen.

**4.3.5** The test facility shall protect the test apparatus and test specimen from exposure to wind and precipitation.

**4.4 Test Apparatus.**

**4.4.1** The test apparatus shall consist of a two-story structure having a height of 15 ft 8 in. ± 1 in. (4.8 m ± 25 mm) with a test room on each story.

**4.4.2** Each test room shall have unfinished inside dimensions of 10 ft ± 0.5 in. wide × 10 ft ± 0.5 in. deep (3.05 m ± 13 mm × 3.05 m ± 13 mm) with an unfinished floor-to-ceiling height of 7 ft ± 0.5 in. (2.13 m ± 13 mm).

**4.4.3*** The test apparatus shall be constructed in accordance with Figure 4.4.3.

**4.4.4** The slabs shall be constructed of reinforced concrete.

**4.4.5** The upper two slabs shall be supported by steel columns designed to support the loads, and the columns shall not be located inside the test rooms.

**4.4.6** The thickness of the concrete slabs shall be as follows:

(1) The first-story slab shall be not less than 6 in. (152 mm) thick.
(2) The second-story slab shall be 8 in. ± 0.5 in. (203 mm ± 13 mm) thick.
(3) The top slab shall be not less than 6 in. (152 mm) thick.

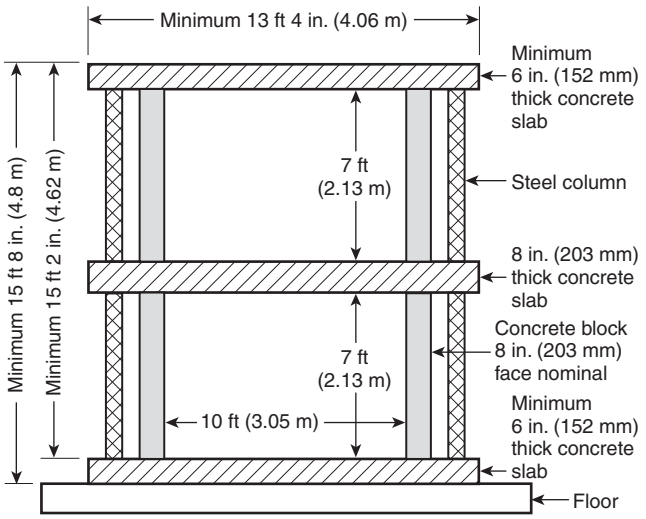



**FIGURE 4.4.3 Front View of Test Apparatus Structure (not to scale). For exact dimensions, see 4.4.1 through 4.4.7.**

**4.4.7** The three permanent walls (one rear wall and two side walls) that form each test room shall be constructed of nominal 8 in. (203 mm) concrete block or equivalent construction.

**4.4.8** The interior surfaces of the first-story test room shall be protected as follows:

(1) The walls and ceiling shall be covered with one layer of nominal $\frac{5}{8}$ in. (16 mm) thick Type X gypsum wallboard conforming to ASTM C1396/C1396M, *Specification for Gypsum Board*, and one layer of nominal 1.5 in. (38 mm) thick nominal 8 lb/ft$^3$ (128 kg/m$^3$) density ceramic fiber insulation on the interior face.
(2) The slab shall be covered with two layers of nominal $\frac{5}{8}$ in. (16 mm) thick gypsum wallboard.

**4.4.9** Insulation shall not be required in the second-story test room.

**4.4.10** Each story shall have one access opening approximately 3.5 ft wide × 6.75 ft high (1.1 m × 2.1 m).

**4.4.11** The first-story access opening shall be located in one of the side walls, and the second-story access opening shall be located in the rear wall of the test room.

**4.4.12** The access door opening for the first-story test room shall be capable of being closed during the fire test.

**4.4.13** Additional access openings shall be permitted in the second-story test room walls for instrumentation and video recording.

**4.5 Movable Test Frame.**

**4.5.1** The movable test frame shall comply with 4.5.1.1 through 4.5.1.3.

**4.5.1.1** The frame shall be designed such that the nominal 4 in. × 4 in. × $\frac{3}{16}$ in. (102 mm × 102 mm × 5 mm) angles meet at the top of the respective floor lines on the test apparatus.

**4.5.1.2** The frame shall be constructed to prevent racking or movement of the wall assembly during movement of the frame and fastening of the frame to the test apparatus.

**4.5.1.3** The frame shown in Figure 4.5.1.3 shall be used to determine the minimum size of the wall assembly.

**4.6 Burners.**

**4.6.1** The burner arrangement shall consist of two gas-fired burners.

**4.6.2** One burner shall be placed inside the first-story test room, and the other burner shall be placed near the top of the first-story window opening of the test specimen, as required by Chapter 7.

**4.6.3** The test room burner shall comply with 4.6.3.1 through 4.6.3.6.

**4.6.3.1** The test room burner shall be constructed of nominal 2 in. (51 mm) outside diameter steel pipe with nominal ⅛ in. (3 mm) diameter holes spaced a nominal 1 in. (25 mm) on center.

**4.6.3.2** The burner holes shall be located along the top surface of the pipe.

**4.6.3.3** The first hole shall be located 3.5 ft ± 1 in. (1.06 m ± 25 mm) from the rear wall on both sides of the gas supply pipes and continue across the front gas supply pipe.

**4.6.3.4** The gas supply pipe located within the test room shall be wrapped with a single layer of nominal 1 in. (25 mm) thick nominal 8 lb/ft$^3$ (128 kg/m$^3$) density ceramic fiber blanket.

**4.6.3.5** The burner shall be positioned with its centerline 2.5 ft ± 1 ft (0.8 m ± 0.3 m) above the floor surface of the test facility.

**4.6.3.6*** Figure 4.6.3.6 shall be used to determine the design of the first-story test room burner.

**4.6.4** The window gas burner shall consist of a 60 in. ± 0.5 in. (1520 mm ± 13 mm) length of nominal 2 in. (51 mm) outside diameter pipe having a 0.5 in. ± 0.06 in. wide × 44 in. ± 0.5 in. long (13 mm ± 1.5 mm × 1118 mm ± 13 mm) slot.

**4.6.5** The burner shall be supplied with gas at both ends through nominal 1 in. (25 mm) outside diameter pipe.

**4.6.6** Figure 4.6.6 shall be used to determine the design of the window burner.

**4.6.7** The window burner shall be wrapped with a layer of nominal 1 in. (25 mm) thick nominal 8 lb/ft$^3$ (128 kg/m$^3$) density ceramic fiber blanket.

**4.6.8** The burner shall be permitted to be mounted on a movable trolley.

**4.6.9** During the fire test, the burner shall be positioned so the slot is located on the top surface of the pipe and centered horizontally in the first-story test room window opening.

**4.6.10** The horizontal centerline of the burner shall be positioned 9 in. ± 0.5 in (230 mm ± 13 mm) below the bottom surface of the window opening header.

**4.6.11** The vertical centerline of the burner shall be positioned between 0 in. and 5 in. (0 mm and 130 mm) from the exterior face of the wall assembly.

**4.6.12** The final position of the window burner from the exterior face of the wall assembly shall be determined from the calibration procedure.

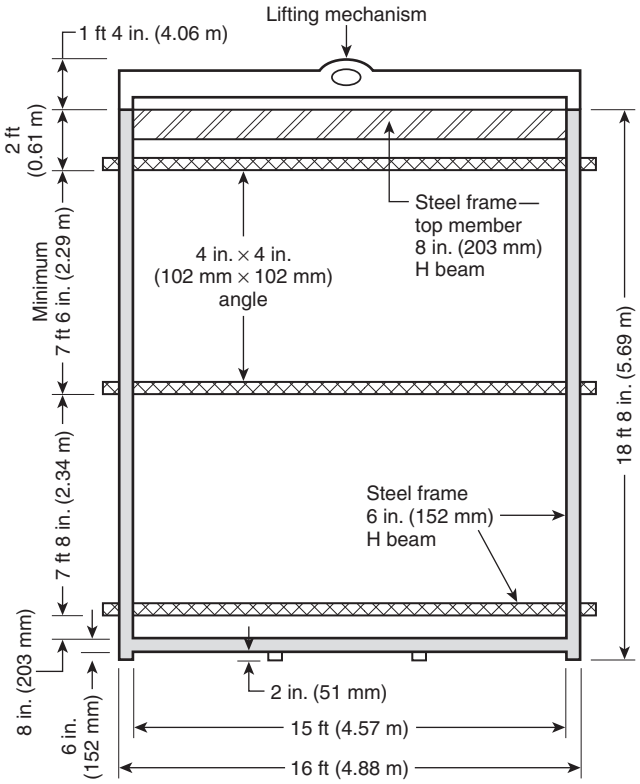
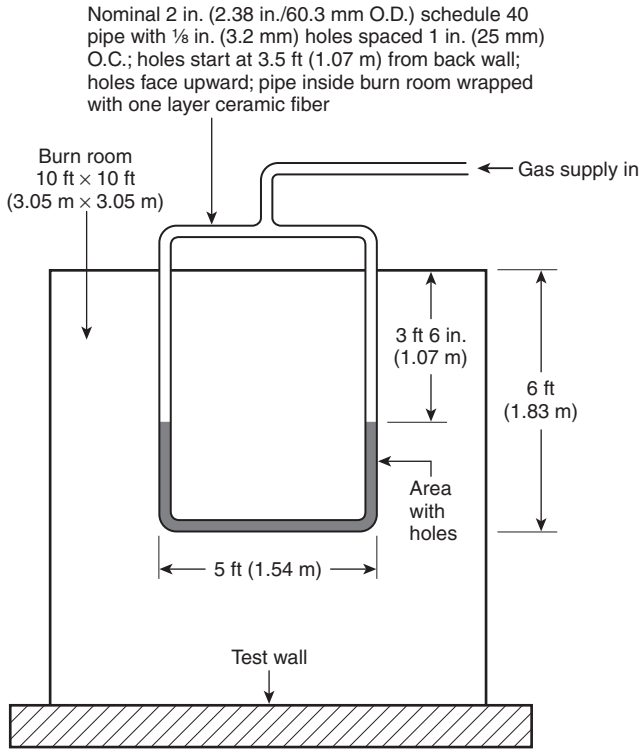



**FIGURE 4.5.1.3 Front View of Movable Wall Frame (not to scale).**




**Δ FIGURE 4.6.3.6 Burn Room Burner — Plan View (not to scale).**

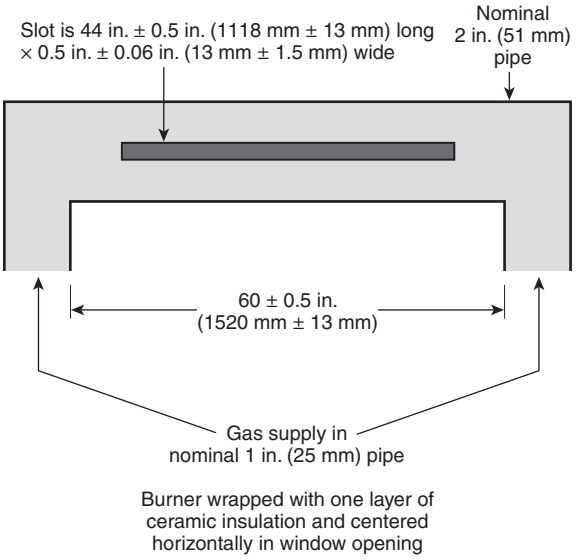



**FIGURE 4.6.6 Plan View of Window Burner (not to scale).**

## Chapter 5 Test Specimens

**5.1 Location of Test Specimens.** The test specimens shall be constructed on the front face of the test apparatus or on the movable test frame specified in 4.5.1.

**5.2 Specimen Mounting.** Figure 5.2(a) through Figure 5.2(c) shall be used to determine the test specimen mounting on the front face of the test apparatus.

**5.3 Size of Test Specimen.** The test specimen shall be not less than 17.5 ft high × 13.3 ft wide (5.3 m high × 4.1 m wide).

**5.4 Position of Test Specimen.**

**5.4.1** The edges of the test specimen shall be positioned on the test apparatus as follows:

(1) Below the top of the first-story slab, not less than 2 in. (51 mm)
(2) Above the top of the top slab, not less than 2 ft (0.6 m)
(3) Beyond the outside face of each side wall, not less than 1 ft (0.305 m)

**5.4.2** The test specimen shall completely cover the front face of the test apparatus except for a window opening located in the test specimen at the first story.

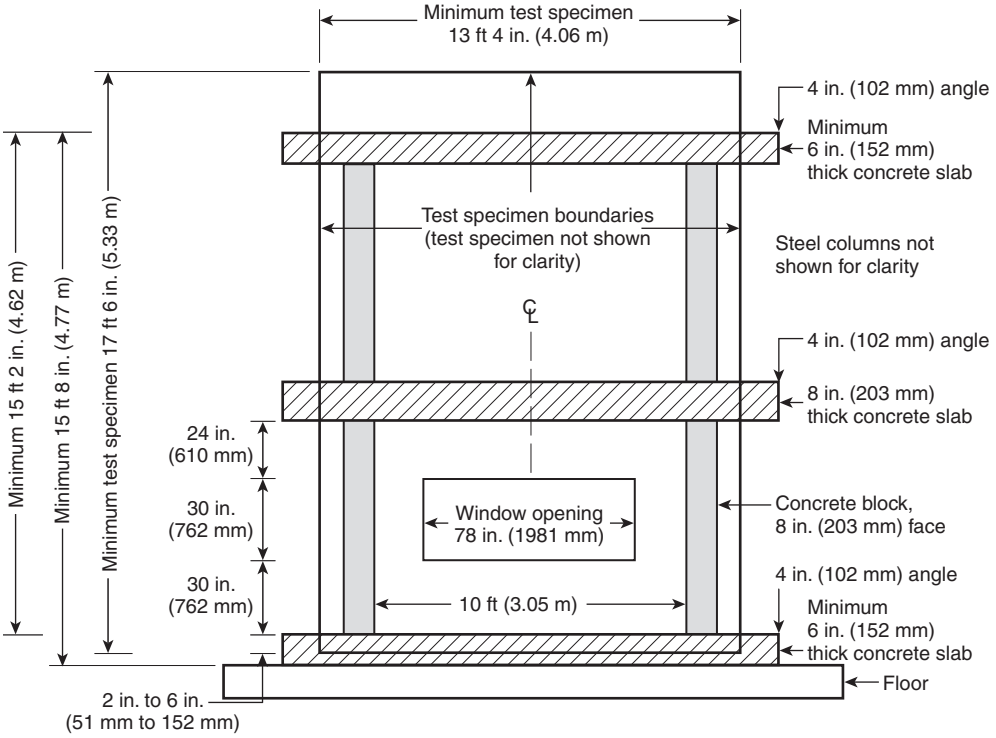



**FIGURE 5.2(a) Front View of Test Specimen Superimposed over Test Apparatus (not to scale).**

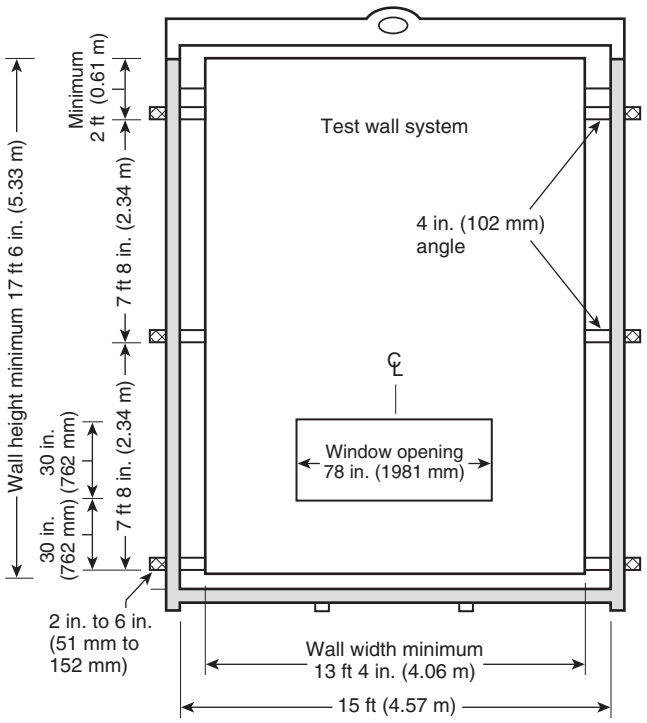



**FIGURE 5.2(b) Front View of Test Specimen in Movable Test Frame (not to scale).**

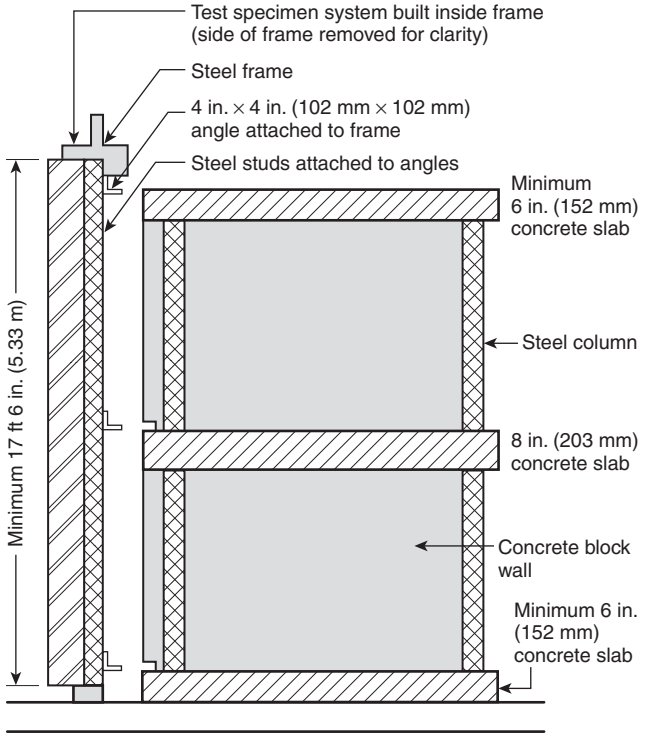



**FIGURE 5.2(c) Side View of Test Apparatus with Test Specimen in Movable Test Frame (not to scale).**

**5.5 Window Opening.**

**5.5.1** The window opening shall be 30 in. ± 0.5 in. high × 78 in. ± 0.5 in. wide (760 mm ± 13 mm high × 1980 mm ± 13 mm wide), with a sill height of 30 in. ± 0.5 in. (760 mm ± 13 mm) above the top of the first-story test room slab.

**5.5.2** The window opening shall be centered horizontally with respect to the test room.

**5.6 Securing Test Specimen to Test Apparatus.**

**5.6.1** The test specimen shall be secured to the test apparatus using a girt system of replaceable nominal 4 in. × 4 in. × $^{3}/_{16}$ in. (102 mm × 102 mm × 5 mm) steel angles.

**5.6.2** A removable spandrel beam shall be mounted on the underside of the second-story floor slab where required for the attachment of the test specimen to the test apparatus.

**5.6.2.1*** Where used, the spandrel beam shall be a W8×21 (W200×31) wide flange steel beam.

**5.6.2.2** Where used, the spandrel beam shall extend completely across the burn room compartment between the interior wall surfaces of the two side walls of the first-story test room.

**5.6.2.3** Where used, the spandrel beam shall be either protected or unprotected at the discretion of the test laboratory or the client.

**5.6.2.4** Where the spandrel beam is used and it has been determined that it will be protected, one layer of nominal 1 in. (25 mm) thick nominal 6 lb/ft$^3$ (96 kg/m$^3$) ceramic fiber blanket shall be used to protect the beam.

**5.6.2.5** Outriggers and other connections provided to the spandrel beam shall not be protected.

**5.7 Construction Details of Test Specimen.**

**5.7.1 General.**

**5.7.1.1** The test specimen shall be constructed and secured to the test frame or apparatus using fastening and construction details representative of actual field installations in accordance with the manufacturer's instructions.

**5.7.1.2*** Details of the construction of the test specimen shall be representative of actual field installations in accordance with the manufacturer's instructions.

***N*** **5.7.1.3** The sides and the top of the wall shall be sealed with noncombustible material prior to the test unless complying with 5.7.1.4.

***N*** **5.7.1.4** Where the top of the wall is not completely sealed in the actual design to be constructed, the assembly shall be tested that way.

***N*** **5.7.1.5** The test assembly shall not have projections added to the wall that extend beyond the outer planar surface of the wall unless they are included in the same location as in the actual construction.

**5.7.1.6*** The framing system used to support the wall assembly that makes up the test specimen shall consist of steel studs or wood studs unless the construction is not intended to incorporate studs.

**5.7.2 Joints and Seams.**

**5.7.2.1 Horizontal Joints and Seams.**

**5.7.2.1.1** At least one horizontal joint or seam in the exterior veneer extending the full width of the test specimen shall be installed in accordance with 5.7.2.1.2, 5.7.2.1.3, and 5.7.2.1.4.

**5.7.2.1.2** The horizontal joint or seam shall be located between 1 ft (305 mm) and 3 ft (914 mm) above the top of the window opening unless otherwise permitted by 5.7.2.1.3 or 5.7.2.1.4.

**5.7.2.1.3** The horizontal joint or seam shall not be required in the test assembly where one of the following criteria is met:

(1) Where the exterior veneer is exterior insulation finish systems (EIFS)
(2) Where the exterior veneer is ¾ in. (19 mm) thick or greater standard stucco veneer
(3) Where the actual design of the wall assembly to be used in the field will not have any horizontal joints

**5.7.2.1.4** Where the wall assembly being tested is a replication of the design to be used in the field and that design will not have a horizontal joint at the location specified in 5.7.2.1, the joint shall be located as per the design.

**5.7.2.2 Vertical Joints and Seams.**

**5.7.2.2.1** At least one vertical joint or seam in the exterior veneer shall be installed in accordance with 5.7.2.2.2, 5.7.2.2.3, and 5.7.2.2.4.

**5.7.2.2.2** The vertical joint or seam shall extend upward the full height of the exterior veneer from the top of the window opening and be located within ±12 in. (152 mm) of the window opening's center line unless otherwise permitted by 5.7.2.2.3 or 5.7.2.2.4.

**5.7.2.2.3** The vertical joint or seam shall not be required in the test assembly where one of the following criteria is met:

(1) Where the exterior veneer is exterior insulation finish systems (EIFS)
(2) Where the exterior veneer is ¾ in. (19 mm) thick or greater standard stucco veneer
(3) Where the actual design of the wall assembly to be used in the field will not have any vertical joints
(4)* Where the actual design of the wall assembly to be used in the field will not have any continuous vertical joints

**5.7.2.2.4** Where the wall assembly being tested is a replication of the design to be used in the field and that design will not have a vertical joint at the location specified in 5.7.2.2, the joint shall be located as per the design.

**5.7.2.3*** Where joints or seams are required by 5.7.2, the installation of the joints and seams shall be representative of actual field installations and shall be in accordance with the manufacturer's instructions.

**5.7.3 Window Headers.**

**5.7.3.1** The window header, jambs, and sill shall be closed using aluminum sheet metal in accordance with 5.7.3.1.1 through 5.7.3.1.2.

**5.7.3.1.1** The aluminum sheet metal shall conform to the following:

(1) Be a maximum thickness of 0.04 in. (1 mm)
(2) Provide a maximum 2 in. (51 mm) vertical leg on the interior face only
(3) Be flush with the exterior face

**5.7.3.1.2** Fasteners used to attach the aluminum sheet metal to the window opening framing shall be spaced a minimum of 6 in. (152 mm).

**5.7.3.2** No material shall be used to fill air gap cavities, if any, or further cap the header, jambs, and sill area.

**5.7.3.3** As an option to 5.7.3.1, the window opening construction used in the test shall represent construction details provided by the client and installed per the manufacturers' instructions.

**5.7.3.4** The window opening details, including drawings and descriptions, shall be included in the test report per Chapter 11.

**5.8 Curing Period.** Prior to the fire test, the test specimen shall be cured as required by the manufacturer.

**5.8.1** In the case of cementitious coatings or materials, not less than 28 days shall elapse from completion of construction of the test specimen to fire testing the test specimen.

**5.8.2** During the curing period, the wall assemblies shall be protected from exposure to the weather.

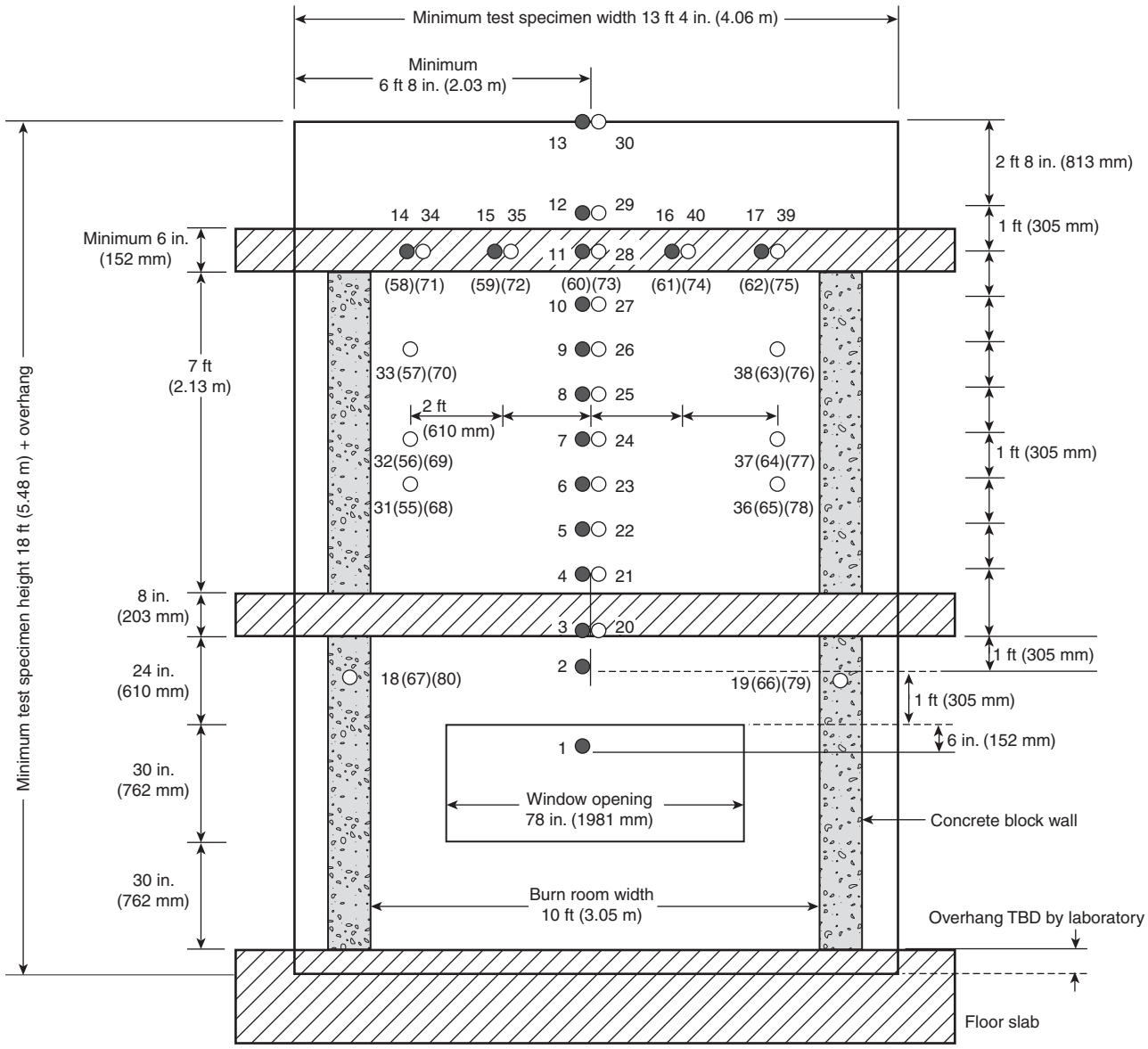
## Chapter 6 Instrumentation

**6.1* Temperature Measurements.** Temperature measurements shall be taken at the following locations:

(1) Exterior wall surface of the test specimen, as shown in Figure 6.1(a)
(2) Combustible insulation in the exterior wall panel of the test specimen, where applicable, as shown in Figure 6.1(a) and in Figure 6.1(b), Details A and B
(3) Cavity air space within the test specimen, where applicable, as shown in Figure 6.1(a) and in Figure 6.1(b), Detail D and Details F through I
(4) Wall cavity insulation and stud cavity insulation, where applicable, as shown in Figure 6.1(a) and in Figure 6.1(b), Details B through I
(5) Interior surface of the test specimen, as shown in Figure 6.1(c)
(6) Below the first-story test room ceiling, as shown in Figure 6.1(d)
(7) For other locations, as shown in Figure 6.1(a) and in Figure 6.1(b), Details A through I, as applicable, for the test specimen construction being tested

**6.2 Gas Flow Meters.** Each burner shall have gas flow metering equipment to measure the expected flow rates for each burner to within 5 percent.

**6.3 Thermocouples.** Temperature measurements shall be made using 20-gauge Type K thermocouples, except that those used to measure the temperatures shown in Figure 6.1(d) shall be 18-gauge Type K thermocouples.



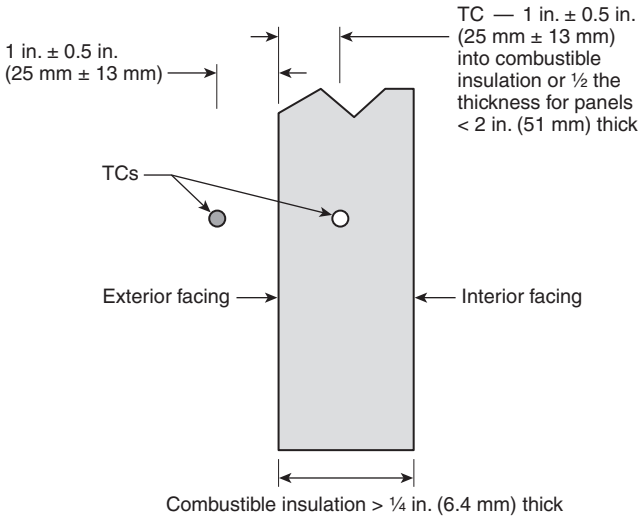

● Thermocouples — 1 in. (25 mm) from exterior wall surface

○ Thermocouples — In the wall cavity air space or the insulation, or both, as shown in Figure 6.1(b) Details A through I.

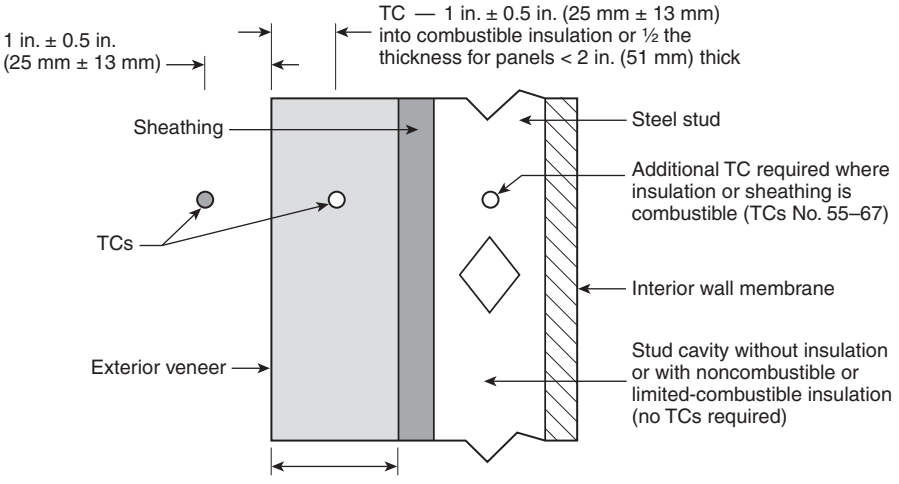
( ) Thermocouples — Additional thermocouples in the insulation or the stud cavity, or both, where required for the test specimen construction being tested, as shown in Figure 6.1(b) Details C through I.

Figure not to scale

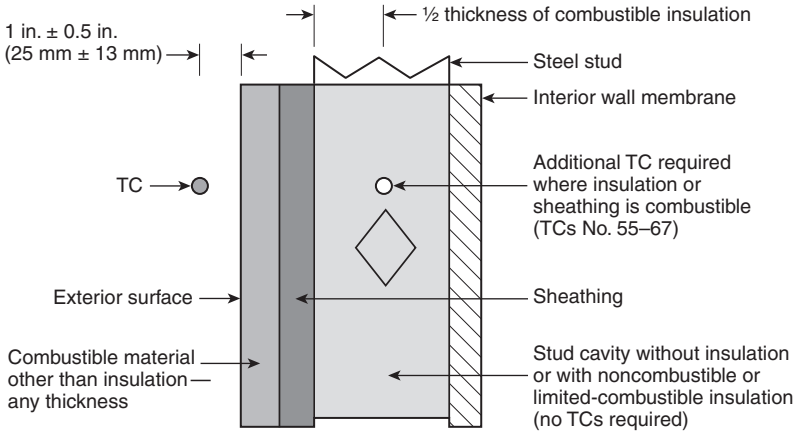
**Δ FIGURE 6.1(a) Front View of Test Specimen Superimposed over Test Apparatus Thermocouple Locations.**




**Detail A**

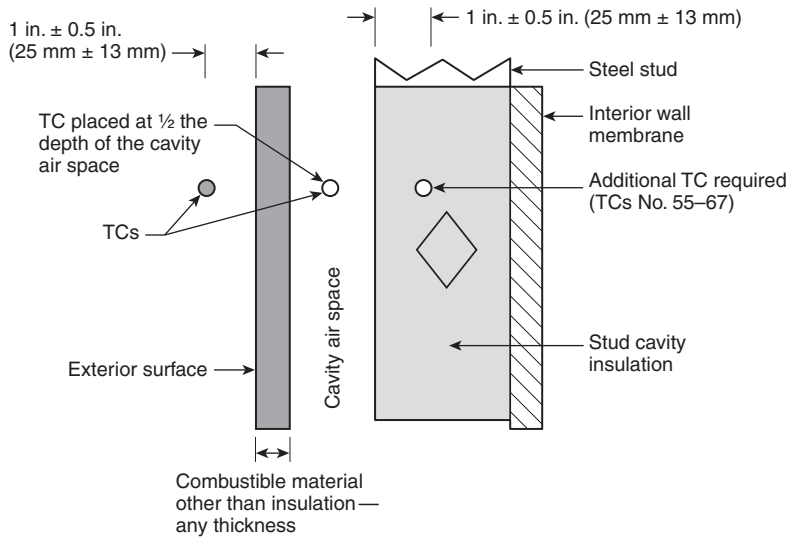



**Detail B**

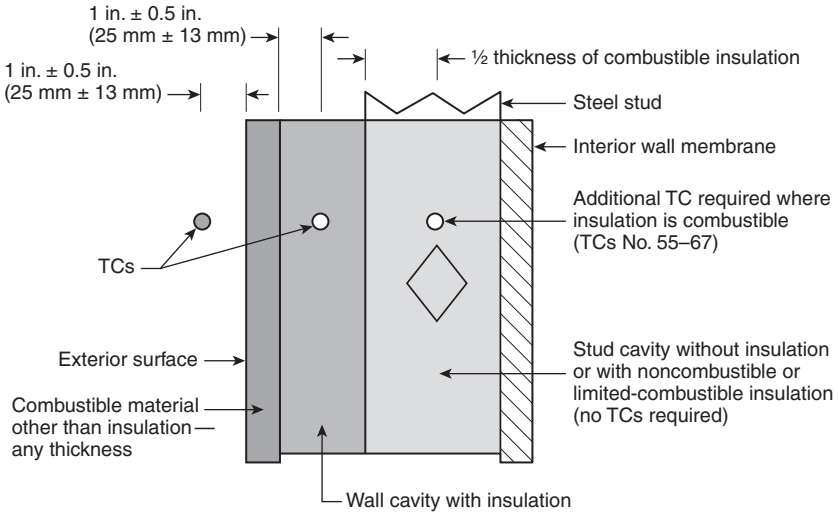



**Detail C**

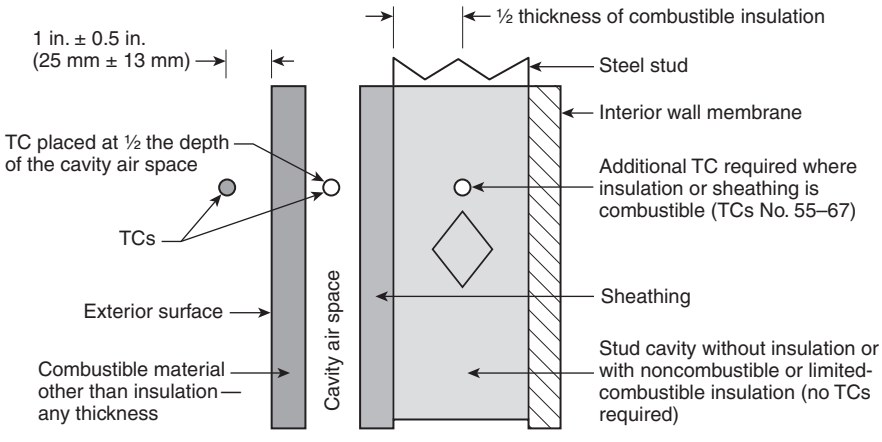
**Δ FIGURE 6.1(b) Instrumentation Arrangement.**




**Detail D**

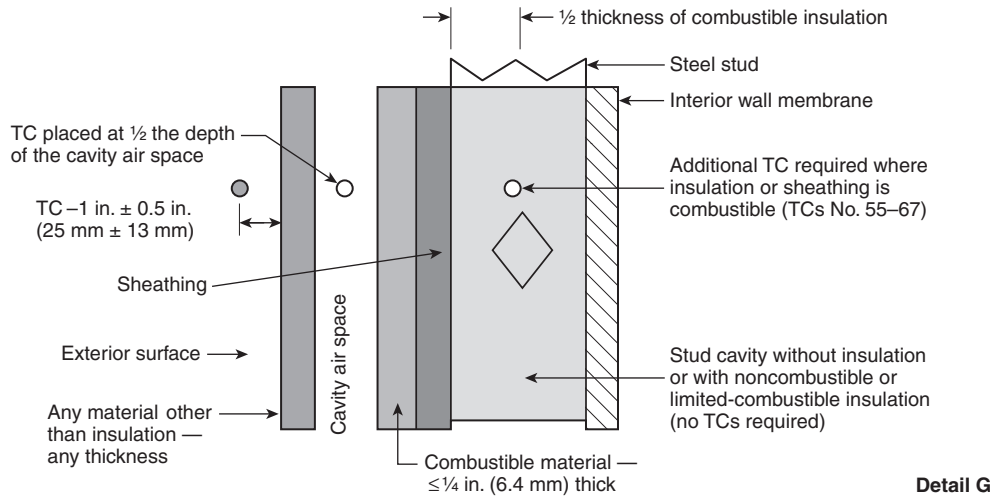



**Detail E**

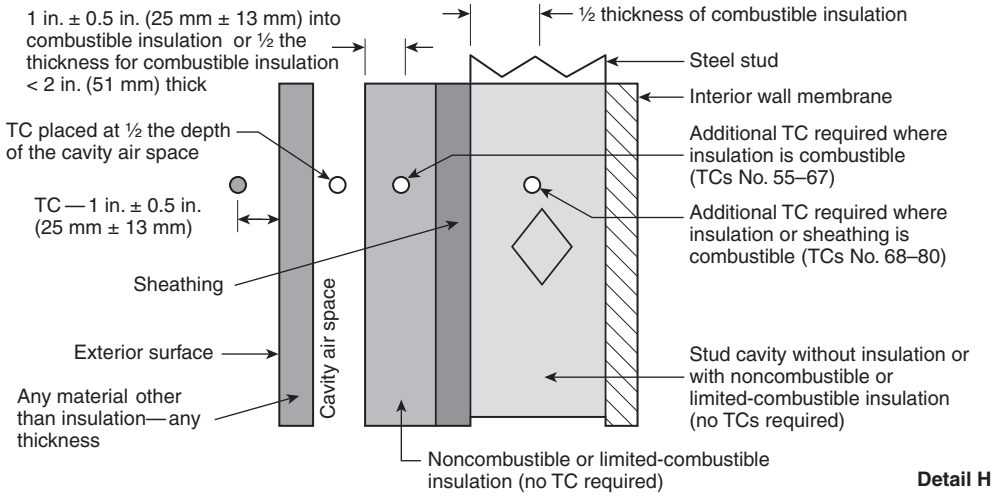



**Detail F**

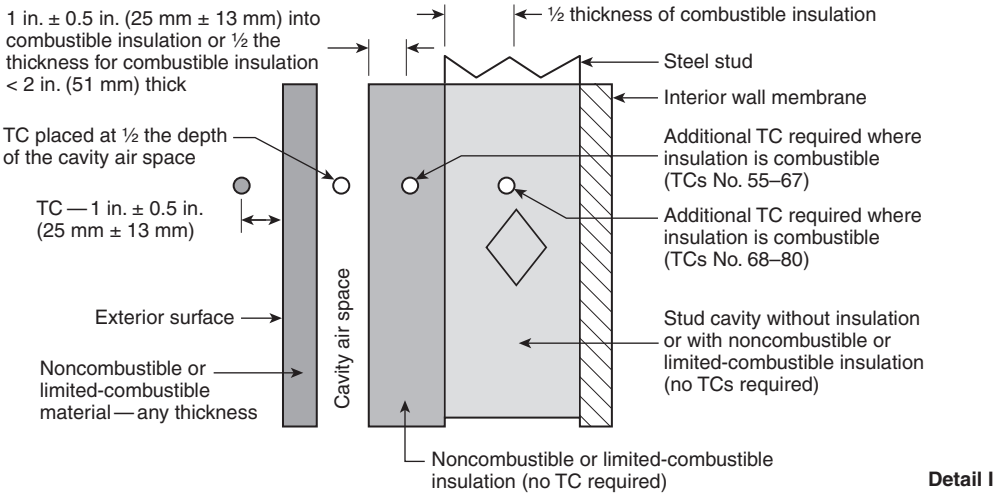
**FIGURE 6.1(b)** ***Continued***




**Detail G**




**Detail H**




**Detail I**

**FIGURE 6.1(b)** ***Continued***

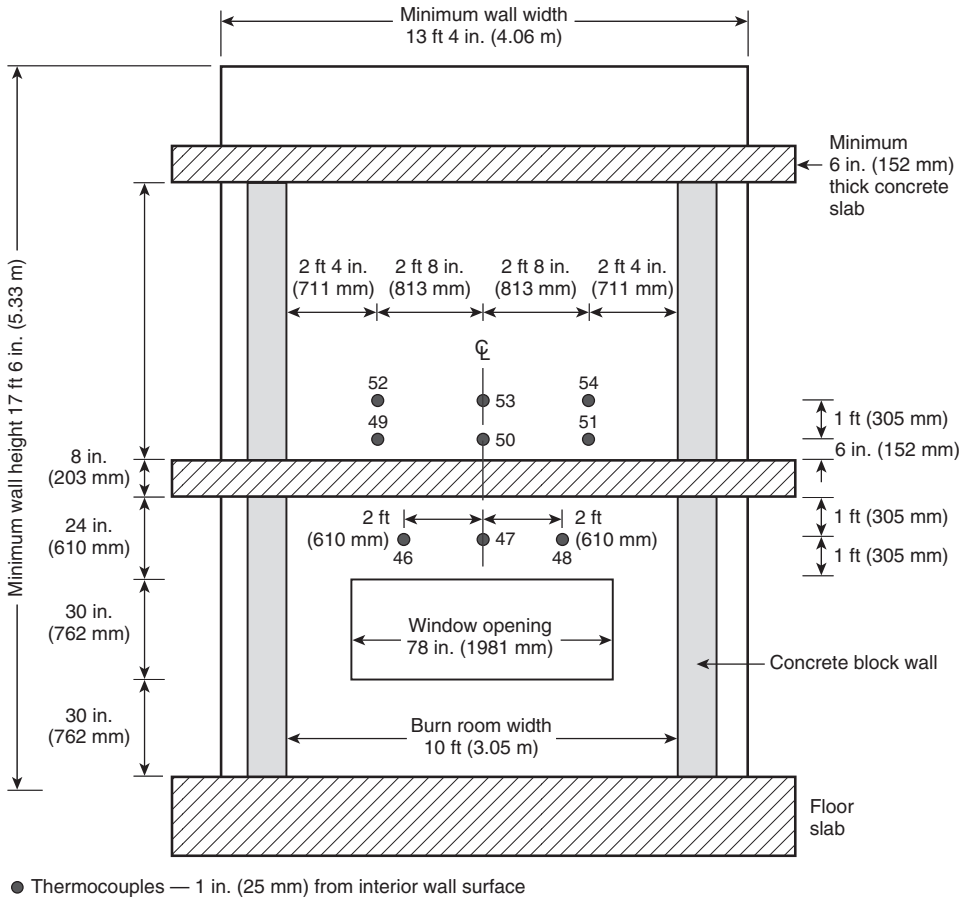



**FIGURE 6.1(c) Interior View of the Test Specimen. Instrumentation arrangement.**

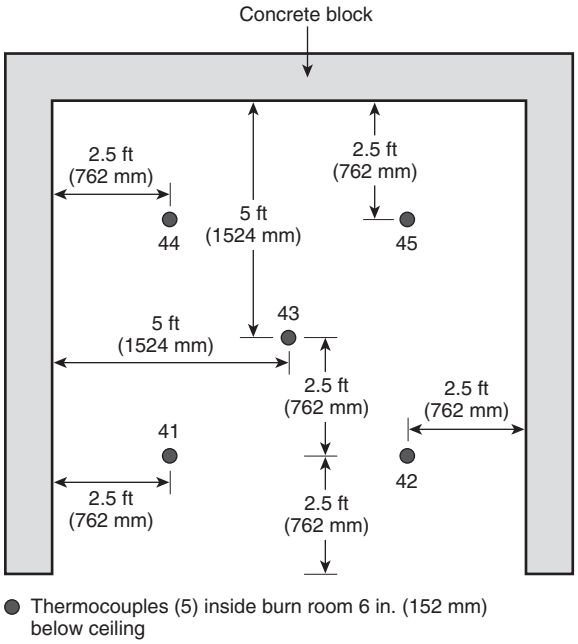



**FIGURE 6.1(d) Plan View — First-Story Test Room. Instrumentation arrangement.**

## Chapter 7 Calibration Procedure

**7.1 Calibration Test Procedure.** A calibration test shall be performed in accordance with this chapter to determine the gas flow rates of the gas burners to be used in the fire test procedure prescribed in Chapter 8.

**7.1.1*** The test specimen for the calibration test shall be constructed of two layers of nominal 5/8 in. (16 mm) thick Type X gypsum wallboard, conforming to ASTM C1396/C1396M, *Specification for Gypsum Board*, applied to both sides of nominal 18-gauge steel studs spaced 24 in. (610 mm) on center.

**7.1.2** Joints shall be taped or caulked.

**7.1.3** The test specimen shall have a height not less than 18 ft (5.5 m) above the floor surface of the test facility and shall have a width not less than 14 ft (4.3 m).

**7.1.4** The perimeter of the window opening shall be completely covered with a layer of nominal 5/8 in. (16 mm) thick Type X gypsum wallboard.

**7.1.5** A spandrel beam shall not be used.

**7.1.6** Calibration instrumentation shall consist of not less than the following:

(1) Temperature measurements taken at the locations shown in Figure 7.1.6(a) and Figure 7.1.6(b) using nominal 20-gauge, Type K thermocouples, and those used to measure the temperatures at the locations shown in Figure 7.1.6(c) must be nominal 18-gauge, Type K thermocouples
(2) No fewer than three 0–5 W/cm$^2$ circular foil total heat flux gauges located as shown in Figure 7.1.6(a)
(3) Gas flow rate measurement equipment for each of the burners

**7.1.7** Prior to the conduct of the calibration test, the paper facing of the gypsum wallboard on the exterior face of the calibration wall assembly shall be burned away by igniting both the room burner and the window burner and immediately adjusting the burners to their maximum flow rates as prescribed in Table 7.1.16 for not less than 5 minutes at these gas flow rates.

**7.1.8** The calibration test shall be conducted with the gas burners supplied during the test according to the calibration gas flow rates prescribed in Table 7.1.16.

**7.1.9** Each burner shall be flowing gas at its prescribed gas flow rate within 15 seconds of each prescribed change in the gas flow rate.

**7.1.10** The initial calibration test shall be conducted with the window burner positioned such that the vertical centerline of the burner is flush with the exterior face of the wall assembly.

**7.1.11*** At the conclusion of the test, the data obtained shall be compared to the values specified in Table 7.1.11.

**7.1.12** To prevent burner changes from affecting the data, the average values for each time period shall be determined using data from 15 seconds after the start of the period through 15 seconds before the end of the period.

**7.1.13** The allowable values for the comparison to the specified average values in Table 7.1.11 shall be no lower than 10 percent below the degree F value and no higher than 20 percent above the degree F value shown in Table 7.1.11.

**7.1.14** For the heat flux measurements, all the determined average values for the locations shown in Table 7.1.11 shall fall within the tolerances of those specified in Table 7.1.11.

**7.1.15** The values for thermocouple nos. 1 and 8 through 14, as shown in Figure 7.1.6(a), shall be reported, but they shall not be used in the calibration determination.

*N* **7.1.16*** The burners shall be fired during the fire test according to the calibration gas flow rates shown in Table 7.1.16.

*N* **7.1.17** Each burner shall attain its prescribed gas flow rate within 15 seconds of each specified change in the gas flow rate.

**7.1.18** If the actual test values are not within the allowable tolerances, then the calibration shall be repeated and the gas flows or window burner position adjusted until the determined values are within the allowable tolerances.

**7.1.19** If it is demonstrated that the burners must follow different flow rates in order to attain the prescribed burn room and/or exterior temperatures and heat fluxes, then the flows derived from the calibration test shall be used.

**7.1.20** If it is demonstrated that the window burner must be repositioned within 5 in. (127 mm) of the exterior face of the calibration wall to attain the prescribed exterior temperatures and heat fluxes, then the position derived from the calibration shall be used in all subsequent testing.

**7.1.21** After the calibration test detailed in Chapter 7 has been successfully completed, the window burner shall be relocated to a minimum of 5 ft (1.52 m) away from the calibration test specimen, and the gas flow rate to the window burner used for the 5- to 10-minute calibration time period shall be reestablished and the burner ignited.

**7.1.21.1** The average height of the fluctuating window burner flame shall be measured at the approximate midpoint of the burner slot and at points approximately 6 in. (153 mm) from each end of the burner slot.

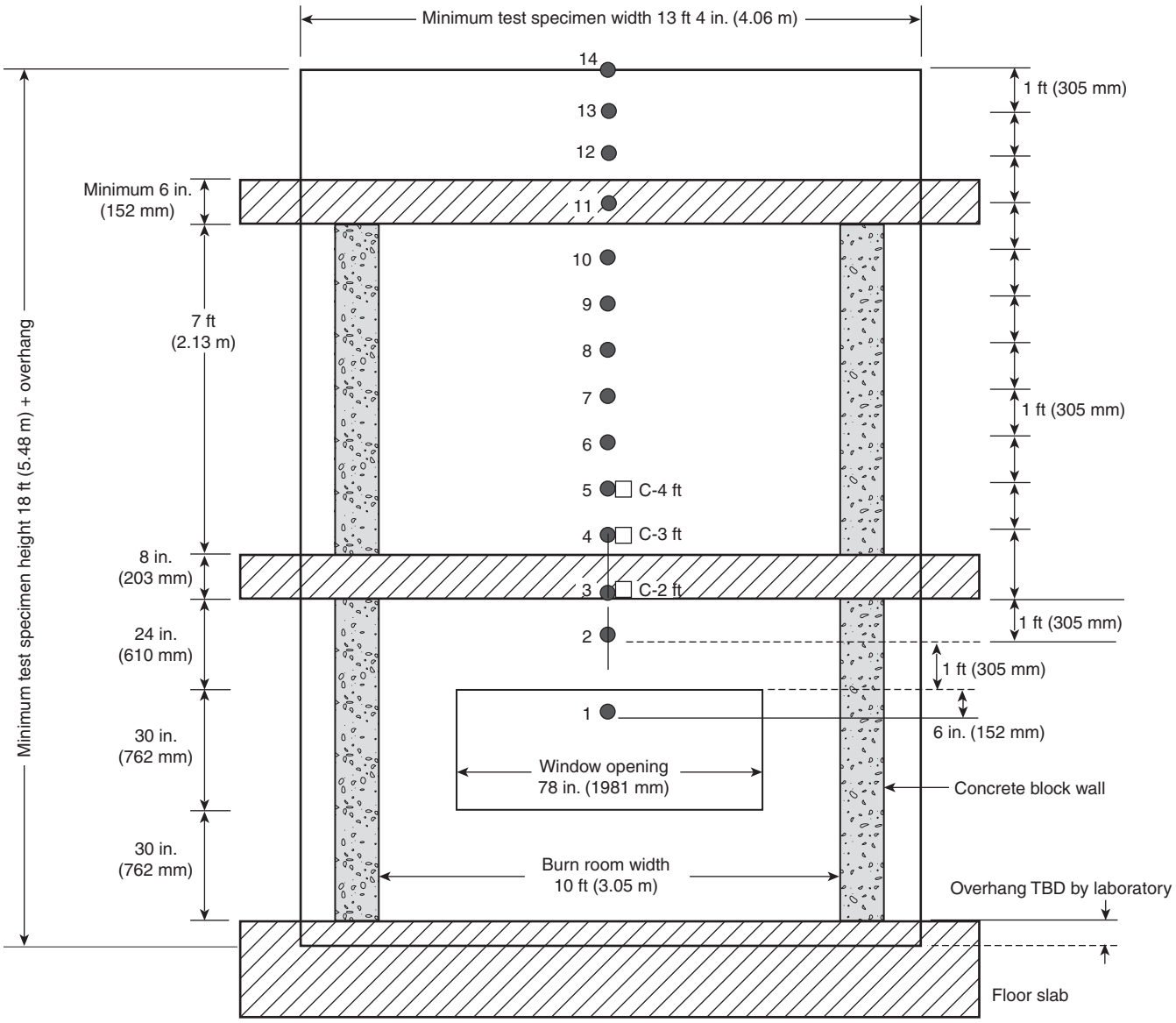
**7.1.21.2** The measurements shall be recorded.

**7.1.21.3** A video recording shall be made of the window burner flame during the 5- to 10-minute period for the purpose of using the video recording as a visual reference when the window burner is required by 7.1.22 to be recalibrated.

**7.1.22** The window burner shall be recalibrated prior to the next test to be consistent with the flame height measurements and visual observations taken in 7.1.21 when any of the following occurs:

(1) The ceramic blanket covering the window burner is replaced.
(2) The burner output distribution has been adversely affected by the accumulation of burning or melting debris, causing a change in the flame geometry.
(3) The burner output distribution has been adversely affected by the impact of falling debris on the blanket, causing a change in the flame geometry.

**7.1.22.1** The same flow rate as in the full-scale calibration test during the 5- to 10-minute time period shall be used.




**Δ FIGURE 7.1.6(a) Front View of Calibration Wall Assembly Superimposed over Test Apparatus. Calibration instrumentation locations (not to scale).**

**7.1.22.2** The ceramic blanket shall be adjusted so that the flame heights at the three specified locations are measured to the same nominal height and look visually similar to that as measured and video recorded respectively in 7.1.21.

**7.2 Frequency of Calibration.** Calibration shall be performed in the following circumstances:

(1) Initially, prior to the first wall assembly test
(2) When significant changes to the gas flow systems are made (e.g., flowmeters are new)
(3) Within 1 year prior to the test of an actual product wall assembly
(4) When the ceramic blankets covering more than 50 percent of the wall or ceiling surface in the burn room are replaced

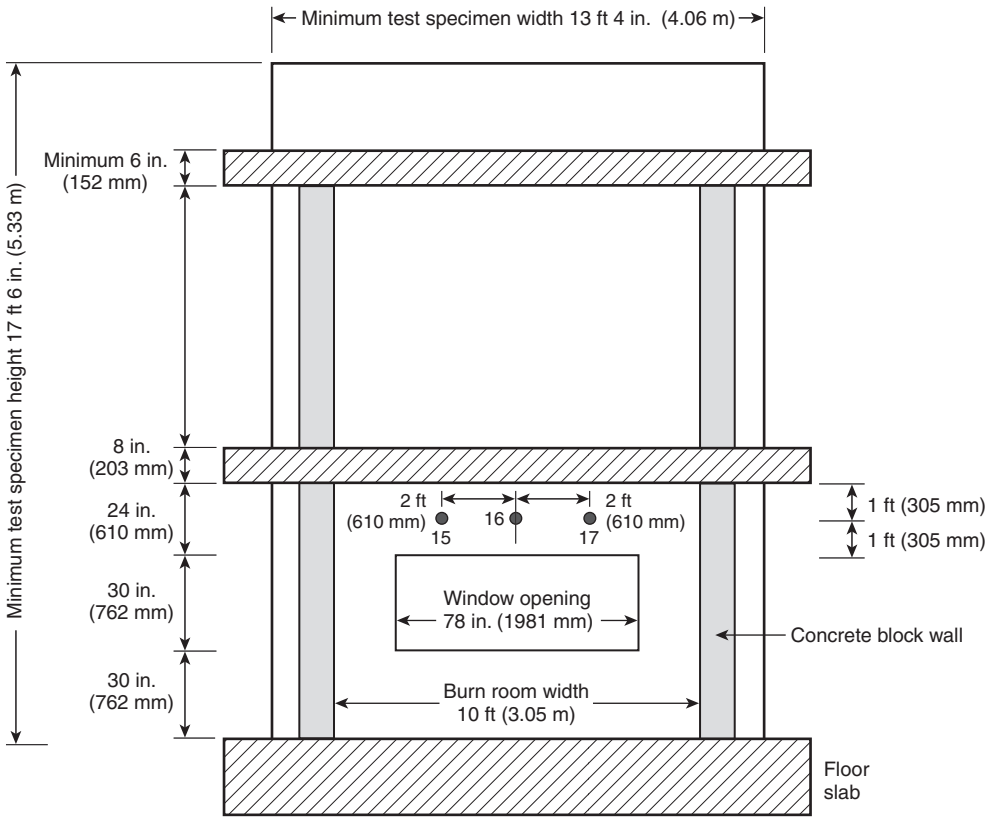



**FIGURE 7.1.6(b) Interior View of the Calibration Wall Assembly. Thermocouple locations (not to scale).**

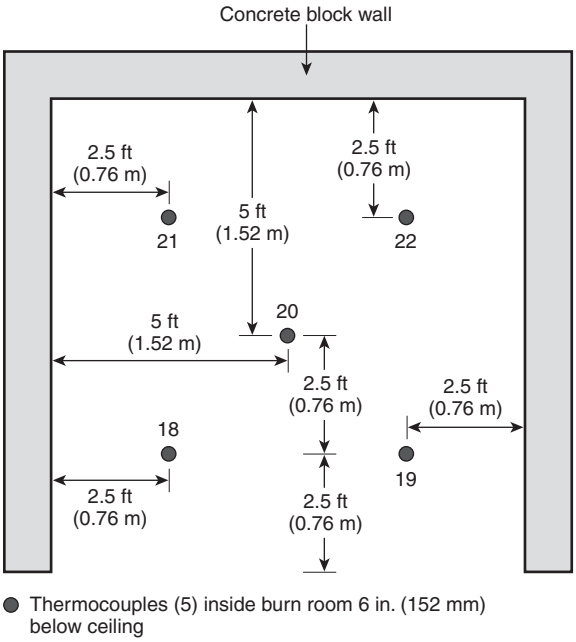



**FIGURE 7.1.6(c) Plan View — First-Story Test Room. Thermocouple locations (not to scale).**

**Table 7.1.11 Calibration Average Values for Time Periods Indicated**

| Thermocouple Location and Numbers | Temperature | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0–5 min | | 5–10 min | | 10–15 min | | 15–20 min | | 20–25 min | | 25–30 min | |
| | °F | °C | °F | °C | °F | °C | °F | °C | °F | °C | °F | °C |
| Test room ceiling: Nos. 18–22 | 1151 | 622 | 1346 | 730 | 1482 | 806 | 1600 | 871 | 1597 | 869 | 1648 | 898 |
| Interior wall surface of test room: Nos. 15–17 | 1065 | 574 | 1298 | 703 | 1433 | 778 | 1578 | 859 | 1576 | 858 | 1655 | 902 |
| 1 ft (305 mm) above top of window opening: No. 2 | 602 | 317 | 870 | 466 | 952 | 511 | 992 | 533 | 1046 | 563 | 1078 | 581 |
| 2 ft (610 mm) above top of window opening: No. 3 | 679 | 359 | 1015 | 546 | 1121 | 605 | 1183 | 639 | 1245 | 674 | 1296 | 702 |
| 3 ft (914 mm) above top of window opening: No. 4 | 646 | 341 | 971 | 521 | 1096 | 591 | 1174 | 634 | 1245 | 674 | 1314 | 712 |
| 4 ft (1219 mm) above top of window opening: No. 5 | 577 | 302 | 858 | 459 | 982 | 528 | 1063 | 573 | 1135 | 613 | 1224 | 662 |
| 5 ft (1524 mm) above top of window opening: No. 6 | 521 | 272 | 765 | 407 | 875 | 469 | 949 | 509 | 1007 | 542 | 1106 | 597 |
| 6 ft (1829 mm) above top of window opening: No. 7 | 472 | 244 | 690 | 366 | 787 | 419 | 856 | 458 | 913 | 489 | 1010 | 543 |

| Calorimeter Locations and Numbers | Heat Flux (W/cm$^2$) | | | | | |
|---|---|---|---|---|---|---|
| | 0–5 min | 5–10 min | 10–15 min | 15–20 min | 20–25 min | 25–30 min |
| 2 ft (610 mm) above top of window opening: Letter C–2ft | 0.9 ± 0.2 | 1.9 ± 0.4 | 2.5 ± 0.5 | 2.9 ± 0.6 | 3.4 ± 0.7 | 3.8 ± 0.8 |
| 3 ft (914 mm) above top of window opening: Letter C–3ft | 1.0 ± 0.2 | 2.0 ± 0.4 | 2.6 ± 0.5 | 3.2 ± 0.6 | 3.7 ± 0.7 | 4.0 ± 0.8 |
| 4 ft (1219 mm) above top of window opening: Letter C–4ft | 0.8 ± 0.2 | 1.5 ± 0.3 | 2.0 ± 0.4 | 2.5 ± 0.5 | 3.0 ± 0.6 | 3.4 ± 0.7 |

*N* **Table 7.1.16 Calibration Gas Flow Rates (Based on Natural Gas)**

| Time Interval | Room Burner | | | | Window Burner | | | |
|---|---|---|---|---|---|---|---|---|
| | SCFM | m$^3$/min | kW | Btu/min | SCFM | m$^3$/min | kW | Btu/min |
| 0:00–5:00 | 38.0 | 1.08 | 687 | 39,064 | 0.0 | 0.00 | 0 | 0 |
| 5:00–10:00 | 38.0 | 1.08 | 687 | 39,064 | 9.0 | 0.25 | 163 | 9,252 |
| 10:00–15:00 | 43.0 | 1.22 | 777 | 44,204 | 12.0 | 0.34 | 217 | 12,336 |
| 15:00–20:00 | 46.0 | 1.30 | 831 | 47,288 | 16.0 | 0.45 | 289 | 16,448 |
| 20:00–25:00 | 46.0 | 1.30 | 831 | 47,288 | 19.0 | 0.54 | 343 | 19,532 |
| 25:00–30:00 | 50.0 | 1.42 | 904 | 51,400 | 22.0 | 0.62 | 398 | 22,616 |

## Chapter 8 Fire Test Procedure

**8.1* Fire Test Procedure.**

**8.1.1** The fire test procedure shall be in accordance with 8.1.2 through 8.1.13.

**8.1.2** The thermocouples installed on the completed test specimen shall be checked to verify that they are operating correctly.

**8.1.3** Prior to final positioning of the window burner, the window burner shall be fired and the resultant flame verified and adjusted as required. Verification of the flame shall consist of visual observation of a consistent flame height over the width of the burner.

**8.1.4** The placement of the window burner shall be verified to be in accordance with 4.6.9 through 4.6.12 and 7.1.20.

**8.1.5** Ambient conditions at the start of the fire test shall be as follows:

(1) The temperature of the air in the test facility shall be between 50°F and 90°F (10°C and 32°C).
(2) The relative humidity of the air in the test facility shall be between 20 percent and 80 percent.
(3) Airflow across the exterior face of the test specimen shall be less than 4.4 ft/sec (1.3 m/sec), as determined by an anemometer placed at a right angle to the exterior face and located within 3 ft (1 m) of the exterior face. The anemometer shall be of the hot wire or vane type and shall have an accuracy of 1 ft/min (305 mm/min).

**8.1.6** The gas supply to the test room burner shall be turned on and the burner ignited.

**8.1.7** The gas flow rates established in accordance with 7.1.16 through 7.1.17 and 7.1.19 shall be followed for test room burners and the window burner except as required in 8.1.8.

**8.1.8** When it has been demonstrated during the calibration procedure that the burners must follow different gas flow rates to attain the prescribed test room and exterior face temperatures and heat fluxes, then the gas flows determined from the calibration tests within a tolerance of ±10 percent shall be used.

**8.1.9** At 5 minutes ± 5 seconds after ignition of the test room burner, the gas supply to the window burner shall be turned on and the burner ignited.

**8.1.10** At 30 minutes ± 5 seconds after ignition of the test room burner, the gas supply to both burners shall be shut off.

**8.1.11** The access opening for the second-story test room shall remain open during the fire tests.

**8.1.12** Any additional access openings in the second-story test room shall be closed during the fire test.

**8.1.13** The window opening shall be the only opening permitted to be open in the first-story test room during the fire test.

## Chapter 9 Data Collection and Observation

**9.1 Duration.**

**9.1.1** Video recording and data collection shall be started not less than 1 minute prior to ignition of the test room burner.

**9.1.2*** Video recording, data collection, and visual observations shall be continued for the 30-minute test duration.

**9.2 Data Recording.** Measurements of the temperatures at the locations specified in Section 6.1 and the gas flows specified in 8.1.6 shall be recorded at intervals not to exceed 15 seconds.

**9.3 Ambient Conditions.** The ambient conditions specified in 8.1.4 shall be recorded at the start of the fire test.

**9.4 Visual Observations.**

**9.4.1** Photographs or digital images shall be taken at the rate of not less than once every minute during the fire test.

**9.4.2** Visual observation of the test specimen and its performance shall be recorded and documented as described by Section 9.4 and the following:

(1) Color photographs, digital images, or color video of the exterior face of the test specimen taken at the following times:
   (a) The end of the fire test
   (b) After the fire test
   (c) During the dissection of the test specimen post-fire-test period
   (d) After the dissection of the test specimen

(2)* Color video recording taken of the test specimen–floor intersection in the second-story test room during the fire test

(3) Color photographs or digital images taken of the interior face of the test specimen before and after the fire test

**9.4.3** The color video and at least one photograph or digital image shall show the laboratory test report identification number and the test date.

**9.4.4** The color video recordings shall include a clock or a timer.

**9.4.5** The timer in 9.4.4 shall be integral to the video, unless a clock or timer that is clearly viewed throughout the fire test is used.

**9.5 Determination of Extent and Depth of Damage.** The test specimen shall be dismantled and dissected to determine the extent and the depth of damage within the combustible components and the condition of the test specimen's exterior wall panel facings.

## Chapter 10 Conditions of Acceptance

**10.1 Test Specimen.** The performance of the test specimen shall be determined on the basis of visual observations both during and after the test in conjunction with the temperature data obtained during the fire test.

**10.2 Performance Criteria.** The test specimen shall be considered as passing the fire test when the performance criteria specified in 10.2.1 through 10.2.6 are met during the 30-minute fire exposure specified in Chapter 8.

**10.2.1 Flame Propagation: Exterior Face of Test Specimen.**

**10.2.1.1** Flame propagation on the exterior face of the test specimen shall not occur either vertically or horizontally beyond the area of flame plume impingement by the window burner flames.

**10.2.1.2** Flame propagation shall be determined to occur if any one of the following conditions is measured or observed:

(1) A temperature of 1000°F (538°C) is measured by any one of the thermocouples numbers 11 and 14 through 17, as shown in Figure 10.2.1.2.
(2) Flames emitting from the surface of the exterior face of the test specimen reach a height of 10 ft (3.05 m) or greater above the top of the window opening, as shown in Figure 10.2.1.2.
(3) Flames emitting from the surface of the exterior face of the test specimen reach a horizontal distance of 5 ft (1.52 m) or greater from the vertical centerline of the window opening, as shown in Figure 10.2.1.2.

**10.2.2 Vertical Flame Propagation: Combustible Components and Insulation.** Flame propagation shall not occur vertically through the combustible components or the combustible insulation installed within the test specimen, as determined in accordance with the following:

(1) For test specimens constructed of exterior wall panels greater than ¼ in. (6.4 mm) thick containing combustible components, temperatures in the combustible components shall not exceed 750°F (417°C) above their temperature as measured immediately after the start of the test by thermocouple nos. 28 and 31 through 40, as shown in Figure 6.1(a) and in Figure 6.1(b), Details A and B.
(2) For test specimens constructed of exterior wall panels containing combustible components and having a wall cavity with an air space as shown in Figure 6.1(a) and in Figure 6.1(b), Details C, E, F, and I, the following conditions shall be met:
   (a) Temperatures in the wall cavity air space shall not exceed 1000°F (538°C) as measured by thermocouples nos. 28 and 31 through 40.

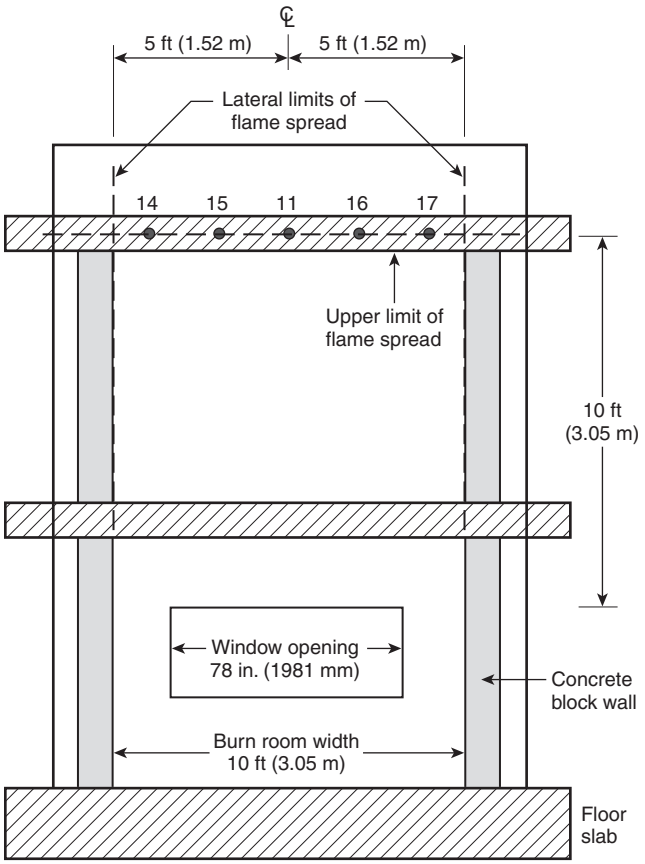



**FIGURE 10.2.1.2 Limits of Flame Propagation — Exterior Surface of Test Specimen (not to scale).**

(b) Temperatures in the wall cavity and stud cavity insulation shall not exceed 750°F (417°C) above their temperature as measured immediately after the start of the fire test by thermocouples nos. 55 through 65 and 68 through 78, as applicable.

(3) For test specimens constructed of exterior wall panels that are ¼ in. (6.4 mm) thick or less, containing combustible components and having a wall cavity without an air space, temperatures in the wall cavity and stud cavity insulation shall not exceed 750°F (417°C) above their temperature as measured immediately after the start of the fire test by thermocouples nos. 28, 31 through 40, and 55 through 65, as applicable, as shown in Figure 6.1(a) and in Figure 6.1(b), Detail D.

(4) For test specimens constructed of noncombustible or limited-combustible exterior wall panels and having a wall cavity with an air space as shown in Figure 6.1(a) and in Figure 6.1(b), Details G, H and I, the following conditions shall be met:

(a) Temperatures in the wall cavity air space shall not exceed 1000°F (538°C) as measured by thermocouples nos. 28 and 31 through 40.

(b) Temperatures in the wall cavity and stud cavity insulation shall not exceed 750°F (417°C) above their temperature as measured immediately after the start of the fire test by thermocouples nos. 55 through 65 and 68 through 78, as applicable.

**10.2.3 Horizontal Flame Propagation: Combustible Components and Insulation.**

**10.2.3.1** Flame propagation shall not occur horizontally through the combustible components or the combustible insulation installed within the test specimen, as determined in accordance with the following:

(1) For test specimens constructed of exterior wall panels greater than ¼ in. (6.4 mm) thick containing combustible components, temperatures in the combustible components shall not exceed 750°F (417°C) above their temperature measured immediately after the start of the fire test by thermocouples nos. 18 and 19, as shown in Figure 6.1(a) and in Figure 6.1(b), Details A and B.

(2) For test specimens constructed of exterior wall panels containing combustible components and having a wall cavity with an air space as shown in Figure 6.1(a) and in Figure 6.1(b), Details C, E, F, and I, the following conditions shall be met:

(a) Temperatures in the wall cavity air space shall not exceed 1000°F (538°C) as measured by thermocouples nos. 18 and 19.

(b) Temperatures in the wall cavity and stud cavity insulation shall not exceed 750°F (417°C) above their temperature as measured immediately after the start of the fire test by thermocouples nos. 66, 67, 79, and 80, as applicable.

(3) For wall assemblies constructed of exterior wall panels that are ¼ in. (6.4 mm) thick or less containing combustible components and having a wall cavity without an air space, temperatures in the wall cavity and stud cavity insulation shall not exceed 750°F (417°C) above their temperature as measured immediately after the start of the test by thermocouples nos. 18, 19, 66, and 67, as applicable, as shown in Figure 6.1(a) and in Figure 6.1(b), Detail D.

(4) For test specimens constructed of noncombustible or limited-combustible exterior wall panels and having a wall cavity with an air space as shown in Figure 6.1(a) and in Figure 6.1(b), Details G, H and I, the following conditions shall be met:

(a) Temperatures in the wall cavity air space shall not exceed 1000°F (538°C) as measured by thermocouples nos. 18 and 19.

(b) Temperatures in the wall cavity and stud cavity insulation shall not exceed 750°F (417°C) above their temperature as measured immediately after the start of the fire test by thermocouples nos. 66, 67, 79, and 80, as applicable.

**10.2.4 Temperatures in Second-Story Test Room.** Temperatures measured 1 in. (25 mm) from the interior surface of the test specimen within the second-story test room shall not exceed 500°F (278°C) above the ambient air temperature of the test facility at the start of the fire test as measured by thermocouples nos. 49 through 54 as shown in Figure 6.1(c).

**10.2.5 Flames in Second-Story Test Room.** Flames shall not occur in the second-story test room.

**10.2.6 Flame Propagation to Adjacent Horizontal Spaces.** Flames shall not occur beyond the intersection of the test specimen and the side walls of the test apparatus.

## Chapter 11 Report

Δ **11.1* Fire Test Report.** A fire test report shall be prepared to document the fire test.

*N* **11.1.1** The fire test report shall contain all of the following:

(1)* Description of the test specimen wall assembly, including the following:
   (a) Drawings showing the structural design in plan and elevation, principal cross-section and other sections as needed for clarity, projections and joint locations and details
   (b) Drawings and description of the construction used in the test around the window opening header, jambs, and sills, including the type and thickness of the closure material around the perimeter of the opening; the fastening detail, including the type, size, and spacing of fasteners around the perimeter of the window opening; and the type, thickness, and density of any insulation or blocking used internal to the window opening closure
   (c) Details of the attachment of the wall assembly to the test apparatus
(2) Location of thermocouples
(3) The date and results (i.e., temperature and heat flux) of the most recent calibration
(4) Ambient conditions at the start of the fire test
(5) Temperatures of all thermocouples during the fire test
(6) Burner gas flow data obtained during the fire test, including type of gas used and total gas flow of both burners for the duration of the fire test
(7) Comparison of burner gas flow data obtained during the fire test to the burner gas flow data obtained during the latest calibration test
(8) Position of the vertical centerline of the window burner with respect to the exterior face of the wall assembly for the fire test and the latest calibration test
(9) Visual observations made during the fire test
(10) Photographs of the following:
   (a) Wall assembly — prior to fire test, exterior face
   (b) Wall assembly — fire test in progress, exterior face
   (c) Wall assembly — post-fire test, exterior face
   (d) Wall assembly — post-fire test, interior face, both stories
   (e) Wall cavity insulation in wall assembly — post-fire test
(11) Damage sketch(es) of the wall assembly
(12) Extent of residual burning that continues during the 10-minute period immediately after the gas flow to the gas burners has been shut off
(13) Visual observations of smoke accumulation inside the second-story test room during the fire test
(14) Performance of the wall assembly with respect to each of the applicable conditions of acceptance *(see Chapter 10)*

## 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** In the late 1970s, the use of foam plastic insulation and other combustible materials in exterior, non-load-bearing walls on noncombustible construction (typically Types I, II, III, and IV) was proposed. At that time, questions were raised concerning the vertical and horizontal spread of fire over the combustible faces or through the combustible cores of these types of exterior walls. In order to address these concerns, a full-scale fire test program was sponsored by the Society of Plastics Industry (SPI). The testing was conducted in 1980 at Southwest Research Institute. This program consisted of a series of full-scale fire tests that utilized an outdoor 26 ft tall two-story building. The test wall systems were erected on two adjoining sides of the building and in one wall; a window opening was placed in the lower floor wall area. A 1285 lb wood crib was placed in the lower floor, and when ignited this fire source produced an NFPA 251 (withdrawn and replaced by ASTM E119, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*) time-temperature fire exposure on the interior of the wall system. At approximately 5 minutes into the test, flames exited the window opening and simultaneously exposed the exterior face of the wall assembly. Temperature measurements and visual observations were made during the 30-minute test and after the test to evaluate the extent of flame propagation. The test series showed that for the wall panel systems evaluated, the extent of flame propagation both vertically and horizontally was limited (Beitel and Evans).

When the ICC *Uniform Building Code (UBC)* was modified to recognize this application, the full-scale fire test was also codified and was published in the 1988 edition of the *UBC* as Test Standard 17-6. When the 1994 edition of the *UBC* was reorganized, the test became UBC Test Standard 26-4.

In the early 1990s, SPI sponsored a test program that developed a reduced-scale version of the UBC 26-4 test. This test used an indoor, intermediate-scale, multistory test apparatus, a single wall with a window opening, and two gas-fired burners to produce the same exposure conditions as the UBC 26-4 test. A combination of temperature measurements and visual observations were used to determine the extent of vertical and horizontal flame propagation over the face of the wall systems or through the combustible core material. After development of the test apparatus, a series of tests were conducted that showed correlation between the new intermediate-scale test and the full-scale UBC 26-4 test. Testing was done with wall systems that both passed and failed in the UBC 26-4 test, with similar results being attained in the intermediate-scale test method (Beitel and Griffith).

This test was recognized by the *UBC* as an alternative to the UBC 26-4 test and was published as UBC Test Standard 26-9 in the 1997 edition of the *UBC*.

In 1998, NFPA adopted NFPA 285, which used as its basis the UBC 26-9 test. The NFPA 285 test is technically the same as the UBC 26-9 test, with the only differences between the test methods being formatting and editorial issues. The *International Building Code* and *NFPA 5000* reference NFPA 285 for assessment of fire performance of exterior walls.

**A.1.1.1** The fire test method described is intended to evaluate the inclusion of combustible components within wall assemblies/panels of buildings.

The test apparatus described in this standard is commonly referred to as the intermediate-scale multistory apparatus (ISMA).

**A.1.1.2** This standard addresses fire exposures from interior fires, including those that reach flashover, break exterior windows, and expose the building facade. It can also be used to evaluate the effects of fire involving the exterior wall assembly. It is not intended to address the effect of exterior radiation from nearby fires but is relevant to fires that start at the exterior wall assembly.

**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, 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.3.2.2 Authority Having Jurisdiction (AHJ).** The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

*N* **A.3.3.6 Exterior Cladding.** Examples of exterior cladding include brick, metal panels, and metal composite panels (MCMs).

**A.3.3.8 Exterior Wallcovering.** Examples include but are not limited to veneers, siding, exterior insulation, and finish systems.

**A.4.4.3** Figure A.4.4.3(a) through Figure A.4.4.3(c) show additional diagrams of the test structure.

**A.4.6.3.6** In relation to Figure 4.6.3.6, Figure A.4.6.3.6 illustrates a side view of burner placement. The window burner is similar to the burner described in Section 5.1 and Figure 1 of ASTM E108, *Standard Test Methods for Fire Tests of Roof Coverings*.

**A.5.6.2.1** Figure A.4.4.3(b) and Figure A.4.4.3(c) provide an illustration of the spandrel beam.

**A.5.7.1.2** The construction of the wall assembly should be typical of actual product use.

**A.5.7.1.6** As in ASTM E119, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*, substituting wood studs for tested steel studs or substituting steel studs for tested wood studs should not be done due to the difference in performance of these two stud materials in full-scale fire tests.

**A.5.7.2.2.3(4)** An example of an assembly without continuous vertical joints is running bond patterns.

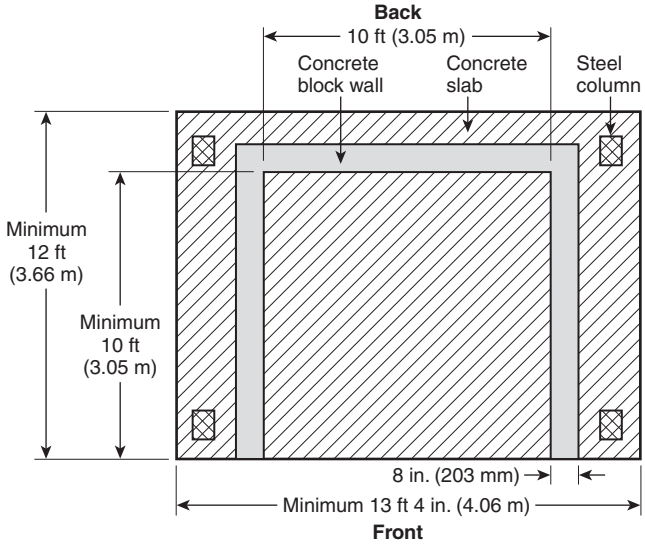



**FIGURE A.4.4.3(a) Plan View of Test Apparatus — Both Stories (not to scale).**

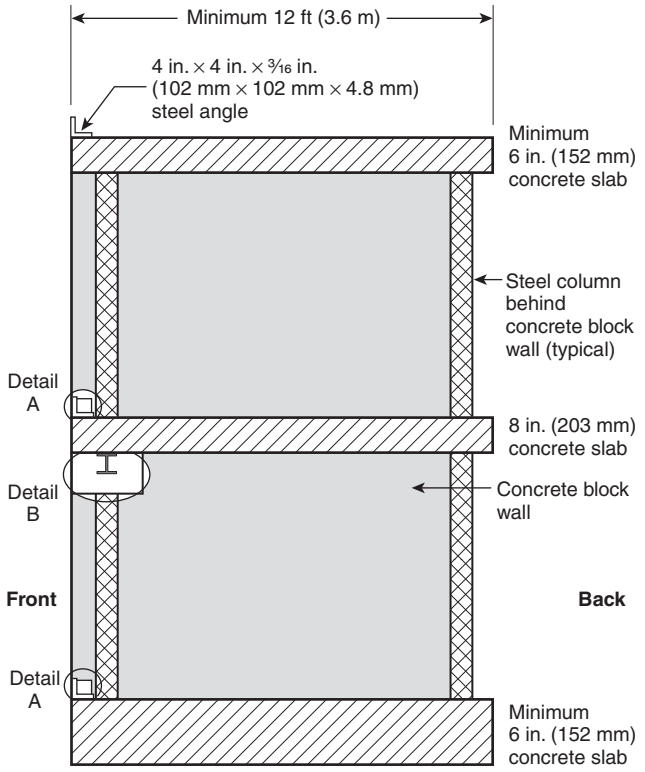



**FIGURE A.4.4.3(b) Section View Through Test Apparatus (not to scale). For Details A and B, see Figure A.4.4.3(c).**

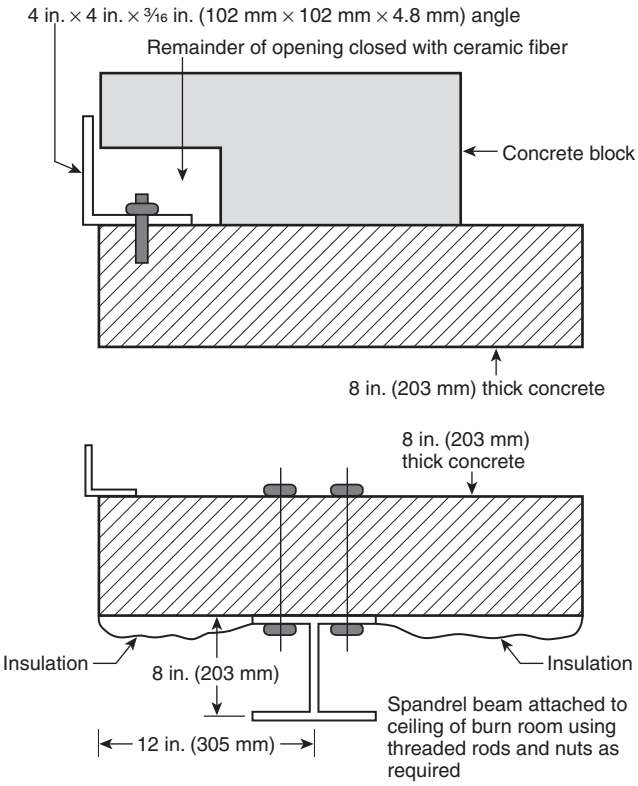



**FIGURE A.4.4.3(c) Details A and B. Also see Figure A.4.4.3(b) (not to scale).**

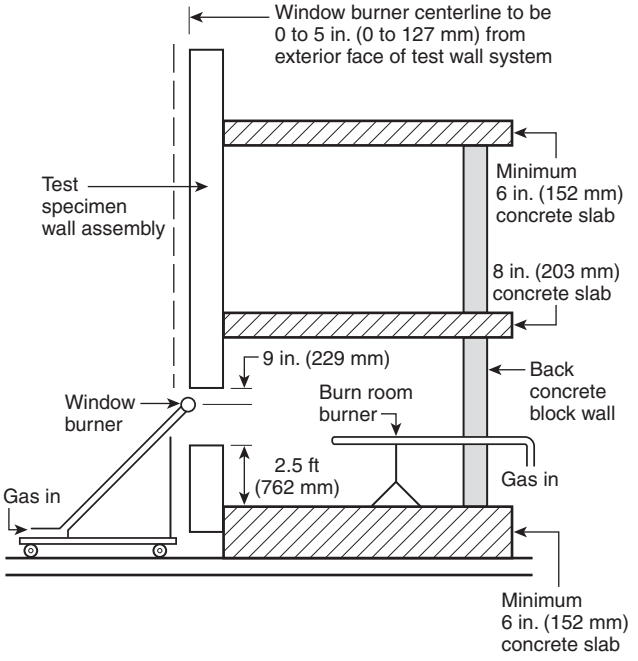



**FIGURE A.4.6.3.6 Section View of Burner Placements for First-Story Test Room (not to scale).**

**A.5.7.2.3** Joints and seams should be caulked/sealed, backed or otherwise installed as appropriate to replicate typical field installations. The presence of joints or seams in materials that are applied under the exterior veneer should be installed as per manufacturer's instructions, and the location of joints and seams are at the client's discretion.

**A.6.1** The thermocouple locations specified in Figure 6.1(b), Details A through D, were developed for the typical wall systems in use at the time the test method was developed. Over time, many new and different wall constructions and configurations have come into use and have been tested. The revisions to Figure 6.1(b) address and clarify the thermocouple locations for newer types of wall systems.

**A.7.1.1** Figure A.7.1.1 illustrates a typical calibration wall assembly.

**A.7.1.11** For example, if the average for the time interval of 5 to 10 minutes is being processed, use the data from the actual test times of 5:15 minutes through 9:45 minutes for the average. This procedure will allow for data to be evaluated during steady burning conditions.

**A.7.1.16** The calibration flow rates shown in Table 7.1.16 are designed to achieve the temperatures shown in Table 7.1.11.

**A.8.1** As an option, after the gas supply has been shut off, continue observing for an additional 10 minutes. Any residual burning on the test specimen should not be extinguished until the gas supply has been shut off for at least 10 minutes, unless the test laboratory determines that the extinguishment is required to maintain safe conditions in the test facility.

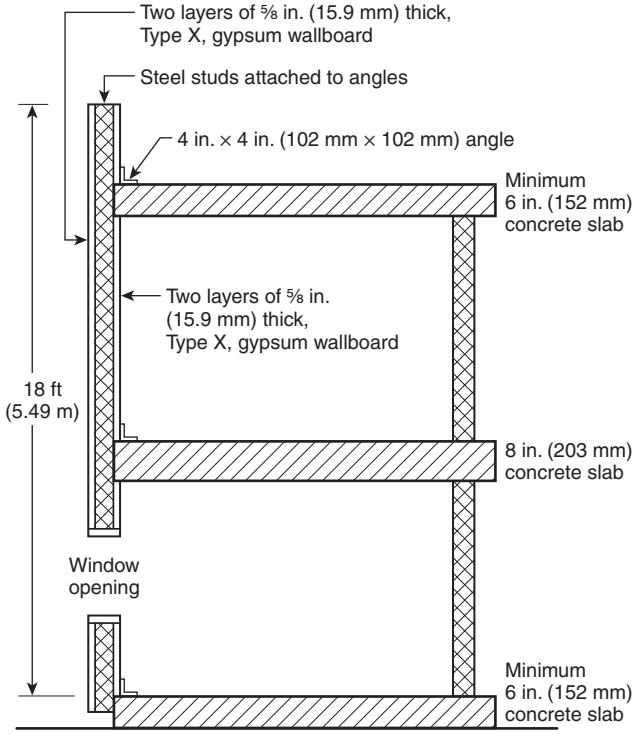



**FIGURE A.7.1.1 Section View of Calibration Wall Assembly (not to scale).**

**A.9.1.2** As an option, after the gas supply has been shut off, continue observing for an additional 10 minutes. Any residual burning on the test specimen should not be extinguished until the gas supply has been shut off for at least 10 minutes, unless the test laboratory determines that the extinguishment is required to maintain safe conditions in the test facility.

**A.9.4.2(2)** This video camera is used to assist in the determination of flame penetration and smoke accumulation in the second-story test room.

**A.11.1** When the observation period is continued, as discussed in A.8.1, the extent of residual burning that continues during the 10-minute period immediately after the gas flow to the gas burners has been shut off should be recorded.

Δ **A.11.1.1(1)** Additional information concerning the wall assembly components might be required by the authority having jurisdiction, including the following:

(1) Flame spread index and smoke developed index values per ASTM E84, *Standard Method of Test for Surface Burning Characteristics of Building Materials*, or UL 723, *Test for Surface Burning Characteristics of Building Materials*, as required
(2) Self-ignition temperature of plastic materials per ASTM D1929, *Test Method for Ignition Properties of Plastics*
(3) Potential heat value of combustible materials per NFPA 259 converted to Btu/ft$^2$ (MJ/m$^2$) for the combustible components in the assembly tested

## *N* Annex B Guide for Extensions of Results from Assemblies that Meet NFPA 285 Test Requirements

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

### *N* B.1 Administration.

#### *N* B.1.1 Scope.

***N*** **B.1.1.1** This annex covers the extension of compliant test results obtained from NFPA 285 tests to wall assemblies that differ from a tested wall assembly in materials, components, or configurations of materials.

***N*** **B.1.1.2** This annex is based on engineering principles and testing experience with regard to the extension of test data based on certain considerations.

***N*** **B.1.1.3** The extension of test data/results in this annex is based on the fire performance of wall assemblies that meet the acceptance criteria of Chapter 10.

#### *N* B.1.2 Purpose.

***N*** **B.1.2.1** The purpose of this annex is to provide guidelines for qualified engineers, design professionals, or individual(s) to follow when performing a design for or making an engineering analysis/judgement on NFPA 285-based wall assemblies.

***N*** **B.1.2.2** This annex is meant to provide guidance to help determine whether a wall assembly made up of different materials or construction than a successful NFPA 285-tested assembly will or will not maintain the appropriate fire performance requirements.

#### *N* B.1.3 Application.

***N*** **B.1.3.1** This annex only applies to evaluating wall assemblies for compliance with NFPA 285. This annex should not be used to evaluate wall assemblies or materials for compliance with other test methods, such as ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*; ASTM E1354, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*; NFPA 268, etc.

***N*** **B.1.3.2** This annex covers the substitution of one material for another material or materials if relevant fire test data or composition details are available for the materials being evaluated.

***N*** **B.1.3.3** The exterior wall assemblies addressed by this annex are referred to as systems. All the systems' materials and components, such as the base wall, in-cavity insulation, water-resistive barrier (WRB), exterior insulation, air cavity, mounting system, and exterior veneer or cladding, are considered parts of the system. These items together must achieve a specific NFPA 285 test result.

***N*** **B.1.3.4** This annex does not purport to be comprehensive in its treatment of nonproprietary modifications of tested construction. Engineering evaluations or tests are recommended for assessing modifications that are not specifically covered by this annex.

***N*** **B.1.3.5** A successful NFPA 285 test with appropriate alternate materials or construction can provide the basis for deviation from the guidelines provided in this annex.

***N*** **B.1.3.6** Deviations based on those described in a previous engineering decision cannot be assumed to pertain to current wall assemblies under review.

***N*** **B.1.3.7** This annex covers the analysis of the following:

(1) Base wall, including the following:
    (a) Base wall with steel studs and gypsum (see Section B.5)
    (b) Base wall with wood studs and gypsum (see Section B.7)
    (c) Base wall alternatives (e.g., concrete and masonry units) (see Section B.6)
    (d) Base wall with cavity insulation (see Section B.8)
(2) Floor line fire stops (see Section B.9)
(3) Exterior sheathing (see Section B.10)
(4) WRB over exterior sheathing (see Section B.11)
(5) Air cavity (see Section B.15)
(6) Exterior insulation (see Section B.12)
(7) Exterior WRB over insulation (see Section B.13)
(8) Drainage mats (see Section B.16)
(9) Exterior cladding (see Section B.16)
(10) Attachment system (see Section B.19)
(11) Window perimeter, including headers, jams, and sills (treatment and flashings) (see Section B.20)

***N*** **B.1.3.8** To apply most of the principles described in this annex, reference to the test report for NFPA 285-tested wall assemblies will likely be necessary.

***N*** **B.1.3.9** To apply some of the principles described in this annex, additional fire test information or data might be required. This data must be provided via referenced sources or fire test data.

*N* **B.1.3.10** In NFPA 285, tested wall assemblies are subjected to specific laboratory fire test exposure conditions. Substitution of different test conditions or changes in construction materials could change the measured fire test response characteristics of a wall assembly. Therefore, the extension of the data and results in this annex are valid only for the fire test exposure conditions and configurations described in NFPA 285.

*N* **B.1.3.11** This annex is intended to help make engineering decisions in regard to the substitution of materials in NFPA 285-tested wall assemblies.

*N* **B.1.3.12** Users of this annex should be knowledgeable of and understand NFPA 285, as well as its pertinent tested assemblies, materials, and conditions of acceptance.

*N* **B.1.3.13** These analyses/judgments can be used for approval when an alternative design, material, or method of construction is proposed for use in a previously successful NFPA 285-tested wall assembly.

*N* **B.2 General.**

*N* **B.2.1** The same conditions of acceptance specified in NFPA 285 and followed to establish a passing result for NFPA 285-tested assemblies should be used as the basis for extension when evaluating the effects of a modification or substitution of components in a wall assembly.

*N* **B.2.2** NFPA 285 has undergone several revisions since its initial publication. When a test is conducted using a test version that is either older or newer than those specified in the applicable code or standard, its effectiveness can be evaluated using ASTM E2989, *Standard Guide for Assessment of Continued Applicability of Reaction to Fire Test Reports Used in Building Regulation*.

*N* **B.2.3** Where replacing a component (or components) in a wall assembly that has been successfully tested per NFPA 285 with baseline components, the alternate components must be analyzed both individually and, more importantly, as a system. Changing one component can affect the overall fire response of another component and the entire wall system. Each component can have a different effect due to the proposed changes and, thus, each component must be evaluated.

*N* **B.2.4** All of the materials used in the construction of the test and actual constructions should be installed per the manufacturer's installation instructions.

*N* **B.2.5** In this document, the term mineral wool applies to both mineral wool products and mineral fiber products.

*N* **B.3 Limitations.**

*N* **B.3.1** The extension of successful NFPA 285 test results is valid only for changes to the tested specimen that fall within normal and reasonable limits of standard construction practices.

*N* **B.3.2** Analyses or judgments are valid only if the identified changes are the only changes to the construction or properties of the components.

*N* **B.3.3** Multiple changes can have a different cumulative effect than that of individual changes applied separately.

*N* **B.3.4** It is not possible to analyze every configuration or every potential change to a tested wall assembly. This annex provides the best information to date. When an engineering analysis/judgment does not support a change, an NFPA 285 test should be conducted.

*N* **B.3.5** This annex is only applicable for evaluating wall assemblies for compliance with NFPA 285. This annex cannot be used for the evaluation of wall assemblies or materials based on other standards, such as ASTM E119, ASTM E1354, NFPA 268, etc.

*N* **B.4 Wall Design.**

*N* **B.4.1** An exterior wall can have many components, including, but not limited to, the following (interior to exterior):

(1) Base wall interior—gypsum wallboard (or another thermal barrier)
(2) Base wall framing—studs (depth, gauge, materials, etc.)
(3) Stud cavity insulation—combustible and noncombustible, thickness, vapor barriers, etc.
(4) Stud cavity floor line firestop—mineral wool (friction fit or Z clip)
(5) Air cavity in stud cavity
(6) Exterior sheathing—gypsum-based sheathing, no sheathing, other sheathing material
(7) Other base walls—concrete, concrete masonry unit (CMU), other (materials, thickness, etc.)
(8) WRB over exterior sheathing—none, mechanically fastened sheet, fluid-applied, self-adhered
(9) Exterior insulation—expanded polystyrene foam plastic insulation (EPS), extruded polystyrene foam plastic insulation (XPS), polyisocyanurate foam plastic insulation (polyiso), spray polyurethane foam plastic insulation (SPF), phenolic foam insulation, mineral wool insulation, etc.
(10) WRB over insulation—none, mechanically fastened sheet, fluid-applied, self-adhered
(11) Exterior cladding or veneer attachment system; air cavities, if required; and joints, joint types, joint locations, and joint configurations
(12) Exterior cladding/veneer—materials, thickness, attachments

*N* **B.5 Analysis: Base Wall—Steel Studs/Gypsum.**

*N* **B.5.1 Interior Wallboard Considerations.**

*N* **B.5.1.1** Most successful NFPA 285 tests use ⅝ in. (16 mm) thick, Type X gypsum wallboard as the interior wallboard. However, ⅝ in. (16 mm) thick, Type C gypsum wallboard can be used as a substitute. Thicker Type X or Type C gypsum wallboard can also be used as a substitute.

*N* **B.5.1.2** Testing experience has shown that using ½ in. (12.7 mm) regular gypsum wallboard can result in failure at thermocouple nos. 18 or 19. Therefore, the use of ½ in. (12.7 mm) regular gypsum board should not be permitted as the interior sheathing unless the material was used in a successful NFPA 285 test.

*N* **B.5.2 Steel Stud Considerations.** Most NFPA 285 tests employ 3⅝ in. deep (92 mm), 20 or 25 GA steel studs spaced 24 in. (0.6 m) on center. Field applications typically use 16 in. (0.4 m) or 24 in. (0.6 m) spacing. Wider spacing is not as stable, as it can potentially make the wall more flexible and prone to warping. As with ASTM E119, testing thicker studs, deeper stud depth, or 16 in. (0.4 m) spacing is allowed for worst-case testing. Testing with lateral bracing requires lateral bracing to be used in actual construction. Testing without lateral bracing allows for lateral bracing as an option.

***N* B.6 Analysis: Base Wall Alternatives—Concrete and CMU.** Testing with non-load-bearing steel or wood stud base wall designs allows for the use of concrete or CMU walls as alternatives.

***N* B.7 Analysis: Base Wall Alternatives—Wood Studs.**

***N* B.7.1** Where a fire-retardant-treated wood (FRTW) stud wall is tested, the results can be applied to a steel stud wall if all of the following conditions are met:

(1) The steel studs must be at the same stud spacing as the tested wood studs.
(2) Lateral bracing of the steel studs must be every 4 ft (1.2 m) vertically.
(3) The depth of the steel stud must be the same as or greater than the tested wood studs.
(4) The steel stud thickness must be 20 GA or thicker.

***N* B.7.2** Where a wood stud wall assembly is tested, the results can be applied to a steel stud wall if all of the following are met:

(1) The wood studs should be nominal 2 in. x 4 in. (50 mm x 100 mm) FRTW and placed at their maximum spacing.
(2) At each floor line of the test wall, two layers of nominal 2 in. (50 mm) thick wood plates should be used.
(3) The header, sill, and jambs should consist of nominal 2 in. × 4 in. (50 mm x 100 mm) thick wood.
(4) The cavities should be empty or contain noncombustible insulation, either faced or unfaced.
(5) For interior wallboard, 5/8 in. (16 mm) thick, Type X gypsum wallboard should be used.

***N* B.7.3** An FRTW wood stud wall might be allowed based on a steel stud wall test. The FRTW wood stud wall assembly would have to comply with B.7.2 above.

***N* B.7.4** FRTW wood sheathing on the outer face of studs is only allowed without a test when the wood sheathing is covered on its exterior face by one layer of 5/8 in. (16 mm), Type X gypsum sheathing and the interior face of the wall is covered by 5/8 in. (16 mm), Type X gypsum wallboard.

***N* B.8 Analysis: Base Wall—Cavity Insulation.**

***N* B.8.1** If the base wall assembly is tested without any insulation, then the cavity can remain empty or contain insulation such as fiberglass or mineral wool. This insulation can be faced or unfaced. Additionally, a maximum thickness of 6mm (0.23 in.) thick water/air barrier made of polyethylene can be used when it is attached to one of the stud faces.

***N* B.8.2** If the base wall assembly is tested with fiberglass (faced or unfaced) insulation, then the cavity can remain empty or contain fiberglass insulation. This insulation can be faced or unfaced. Additionally, a thin water/air barrier with a maximum thickness of 6 mm (0.23 in.) polyethylene can be used when it is attached to one of the stud faces.

***N* B.8.3** If the base wall assembly is tested with mineral wool (faced or unfaced) insulation, then the cavity must contain mineral wool insulation. This insulation can be faced or unfaced. Additionally, a thin water/air barrier with a maximum thickness of 6 mm (0.23 in.) can be used when it is attached to one of the stud faces.

***N* B.8.4** Testing with cellulose insulation in the base wall assembly allows for the use of cellulose insulation of the same material and method of application as tested (e.g., wet-applied, dry-applied, etc.). Testing with cellulose insulation can also enable the use of fiberglass or mineral wool insulation, which can be faced or unfaced. However, testing with no insulation does not allow for the use of cellulose as optional insulation.

***N* B.8.5 SPF Insulation.**

***N* B.8.5.1** The following sections only apply where the SPF is encapsulated on all sides within a framed stud wall (i.e., horizontal floor line firestops at each floor, lateral studs, in-plane gypsum board on both sides). It has been shown that, when testing with and without air cavities and studs of various thicknesses and depths, the burning of SPF is trapped by the floor line firestops and stud framing when clad on both sides with 5/8 in. (16 mm) thick, Type X gypsum wallboard or sheathing. Different guidelines apply for open-cell vs. closed-cell SPF, as shown in the following sections.

***N* B.8.5.1.1 Open-Cell SPF.**

***N* B.8.5.1.1.1** Testing with the full stud cavity depth of an open-cell SPF allows for the use of greater steel stud depth where the tested open-cell SPF depth or lesser is installed with an air cavity (if used) between the SPF and the gypsum wallboard.

***N* B.8.5.1.1.2** It is permissible to determine a worst-case SPF formulation via testing to ASTM E1354. The worst case is to be tested in the NFPA 285 test wall assembly to facilitate extension to other SPFs within that manufacturer's brand.

***N* B.8.5.1.1.3** It is typically not permissible for the SPF of one manufacturer to be used in an NFPA 285 test based on data from another manufacturer.

***N* B.8.5.1.1.4** It is permissible for a specific SPF that had been successfully tested per the base wall test described in Section B.22 to be used as a base wall assembly with other materials applied to its exterior face.

***N* B.8.5.1.2 Closed-Cell SPF.** Because of the potential intumescing nature of closed-cell SPF, the following rules must apply:

(1) A test with partial stud depth cavity fill does not allow for the use of full cavity fill with closed-cell SPF.
(2) Testing partial stud depth cavity fill with an air cavity allows for any stud depth to contain any depth of partial fill of the SPF as long as the same air cavity is provided.
(3) Testing with full stud depth fill allows for full stud depth cavity fill or less.

***N* B.8.5.1.2.1** It is typically not permissible to allow a manufacturer's SPF to be substituted based on fire performance data from another manufacturer's product.

***N* B.8.5.1.2.2** It is permissible to allow a specific SPF successfully tested per the base wall test described in Section B.22 to be used as a base wall assembly with other materials applied to its exterior face.

***N* B.8.6** EPS, XPS, phenolic, and polyiso foam plastic insulations are not typically used in stud cavities but can be employed in NFPA 285 test assemblies that use these materials as insulation in the stud cavity.

***N* B.8.6.1** Testing the maximum thickness and density (for EPS or XPS) allows for lesser density and thickness. Testing the maximum thickness of polyisocyanurate or phenolic allows for thinner sections.

**N B.8.6.2** Phenolic or polyiso brands/products cannot be interchanged unless each brand/product has been tested to be used in the stud cavity per NFPA 285.

**N B.8.6.3** A Class A polyiso per ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Standard Test for Surface Burning Characteristics of Building Materials*, can be used in lieu of a Class B polyiso only when the same facer is used on the Class A polyiso and a Class B polyiso that was tested per NFPA 285. A Class A phenolic can be used in lieu of a Class B phenolic only when the same facer is used on the Class A phenolic and a Class B phenolic that was tested per NFPA 285.

**N B.9 Analysis: Floor Line Firestops.**

**N B.9.1** In actual construction, all NFPA 285-compliant stud base walls require floor line firestops within the stud cavity. Where the stud cavity is empty or where insulation is used in the stud cavity, firestopping material is required. The firestopping materials typically used are minimum 4 pcf mineral wool (friction-fit or Z-clipped in place). The mineral wool should be the full depth of the stud cavity and a minimum of 4 in. (100 mm) high.

**N B.9.2** Where mineral wool is friction- fit, it should be compressed a minimum of 25 percent. Where mineral wool is Z-clipped in place, the Z-clips should be steel. In some constructions, perimeter joint fire barrier systems approved per ASTM E2307, *Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-scale, Multi-story Test Apparatus,* can replace a mineral wool system as long as the ASTM E2307-based joint is approved for use with the specific wall design in question. It is important that the fire path be analyzed so that the fire can be stopped by the ASTM E2307-based system, including within the stud cavity of the base wall. A wall with an ASTM E2307-based firestop system should not be installed up against combustible insulation; it should be installed next to mineral wool (of the approved thickness and density), gypsum wallboard (where approved for the ASTM E2307-based system), metallic spandrel plates (where approved by the ASTM E2307-based system), or wall configurations that have been specifically tested to ASTM E2307.

**N B.9.3** If intumescent firestopping materials are used in the NFPA 285-tested wall assembly, they must also be used in the actual construction. The location(s) of the intumescent firestopping in the tested assembly and the actual assembly must be evaluated so that the tested configuration can be realistically installed and can protect the actual wall assembly.

**N B.10 Analysis: Exterior Sheathing.**

**N B.10.1** NFPA 285 tests usually incorporate ½ in. (12.7 mm) regular gypsum sheathing; ⅝ in. (16 mm) thick, Type X gypsum sheathing conforming to ASTM C1396/C1396M, *Standard Specification for Gypsum Board*; or ⅝ in. (16 mm) thick, Type X glass mat sheathing conforming to either ASTM C1177, *Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing,* or ASTM C1178, *Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.* Testing with one of these materials qualifies the other materials of the same or greater thickness.

**N B.10.2** For wall assembly designs that do not allow for exterior sheathing, the specific configuration of the wall assembly that passed the NFPA 285 testis more critical.

**N B.10.3** Where exterior insulation is tested with no exterior gypsum sheathing (i.e., the insulation is the exterior sheathing), the use of any gypsum-based sheathing between the studs and the exterior insulation is permitted.

**N B.11 Analysis: WRB Over Exterior Sheathing.**

**N B.11.1** Some successful NFPA 285-tested wall assemblies have incorporated a WRB product over the exterior sheathing. Testing with a specific WRB allows for WRBs with lower or lesser fire characteristics to be used in place of the specific tested WRB.

**N B.11.2** One method of determining the fire characteristics of WRBs is using a cone calorimeter per ASTM E1354.

**N B.11.3**

**N B.11.3.1** Cone calorimeter testing is to be conducted as follows:

(1) Testing should be done in triplicate for each material.
(2) Testing should be conducted at a radiant heat exposure of 50 kW/m$^2$ (4.4 Btu/ft$^2$/sec).
(3) Test material should be applied to the paintable paper face of one layer of ⅝ in. (16 mm) thick, Type X interior gypsum wallboard (not sheathing).
(4) The test should be conducted per ASTM E1354 and all the standard data that has been collected and reported.

**N B.11.3.2** When comparing test data between two or more WRBs, the following data should be considered:

(1) Ignition time(s)
(2) Peak heat release rate (kW/m$^2$)
(3) Average heat release for 60-second intervals (kW/m$^2$)
(4) Average heat release for 180-second intervals (kW/m$^2$)
(5) Average heat release for 300-second intervals (kW/m$^2$)
(6) Total heat released (MJ/m$^2$)
(7) Effective heat of combustion (MJ/kg)

**N B.11.3.2.1** When comparing data values, the parameters in B.11.3.2(3) through B.11.3.2(7) are the most important.

If all the values of the proposed WRB result in the same or improved fire performance compared to the tested WRB, then the substitution can be allowed.

If one or more of the values of the proposed WRB result in reduced fire performance compared to the tested WRB, then a determination must be made as to whether the proposed WRB can be used.

If the peak heat release rate (Pk–HRR) of an alternative WRB is nearly the same as the baseline WRB, the time to ignition ($T_{ign}$) should be considered as well using the Fire Performance Index formula below:

**N** **[B.11.3.2.1]**

$$\text{Fire Performance Index} = \frac{Pk - HRR}{T_{ign}}$$

where:
Pk–HRR = peak heat release rate
$T_{ign}$ = time to ignition

Any such determination and substantiation should be provided in writing.