NFPA® 415

Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways

2016 Edition

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

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NFPA®415

Standard on

Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways

2016 Edition

This edition of NFPA 415, *Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways*, was prepared by the Technical Committee on Airport Facilities. It was issued by the Standards Council on May 26, 2015, with an effective date of June 15, 2015, and supersedes all previous editions.

This edition of NFPA 415 was approved as an American National Standard on June 15, 2015.

Origin and Development of NFPA 415

NFPA 415, *Standard on Aircraft Fueling Ramp Drainage,* was first adopted in 1961. Subsequent editions were published in 1966, 1973, 1977, 1983, 1987, and 1992.

NFPA 416, *Standard on Construction and Protection of Airport Terminal Buildings,* was first adopted in 1962. Subsequent editions were published in 1967, 1972, 1973, 1975, 1983, 1987, and 1993.

NFPA 417, *Standard on Construction and Protection of Aircraft Loading Walkways,* was first adopted in 1963. Subsequent editions were published in 1968, 1973, 1977, 1985, and 1990.

The 1997 edition of NFPA 415 combined those three documents and was given a new title, *Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways.*

The 2002 edition was a partial revision of the 1997 edition.

The 2008 edition of this standard was a partial revision of the 2002 edition and included the following changes:

(1) Revision of 4.1.2 to correlate with the provisions of NFPA *101®*, *Life Safety Code®*, for interior finish
(2) Revision of 6.2.4 to restrict the use of transparent and translucent walls in aircraft loading walkways
(3) Revision of 6.3.2 and the addition of 6.3.2.1 to replace a reference to certain provisions of NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, that no longer exist in that standard

The 2013 edition provided updated references to test standards.

The 2016 edition permits passenger loading walkways to utilize transparent walls.

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

Committee Scope: This Committee shall have primary responsibility for documents on fire safety for the construction and protection at airport facilities involving construction engineering but excluding airport fixed fueling systems.

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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. 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 D. 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 D.

Chapter 1 Administration

1.1 Scope. This standard specifies the minimum fire protection requirements for the construction and protection of airport terminal buildings. It specifies the minimum requirements for the design and maintenance of the drainage system of an aircraft fueling ramp to control the flow of fuel that can be spilled on a ramp and to minimize the resulting possible danger. In addition, it contains the minimum requirements for the design, construction, and fire protection of aircraft loading walkways between the terminal building and aircraft.

1.2* Purpose. The purpose of this standard is to provide a reasonable degree of protection for life and property from fire at airport terminal complexes.

1.2.1 Requirements applicable to ramp drainage systems are intended to limit the fire hazard from fuel spillage in the following ways:

(1) Controlling the spread of a fuel spill to limit exposure to buildings, aircraft loading walkways, concourses, or elevated structures in order to prevent the fuel's liquid or vapors from reaching a source of ignition or accumulating within structures
(2) Limiting the spread of the fuel spill over the ramp surface and preventing the transmission of vapors by the drainage system from exposing aircraft or other equipment parked or operating on the ramp

1.2.2 The purpose of this standard is also to specify minimum criteria for fire protection of aircraft loading walkways that can serve as egress routes from aircraft in the event that a fire caused by a flammable liquid spill on the airport ramp exposes the walkway and the aircraft.

1.3 Application. It is not intended that the provisions of this document be applied to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the document, except in those cases where it is determined by the authority having jurisdiction that the existing situation involves a distinct hazard to life or adjacent property.

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 10, *Standard for Portable Fire Extinguishers,* 2013 edition.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam,* 2015 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2016 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2013 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection,* 2012 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems,* 2015 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment,* 2011 edition.

NFPA 54, *National Fuel Gas Code,* 2015 edition.

NFPA 70®, National Electrical Code®, 2014 edition.

NFPA 72®, National Fire Alarm and Signaling Code, 2016 edition.

NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment,* 2014 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 2015 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids,* 2015 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations,* 2014 edition.

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

NFPA 220, *Standard on Types of Building Construction,* 2015 edition.

NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source,* 2015 edition.

NFPA 407, *Standard for Aircraft Fuel Servicing,* 2012 edition.

NFPA 409, *Standard on Aircraft Hangars,* 2016 edition.

NFPA 5000®, Building Construction and Safety Code®, 2015 edition.

2.3 Other Publications.

2.3.1 AATCC Publications. American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709-2215.

AATCC 192, "Weather Resistance of Textiles: Sunshine-Arc Lamp Exposure With and Without Wetting," 2009.

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. www.astm.org

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2014.

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

ANSI/UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials,* 2008.

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. (Reserved)

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. 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 Aircraft Fueling Ramp. Any outdoor area at an airport, including aprons and hardstands, where aircraft are normally fueled or defueled.

3.3.2 Aircraft Loading Walkway. An aboveground device through which passengers move between a point in an airport terminal building and an aircraft. Included in this category are walkways that are essentially fixed and permanently placed, or walkways that are essentially mobile in nature and that fold, telescope, or pivot from a fixed point at the airport terminal building.

3.3.3 Airport Ramp. Any outdoor area, including aprons and hardstands, where aircraft can be positioned, stored, serviced, or maintained, irrespective of the nature of the surface of the area.

3.3.4* Airport Terminal Building. A structure used primarily for air passenger enplaning or deplaning, including ticket sales, flight information, baggage handling, and other necessary functions in connection with air transport operations. This term includes any extensions and satellite buildings used for passenger handling or aircraft flight service functions. Aircraft loading walkways and "mobile lounges" are excluded.

3.3.5 Potential Fuel Spill Points. The points on or around the aircraft or airport ramp where fuel can be released. These points include fueling hydrants, fuel servicing vehicles, fuel tank fill connections, fuel vent openings, and fuel dump valves.

3.3.6 Satellite. A structure that can be adjacent to but separated from the airport terminal building, accessible above ground or through subway passages, and used to provide flight service operations, such as passenger check-in, waiting rooms, food service, enplaning or deplaning, etc.

Chapter 4 Airport Terminal Buildings

4.1 General.

4.1.1 Airport terminal buildings shall be of Type I, Type II, or Type IV construction, as defined in *NFPA 5000* or NFPA 220. *(See Annex B.)*

4.1.2* Interior finish materials shall be limited to Class A or Class B regardless of the occupant load.

4.1.3 Aircraft fueling facilities and ramps shall be designed in accordance with NFPA 407 and Chapter 5 of this standard.

4.1.4 Belowgrade areas and blind spaces in airport terminal buildings shall be protected against flammable fuel and vapor penetration or shall be mechanically ventilated to provide at least four complete air changes per hour. The mechanical ventilation system shall be installed in accordance with NFPA 91.

4.1.5 Glazing Material–Covered Openings Facing the Ramp.

4.1.5.1 Openings covered with glazing material that have the lowest part of the glazing material not less than 7 ft (2.1 m) above each finished floor level shall not be required to comply with 4.1.5.3.

4.1.5.2 Openings covered with glazing material listed for use in a fire barrier and installed in accordance with the listing shall not be required to comply with 4.1.5.3.

4.1.5.3 Where potential fuel spill points are located less than 100 ft (30.5 m) horizontally from glazing material–covered openings in airport terminal building walls facing the airport ramp, they shall be provided with an automatically activated water spray system in accordance with 4.1.5.3.1 or an automatically activated, listed fire shutter system in accordance with 4.1.5.3.2. *(See Annex C.)*

4.1.5.3.1 Where an automatically activated water spray system(s) is provided, it shall be installed in accordance with NFPA 15.

4.1.5.3.1.1 The system shall be designed to provide a density of at least 0.25 gpm/ft^2 [10.2 (L/min)/m^2] over the exterior surface area of the glazing material.

4.1.5.3.1.2 Where multiple water spray systems are used, the water supply shall be capable of supplying all systems that could be expected to operate as a result of one fire incident.

4.1.5.3.1.3 The detection system design analysis for the water spray system shall include consideration of false alarms and detector response time.

4.1.5.3.2 Where an automatically activated, listed fire shutter is provided, it shall be installed in accordance with its listing.

4.2 Heating, Ventilating, and Air Conditioning.

4.2.1 Heating, ventilating, and air-conditioning systems shall be installed in accordance with NFPA 31, NFPA 54, and NFPA 90A, as applicable.

4.2.2* Air supply intake and exhaust openings for air-conditioning or ventilating equipment serving the terminal building, if located on the ramp side, shall be not less than 10 ft (3 m) above the grade level of the ramp and shall be at least 50 ft (15 m) from any point of flammable vapor release.

4.2.3* Openings to rooms that contain coal-, gas-, or oil-fired equipment or any other open-flame device and that face the ramp side of the terminal shall be above ramp grade and 50 ft (15 m) from any point of flammable vapor release.

4.2.4 Stacks or chimneys from a boiler, heater, or incinerator shall terminate at least 20 ft (6.1 m) above ramp grade and above the roof of the building. Stacks or chimneys from boilers or heaters that use solid fuel or from any incinerator shall be fitted with double screening to control fly ash and sparks. Such stacks or chimneys shall be located so the outlet is at least 100 ft (30.5 m) horizontally from any aircraft position or point of flammable vapor release.

4.2.5 Incinerators shall conform to the requirements of Chapter 4 of NFPA 82.

4.2.6 Exhaust hood ventilation systems for restaurant and flight kitchens shall conform to the applicable portions of NFPA 96.

4.3 Exits.

4.3.1 Airport terminal building means of egress shall conform to the requirements of NFPA *101*.

4.3.2* In addition to the exit signage requirements specified in NFPA *101*, doors serving as exits that discharge onto an airport ramp and are provided solely for the purpose of meeting emergency egress requirements from public areas shall be placarded "Emergency Exit Only" in letters at least 2 in. (50 mm) high.

4.4 Electrical.

4.4.1 All electrical installations shall be in accordance with *NFPA 70*.

4.4.2 Ventilation and access openings for transformer or electrical service rooms or vaults located on the ramp side of an airport terminal building shall be located in accordance with 4.2.2.

4.5 Fire Protection.

4.5.1* Sprinkler Systems.

4.5.1.1 An airport terminal building with more than 12,000 ft^2 (1115 m^2) total floor area for the assembly portion of the occupancy shall be provided with an automatic sprinkler system installed in accordance with NFPA 13.

4.5.1.2 Terminal buildings with less than 12,000 ft^2 (1115 m^2) total floor area for the assembly portion of the occupancy shall not be required to be provided with an automatic sprinkler system.

4.5.1.3 Passenger-handling areas shall be classified as Ordinary Hazard Group 1 Occupancy, as defined in NFPA 13, for the purpose of sprinkler system design.

4.5.1.4 Baggage, package, and mail-handling areas shall be classified as Ordinary Hazard Group 2 Occupancy, as defined in NFPA 13, for the purpose of sprinkler system design.

4.5.1.5* Other areas of the airport terminal building shall be classified in accordance with Chapter 5 of NFPA 13 based on the occupancy of the area.

4.5.1.6 Covered Plane-Loading Positions. Airport terminal buildings having canopy areas or roofed-over recesses at aircraft loading positions that, in effect, place the aircraft totally or substantially under such canopies or roofs shall have the canopies or roofs protected by automatic sprinkler systems in accordance with NFPA 409.

4.5.2 Fire Alarm and Communications Systems. A fire alarm and communications system shall be installed as required by 12.3.4 of NFPA *101*.

4.5.2.1 Means to alert the public fire department or the airport fire station shall be available through manual fire alarm pull stations. Manual fire alarm services shall be installed in accordance with *NFPA 72*.

4.5.2.2* Annunciation for all building fire alarm signals shall be provided near the front entrance of the building.

4.5.2.3 If the public fire department has two-way voice communication with a constantly attended location, 4.5.2.2 shall not apply.

4.5.3 Fire Hydrants. Fire hydrants shall be provided on both the ramp and the street sides of airport terminal buildings. Such hydrants shall be located so that no portion of the terminal building is more than 500 ft (152.4 m) from a hydrant.

4.5.4 Standpipe and Hose Systems. Standpipe and hose systems shall be provided for all airport terminal buildings in excess of two stories [35 ft (10.7 m)] in height or 100 ft (30.5 m) in shortest horizontal dimension. Standpipe and hose systems shall be installed in accordance with NFPA 14.

4.5.4.1 Class I standpipe systems shall be provided in buildings protected throughout by an approved automatic sprinkler system. Each 2½ in. (63.5 mm) hose connection shall be equipped with a 2½ in. × 1½ in. (63.5 mm × 38 mm) reducer and cap.

4.5.4.2 Class III standpipe systems shall be provided in nonsprinklered buildings. The exceptions in NFPA 14, for Class III systems shall be applicable to this requirement.

4.5.5 Water Supply. Water supply from public or private sources shall be adequate to supply maximum calculated sprinkler demand plus a minimum of 500 gpm (1893 L/min) for hose streams. The supply shall be available at the rate specified for a period of at least 1 hour.

4.5.5.1* Main sizes shall be hydraulically calculated based on the total domestic and fire protection requirements. Mains shall be not less than 8 in. (203 mm) in diameter except that laterals shall be permitted to be 6 in. (152 mm) in diameter if not over 200 ft (61 m) long.

4.5.5.2* Hydrants shall be readily accessible to fire-fighting vehicles traveling on surfaces adequate for supporting such vehicles.

4.5.5.2.1 Hydrants shall be listed.

4.5.5.2.2 Hydrants shall be located or protected to prevent mechanical or vehicular damage, including taxiing aircraft.

4.5.5.2.3 Hydrants recessed into the ground shall have identifiers in the pavement to assist in their prompt location at night and by personnel who might not be familiar with the location of the hydrants.

4.5.5.3* Water supply systems shall be regularly tested to ensure operation.

4.5.6 Portable Fire Extinguishers. Portable fire extinguishers shall be provided throughout the airport terminal building in accordance with NFPA 10.

Chapter 5 Aircraft Fueling Ramp Drainage

5.1 Aircraft Fueling Ramp Slope and Drain Design.

5.1.1* Aircraft fueling ramps shall slope away from terminal buildings, aircraft hangars, aircraft loading walkways, or other structures, with a minimum grade of 1 percent (1:100) for the first 50 ft (15 m). Beyond this distance, the ramp slope to drainage inlets shall be permitted to be reduced to a minimum of 0.5 percent (1:200).

5.1.2* Aircraft fueling ramp drainage as specified herein shall be accomplished by the provisions of 5.1.1 in conjunction with the following:

(1) The use of drain inlets with connected piping
(2) The use of open-grate trenches

5.1.3 Drainage inlets, where provided, shall be located a minimum of 50 ft (15 m) from structures outlined in 5.1.1.

5.1.4 The drainage system of any aircraft fueling ramp shall be so designed that the fuel or its vapor cannot enter into the drainage system of buildings, areas utilized for automobile parking, public or private streets, or the public side of airport terminal or aircraft hangar structures. In no case shall the design allow fuel to collect on the aircraft fueling ramp or adjacent ground surfaces where it could constitute a fire hazard.

5.1.5 The final separator or interceptor for the entire airport drainage system shall be designed to allow disposal of combustible or flammable liquids into a safely located, approved containment facility.

5.1.6 Grates and drain covers shall be removable to facilitate cleaning and flushing.

5.1.7* If open-grate drainage trenches are used as a collection means, such open trenches, including branches, shall not be over 125 ft (38 m) in length with a minimum interval of 6 ft (1.8 m) between open-trench sections to act as fire stops. Each 125 ft (38 m) section shall be individually drained through underground piping. Open trenches shall not be used where they are in the line of pedestrian or passenger traffic.

5.1.8 Underground piping and components used in drainage systems shall be noncombustible and inert to fuel.

5.2 Drain and Separator Maintenance.

5.2.1* Periodic maintenance checks shall be conducted of all ramp drainage systems and interceptors to ensure that they are clear of obstructions and function properly.

5.2.2 Large-volume flushing with water shall be conducted through appropriate drainage elements to purge residual fuel from these drainage elements after any large fuel spill on the aircraft fueling ramp enters the drainage system.

Chapter 6 Aircraft Loading Walkways

6.1 Basic Design.

6.1.1* Each aircraft loading walkway installation shall be designed to provide a safe means of egress from the aircraft for a period of 5 minutes under fire exposure conditions equivalent to a free-burning jet fuel spill fire.

6.1.2 Protection of the aircraft loading walkway shall be accomplished by one of the following methods:

(1) Construction design meeting the requirements of Sections 6.1 through 6.4
(2) Fixed fire protection meeting the requirements of Sections 6.1, 6.2, and 6.5

6.2 Requirements for All Aircraft Loading Walkways.

6.2.1* Interior finish other than textiles of walls, ceilings, and walkways shall be Class A as defined in 10.2.3.4.1 of NFPA *101* and classified in accordance with ASTM E84, *Standard Test*

Method for Surface Burning Characteristics of Building Materials, or ANSI/UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*.

6.2.2 Interior textile finish of walls and ceilings in walkways shall be as limited by 10.2.4.1(5) of NFPA *101*.

6.2.3 Interior floor finish in walkways shall be Class I as defined in 10.2.7.4.1 of NFPA *101* and classified in accordance with NFPA 253.

6.2.4* During a ramp fire emergency, walkway interiors shall have a positive air pressure delivered from a source that shall remain uncontaminated.

6.2.5* Any source of negative air pressure in the aircraft loading walkway shall be automatically shut down in the event of a fire emergency.

6.2.6 Any door in the egress path through the loading walkway to the terminal building shall swing in the direction of egress from the aircraft toward the terminal building and shall be equipped with panic hardware on the aircraft side.

6.2.7* Where loading walkways are provided, the walkway, including the bumpers, curtains, and canopies, shall be seated according to the manufacturer's instruction and training whenever the walkway is in service.

6.2.8 Cab and Rotunda Slat Curtains.

6.2.8.1 Cab slat curtains and rotunda slat curtains shall meet the requirements of 6.4.8 by one of the following methods:

(1) Intrinsic structural features
(2) Fire-resistive coatings
(3) Automatically activated water cooling systems in accordance with 6.5.2
(4) Automatically activated fire curtains
(5) Local application of a foam system in accordance with 6.5.3 under the cab and rotunda that is automatically activated and covers an area extending 15 ft (4.6 m) beyond the perimeter of the cab and rotunda. This shall supersede the 10 ft (3 m) criteria of 6.5.3.

6.2.8.2 When the rotunda is located more than 50 ft (15 m) from the fuel fill or fuel vent point of aircraft and the rotunda slot curtain is of noncombustible construction, 6.2.8.1 shall not apply.

6.2.9 Emergency Lights. Emergency lights shall be installed in all aircraft loading walkways in accordance with NFPA *101*.

6.2.10* The minimum obstruction-free width of walking surface shall be 36 in. (914 mm). Changes in elevation between telescoping sections of the loading walkway's walking surface shall not exceed 1 in 20 slope when the loading walkway is level. Existing loading walkways shall be permitted to be continued in service.

6.3 Materials.

6.3.1 Exterior surfaces of floors, roofs, walls, and load-bearing structural members shall be constructed entirely of materials or composite assemblies that maintain the structural integrity and heat transfer characteristics needed to meet the requirements specified in 6.1.1 and Section 6.4.

6.3.2 Flexible closures, canopies, wipers, and weather-sealing devices shall be subjected to the accelerated weathering procedures specified in 6.3.2.1, after which they shall meet the requirements of 6.4.7 or 6.4.10 of this standard, as applicable.

6.3.2.1 Specimens shall be exposed for 100 hours using the apparatus and procedure specified in Cycle 1 Option A of AATCC Test Method 192, "Weather Resistance of Textiles: Sunshine-Arc Lamp Exposure With and Without Wetting."

6.3.3 The manufacturer shall provide, in writing, the anticipated service life expectancy of components that contribute to fire safety.

6.4 Fire Tests.

6.4.1 Scope of Fire Tests.

6.4.1.1 Tests shall be conducted to establish the performance of materials and methods of construction and to verify their structural integrity and heat transfer characteristics so as to satisfy the 5-minute exit route criteria specified in 6.1.1.

6.4.1.2 The test methods specified in this chapter shall be applicable to assemblies of units and to composite assemblies of structural materials for aircraft loading walkways, including walls, girders, beams, slabs, and composite slab and beam assemblies for floor and walls either tested individually as floor or wall panels or as a complete assembly. Also, they shall be applicable to other assemblies and structural units that constitute permanent integral parts of a finished aircraft loading walkway.

6.4.1.3 The condition of acceptance for tests specified in this section for aircraft loading walkways shall be documented by one of the methods in 6.4.1.3.1 and 6.4.1.3.2. Such submittals shall be subject to acceptance by the authority having jurisdiction.

6.4.1.3.1 Tests shall be conducted in accordance with the requirements and procedures of Section 6.4.

6.4.1.3.2 Evidence of compliance shall be permitted to be achieved by other methods such as modeling, calculation, or testing. The submitter must show that the method used proves that components achieve a level of fire safety at least equal to that produced by the procedure in Section 6.4.

6.4.1.4 The tests shall register performance during the required period of exposure and shall not be construed as having determined suitability for use after fire exposure.

6.4.2 Time-Temperature Curve to Be Used. The conduct of fire tests of materials and construction shall be controlled by the time-temperature curves in Figure 6.4.2 and Table 6.4.2.

6.4.3 Furnace Temperatures.

6.4.3.1 The temperature fixed by the curve shall be deemed to be the average temperature obtained from the readings of not fewer than nine thermocouples for a floor or wall section. The thermocouples shall be symmetrically located and distributed to show the temperature near all parts of the sample and shall be partially enclosed in porcelain tubes ¾ in. (19 mm) in outside diameter and ⅛ in. (3 mm) in wall thickness, with a minimum exposed length of thermocouple wires of 1½ in. (38 mm). The exposed length of the pyrometer tube and thermocouples in the furnace chamber shall be not less than 12 in. (305 mm). Other types of thermocouples or pyrometers that under test conditions give the same indications as those specified herein within the limit of accuracy that applies for real-

Table 6.4.2 Typical Furnace Time-Temperature Gradients for Fire Testing of Aircraft Loading Walkways

Time (min:sec)	Exposed Floor Section Temperatures		Exposed Wall Section Temperatures	
	°C	°F	°C	°F
0:00	20	68	20	68
0:20	160	320	90	194
0:40	300	572	165	329
1:00	440	824	235	455
1:20	580	1076	310	590
1:40	720	1328	380	716
2:00	860	1580	450	842
2:20	915	1679	520	968
2:40	940	1724	595	1103
3:00	955	1751	635	1175
3:20	960	1760	660	1220
3:40	965	1769	675	1247
4:00	970	1778	685	1265
4:20	970	1778	690	1274
4:40	975	1787	690	1274
5:00	975	1787	690	1274
5:20	975	1787	695	1283
5:40	980	1796	695	1283
6:00	980	1796	695	1283
6:20	985	1805	700	1292
6:40	985	1805	700	1292
7:00	990	1814	700	1292
7:20	990	1814	705	1301
7:40	995	1823	705	1301
8:00	995	1823	705	1301
8:20	995	1823	710	1310
8:40	1000	1832	710	1310
9:00	1000	1832	710	1310
9:20	1005	1841	715	1319
9:40	1005	1841	715	1319
10:00	1005	1841	715	1319

Note: See also Figure 6.4.2.

time furnace temperature measurements shall be permitted to be used.

6.4.3.1.1 For floor sections, the junction of the thermocouples shall be placed 12 in. (305 mm) away from the exposed surface of the sample at the beginning of the test and during the test shall not touch the sample as a result of its deflection.

6.4.3.1.2 For walls, the thermocouples shall be placed 6 in. (152 mm) away from the exposed face of the sample at the beginning of the test and shall not touch the sample during the test as a result of its deflection.

6.4.3.2 The temperatures shall be measured and reported at intervals not exceeding 15 seconds.

6.4.3.3 The accuracy of the furnace control shall be such that at any given time the temperature obtained by averaging the results from the pyrometer readings shall not be less than 90 percent of the temperature curve shown in Figure 6.4.2.

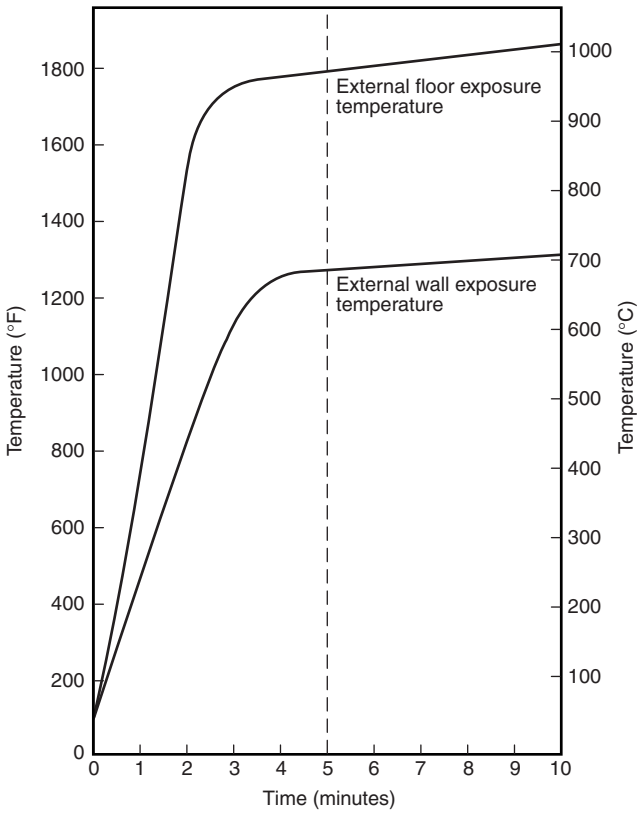

FIGURE 6.4.2 Typical Furnace Time-Temperature Curves for Fire Testing of Aircraft Loading Walkways. ***(See Table 6.4.2.)***

6.4.4 Temperatures of Unexposed Surfaces of Floors and Walls.

6.4.4.1 Temperatures of unexposed surfaces shall be measured with exposed-type thermocouples placed under felted refractory fiber pads.

6.4.4.1.1 The refractory fiber pads shall be of flexible, felted material, free of organic additives, and they shall exhibit the following properties:

(1) Length and width shall be 6 in. ± ⅛ in. (152 mm ± 3.18 mm).
(2) Thickness shall be 0.375 in. ± 0.063 in. (9.5 mm ± 1.6 mm).
(3) Dry weight shall be 0.147 lb ± 0.053 lb (67 g ± 24 g).
(4) Thermal conductivity [at 150°F (66°C)] shall be 0.37 Btu in./hr ft^2·°F ± 0.03 Btu in./hr ft^2·°F (0.053 W/m·C ± 0.004 W/m·C).
(5)* Hardness indentation on soft face shall be 0.075 in. ± 0.025 in. (1.9 mm ± 0.6 mm).
(6) The pads shall be shaped by wetting, forming, and drying to constant weight to provide complete contact on sharply contoured surfaces.

6.4.4.1.2 The thickness measurement shall be made under the light load of a ½ in. (13 mm) diameter pad of a dial micrometer gauge.

6.4.4.1.3 The wire leads of the thermocouple shall have an immersion under the pad and shall be in contact with the unexposed surface for not less than 1½ in. (38 mm). The hot

junction of the thermocouple shall be placed approximately under the center of the pad. The outside diameter of protecting or insulating tubes shall be not more than $\frac{5}{16}$ in. (8 mm). The pad shall be held firmly against the surface and shall fit closely about the thermocouples. The wires from the thermocouple in the length covered by the pad shall be not heavier than No. 18 B&S gauge 0.04 in. (1.02 mm) and shall be electrically insulated with heat-resistant and moisture-resistant coatings.

6.4.4.2 Temperature readings shall be taken at not less than nine points on the surface. Five of these shall be symmetrically located: one to be approximately at the center of the walkway specimen and four to be approximately at the center of its quarter sections. The other four shall be located at the discretion of the testing authority to obtain representative information on the performance of the walkway specimen under test. None of the thermocouples shall be located nearer to the edges of the test specimen than one and one-half times the thickness of the construction or 12 in. (305 mm). Thermocouples shall not be located opposite or on top of beams, girders, or other structural members.

6.4.4.3 Temperature readings shall be taken at intervals not exceeding 15 seconds.

6.4.4.4 Where the conditions of acceptance place a limitation on the temperature of the unexposed surface, the temperature end point of the fire-endurance period shall be determined by the average of the measurements taken at individual points. If a temperature rise of 30 percent in excess of the specified limit occurs at any one of these points, the remainder shall be ignored and the fire-endurance period judged as having ended.

6.4.5 Test Specimen.

6.4.5.1 The test specimen shall be representative of the construction for the classification desired in regard to materials, workmanship, and details such as dimensions of parts and shall be built under conditions representative of actual aircraft loading walkway construction and operation. The physical properties of the materials and ingredients used in the test specimen shall be determined and recorded.

6.4.5.2 The test specimen shall be protected during and after fabrication to ensure normality of its quality and condition at the time of the test. The ambient air temperature at the beginning of the test shall be within the range of 50°F to 90°F (10°C to 32°C). The velocity of air across the unexposed surface of the sample, measured just before the test begins, shall not exceed 4.4 ft/sec (1.3 m/s), as determined by an anemometer placed at right angles to the unexposed surface. If mechanical ventilation is employed during the test, an air stream shall not be directed across the surface of the specimen.

6.4.5.3* The fire-endurance test shall be continued on the specimen with its applied load, if any, until failure occurs, or until the specimen has withstood the test conditions for a period of 10 minutes.

6.4.5.4 Results shall be reported in accordance with the performance in the tests prescribed in these methods. Time-temperature results shall be reported at 15-second intervals. Reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace fire is cut off, including information on deformation, spalling, cracking, burning of the specimen or its component parts, continuance of flaming, and production of smoke.

6.4.6 Tests of Walls and Floors.

6.4.6.1 The dimensions of the sample to be tested shall be determined based on the construction features of the specific walkway being tested. The dimensions selected shall ensure that the sample, when tested, will demonstrate the ability of the most critical elements of the walkway to withstand stress concentrations without failure and without separations that would permit fire and smoke intrusion. Verification documentation supporting the selection of the dimensions shall be approved by the authority having jurisdiction.

6.4.6.2 The effect of exposure to elevated temperatures of working stress seen as worst-case load combinations during actual usage shall be accomplished by one of the following two methods:

(1) A superimposed load to the specimen shall be applied in a manner calculated to develop theoretically the design-allowable stresses contemplated by the design during the test described in 6.4.2.
(2) The yield strength of the structural medium shall be correlated to the maximum temperature recorded in 6.4.2. Structural submittals shall be made using this new yield strength showing nonfailure conditions have been met.

6.4.6.2.1 Worst-case load combinations shall be derived from the following:

(1) Floor live load: 40 lb/ft^2 (195 kg/m^2)
(2) Roof load: 25 lb/ft^2 (122 kg/m^2)
(3) Wind load: 12.5 lb/ft^2 (61 kg/m^2)

6.4.6.3 The test shall be successful when the following conditions of acceptance are met:

(1) The wall or floor section shall have sustained the applied load during the fire-endurance test without passage of flame for a minimum period of 5 minutes. Flaming shall not appear on the unexposed face.
(2) The maximum allowable surface temperature of the cool side of a wall or floor section shall not exceed 250°F (121°C) during a 5-minute exposure as determined by 6.4.4.4.

6.4.7 Tests of Flexible Closures.

6.4.7.1 The test specimen area exposed to the test fire shall not be less than 2 ft × 2 ft (0.62 m × 0.62 m). The test specimen shall be representative of all elements of the flexible closure, including framework assembly and mechanisms for attachment to the aircraft loading walkway.

6.4.7.2 The test shall be successful when all the conditions of acceptance in 6.4.7.2.1 through 6.4.7.2.3 are met.

6.4.7.2.1 The test specimen shall have withstood the fire-endurance test as defined by the time-temperature curve for external walkway wall exposure in Figure 6.4.2 without passage of flame for a minimum period of 5 minutes.

6.4.7.2.2 The closure material also shall pass the following test, designed to measure the radiant heat flux to which humans can be subjected while exiting an aircraft under a fuel spill fire emergency condition. A specimen of the closure material that reproduces the most expanded actual field operating configu-

ration, regarding folds and pleats, existing 6 ft (1.8 m) above the floor shall be tested in a furnace. The furnace temperature applied to the exposed exterior surface of the closure material shall be raised in accordance with the time-temperature curve for external walkway wall exposure in Figure 6.4.2. Measurements shall be taken by a radiometer positioned between a minimum distance of 39.4 in. (1 m) and a maximum distance of 78.7 in. (2 m) away from the cool side surface of the test specimen. The radiometer shall have a view angle small enough such that it "sees" only the test specimen and not the frame or furnace wall. The approximate equivalent human exposure in the walkway shall not exceed 0.65 W/cm^2. The approximate equivalent human exposure shall be calculated by multiplying the maximum actual radiometer reading for the test in W/cm^2 at the radiometer by the following:

[6.4.7.2.2]

$$\frac{0.31\left(\tan^2\frac{\Theta}{2}+1\right)}{\tan^2\frac{\Theta}{2}\tau}$$

where:

Θ = the total view angle of the test radiometer
τ = correction factor for absorption due to humidity

6.4.7.2.2.1 Table 6.4.7.2.2.1 shall be used to determine the appropriate τ.

6.4.7.2.3 The framework assembly supporting the closure curtain material and mechanisms for attachment shall be capable of maintaining structural integrity when subjected to the fire defined by the time-temperature curve for external walkway wall exposure in Figure 6.4.2.

6.4.8 Test of Cab and Rotunda Slat Curtains.

6.4.8.1 The test specimen area exposed to the test fire shall not be less than 2 ft × 2 ft (0.62 m× 0.62 m). The test specimen shall be representative of all elements of the cab and rotunda slat curtains, including framework assembly and mechanisms for attachment to the aircraft loading walkway.

6.4.8.2 For conditions of acceptance, the test sample shall be capable of withstanding the fire-endurance test as defined by the time-temperature curve in Figure 6.4.2 appropriate for the walkway location being tested without passage of flame for a period of 5 minutes. Flaming shall not appear on the unexposed face.

Table 6.4.7.2.2.1 τ Factors

Relative Humidity During Test (%)	τ Factors Based on Distance from Source to Sensor		
	39.4 in. (1 m)	59.1 in. (1.5 m)	78.7 in. (2 m)
0–25	0.96	0.95	0.94
25–50	0.94	0.93	0.92
50–100	0.92	0.91	0.90

6.4.9 Tests of Bumpers.

6.4.9.1* Bumper assemblies shall be tested in continuous contact against a simulated aircraft fuselage in a manner representative of intended usage.

6.4.9.2 The specimen shall be configured in a manner representative of actual fabrication and shall include the bumper proper and mechanism for bumper attachment to the aircraft loading walkway.

6.4.9.3 For conditions of acceptance, bumpers shall be capable of withstanding the fire-endurance test as defined by the time-temperature curve for external walkway flooring exposure in Figure 6.4.2 without passage of flame for a period of 5 minutes. Flaming shall not appear on the unexposed face.

6.4.10 Tests of Miscellaneous Seals and Weather-Stripping Assemblies.

6.4.10.1 The testing laboratory shall construct a steel stud wall assembly consisting of one layer of ½ in. (13 mm) Type X gypsum wallboard on the exposed face. A hole shall be framed out in the center of the test wall where another steel stud–gypsum wallboard assembly shall be inserted. The smaller assembly to be inserted into the wall shall be constructed such that the opening between the test wall and the smaller assembly allows the weather stripping or seal material to fill the gap in a manner representative of end-use application. The entire assembly then shall be placed against the furnace for the required exposure.

6.4.10.2 The size of the test specimen shall not be less than 2 ft (0.62 m) long.

6.4.10.3 For conditions of acceptance, these components shall be capable of withstanding the fire-endurance test as defined by the time-temperature curve in Figure 6.4.2 appropriate for the walkway location being tested without passage of flame for a period of 5 minutes. Flaming shall not appear on the unexposed face.

6.5 Fire Suppression Systems.

6.5.1* The fixed fire suppression specified in 6.1.2 shall be provided by one of the following systems:

(1) Fixed water spray system specified in 6.5.2
(2) Fixed foam system specified in 6.5.3

6.5.2 The fixed water spray system shall be of the open-head, deluge type and shall meet the requirements of NFPA 15. The system shall be designed so that the water is discharged directly on all walkway outer surfaces and structural members being protected. The system shall be automatically actuated and designed for a minimum discharge duration of 5 minutes.

6.5.3 The fixed foam system shall be adequate to blanket the area under the walkway when positioned at the aircraft exit door(s) and for a distance of approximately 10 ft (3 m) in all directions. The system shall meet the requirements of NFPA 11 or NFPA 16. The system shall be automatically activated. This system shall be capable of discharging in such a manner that the protected area previously described will be free of fire for a minimum duration of 5 minutes.

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.1.2 The adequacy and usefulness of airport terminal buildings depend, to a large extent, on the fire resistance of their construction and the fire protection provided within the buildings.

The provision of aircraft rescue and fire-fighting equipment at airports meeting the recommendations of NFPA 403 and NFPA 414 will be useful in controlling ramp fires. The provision of hydrants on the ramp side of airport terminal buildings will assist in meeting supplemental fire protection needs in those areas.

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.

A.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.4 Airport Terminal Building. The term *terminal* is sometimes applied to airport facilities other than those serving passengers, such as cargo- and freight-handling facilities and fuel-handling facilities. These facilities are covered by other NFPA standards, such as NFPA 30.

A.4.1.2 Furniture, floor and wall coverings, and other furnishings in airport terminal occupancies, including passenger holding lounges, waiting areas, restaurant dining rooms, bars, and retail stores, should not be made of materials that have high combustibility, smoke-development characteristics, or both, for example, some plastic foams, latex-rubber foam, some plastics, and some synthetic fibers. Such materials have a tendency to release combustible gases at relatively low temperatures, making them easily ignitible. When burning, these materials also release high amounts of heat energy at rapid rates, thereby contributing greatly to fire propagation.

Interior finish Class A and Class B are described in NFPA *101*.

A.4.2.2 Examples of points of flammable vapor release are fuel tank vent openings and fuel hydrant pits. Air supply intake and exhaust openings for air-conditioning or ventilating equipment serving the terminal building should not be located on the ramp side of an airport terminal building. Fixed air-conditioning and ventilating equipment serving only aircraft should be in a room that has no openings communicating with the remainder of the terminal building.

A.4.2.3 Rooms that contain coal-, gas-, or oil-fired equipment or any other open-flame device should not have openings on the ramp side of the building. Combustion and ventilation air should be supplied from the street side or the roof of the building or through a gravity louver from a nonhazardous area in the building.

A.4.3.2 The hazards to persons from jet intakes and blast, noise, propellers, and so forth, on the ramp should be taken into consideration in locating emergency exit points leading to ramps from the airport terminal building. A means of notification of unauthorized usage (such as an alarm system) of these emergency exits may be desirable.

A.4.5.1 The assembly portion of the terminal building may include areas such as the concourse waiting areas, baggage claim areas, and restaurants. The assembly portion should exclude kitchens, toilets, small office areas, and other areas not normally accessible to the public.

A.4.5.1.5 The exposure to the airport terminal building from the airport ramp is significant. The number of building sprinklers operating from the exposure fire could be greater than the number of building sprinklers operating from an internal ignition source.

A.4.5.2.2 If the public fire department is responding to the "street" side of the airport terminal building, timely access to the normal alarm receiving point may be limited by emergency conditions or distance. Planned radio communication with a constantly attended alarm-receiving point can assist in a more efficient response by the public fire department. The remote annunciator on the street side of the terminal building can provide building condition information not otherwise available.

A.4.5.5.1 Valves should be installed to facilitate proper control and should be based on a calculation of the number of units (suppression systems and hydrants) that would be impaired when portions of the system are out of service for repair, maintenance, modification, or expansion. Valves should be so located and identified as to be readily accessible for operation. Particular attention should be given to valving the following locations:

(1) Points of connection of supplies to loops or grids
(2) Intervals in main loop
(3) Grid intersections
(4) Beginnings of laterals

(5) Each connection to hydrants

General fire flow requirements at airports should be based on the maximum fire flow demands (automatic sprinklers, hose, and supplemental systems) anticipated. To determine actual demands, the appropriate NFPA standard should be consulted. Table A.4.5.5.1 lists the range of fire flows and is given only as a guide.

A.4.5.5.2 Hydrants should be placed in strategic locations on the loops or grids. Operational requirements should be considered in the determination of hydrant locations on or near taxiways and runways where snow and ice may be present.

A.4.5.5.3 All hydrants should be flushed and all valves operated at least once a year.

Table A.4.5.5.1 Flow Demand References

Building—Occupancy	Reference to Other Standards	Range of Fire Flows (Sprinklers, Hose, Supplemental)
Terminal	NFPA 13, NFPA 15	1000 gpm–3500 gpm
Hangar	NFPA 409	Wide range; for large hangars, could approximate 25,000 gpm
Cargo	NFPA 13, NFPA 15, and NFPA 1	1500 gpm–4000 gpm

For SI units, 1 gal = 3.8 L.

After extensive changes to the airport water supply system, full flow tests should be made in the areas affected to ensure that adequacy has been retained or expected improvements have been obtained.

Fire pumps or spare pumps should be given turnover tests at least weekly and full flow tests at least annually. Internal combustion engines driving pumps should be run once a week for at least one-half hour each time.

A.5.1.1 Consideration should be given to the hydraulic problem in disposal of surface water, safe disposal of fuel that might be spilled on the ramp, and the gradient to be overcome in the movement of aircraft. A ratio of 40,000 ft^2 (3716 m^2) per drainage inlet should not be exceeded with minimum flow distances to drains, but drain inlets should be located so as not to endanger aircraft placements within the ramp area so described.

A.5.1.2 Figure A.5.1.2(a) and Figure A.5.1.2(b) illustrate two possible fueling ramp drainage arrangements. Figure A. 5.1.2(a) shows one possible arrangement of an aircraft fueling ramp drainage system using the optional trapped drain inlets. Figure A.5.1.2(b) shows another possible arrangement of an aircraft fueling ramp drainage system using an open-grate drainage trench.

A.5.1.7 The individual drain is intended to prevent flow of a spill in one trench from flowing through other trenches. Refer to Figure A.5.1.2(b).

A.5.2.1 It is suggested that maintenance checks be conducted at least four times a year and more often if climatic or other local conditions so dictate.

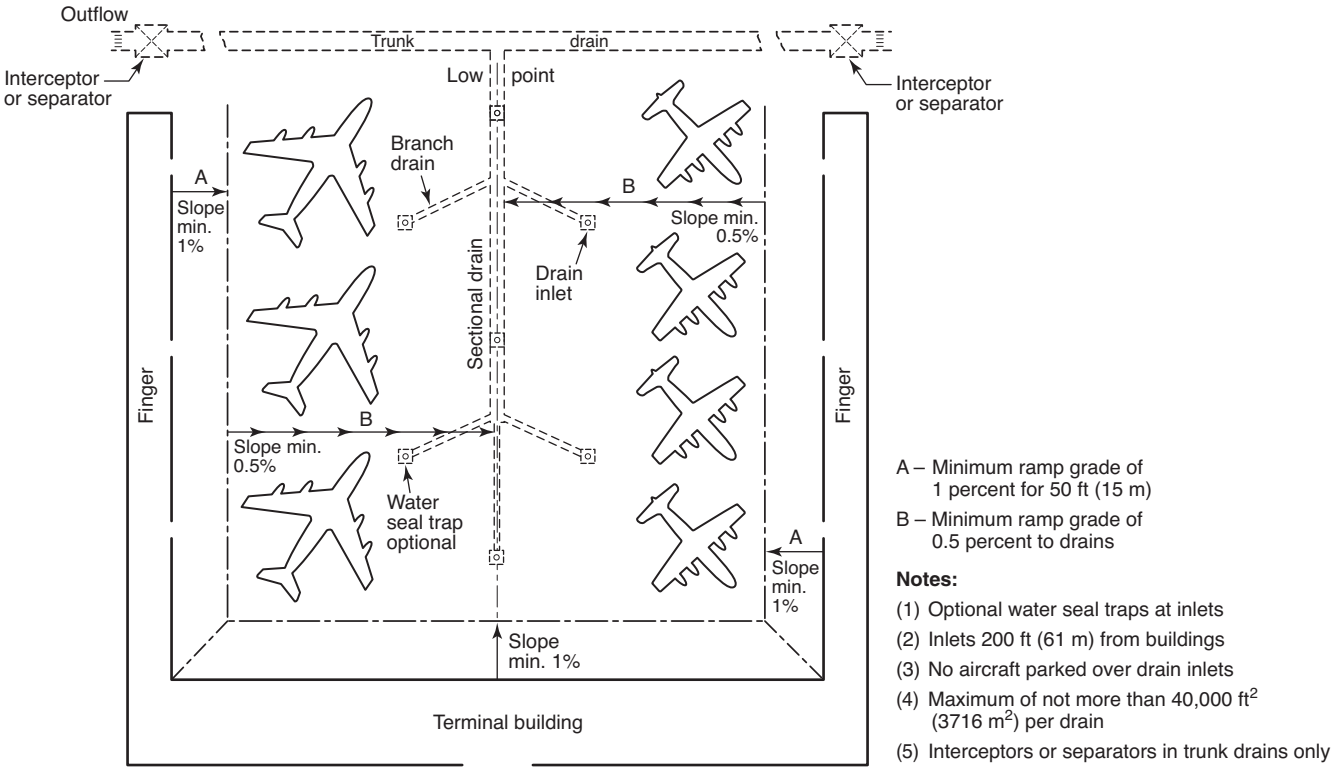

FIGURE A.5.1.2(a) Example of Ramp Drainage Using Trapped Drain Inlets.

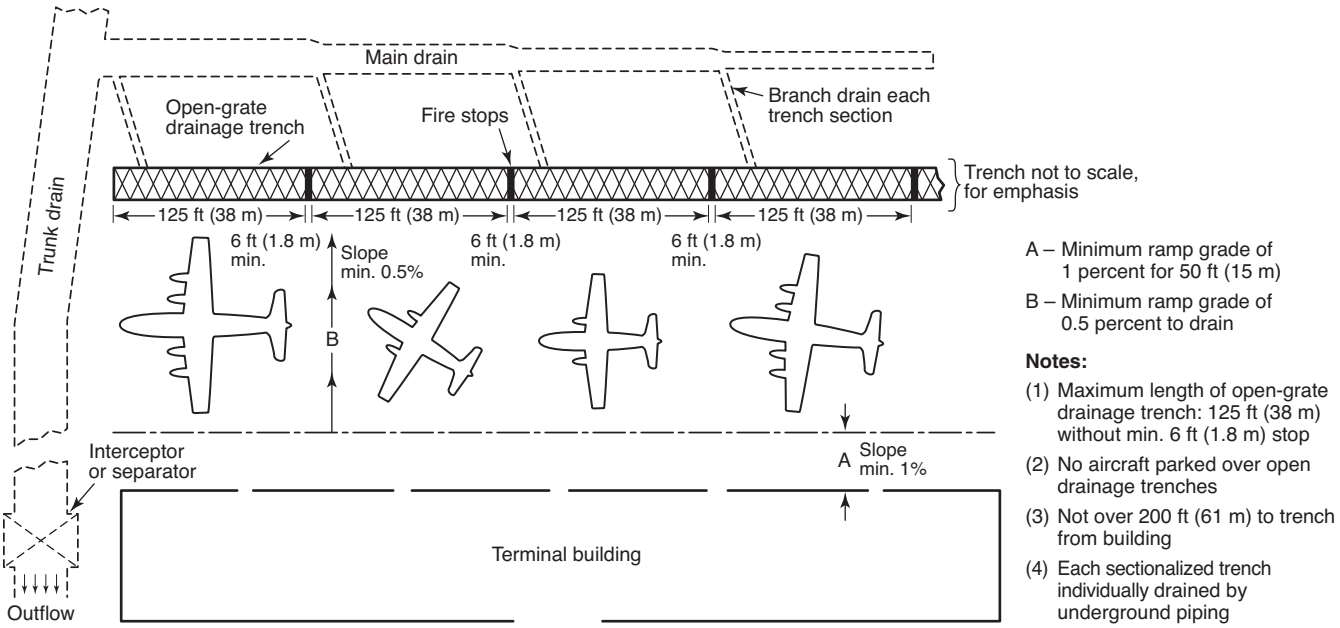

FIGURE A.5.1.2(b) Example of Ramp Drainage Using an Open-Grate Drainage Trench.

A.6.1.1 The loading walkway(s) provide the principal means of egress while an aircraft is at the terminal. The normal aircraft escape systems (escape slides) are routinely disabled when the aircraft is at the terminal building; additionally, the doors are often blocked by ground servicing equipment.

A.6.2.1 Fire tests have shown that smoke and toxic products generated within the walkway from the decomposition of certain materials can hinder the egress of passengers from an aircraft during a fire emergency. Existing technology does not permit establishment of performance criteria for acceptable levels of smoke density and toxic products. Where the tests specified indicate that materials used in walkway construction can degrade, thermal barriers or insulation should be used to reduce the rate of temperature rise and to delay the decomposition of susceptible materials. Of particular concern are those materials used in floor construction, such as plywood and floor coverings. The insulation materials used should produce minimal smoke under fire exposure conditions.

A.6.2.4 The source of uncontaminated air is normally from the airport terminal building.

A.6.2.5 Aircraft loading walkways can be used for a return air plenum as part of a system that provides ventilation for the aircraft. This system can create a positive or negative pressure in the walkway during normal operation and might use air from the ramp for make-up. Systems of this type, as well as any exhaust fans on the walkway, are therefore to be automatically shut down in the event of a fire emergency outlined in 6.1.1.

A.6.2.7 Bumpers, curtains, and canopies are essential elements necessary to ensure the fire performance of the walkway's system to provide a safe egress path in the event of a spill fire on the ramp. Many users view the canopies and curtains as weather protection devices and not essential fire safety devices. Because of the physical variations in airframe fuselage shapes, it is not possible to achieve 100 percent contact of bumpers and canopies against all aircraft fuselages.

A.6.2.10 Most loading walkways can change elevation to serve a variety of aircraft. The slope of the walking surfaces changes as the loading walkway is adjusted to serve various aircraft. Therefore it is not practical to limit the slope of the overall walking surface. Slopes of 1 in 20 and less are considered a level surface in most accessibility standards. This means the transitions between telescoping sections of the loading walkways will not subject users to a ramp within a ramp when the loading walkway is not level.

A.6.4.4.1.1(5) Indentation should be determined in accordance with ASTM Test Method C569, *Standard Test Method for Indentation Hardness of Preformed Thermal Insulations*. Modified Brinell values of hardness are obtained by the following relationship, where y = the measured indentation in inches:

[A.6.4.4.1.1(5)]

$$Hardness = \frac{2.24}{y}$$

ASTM Test Method C569 has been withdrawn by the publisher but the latest approved version of this historical standard is still available from ASTM.

A.6.4.5.3 The 10-minute fire endurance test period specified is to give those conducting the tests a better opportunity to discriminate between different test samples.

A.6.4.9.1 A suggested test configuration is to construct two steel stud frames of suitable size to cover the test furnace when lying side-by-side and flat. On the exposed face of each frame, one layer of ½ in. (13 mm) Type X gypsum board should be fastened to the steel stud framing. To the edge of one frame, the bumper assembly should be fastened in a manner representative of end-use application. To the edge of the other frame, a sheet of ½ in. (13 mm) thick steel having dimensions such that there is a minimum of 6 in. (150 mm) of steel extending past the bumper assembly in all directions should be fastened to the

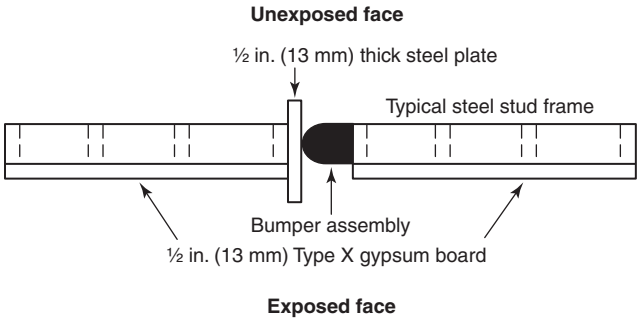

FIGURE A.6.4.9.1 Proposed Method for Testing of Bumper Assemblies.

steel studs. The steel plate is used to simulate the aircraft sidewall. The two frames are brought together such that the bumper assembly is placed in firm contact with the simulated aircraft sidewall and the two frames are fastened together. This unit becomes the test assembly and is placed on the test furnace for the fire exposure period. *(See Figure A.6.4.9.1 for a sketch of the test assembly.)*

A.6.5.1 The design of automatic actuation equipment should take into consideration the possibility of heat or pressure sources that could exist in the areas where these systems are installed (e.g., operation of turbine engines in the vicinity, heat-creating equipment on the ramp, hot air curtains at terminal openings).

Annex B Building Construction Types

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

B.1 Building construction types are defined in *NFPA 5000*. The following material is extracted from the 2015 edition of *NFPA 5000* and is included here as a convenience for users of this standard. NFPA 220 contains identical material that is extracted from *NFPA 5000*. Any requests for Formal Interpretations (FIs) or Tentative Interim Amendments (TIAs) on the following material should be directed to the Technical Committee on Building Construction.

B.1.1 Buildings and structures shall be classified according to their type of construction, which shall be based upon one of five basic types of construction designated as Type I, Type II, Type III, Type IV, and Type V, with fire resistance ratings not less than those specified in Table B.1.1 [in this standard] and 7.2.3 through 7.2.6 [of *NFPA 5000*], and with fire resistance ratings meeting the requirements of 7.2.7 [of *NFPA 5000*]. [**5000:**7.2.1.1]

B.1.2 Type I and Type II Construction. Type I (442 or 332) and Type II (222, 111, or 000) construction shall be those types in which the fire walls, structural elements, walls, arches, floors, and roofs are of approved noncombustible or limited-combustible materials. [**5000:**7.2.3.1]

B.1.3 Type III Construction. Type III (211 or 200) construction shall be that type in which exterior walls and structural elements that are portions of exterior walls are of approved noncombustible or limited-combustible materials, and in which fire walls, interior structural elements, walls, arches, floors, and roofs are entirely or partially of wood of smaller dimensions than required for Type IV construction or are of approved noncombustible, limited-combustible, or other approved combustible materials. [**5000:**7.2.4.1]

B.1.4 Type IV Construction. Type IV (2HH) construction shall be that type in which fire walls, exterior walls, and interior bearing walls and structural elements that are portions of such walls are of approved noncombustible or limited-combustible materials, except as allowed for exterior walls in 7.2.5.6.7 [of *NFPA 5000*]. Other interior structural elements, arches, floors, and roofs shall be of solid or laminated wood or cross-laminated timber without concealed spaces and shall comply with the allowable dimensions of 7.2.5.5 [of *NFPA 5000*]. [**5000:**7.2.5.1]

B.1.5 Type V (111 or 000) Construction. Type V (111 or 000) construction shall be that type in which structural elements, walls, arches, floors, and roofs are entirely or partially of wood or other approved material. [**5000:**7.2.6]

Annex C Glazing Materials

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

C.1 The use of glass and other glazing materials in airport terminal building walls facing the ramp should be avoided if the fueling ramp drainage inlets or the probable points of fuel spillage from aircraft are less than 100 ft (30.5 m) from such walls. This standard prohibits locating drainage inlets less than 50 ft (15 m) from any airport terminal building walls.

This recommendation is made because the radiant heat release from a serious fuel spill fire can be expected to break glass windows up to 75 ft (22.9 m) away and cause ignition of combustible materials within the building.

Protection provided by automatically operated outside spray nozzles is not intended to provide a safe refuge area for occupants. The degree of protection at the opening is intended to provide a period of time for the safe egress of building occupants in the vicinity of the exposed window area.

The presence of automatic sprinkler protection in the airport terminal building would be expected to control a fire initiated in the building due to an exposure fire. Glazing material above the 7 ft (2.1 m) finished floor level will not cause immediate exposure to building occupants.

Care should be exercised in the selection and adjustment of detection equipment to ensure proper operation and to guard against inadvertent operation of the system caused by normally fluctuating conditions. Due to the normal activity on the airport ramp, the radiated energy of a spill fire might not be received at a particular detector location but can still expose the building wall.

An aircraft terminal building is unique because there can be a large population in the terminal building at the same time that a high hazard exposes the terminal. This combination presents the potential for a serious emergency situation.

An exposure evaluation should be developed for potential fuel spill points more than 50 ft (15 m) but less than or equal to 100 ft (30.5 m) from the airport terminal building. The exposure evaluation should describe the location and severity of potential fuel spill points and the design features that control exposure fire damage to the airport terminal building

Table B.1.1 Fire Resistance Ratings for Type I Through Type V Construction (hr)

	Type I		Type II			Type III		Type IV	Type V	
Construction Element	**442**	**332**	**222**	**111**	**000**	**211**	**200**	**2HH**	**111**	**000**
Exterior Bearing Walls[a]										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0[b]	2	2	2	1	0[b]
Supporting one floor only	4	3	2	1	0[b]	2	2	2	1	0[b]
Supporting a roof only	4	3	1	1	0[b]	2	2	2	1	0[b]
Interior Bearing Walls										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	2	1	0
Supporting one floor only	3	2	2	1	0	1	0	1	1	0
Supporting roofs only	3	2	1	1	0	1	0	1	1	0
Columns										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H	1	0
Supporting one floor only	3	2	2	1	0	1	0	H	1	0
Supporting roofs only	3	2	1	1	0	1	0	H	1	0
Beams, Girders, Trusses, and Arches										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H	1	0
Supporting one floor only	2	2	2	1	0	1	0	H	1	0
Supporting roofs only	2	2	1	1	0	1	0	H	1	0
Floor/Ceiling Assemblies	2	2	2	1	0	1	0	H	1	0
Roof/Ceiling Assemblies	2	1½	1	1	0	1	0	H	1	0
Interior Nonbearing Walls	0	0	0	0	0	0	0	0	0	0
Exterior Nonbearing Walls[c]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]

H: Heavy timber members *(see text for requirements)*.
[a]See 7.3.2.1 [of *NFPA 5000*].
[b]See Section 7.3 [of *NFPA 5000*].
[c]See 7.2.3.2.12, 7.2.4.2.3, and 7.2.5.6.8 [of *NFPA 5000*].
[**5000:** Table 7.2.2.1]

and occupants. Catastrophic crashes between aircraft or aircraft and the building are not part of the evaluation.

The exposure evaluation should include consideration of each of the following:

(1) Fuel spill points
(2) Fuel spill rates
(3) Fuel spill pool size
(4) Ramp drainage design
(5) Exposed wall construction
(6) Wall openings (windows, doors, etc.)
(7) Interior building fire protection features

The many factors affecting the exposure make each facility layout a different design problem. The building design, aircraft fueling ramp design, aircraft fueling system, and aircraft fueling ramp drainage system will affect the exposure.

The building design features that affect the degree of exposure include building construction characteristics, the size of windows facing the ramp, the presence of automatic sprinkler protection, and the exit arrangements. The exposed wall will provide a different degree of protection to the building interior and building occupants depending on the building wall construction material.

The presence of openings, particularly glass, will significantly increase the radiated energy inside the building. The extent to which the radiated energy transmission is affected will depend on the size of the opening, the opening location with respect to the spill fire, and the building arrangement inside the opening.

The aircraft fueling ramp design will affect the size and duration of a fuel spill fire. Both the direction and the rate of drainage can influence the fire exposure to the airport terminal building. When the characteristics of the ramp design and the ramp drainage system are considered together, the variables, such as ramp construction material, ramp slope, drain inlet location, and drainage system capacity, will affect the exposure. Ramp drainage trenches present a different exposure to the airport terminal building wall from drain inlets to an underground piping system.

Aircraft fueling systems are generally fixed piping systems with strategically located fuel hydrants. Fuel servicing vehicles serve as the transfer mechanism between the fixed piping system and the aircraft. Refer to NFPA 407 for design considerations used in the airport fueling systems. Smaller or older

airports may use tanker trucks. Tanker trucks are also used as backup to the fixed piping systems. The presence of a tanker truck at the aircraft puts a larger quantity of fuel on the ramp.

Exposure fire damage can be minimized in three different ways: physical separation, fire-resistance-rated exterior wall construction, and fire suppression systems. These protection methods can be utilized individually or in combination.

Annex D Informational References

D.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

D.1.1 NFPA Publications. NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1, *Fire Code*, 2015 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2016 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2012 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2015 edition.

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

NFPA 220, *Standard on Types of Building Construction*, 2015 edition.

NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports*, 2014 edition.

NFPA 407, *Standard for Aircraft Fuel Servicing*, 2012 edition.

NFPA 409, *Standard on Aircraft Hangars*, 2016 edition.

NFPA 414, *Standard for Aircraft Rescue and Fire-Fighting Vehicles*, 2012 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2015 edition.

D.1.2 Other Publications.

D.1.2.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428–2959.

ASTM Test Method C569, *Standard Test Method for Indentation Hardness of Preformed Thermal Insulations*, 1983. (withdrawn)

D.2 Informational References. The following documents or portions thereof are listed here as informational resources only. They are not a part of the requirements of this document.

D.2.1 References on Heat Exposure to Man.

Buettner, K. "Effects of Extreme Heat on Man." (PB 16.026 U.S. Dept. of Commerce, FSTI), *Journal of the American Medical Association*, vol. 144, no. 9 (October 28, 1950), 732–738.

Flight Surgeon's Guide, Department of the Air Force (AFP-161-18) (December 27, 1968), 5–7.

Tolerances to Thermal Extremes in Aerospace Activities (AM 70-22), Office of Aviation Medicine, U.S. Dept. of Transportation, FAA (December 1970).

D.3 References for Extracts in Informational Sections.

NFPA 5000®, *Building Construction and Safety Code®*, 2015 edition.

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