

NFPA® 221

Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls

2012 Edition



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



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Standard for

High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls

2012 Edition

This edition of NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, was prepared by the Technical Committee on Building Construction. It was issued by the Standards Council on May 31, 2011, with an effective date of June 20, 2011, and supersedes all previous editions.

This edition of NFPA 221 was approved as an American National Standard on June 20, 2011.

Origin and Development of NFPA 221

The Technical Committee on Building Construction undertook a project to develop a new document to govern fire walls in 1991. At the time, no standard existed to assist code authorities, architects, or engineers on the criteria that were necessary to properly design and construct a fire wall. The first edition of NFPA 221 was issued in 1994. It contained information on various types of fire walls including basic design criteria, proper protection of penetrations, and special design practices for exterior protection features.

The 1997 edition of NFPA 221 contained several changes, including the addition of specific criteria for treatment of seismic separation assemblies, additional criteria for proper protection of raceway penetrations, and the addition of several suggested protection schemes for properly protecting an egress door located in a fire wall.

The 2000 edition addressed specific testing criteria for performance of rated assemblies that included expansion, seismic, and control joints in fire wall and fire barrier wall assemblies. In addition, a second test protocol was recognized for tests of through penetrations.

The 2006 edition introduced two distinct types of fire walls. Presented in Chapter 5, the “high challenge fire wall” requirements are an evolution of the fire wall requirements found in the 2000 edition of NFPA 221, while the “fire wall” requirements presented in Chapter 6 are based upon the requirements found in the 2003 edition of *NFPA 5000®*, *Building Construction and Safety Code®*. Chapter 4 of this document contains extracts from *NFPA 5000*, Chapter 8, on such topics as analytical methods, duct and air-transfer openings, joints, opening protectives, and penetrations. Please note these extracts were stylistically adjusted to reflect this document’s exclusive focus on walls by eliminating references to floors, floor-ceiling assemblies, smoke dampers, and partitions.

The 2009 edition was updated to reflect changes to Chapter 8 of *NFPA 5000*. Other changes included recognition of the new criteria used to determine building height and grade geometries, further clarifications as to where a provision applies to a particular type of wall, and the addition of a new requirement concerning horizontal exits served by bridges between buildings.

The 2012 edition is a reaffirmation of the previous edition, with updated references to reflect changes in UL and ASTM documents.

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Committee Scope: This committee shall have primary responsibility for documents on the selection and design of types of building construction, exterior walls, building height and area, firewalls, and fire barrier walls, as they relate to the protection of life and property from fire. For the processing of *NFPA 5000*, Chapter 7, and Sections 8.3 and 8.4, this committee reports directly to the *NFPA 5000* TCC; whereas, for the processing of *NFPA 220* and *NFPA 221*, this committee does not report to the *NFPA 5000* TCC.



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A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex B. 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 publications can be found in Chapter 2 and Annex B.

Chapter 1 Administration

1.1 Scope. This standard specifies requirements for the design and construction of high challenge fire walls, fire walls, and fire barrier walls including protection of openings and penetrations.

1.2 Purpose. This standard prescribes minimum requirements for the design and construction of high challenge fire walls, fire walls, and fire barrier walls for use in providing safety to life and protection of property from fire.

1.3 Application. The minimum requirements for high challenge fire walls, fire walls, and fire barrier walls apply to walls that are required to separate buildings or subdivide a building to prevent the spread of fire. The minimum fire resistance rating of a wall assembly is outside the scope of this document.

1.4 Retroactivity.

1.4.1 The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.4.2 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard.

1.4.3 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.5 Equivalency.

1.5.1 Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.2 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.6 Units.

1.6.1 SI Units. Metric units in this standard are in accordance with the modernized metric system known as the International System of Units (SI).

1.6.2 Primary and Equivalent Values. If a value for a measurement as given in this standard is followed by an equivalent value in other units, the first stated value shall be regarded as the requirement. A given equivalent value might be approximate.

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 13, *Standard for the Installation of Sprinkler Systems*, 2010 edition.

NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*, 2010 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2010 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2010 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2012 edition.

NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, 2012 edition.

NFPA 220, *Standard on Types of Building Construction*, 2012 edition.

NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Material*, 2006 edition.

NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*, 2008 edition.

NFPA 257, *Standard on Fire Test for Window and Glass Block Assemblies*, 2007 edition.

NFPA 5000®, *Building Construction and Safety Code*®, 2012 edition.

2.3 Other Publications. (Reserved)

2.3.1 ACI Publications. American Concrete Institute, P.O. Box 9094, Farmington Hills, MI 48333.

ACI 216.1/TMS 0216.1, *Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies*, 2008.



2.3.2 ASCE Publications. American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191-4400.

ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, 2005 with Supplement 1.

ASCE/SFPE 29, *Standard Calculation Methods for Structural Fire Protection*, 2005.

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

ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 2009.

ASTM E 814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*, 2002.

ASTM E 1966, *Standard Test Method for Fire-Resistive Joint Systems*, 2001.

2.3.4 SPRI Publications. Single Ply Roofing Industry (SPRI), 77 Rumford Avenue, Suite 3B, Waltham, MA 02453.

ANSI/SPRI RP-4, *Wind Design Standard for Ballasted Single-Ply Roofing Systems*, 2002.

2.3.5 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 10C, *Standard for Positive Pressure Fire Tests of Door Assemblies*, 2009.

ANSI/UL 263, *Standard for Fire Tests of Building Construction and Materials*, 2003, Revised 2007.

ANSI/UL 555, *Standard for Fire Dampers*, 2006, Revised 2010.

ANSI/UL 1479, *Standard for Fire Tests of Through-Penetration Firestops*, 2003, Revised 2010.

ANSI/UL 2079, *Standard for Tests for Fire Resistance of Building Joint Systems*, 2004, Revised 2008.

2.3.6 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*®, 2012 edition.

ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, 2005 with Supplement 1.

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* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

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. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Contents.

3.3.1.1 Low Hazard. Low hazard contents shall be classified as those of such low combustibility that no self-propagating fire therein can occur. [5000, 2012]

3.3.1.2 Ordinary Hazard. Ordinary hazard contents shall be classified as those that are likely to burn with moderate rapidity or to give off a considerable volume of smoke. [5000, 2012]

3.3.2 Damper.

3.3.2.1 Combination Fire and Smoke Damper. A device that meets both the fire damper and smoke damper requirements. [5000, 2012]

3.3.2.2* Fire Damper. A device, installed in an air-distribution system, that is designed to close automatically upon detection of heat to interrupt migratory airflow and to restrict the passage of flame. [5000, 2012]

3.3.2.3 Smoke Damper. A device within an air-distribution system to control the movement of smoke. [5000, 2012]

3.3.3 Element.

3.3.3.1 Load-Bearing Element. Any column, girder, beam, joist, truss, rafter, wall, floor, or roof sheathing that supports any vertical load in addition to its own weight, or any lateral load. [5000, 2012]

3.3.3.2 Structural Element. The columns and girders, beams, trusses, joists, braced frames, moment-resistant frames, and vertical and lateral resisting elements, and other framing members that are designed to carry any portion of the dead or live load and lateral forces, that are essential to the stability of the building or structure. [5000, 2012]

3.3.4 Finished Ground Level (Grade). The level of the finished ground (earth or other surface on ground).

3.3.5 Fire Protection Rating. The designation indicating the duration of the fire test exposure to which a fire door assembly or fire window assembly was exposed and for which it met all the acceptance criteria as determined in accordance with NFPA 252 or NFPA 257, respectively. [5000, 2012]

3.3.6* Fire Resistance Rating. The time, in minutes or hours, that materials or assemblies have withstood a fire exposure as

determined by the tests, or methods based on tests, prescribed by this standard. [5000, 2012]

3.3.7 Firestop. A specific system, device, or construction consisting of the materials that fill the openings around penetrating items such as cables, cable trays, conduits, ducts, pipes, and their means of support through the wall or floor openings to prevent the spread of fire. [5000, 2012]

3.3.8 Footing. Part of the foundation of a structure that spreads and transmits the load direct to the soil or to piles. [5000, 2012]

3.3.9 Grade Plane. A reference plane representing the average of the finished ground level adjoining the building at all exterior walls. When the finished ground level slopes down from the exterior walls, the grade plane is established by the lowest points within the area between the building and the lot line or, when the lot line is more than 6 ft (1.8 m) from the building, between the building and a point 6 ft (1.8 m) from the building.

3.3.10 High Hazard Materials. Materials that are combustible or flammable liquids, flammable gases, and combustible dusts.

3.3.11 Penetration.

3.3.11.1* Membrane Penetration. An opening for penetrations made through one side of a fire resistance-rated assembly. [5000, 2012]

3.3.11.2* Through-Penetration. An opening for penetrations that pass through both sides of a vertical or horizontal fire resistance-rated assembly. [5000, 2012]

3.3.12 Smoke Barrier. A continuous membrane, or a membrane with discontinuities created by protected openings, where such membrane is designed and constructed to restrict the movement of smoke. [5000, 2012]

3.3.13 Structural Frame. Frame composed of individual members of a building or structure required to transmit loads to the ground. [5000, 2012]

3.3.14 Wall.

3.3.14.1 Angle Wall. An exterior wall that intersects with a high challenge fire wall at an angle of 135 degrees or less at the end of the high challenge fire wall. (See Figure 5.16.3.1).

3.3.14.2 Bearing Wall. Any wall meeting either of the following classifications: (1) any metal or wood stud wall that supports more than 100 lb/linear ft (1400 N/linear m) of vertical load in addition to its own weight or (2) any concrete or masonry wall that supports more than 200 lb/linear ft (2800 N/linear m) of vertical load in addition to its own weight. [ASCE/SEI 7:11.2]

3.3.14.3 Bearing Wall System. A structural system with bearing walls providing support for all or major portions of the vertical loads. Shear walls or braced frames provide seismic force resistance. [ASCE/SEI 7:11.2]

3.3.14.4 End Wall. An exterior wall that intersects with a high challenge fire wall at an exterior angle of more than 135 degrees at the end of the high challenge fire wall. (See Figure 5.16.2.1(a), Figure 5.16.2.1(b), and Figure 5.16.2.3.)

3.3.14.5 Fire Barrier Wall. A wall, other than a fire wall, having a fire resistance rating.

3.3.14.6* Fire Wall. A wall separating buildings or subdividing a building to prevent the spread of fire and having a fire resistance rating and structural stability.

3.3.14.7 High Challenge Fire Wall. A wall used to separate buildings or subdivide a building with high fire challenge occupancies, having enhanced fire resistance ratings and enhanced appurtenance protection to prevent the spread of fire, and having structural stability.

3.3.14.8 Nonbearing Wall. Any wall that is not a bearing wall. [ASCE/SEI 7:11.2]

Chapter 4 General Requirements

4.1 Scope. The provisions of this chapter apply to high challenge (HC) fire walls, fire walls, and fire barrier walls unless modified by provisions of Chapters 5, 6, or 7, respectively, and shall hereafter in this chapter be referred to as walls.

4.2* Design Loads. All walls and their supports shall be designed for loads in accordance with ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, and to withstand a minimum uniform load of 5 lbf/ft² (0.24 kPa) from either direction applied perpendicular to the face of the wall.

4.3 Fire Resistance Ratings.

4.3.1 The fire resistance rating of assemblies shall be determined in accordance with NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Material*, ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, or ANSI/UL 263, *Standard for Fire Tests of Building Construction and Materials*, or other approved test methods or analytical methods in accordance with 4.3.2.

4.3.2 Analytical Methods. [5000:8.2.3]

4.3.2.1 General. Analytical methods utilized to determine the fire resistance rating of building assemblies shall comply with 4.3.2.2 or 4.3.2.3. [5000:8.2.3.1]

4.3.2.2* Calculations. [5000:8.2.3.2]

4.3.2.2.1 Where calculations are used to establish the fire resistance rating of structural elements or assemblies, they shall be permitted to be performed in accordance with ASCE/SFPE 29. [5000:8.2.3.2.1]

4.3.2.2.2 Where calculations are used to establish the fire resistance rating of concrete or masonry elements or assemblies, the provisions of ACI 216.1/TMS 0216.1 shall be permitted to be used. [5000:8.2.3.2.2]

4.3.2.3 Methods. [5000:8.2.3.3]

4.3.2.3.1 Except for the method specified in 4.3.2.2, analytical methods used to calculate the fire resistance rating of building assemblies or structural elements shall be approved. [5000:8.2.3.3.1]

4.3.2.3.2 Where an approved analytical method is utilized to establish the fire resistance rating of a structural element or building assembly, the calculations shall be based on the fire exposure and acceptance criteria specified in NFPA 251. [5000:8.2.3.3.2]

4.4 Ducts and Air-Transfer Openings. [5000:8.8.8]

4.4.1 General. The provisions of Section 4.4 shall govern the materials and methods of construction used to protect ducts and air-transfer openings in fire walls, fire resistance-rated horizontal assemblies, and fire barrier walls. [5000:8.8.8.1]

4.4.2* Fire Damper Requirements. Fire dampers shall be installed to protect ducts and air-transfer openings that penetrate fire barriers and fire walls as required by other sections of the applicable building code. [5000:8.8.8.2]

4.4.2.1 Fire dampers shall be designed and tested in accordance with the requirements of UL 555 and shall have the minimum fire protection rating specified in Table 4.4.2.1 for the rating of the assembly penetrated. [5000:8.8.8.2.1]

Table 4.4.2.1 Fire Damper Rating

Fire Resistance Rating of Wall Assembly	Minimum Damper Rating (hr)
3-hr or greater fire resistance-rated assemblies	3
Less than 3-hr fire resistance-rated assemblies	1½

Source: NFPA 5000; Table 8.8.8.2.1

4.4.2.2 In systems where fans continue to operate in the emergency mode, dynamic fire dampers shall be required. [5000:8.8.8.2.2]

4.4.2.3 Fire dampers shall be required in the following locations:

- (1) Ducts and air-transfer openings penetrating walls or partitions having a fire resistance rating of 2 or more hours
- (2) Ducts and air-transfer openings penetrating shaft walls having a fire resistance rating of 1 or more hours
- (3) Ducts and air-transfer openings penetrating floors that are required to have protected openings where the duct also is not protected by a shaft enclosure
- (4) Air-transfer openings that occur in walls or partitions that are required to have a fire-resistive rating of 30 minutes or more [5000:8.8.8.2.3]

4.4.2.4 Fire dampers shall not be required in the following locations:

- (1) In floors that do not require protected floor openings
- (2) In a duct system serving only one floor and used only for exhaust of air to the outside and not penetrating a wall having a required fire resistance rating of 2 hours or more or passing entirely through the system and contained within its own dedicated shaft
- (3) Where branch ducts connect to enclosed exhaust risers in which the airflow is upward, and steel subducts at least 22 in. (560 mm) in length are carried up inside the riser at each inlet [5000:8.8.8.2.4]

4.4.3 Installation. [5000:8.8.8.3]

4.4.3.1 Air-conditioning, heating, and ventilating ductwork and related equipment, including fire dampers, smoke dampers, combination fire and smoke dampers, and ceiling radiation dampers, shall be installed in accordance with NFPA 90A or NFPA 90B, where applicable. [5000:8.8.8.3.1]

4.4.3.2 The equipment specified in 4.4.3.1 shall be installed in accordance with the requirements of Section 4.4, the manufacturer's installation instructions, its listing, and the applicable mechanical code as specified in Chapter 50 of NFPA 5000. [5000:8.8.8.3.2]

4.4.4 Access and Identification. [5000:8.8.8.4]

4.4.4.1 Access. Fire and smoke dampers shall be provided with an approved means of access, as follows:

- (1) The means of access shall be large enough to allow inspection and maintenance of the damper and its operating parts.
- (2) The access shall not affect the integrity of fire resistance-rated assemblies.
- (3) The access openings shall not reduce the fire resistance rating of the assembly.
- (4) Access doors in ducts shall be tight-fitting and suitable for the required duct construction.
- (5) Access and maintenance shall comply with the requirements of the mechanical code.

[5000:8.8.8.4.1]

4.4.4.2 Identification. Access points to fire and smoke dampers shall be permanently identified by one of the following:

- (1) A label having letters not less than ½ in. (13 mm) in height reading as follows in (a), (b), or (c):
 - (a) FIRE/SMOKE DAMPER
 - (b) SMOKE DAMPER
 - (c) FIRE DAMPER
- (2) Symbols as approved by the authority having jurisdiction.

[5000:8.8.8.4.2]

4.4.5* Fire Damper Actuation Device. The operating temperature of the heat-actuating device shall be approximately 50°F (27.8°C) above the normal temperature within the duct system, but not less than 160°F (71°C); or it shall be not more than 286°F (141°C) where located in a required smoke control system; or, where a combination fire and smoke damper is installed, it shall not exceed 350°F (177°C) where located in a smoke control system. [5000:8.8.8.5]

4.5* Double Wall Assemblies. Where either wall of a double wall is laterally supported by a building frame with a fire resistance rating less than that required for the wall, double wall assemblies shall be considered to have a combined assembly fire resistance rating as specified in Table 4.5.

Table 4.5 Fire Resistance Ratings for Double Wall Assemblies

Fire Resistance Rating of Each Wall (hr)	Equivalent to Single Wall (hr)
3	4
2	3
1	2

4.6* Impact Damage.

4.6.1 Where the wall is subject to impact damage from moving vehicles or the handling of merchandise or other activity, protection against impact damage shall be provided for an appropriate height but not less than 60 in. (1525 mm) from the finished floor.

4.6.2 Where the fire-protective covering of a structural element required to have a fire resistance rating by Section 5.4 or Section 6.4 is subject to impact damage from moving vehicles, the handling of merchandise, or other activity, protection against impact damage shall be provided for an appropriate height but not less than 60 in. (1525 mm) from the finished floor.