

NFPA® 286

Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

2015 Edition



NFPA®, 1 Batterymarch Park, Quincy, MA 02169-7471, USA
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Standard Methods of

Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

2015 Edition

This edition of NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*, was prepared by the Technical Committee on Fire Tests. It was issued by the Standards Council on November 11, 2014, with an effective date of December 1, 2014, and supersedes all previous editions.

This edition of NFPA 286 was approved as an American National Standard on December 1, 2014.

Origin and Development of NFPA 286

The 2000 edition was the first edition of this standard. This document was developed in response to activities associated with the regulation of interior finishes in NFPA 101, *Life Safety Code*. The Fire Safety Technical Committee on Furnishings and Contents had proposed modifications to NFPA 265, *Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Wall Coverings*, for the 1997 edition of NFPA 101. These modifications would have established a test protocol that was not appropriate to the scope of NFPA 265. NFPA 286 addresses those concerns associated with interior finishes that do not remain in place during testing to NFPA 265 test protocols.

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, particularly with regard to the test procedure. The purpose of the document was revised to clarify the document's intent. Technical changes addressed recording and documentation of the fire test.

The 2011 edition expanded the scope of the document to include provisions for all wall and ceiling interior finish. A new annex section addressing acceptance criteria was added.

The 2015 edition includes a new section on laminated products and revised test procedures to be consistent with NFPA 285.



Technical Committee on Fire Tests

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Southwest Research Institute, TX [RT]

Scott W. Adams, Park City Fire Service District, UT [E]
Rep. International Fire Marshals Association
Farid Alfawakhiri, American Iron and Steel Institute,
IL [M]
Jesse J. Beitel, Hughes Associates, Inc., MD [SE]
James A. Burns, New York State Department, NY [E]
Rep. Firemen's Association of the State of New York
Gordon H. Damant, Inter-City Testing & Consulting
Corp. of California, CA [SE]
Scott E. Dillon, Crane Engineering, IL [SE]
William E. Fitch, Phyrefish.com, FL [SE]
Marcelo M. Hirschler, GBH International, CA [SE]
Paul A. Hough, Armstrong World Industries, Inc., PA [M]
Mohammed M. Khan, FM Global, MA [I]

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Rodney A. McPhee, Canadian Wood Council,
Canada [M]
Kathleen A. Newman, Firetect, CA [M]
David T. Sheppard, U.S. Bureau of Alcohol, Tobacco,
Firearms & Explosives, MD [RT]
Dwayne E. Sloan, UL LLC, NC [RT]
Kuma Sumathipala, American Wood Council, DC [M]
Robert A. Wessel, Gypsum Association, MD [M]

Alternates

Erik H. Anderson, Koffel Associates, Inc., MD [SE]
(Alt. to W. E. Koffel)
Richard J. Davis, FM Global, MA [I]
(Alt. to M. M. Khan)
Timothy Earl, GBH International, MI [SE]
(Alt. to M. M. Hirschler)
Sam W. Francis, American Wood Council, PA [M]
(Alt. to K. Sumathipala)
Stephen P. Fuss, U.S. Bureau of Alcohol, Tobacco,
Firearms & Explosives, MD [RT]
(Alt. to D. T. Sheppard)
Marc L. Janssens, Southwest Research Institute, TX [RT]
(Alt. to B. L. Badders, Jr.)

Arthur J. Parker, Hughes Associates, Inc., MD [SE]
(Alt. to J. J. Beitel)
Stanislav I. Stoliarov, University of Maryland, MD [SE]
(Alt. to A. W. Marshall)
Ineke Van Zeeland, Canadian Wood Council,
Canada [M]
(Alt. to R. A. McPhee)
Robert J. Wills, American Iron and Steel Institute,
AL [M]
(Alt. to F. Alfawakhiri)
Joe Ziolkowski, American Furniture Manufacturers
Association, NC [M]
(Alt. to R. T. Long, Jr.)

Nonvoting

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Association, VA [M]
Rep. American Fiber Manufacturers Association

Rohit Khanna, US Consumer Product Safety
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Information on referenced publications can be found in Chapter 2 and Annex D.

Chapter 1 Administration

1.1* Scope. This standard describes a method for determining the contribution of interior finish materials to room fire growth during specified fire exposure conditions.

1.1.1 This method is intended for the evaluation of the flammability characteristics of wall and ceiling interior finish, where such materials constitute the exposed interior surfaces of buildings.

1.1.2 This fire test method is not intended for the evaluation of fire resistance of assemblies, nor is it intended for the evaluation of the effect of fires that originate within a wall assembly.

1.1.3 This standard specifies three types of specimen mounting, depending on the application of the interior finish material, as follows:

- (1) Three walls (for interior finish to be used on walls only)
- (2) Three walls and the ceiling (for interior finish to be used on walls and ceilings)
- (3) The ceiling alone (for interior finish to be used on ceilings only)

1.2 Purpose.

1.2.1 This method of test measures certain fire performance characteristics of interior finish materials in an enclosure under specified fire exposure conditions.

1.2.2 This method of test determines the potential extent to which the interior finish materials contribute to fire growth in a room, including the heat and smoke released, the combustion products released, and the potential for fire spread beyond the room, under the particular conditions simulated.

1.2.3 The method of test provides the following:

- (1) Extent of fire growth in the fire test room
- (2) Rate of heat release by the specimen
- (3) Total heat released by the specimen
- (4) Time to flashover in the fire test room if flashover occurs
- (5) Time to flame extension beyond the doorway of the fire test room if flame extension occurs
- (6) Total heat flux incident to the floor of the fire test room
- (7) Upper level gas temperature in the fire test room
- (8) Smoke obscuration, as determined in the exhaust duct
- (9) Production of carbon monoxide, as determined in the exhaust duct
- (10) Emissions of other combustion gases, as determined in the exhaust duct

1.2.4 This method does not provide data that can be generalized to apply to rooms or spaces of different shapes, sizes, and ventilation.

1.2.5 The performance observed in the test is based on the test conditions.

1.2.6 If a test specimen is exposed to a different environment, as in an actual fire, the performance of the specimen can be different.

1.2.7 The method of test does not provide the following:

- (1) Full information concerning toxicity of combustion gases
- (2) Fire resistance of wall-ceiling systems

1.3 Application.

1.3.1 The specimen is tested by using the ignition source described in 1.3.10.

1.3.2 Ceiling finish materials are tested mounted on the ceiling only.

1.3.3 For materials intended for use only as interior wall finish, the specimen is mounted on three walls of the fire test room.

1.3.4 For materials intended for use as interior wall and ceiling finish, the specimen is mounted on three walls and on the ceiling of the fire test room.

1.3.5 These methods use a gas burner to produce a diffusion flame to expose the walls in the corner of a fire test room 2.44 m × 3.66 m × 2.44 m (8 ft × 12 ft × 8 ft).

1.3.6 The burner produces a prescribed rate of heat output, as described in 1.3.10.

1.3.7 The contribution of the interior finish material to fire growth is measured by constant monitoring of the following:

- (1) Incident heat flux on the center of the floor
- (2) Temperature of the gases in the upper part of the fire test room
- (3) Rate of heat release
- (4) Smoke release
- (5) Time to flashover

1.3.8 The test is conducted with natural ventilation to the fire test room provided through a single doorway that is 0.78 m × 2.02 m (30.75 in. × 79.50 in.).

1.3.9 The combustion products are collected in a hood that feeds into a plenum connected to an exhaust duct in which measurements of the gas velocity, temperature, smoke obscuration, and concentrations of selected gases are made.

1.3.10* The ignition source is a gas burner that is capable of supplying a net rate of heat output of 40 kW for 5 minutes followed by 160 kW for 10 minutes, for a total exposure period of 15 minutes.

1.3.11 Flashover is considered to have occurred when any two of the conditions indicated in 9.1(10) have been attained.

Chapter 2 Referenced Publications

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

2.2 NFPA Publications. (Reserved)

2.3 Other Publications.

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

ASTM C1186, *Standard Specification for Flat Fiber-Cement Sheets*, 2008 (2012).

ASTM C1396/C 1396 M, *Specification for Gypsum Board*, 2013.

ASTM E136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, 2012.

2.3.2 CSA Publications. Canadian Standards Association, 5060 Spectrum Way, Mississauga, ON, L4W 5N6, Canada.

CSA Standard O121, *Douglas Fir Plywood*, 2009 (R2013).

2.3.3 NIST Publications. National Institute of Standards and Technology, 100 Bureau Drive, Gaithersburg, MD 20899-1070.

NIST Voluntary Product Standard PS 1, *Structural Plywood*, 2009.

2.3.4 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 101®, *Life Safety Code*®, 2015 edition.

NFPA 265, *Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls*, 2015 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 Shall. Indicates a mandatory requirement.

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

3.2.3 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.

3.3.1 Average Upper Gas Layer Temperature. Temperature based on the average of the four ceiling quadrant thermocouples and the center of the room ceiling thermocouple. [265, 2015]

3.3.2 Site-Fabricated Stretch System. A system, fabricated on-site, and intended for acoustical, tackable, or aesthetic purposes, that is comprised of three elements: (1) a frame (constructed of plastic, wood, metal, or other material) used to hold fabric in place, (2) a core material (infill, with the correct properties for the application), and (3) an outside layer, comprised of a textile, fabric, or vinyl, that is stretched taut and held in place by tension or mechanical fasteners via the frame. [101, 2015]

3.3.3* Textile. A fabric made of natural or man-made fibers.

Chapter 4 Test Equipment

4.1 Ignition Source.

4.1.1* The ignition source for the test shall be a gas burner with a nominal 305 mm × 305 mm (12 in. × 12 in.) porous top surface, as shown in Figure 4.1.1.

4.1.1.1 The material specified in 4.1.1 shall be a minimum 102 mm (4 in.) layer of white Ottawa sand used to provide the horizontal surface through which the gas is supplied.

4.1.1.2 A burner using a layer of sand as specified in 4.1.1.1 shall be used for test specimens with a potential for dripping.

4.1.2 The top surface of the burner through which the gas is applied shall be located horizontally 300 mm ±50 mm (12 in. ±2 in.) above the floor.

4.1.2.1 The burner enclosure shall be in contact with both walls in a corner of the fire test room, opposite from the door.

4.1.3 The gas supply to the burner shall be of C.P. grade propane (99 percent purity).

4.1.3.1 Flow rates of gas shall be calculated using a net heat of combustion of propane of 85 MJ/m³ (2280 Btu/ft³) at standard conditions of 101 kPa pressure (absolute pressure of 14.7 psi) and 20°C (68°F) temperature.

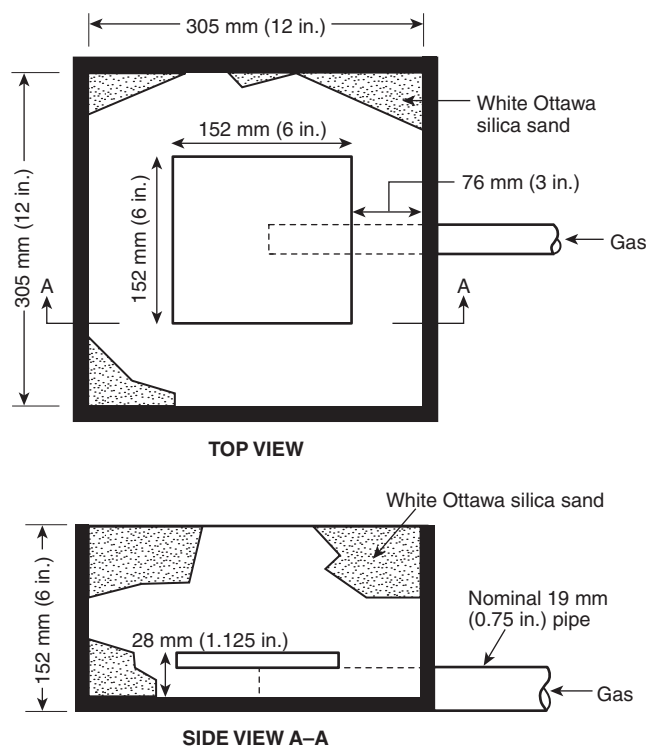


FIGURE 4.1.1 Gas Burner.

4.1.3.2 The gas flow rate shall be metered throughout the test, with an accuracy of at least ± 3 percent.

4.1.3.3 The heat output to the burner shall be controlled within ± 5 percent of the prescribed value.

4.1.4* The gas supply to the burner shall produce a net heat output of $40 \text{ kW} \pm 1 \text{ kW}$ for the first 5 minutes, followed by a net heat output of $160 \text{ kW} \pm 5 \text{ kW}$ for the next 10 minutes.

4.1.5 The burner design shall allow switching from the first fixed net heat output of 40 kW to the second fixed net heat output of 160 kW within 10 seconds.

4.1.6 Burner controls shall be provided for automatic shutoff of the gas supply if flameout occurs.

4.1.7 The burner shall be ignited by a pilot burner or a remotely controlled spark igniter.

4.2 Geometry and Construction of the Fire Test Room.

4.2.1* The interior dimensions of the floor of the fire test room, when the specimens are in place, shall be as shown in Figure 4.2.1 and shall measure $2.44 \text{ m} \pm 0.05 \text{ m} \times 3.66 \text{ m} \pm 0.05 \text{ m}$ ($8 \text{ ft} \pm 2 \text{ in.} \times 12 \text{ ft} \pm 2 \text{ in.}$).

4.2.1.1 The finished ceiling shall be $2.44 \text{ m} \pm 0.05 \text{ m}$ ($8 \text{ ft} \pm 2 \text{ in.}$) above the floor.

4.2.1.2 There shall be four walls at right angles defining the fire test room as shown in Figure 4.2.1.

4.2.2* The fire test room shall be placed indoors in a draft-free, heated space that is large enough to ensure that the surroundings do not influence the test fire.

4.2.3 There shall be a $0.78 \text{ m} \pm 0.02 \text{ m} \times 2.02 \text{ m} \pm 0.02 \text{ m}$ ($30.75 \text{ in.} \pm 0.75 \text{ in.} \times 79.5 \text{ in.} \pm 0.75 \text{ in.}$) doorway in the center of

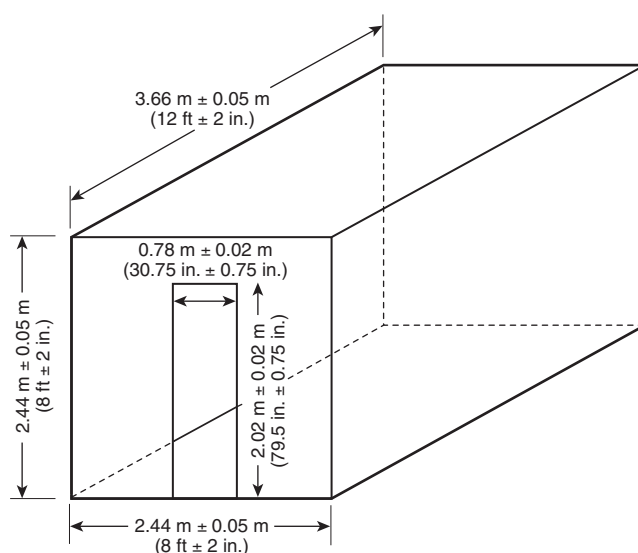


FIGURE 4.2.1 Interior Fire Test Room Dimensions and Interior Doorway Dimensions.

one of the $2.44 \text{ m} \times 2.44 \text{ m}$ ($8 \text{ ft} \times 8 \text{ ft}$) walls, and there shall be no other wall, floor, or ceiling openings that allow ventilation.

4.2.4* The fire test room shall meet the following criteria:

- (1) The room shall be a framed (with wood or metal studs) or concrete block structure.
- (2) The inside surface of the walls, ceiling, and floor shall be of calcium silicate board of 500 kg/m^3 to 800 kg/m^3 (31 lb/ft^3 to 50 lb/ft^3) density and shall be a minimum of 12 mm (0.5 in.) in nominal thickness or shall be of fire-rated (Type X) gypsum wallboard that is at least 12 mm (0.5 in.) in nominal thickness.

4.2.5 The door frame shall be constructed such that it remains unchanged during the test period to a tolerance of ± 1 percent in height and width.

Chapter 5 Specimen Mounting

5.1 Specimen Mounting.

5.1.1* Test specimens shall be mounted on a framing or support system that is comparable to that intended for their actual field use, using substrates, backing materials, insulation, or air gaps as appropriate to the intended application, and representing a typical value of thermal resistance for the wall system.

5.1.2 If a manufacturer specifies the use of an adhesive, then specimens shall be mounted using the adhesive and the application rate specified by the manufacturer and shall be comparable to actual field installations.

5.1.3* Mounting methods shall be grouped according to materials to be tested, which are categorized either by their usage or by the form of the material.

5.1.3.1 The mountings shall be described for test method uniformity and for good laboratory practice.

5.1.3.2 The mountings shall not imply restriction in the specific details of field installation.

5.1.3.3 The mountings shall be used for general material testing for which the specific details of the field installation either have not been established or are so broad that any single installation method is not representative of the full range of installation possibilities.

5.1.4 Where an interior finish material exhibits a distinct direction, the wall portion of the test sample shall be mounted so that the distinct direction is vertical, unless the manufacturer indicates that a different method of mounting will be used in actual installations, except as indicated in 5.1.5.

5.1.5 Where a panel system has been designed to be mounted as a wall interior finish material so that the distinct direction can be vertical or horizontal, it shall be tested in both orientations and the results shall be reported separately for each orientation.

5.1.6 If the product to be tested is in panel form, the standard dimensions (width, length, and thickness) of the panels shall be used.

5.1.7 If panels are tested in other than panel form, the rationale for the change shall be stated in the report.

5.1.8 A detailed description of the mounting method used shall be given in the test report.

5.1.9 If a special mounting technique is used in order to improve the physical behavior of the specimen during the test, it shall be clearly stated in the report.

5.2 Materials Using Substrates.

5.2.1 Thin surface materials, thermoplastic products that melt, paints, and varnishes shall be applied, depending on their end use, to one of the substrates identified in 5.2.1.2 through 5.2.1.4.

5.2.1.1 When mounted on substrates described in 5.2.1.2 and 5.2.1.3, materials that use studs for support in an actual installation shall not be required to incorporate studs and the associated airspace in the test specimen.

5.2.1.2 The following substrates shall be acceptable:

- (1) Noncombustible fiber-reinforced silicate board with a dry density of $680 \text{ kg/m}^3 \pm 50 \text{ kg/m}^3$ ($42 \text{ lb/ft}^3 \pm 3 \text{ lb/ft}^3$), at a thickness of 9 mm to 13 mm ($\frac{3}{8} \text{ in. to } \frac{1}{2} \text{ in.}$)
- (2) Noncombustible board with a dry density of $1650 \text{ kg/m}^3 \pm 150 \text{ kg/m}^3$ ($103 \text{ lb/ft}^3 \pm 9 \text{ lb/ft}^3$), at a thickness of 9 mm to 13 mm ($\frac{3}{8} \text{ in. to } \frac{1}{2} \text{ in.}$)
- (3) Ordinary particleboard with a density of $680 \text{ kg/m}^3 \pm 50 \text{ kg/m}^3$ ($42 \text{ lb/ft}^3 \pm 3 \text{ lb/ft}^3$) at normal conditioning atmosphere of 50 ± 5 percent relative humidity and $23^\circ\text{C} \pm 2^\circ\text{C}$ ($73^\circ\text{F} \pm 4^\circ\text{F}$) temperature, at a thickness of 9 mm to 13 mm ($\frac{3}{8} \text{ in. to } \frac{1}{2} \text{ in.}$)
- (4)*Gypsum wallboard, complying with ASTM C1396/C1396M, *Specification for Gypsum Board*, at a thickness of 12.7 mm to 15.9 mm ($\frac{1}{2} \text{ in. to } \frac{5}{8} \text{ in.}$)

5.2.1.3* Other substrates shall be acceptable if the end use of the product requires them.

5.2.1.4 The use of alternative substrates as permitted by 5.2.1.3 shall be justified in the report.

5.2.2 Paints and varnishes shall be applied to the substrate with the application rate specified by the sponsor.

5.2.3 Coating materials, such as cementitious mixtures, mastic coatings, sprayed fibers, or similar materials, shall be mixed and applied to the substrate board as specified in the manufacturer's instructions at the thickness, coverage rate, or density recommended by the manufacturer.

5.2.4 Coating intended for application to a wood surface shall be applied to a substrate as specified in 5.2.1.2(2).

5.2.5 Coating materials intended for application to specific combustible surfaces other than wood shall meet the following criteria:

- (1) They shall be applied to the specific surface for which they are intended.
- (2) The coating material and combustible material shall be attached to the substrate board as specified in 5.2.1.

5.2.6 Coating materials intended for application only to non-combustible surfaces shall be applied to a substrate as specified in 5.2.1.2(1) or 5.2.1.2(2).

5.3 Backing Materials.

5.3.1 Whenever calcium silicate board or gypsum wallboard is specified as a backing substrate in this standard, the material shall be as described in 5.2.1.

5.3.2 All backing materials, when used, shall be supported on a framed support system as shown in Figure 5.3.2.

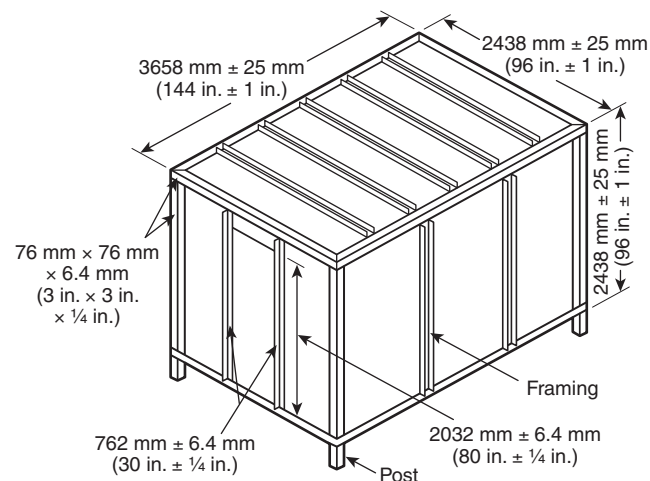


FIGURE 5.3.2 Steel Frame Support System.

5.3.3 When metal screws in combination with washers and wing nuts are specified for fastening, they shall be one of the following:

- (1) Standard 6.35 mm ($\frac{1}{4} \text{ in.}$) by 0.8 threads per mm [20 threads per in. (TPI)]
- (2) Round-head steel machine screws, 6.35 mm ($\frac{1}{4} \text{ in.}$) by 0.8 threads per mm (20 TPI) steel wing nuts
- (3) 51 mm (2 in.) outside diameter by 1 mm (0.044 in.) thick flat steel washers with a 7 mm ($\frac{9}{32} \text{ in.}$) inside diameter hole

5.3.4 Fastening screws shall be installed as shown in Figure 5.3.4.

5.3.5 The fastening pattern shall be as shown in Figure 5.3.5(a) for rigid wall materials, and in Figure 5.3.5(b) for flexible wall materials.