

NFPA[®]

409

Standard on Aircraft Hangars

2022



NFPA® 409

Standard on Aircraft Hangars

2022 Edition



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NFPA® 409

Standard on

Aircraft Hangars

2022 Edition

This edition of NFPA 409, *Standard on Aircraft Hangars*, was prepared by the Technical Committee on Airport Facilities. It was issued by the Standards Council on October 2, 2021, with an effective date of October 22, 2021, and supersedes all previous editions.

This edition of NFPA 409 was approved as an American National Standard on October 22, 2021.

Origin and Development of NFPA 409

The original fire protection recommendations for the construction and protection of airplane hangars were published by the National Board of Fire Underwriters (NBFU), now the American Insurance Association, in 1930. Revisions were issued by the NBFU in 1931, 1943, 1945, and 1950. The 1943, 1945, and 1950 editions were published as NBFU Pamphlet 85.

In 1951, the National Fire Protection Association organized a Committee on Aircraft Hangars, to which the NBFU and other interested groups lent their support. NFPA's first standard on aircraft hangars was adopted in 1954 and NBFU adopted the same text, rescinding its 1950 standard. Revisions were made in 1957 and 1958 by the NFPA committee.

In 1959, a reorganization of NFPA's aviation standards resulted in the assignment of NFPA 409 to the Sectional Committee on Aircraft Hangars and Airport Facilities, which prepared the 1960, 1962, 1965, 1966, 1967, 1969, 1970, 1971, 1972, 1973, and 1975 editions. In 1978, the sectional committee was reorganized as the Technical Committee on Airport Facilities and completed a revision of NFPA 409. The document underwent extensive editorial revision and partial technical revision in 1984 and was again revised in 1990 and 1995.

For the 2001 edition of NFPA 409, the fire protection requirements for Group I hangars were extensively revised, and new criteria were added for membrane-covered rigid-steel-frame-structure hangars.

The 2004 edition of this standard was a partial revision.

The 2011 edition of NFPA 409 was another partial revision. Criteria were added to clarify where sprinklers are required for smaller hangars, such as those used by general aviation entities. In addition, unenforceable terms were removed to comply with the *Manual of Style for NFPA Technical Committee Documents*.

For the 2016 edition of NFPA 409, the committee re-examined many of the long-standing requirements with respect to current technologies, modern design practices, and known fire loss history. That fresh look resulted in the relaxation of the requirements for divided water reservoirs, redundant fire pumps, and reserve supplies of foam concentrate, among others. In addition, the requirements for the zoning of low-level foam systems were changed to permit Group I and Group II hangars, and Chapter 8 was simplified for Group III hangars.

The 2022 edition includes both new provisions and updates to existing sections of NFPA 409. In Chapter 1, new sections on application and retroactivity have been added to allow for their use within the standard. Several new definitions have been added in Chapter 3 to provide further context for the technical changes made during this revision cycle. A new Chapter 4, Fire Protection Approaches, has been introduced, and it allows for an evaluation of the fire risks and hazards for an aircraft hangar as found on a specific site. Complementing Chapter 4 is the new Chapter 5, Performance-Based Design Approach. This chapter permits the use of a performance-based design for aircraft hangars based on specified criteria and a final approval performed by the authority having jurisdiction. In Chapter 6, a new section on ignitable liquid drainage floor assemblies has

been added to permit the use of this protection method within specified hangars. Changes to Chapter 11 outline revised and new inspection, testing, and maintenance requirements that have applicability across several NFPA documents. Finally, changes to other existing requirements, as well as updates pertaining to general organization and reference publications, have been provided.

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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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NFPA 409

Standard on

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2022 Edition

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Information on referenced and extracted publications can be found in Chapter 2 and Annex D.

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard contains the minimum requirements for the proper construction of aircraft hangars and protection of aircraft hangars from fire.

1.1.2 This standard applies only to buildings or structures used for aircraft storage, maintenance, or related activities. Other uses within an aircraft hangar shall be protected in accordance with other applicable NFPA standards.

1.1.3* This standard applies to aircraft hangars containing aircraft that use liquid hydrocarbon fuels.

1.2* Purpose. The purpose of this standard is to provide a reasonable degree of protection from fire for life and property in aircraft hangars, based on sound engineering principles, test data, and field experience.

1.3 Application. The application of this standard shall be permitted to be based on the risk considerations outlined in Chapter 4.

1.3.1 A documented risk assessment shall be permitted to be the basis for the implementation of this standard.

1.4 Retroactivity. 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. [13:1.4]

1.4.1 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. Where specified, the provisions of this standard shall be retroactive. [13:1.4.1]

1.4.2 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. [13:1.4.2]

1.4.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided. [13:1.4.3]

1.5 Equivalency. 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.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.6 New Technology.

1.6.1 Nothing in this standard shall be intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by this standard is not lowered.

1.6.2 Materials or devices not specifically designated by this standard shall be utilized in complete accord with all conditions, requirements, and limitations of their listings.

1.7 Units.

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

1.7.1.1 The units are listed in Table 1.7.1.1 with conversion factors.

Table 1.7.1.1 Metric Units of Measurement

Name of Unit	Unit Symbol	Conversion Factor
Liter	L	1 gal = 3.785 L
Millimeter	mm	1 in. = 25.4 mm
Meter	m	1 ft = 0.305 m
Kilogram	kg	1 lb (mass) = 0.454 kg
Degree Celsius	°C	(5/9)(°F – 32) = °C
Bar	bar	1 psi = 0.0689 bar

1.7.1.2 If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated is to be regarded as the requirement.

1.7.1.3 A given equivalent value can be considered approximate.

1.7.2 The conversion procedure for the SI units is to multiply the quantity by the conversion factor and then round the result to the appropriate number of significant digits.

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 4, *Standard for Integrated Fire Protection and Life Safety System Testing*, 2021 edition.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2022 edition.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2021 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, (withdrawn) 2019 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2022 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2022 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2020 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2021 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 2020 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 2021 edition.

NFPA 54, *National Fuel Gas Code*, 2021 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2020 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2019 edition.

NFPA 70®, *National Electrical Code*®, 2020 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*®, 2022 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2022 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2021 edition.

NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, 2021 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids*, 2020 edition.

NFPA 101®, *Life Safety Code*®, 2021 edition.

NFPA 220, *Standard on Types of Building Construction*, 2021 edition.

NFPA 410, *Standard on Aircraft Maintenance*, 2020 edition.

NFPA 415, *Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways*, 2022 edition.

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, 2019 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2020 edition.

2.3 Other Publications.

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

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

ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*, 2013.

2.3.2 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2021 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2022 edition.

NFPA 70®, *National Electrical Code*®, 2020 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, 2021 edition.

NFPA 101®, *Life Safety Code*®, 2021 edition.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, 2021 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

3.2.3* 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 phrases “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 Access Door. Any opening through which any portion of the aircraft is passed to gain entry to the hangar.

3.3.2 Aircraft Hangar. A building or other structure inside of which any part of an aircraft is housed. This does not apply to aircraft weather shelters that have two or more open sides or that have no means to enclose an aircraft.

3.3.3* Aircraft Storage and Servicing Area. That part of a hangar normally used for the storage and servicing of one or more aircraft, not including any adjacent or contiguous areas or structures, such as shops, storage areas, and offices.

3.3.4 Calculation Method.

3.3.4.1 Demand Calculation Method. Hydraulic calculation procedure for determining the minimum theoretical flow and pressure required to produce a minimum specified total discharge from a specific configuration of piping and discharge devices.

3.3.4.2 Supply Calculation Method. Hydraulic calculation procedure for determining the maximum theoretical flows and pressures in a system with a specific configuration of piping and discharge devices supplied by a water distribution system.

3.3.5* Defueled Aircraft. An aircraft that has never been fueled or whose fuel system has had flammable or combustible liquid removed to meet one of the following criteria: (1) Individual tanks/cells contain less than 1 percent of their volumetric capacity; (2) Aircraft is drained to remove fuel to the greatest extent possible utilizing sump drains and other accessible non-maintenance means.

3.3.6 Detection System. A system consisting of detectors; controls; control panels; automatic and manual actuating mechanisms; all wiring, piping, and tubing; and all associated equipment that is used to actuate an extinguishing system.

3.3.7 Fire Barrier Wall. A wall, other than a fire wall, having a fire resistance rating. [221, 2021]

3.3.8 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. [221, 2021]

3.3.9 Foam-Water Deluge System. A foam-water sprinkler system employing open discharge devices, which are attached

to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system, which is installed in the same areas as the discharge devices. [11, 2021]

3.3.10 Gross Wing Area. See 3.3.20, Wing Area.

3.3.11 Hangar Fire Area. An area within an aircraft hangar subject to loss by a single fire because of lack of internal subdivisions as specified in Section 7.3 or 10.2 of this standard, as appropriate.

N 3.3.12* Liquid Drainage Floor Assembly. A drainage system that allows liquids to flow into a listed floor system where liquid is removed from the hangar.

3.3.13 Membrane Hangar. A hangar that uses a flexible structural fabric or film that supports the imposed loads and transmits them to a supporting structure. The membrane carries only tension or shear in the plane of the membrane.

3.3.14* Paint Hangar. An aircraft hangar that is occupied primarily for the application of paint or other flammable or combustible liquids involving an entire aircraft or major portions of an aircraft.

N 3.3.15* Professional Engineer. A person registered or licensed to practice engineering in a jurisdiction, subject to all laws and limitations imposed by the jurisdiction. (SAF-FUN) [101, 2021]

N 3.3.16 Qualified. A competent and capable person who has met the requirements and training for a given field acceptable to the AHJ. [96, 2021]

3.3.17 Single Hangar Building. A building with one area for the storage and servicing of aircraft and any attached, adjoining, or contiguous structure, such as a lean-to, shop area, or parts storage area not separated as specified in Section 7.3 or 10.2 of this standard, as appropriate.

3.3.18* Tail Height. The maximum tail height as stated in aircraft manufacturers' specifications.

3.3.19 Weathered-Membrane Material. Membrane material that has been subjected to a minimum of 3000 hours in a weatherometer in accordance with ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*, or approved equivalent.

3.3.20* Wing Area. Total projected area of clean wing (no projecting flaps, slats, and other items), including all control surfaces and the area of the fuselage bounded by the leading and trailing edges projected to the centerline (inapplicable to slender-delta aircraft with extremely large leading-edge sweep-angle). Net area excludes projected areas of fuselage, nacelles, and other items.

N Chapter 4 Fire Protection Approaches

N 4.1 Fire Protection Approach. The fire protection approach for aircraft hangars shall be permitted to be determined based on an evaluation of the fire risks, hazards associated with the site, services provided, the business continuity planning, and disaster restoration capabilities of the aircraft hangar specific to the site.

N 4.1.1 The fire protection approach shall be permitted to be established with consideration given to the following factors:

- (1) The threat to facility occupants, the general public, emergency responders, and exposed property from a fire occurring at the facility or adjacent to or within the hangar
- (2) The importance of the continuity of the operations being performed in the hangar, the value of the facility and its contents, and the potential for environmental impact
- (3) Methods and equipment employed as part of a risk management or business continuity strategy that allow the hangar or aircraft to remain operable during and after an event or to be replaced or restored
- (4) The potential for a given protection strategy to result in a service or business interruption or inhibit the ability of the aircraft hangar to operate in a timely manner post-event

N 4.1.2 The fire protection approach shall be developed using one of the following strategies within the aircraft storage and service areas:

- (1) A prescriptive-based approach in accordance with this standard
- (2) A fire risk-based approach in accordance with 4.1.3 and Section 4.2

N 4.1.3 A fire risk-based approach shall be permitted to be used to determine the construction, fire suppression, fire detection, and utility requirements of the aircraft storage and service areas that are necessary to achieve the purpose of this standard where specifically permitted by this standard. (See Section 1.2.)

N 4.2 Fire Risk Assessment.

N 4.2.1* The fire risk-based approach permitted by 4.1.2, also known as the risk assessment, shall be documented and approved by the authority having jurisdiction (AHJ).

N 4.2.2 The fire risk assessment shall include an evaluation of the risk management considerations outlined in 4.2.3 and involve all aircraft hangar stakeholders.

N 4.2.2.1 Fire risk assessment documents shall be prepared by a licensed professional engineer with experience in all aspects of fire protection and life safety system design for aircraft hangars and they shall be acceptable to the AHJ.

N 4.2.3* At a minimum, the following risk management elements shall be documented and considered to determine the level of acceptable fire risk as part of the fire risk assessment:

- (1) Type and quantity of fuel in the aircraft or if the aircraft is unfueled
- (2) Type of operations and activities performed within the aircraft storage and service area
- (3) Risk of flammable or combustible liquid spills and equipment or the process for containment and control
- (4) Life safety aspects of an emergency event within the aircraft storage and service area
- (5) Fire threat to the hangar occupants and exposed property or operations in aircraft storage and service areas
- (6) Continuity of service, operation, and the effects of business interruption, including the business or operational impact of a loss of aircraft (specifically military and unique aircraft)
- (7) Quantity, size, and value of the aircraft within the hangar

- (8) Size and value of the hangar
- (9) Economic loss from loss of function or business interruption
- (10) Economic loss from value of equipment other than the aircraft or the hangar
- (11) Regulatory and reputation impact
- (12) Potential environmental impact
- (13) Construction and compartmentation of the aircraft storage and service area
- (14) Fire suppression and detection features provided for the aircraft storage and service area
- (15) Response time by emergency forces to an alarm
- (16) Local firefighting capabilities and resources
- (17) Evaluation and acknowledgment of hull and hangar insurance representatives
- (18) Redundant infrastructure, including off-site aircraft hangars to support operations
- (19) Redundant equipment, including replacement aircraft and other equipment within the aircraft hangar or the aircraft
- (20) Life safety of emergency responders, the general public, and occupants of aircraft storage and service areas and adjacent spaces
- (21) Life cycle costs

N 4.2.4 The fire risk assessment shall address the entire aircraft hangar, including all the adjacent support areas and exposures.

N 4.2.5 An approved, performance-based approach, in accordance with Chapter 5, shall be permitted to be applied selectively to specifically identified areas, hazards, or equipment or the specific fire protection requirements for the aircraft storage and service area as an alternative to the risk-based approach outlined in this chapter.

N 4.2.6 Independent Review. The AHJ shall be permitted to require an approved, independent third party to review the proposed fire risk assessment.

N 4.2.7 Risk Assessment Documentation and Follow-Up. The key components and requirements of the risk assessment shall be documented and located within the facility.

N 4.2.8 It shall be the responsibility of the facility owner/operator to ensure that the operations and hazards within the facility align with the risk assessment performed.

N Chapter 5 Performance-Based Design Approach

N 5.1 Performance-Based Design Approach. The requirements of Chapter 5 shall be used to recognize performance-based practices.

N 5.2 Goals and Objectives. The performance-based design shall meet the following goals and objectives:

- (1) Allow an alternative means to be utilized for elements of an aircraft hangar as permitted in this standard
- (2) The risk assessment, design criteria, design brief, system performance, and testing criteria are developed in accordance with this section
- (3) Meet the scope and purpose of the standard as detailed in Section 1.1 and Section 1.2
- (4) The performance-based design provides equivalent level of protection to the prescriptive requirements of this standard

N 5.3* Qualifications. The performance-based design documents shall be prepared by a licensed professional engineer with experience in fire protection and life safety system design, risk assessments, and acceptable to the AHJ.

N 5.4* Independent Review. The AHJ shall be permitted to require an approved, independent third party to review the proposed design brief based and the Performance-Based Design Report and the Design Brief.

N 5.5 Final Determination. The authority having jurisdiction shall make the final determination as to whether the performance objectives have been met.

N 5.6 Maintenance of Performance-Based Design Approach. The design features required for an aircraft hangar to continue to meet the performance goals and objectives of this standard shall be maintained for the life of the building. A re-evaluation of the Performance-Based Design Report shall be performed every 3 years by a licensed professional engineer to ensure compliance.

N 5.7 Performance Criteria.

N 5.7.1 General. All designs shall meet the goals and objectives specified in Section 5.2 and the performance criterion of 5.7.2, and all the aircraft hangar stakeholders shall concur with the design and risk management considerations.

N 5.7.2 Performance Criterion. In addition to life safety considerations, the performance criterion shall include the protection of the aircraft storage and service area from damage by fire or its associated effects, including smoke, corrosion, heat, and water.

N 5.7.3 Aircraft Hangar Stakeholders. Aircraft hangar stakeholders shall include, but not be limited to, the following:

- (1) Registered professional engineers experienced in fire protection and life safety system design and risk assessments
- (2) The owner or owner's representative
- (3) Hull and hangar insurance representatives
- (4) Representatives of the authority having jurisdiction
- (5) Representatives of emergency response entities
- (6) Building design professionals (architectural, structural, civil, mechanical, plumbing, and electrical design professionals)

N 5.7.4* The design of the aircraft hangar shall include the preparation of a Design Brief that is prepared utilizing recognized performance-based design practices.

N 5.7.4.1* Any deviation from a prescriptive requirement in this standard shall be detailed in the Design Brief and the Performance-Based Design Report.

N 5.7.4.2 Design specifications and briefs used for performance-based design shall be clearly documented and proven to be realistic and sustainable.

N 5.7.4.3* Specific inspection, testing, and maintenance requirements that are necessary to maintain the reliable performance of the fire safety features of an aircraft storage and servicing area shall be stated in the Performance-Based Design Report.

N 5.7.4.4 The applicable items of Chapter 11 of this standard shall apply and include inspections, testing, and maintenance items and frequencies unless specified otherwise in the Performance-Based Design Report.

Chapter 6 Aircraft Hangar Groups

6.1 Aircraft Hangar Classification. For the purposes of this standard, aircraft hangars shall be classified as specified in 6.1.1 through 6.1.4.

6.1.1 Group I Aircraft Hangar. A Group I aircraft hangar shall have at least one of the following features and operating conditions:

- (1) An aircraft access door height over 8.5 m (28 ft)
- (2) A single fire area in excess of 3716 m² (40,000 ft²)
- (3) Provision for housing an aircraft with a tail height over 8.5 m (28 ft)

6.1.2 Group II Aircraft Hangar. A Group II aircraft hangar shall have both of the following features:

- (1) An aircraft access door height of 8.5 m (28 ft) or less
- (2) A single fire area for specific types of construction in accordance with Table 6.1.2

6.1.3 Group III Aircraft Hangar. A Group III hangar shall have both of the following features:

- (1) An aircraft access door height of 8.5 m (28 ft) or less
- (2) A single fire area that measures up to the maximum square footage permitted for specific types of construction in accordance with Table 6.1.3

6.1.4 Group IV Aircraft Hangar. A Group IV aircraft hangar shall be any structure constructed of a membrane-covered rigid-steel frame.

Table 6.1.2 Fire Areas for Group II Aircraft Hangars

Type of Construction	Single Fire Area (Inclusive)	
	m ²	ft ²
Type I (443) and (332)	2,787–3,716	30,001–40,000
Type II (222)	1,858–3,716	20,001–40,000
Type II (111), Type III (211), and Type IV (2HH)	1,394–3,716	15,001–40,000
Type II (000)	1,115–3,716	12,001–40,000
Type III (200)	1,115–3,716	12,001–40,000
Type V (111)	743–3,716	8,001–40,000
Type V (000)	465–3,716	5,001–40,000

Table 6.1.3 Maximum Fire Areas for Group III Aircraft Hangars

Type of Construction	Maximum Single Fire Area	
	m ²	ft ²
Type I (443) and (332)	2,787	30,000
Type II (222)	1,858	20,000
Type II (111), Type III (211), and Type IV (2HH)	1,394	15,000
Type II (000)	1,115	12,000
Type III (200)	1,115	12,000
Type V (111)	743	8,000
Type V (000)	465	5,000

Chapter 7 Construction of Group I and Group II Aircraft Hangars

7.1 Defueled Aircraft. Defueled aircraft hangars shall comply with Chapter 7, except as modified by Chapter 14.

7.1.1 The construction requirements in 7.2.1 shall be permitted to be modified where a risk assessment, as outlined in Chapter 4, identifies that an alternative means of construction is acceptable.

7.2 Types of Construction.

7.2.1* Group I hangars shall be either Type I or Type II construction in accordance with NFPA 220. Group II hangars shall be constructed of any of the types of construction specified in NFPA 220 or any combination thereof.

7.2.2* Mezzanines, tool rooms, and other enclosures within aircraft storage and servicing areas shall be constructed of noncombustible material or limited-combustible material as defined in NFPA 220 in all hangars except those of Type V (111) and (000) construction.

7.3 Internal Separations.

7.3.1* Where aircraft storage and servicing areas are subdivided into separate fire areas, the separation shall be by a fire barrier wall having not less than a 2-hour fire resistance rating. Any openings in such fire barrier walls communicating directly between two aircraft storage and servicing areas shall be provided with a listed 2-hour fire door or 2-hour shutter actuated from both sides of the wall. Where areas are of different heights, the tallest wall shall have a fire resistance rating of not less than 2 hours.

7.3.2 Where two or more aircraft storage and servicing areas constituting separate fire areas are separated by continuous offices, shops, and parts storage areas, one of the two walls between the aircraft storage and servicing areas and the offices, shops, and parts storage areas shall comply with 7.3.1. The other wall shall comply with 7.3.3.

7.3.3* Partitions and ceilings separating aircraft storage and servicing areas from all other areas, shops, offices, and parts storage areas shall have at least a 1-hour fire resistance rating with openings protected by listed fire doors or shutters having a minimum fire resistance rating of 45 minutes.

7.3.4 Where a storage and servicing area has an attached, adjoining, or contiguous structure, such as a lean-to, shop, office, or parts storage area, the wall common to both areas shall have at least a 1-hour fire resistance rating, with openings protected by listed fire doors having a minimum fire resistance rating of 45 minutes and actuated from both sides of the wall.

7.4 Clear Space Distance Requirements Around Hangars.

7.4.1 Precautions shall be taken to ensure ready access to hangars from all sides. Separation shall be provided to reduce fire exposure between buildings. The clear spaces specified in Table 7.4.1 shall not be used for the storage or parking of aircraft or concentrations of combustible materials, nor shall buildings of any type be erected therein.

7.4.2 For single hangar buildings, the clear space distances specified in Table 7.4.1 shall be maintained on all sides of the single hangar. Where mixed types of construction are involved,

Table 7.4.1 Clear Space Distances for Single Hangar Buildings

Type of Construction	Minimum Separation Required	
	m	ft
Type I (443) and (332)	15	50
Type II (222)	15	50
Type II (111), Type III (211), and Type IV (2HH)	15	50
Type II (000)	15	50
Type III (200)	15	50
Type V (111) and (000)	23	75

the less fire-resistant type of construction shall be used to determine the clear space required.

7.4.2.1 Where both exposing walls and openings therein of adjacent single hangar buildings have a minimum fire resistance rating of at least 3 hours, no minimum separation distance shall be required.

7.4.2.2 Where the exposing wall and any openings therein of one hangar have a minimum fire resistance rating of at least 2 hours, the minimum separation distance shall be permitted to be reduced to not less than 7.5 m (25 ft) for single hangar buildings.

7.4.2.3* Where the exposing walls of both buildings have a minimum fire resistance rating of at least 2 hours, with all windows protected by listed glass in fixed steel sash having a minimum fire resistance rating of 45 minutes, with outside sprinkler protection and each doorway protected with one automatically operated listed fire door having a minimum fire resistance rating of 1½ hours, the clear space distance shall be permitted to be reduced to not less than 7.5 m (25 ft) between single hangar buildings. Under such conditions, the glass area in the exposing walls shall be not more than 25 percent of the wall area.

7.5 Floors.

7.5.1 The surface of the grade floor of aircraft storage and servicing areas, regardless of type of hangar construction, shall be noncombustible and above the grade of the approach or apron at the entrance to the hangar.

7.5.2* The floors of adjoining areas that pose flammable or combustible liquid spill hazards and that connect with aircraft storage and servicing areas shall be noncombustible and shall be designed to prevent a spill from entering the aircraft storage and servicing area.

7.5.3 Floor openings in multistoried sections of hangars shall be enclosed with partitions or protected with construction having a fire resistance rating not less than that required for the floor construction where the opening is made.

7.6 Roofs.

7.6.1* Roof coverings shall be of an approved type of tile, slate, metal, or asphalt shingle or of built-up roofing finished with asphalt, slate, gravel, or other approved material. Roof coverings shall be listed as Class A or Class B.

7.6.2 Where insulated metal deck assemblies are used, they shall meet or exceed FM Class 1 or UL Fire Classified ratings.

7.6.3* Spaces under roofs, created where suspended ceilings are provided in aircraft storage and servicing areas, shall be cut off from the area below so that the space cannot be used for storage or other occupancy. The space shall be provided with ventilation louvers to ensure air circulation therein.

7.7 Primary Structural Steel Columns Supporting the Roof.

7.7.1 In aircraft storage and servicing areas, protection of columns shall be required in accordance with Section 7.7.

7.7.2 All columns of the aircraft storage and servicing areas shall be made fire resistant using listed materials and methods to provide a fire-resistive rating of not less than 2 hours.

7.7.2.1 All fire-resistant materials used to protect columns shall be of the type that resists damage from discharge of the fixed fire protection system.

7.7.3* Fixed water or foam-water systems or additional discharge devices as an extension of the overhead system shall be permitted to be used in lieu of a 2-hour fire resistance rating, if such systems are designed specifically to protect the columns. Overspray from overhead sprinklers to protect columns shall not be permitted.

7.7.3.1 Distances between discharge devices vertically shall not exceed 3 m (10 ft).

7.7.3.2 The use of nozzles or open-head sprinklers with any nominal K-factor for column protection shall be permitted.

7.7.3.3 A listed strainer shall be provided on the supply side of sprinklers with nominal K-factors of less than K-2.8 (40). [13:9.4.4.2(3)]

7.7.3.4* Vertical structural steel members shall be protected by nozzles and piping of such size and arrangement as to discharge a net rate of not less than 10.2 (L/min)/m² (0.25 gpm/ft²) over the wetted area. [15:7.4.3.4]

7.7.3.5 Discharge devices for the protection of columns within the remote area of the overhead sprinkler systems shall be included in the calculations for the overhead system.

7.7.4 All fire-resistant materials used to protect structural steel columns shall be of a type that resists damage from discharge of the fixed fire protection system.

7.8 Doors.

7.8.1 Hangar doors that accommodate aircraft shall be constructed of noncombustible materials; limited-combustible materials; materials having a Class A flame spread rating when tested in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*; or materials passing the NFPA 701 test method.

7.8.2 The power source for hangar doors shall operate on independent circuits and shall not be de-energized when the main disconnect switches for general hangar power are shut off.

7.8.3* Vertical traveling doors shall be counterbalanced, and horizontal slide or accordion-type doors shall be arranged so that the doors can be opened through manual or auxiliary operation.

7.8.4* In areas where freezing temperatures occur, door tracks or the bottom edges of doors shall be protected by heating

coils or equivalent means to prevent ice formation that has the potential to prevent or delay operation.

7.9 Curtains. Where curtains are used to enclose a work area, they shall be of a listed flame-retardant type.

7.10 Landing Gear Pits, Ducts, and Tunnels.

7.10.1* Landing gear pits, ducts, and tunnels located below floor level shall be designed on the premise that flammable liquids and vapor will be present at all times. Materials and equipment shall be impervious to liquids and shall be fire resistant or noncombustible.

7.10.2 Electrical equipment for all landing gear pits, ducts, and tunnels located below hangar floor level shall be approved for use in Class I, Division 1, Group D hazardous locations in compliance with Article 501 of NFPA 70.

7.10.3 All landing gear pits, ducts, and tunnels shall be provided with a positive mechanical exhaust ventilation system capable of providing a minimum rate of five air changes per hour during daily operations and be designed to discharge externally to the hangar.

7.10.4 Upon the detection of flammable vapors, the ventilation system shall be capable of providing a minimum ventilation rate of 30 air changes per hour for the landing gear pit and all associated ducts or tunnels.

7.10.5* The ventilation system shall be controlled by an approved continuous-reading combustible gas-analyzing system that is arranged to operate the ventilation system at the rate specified in 7.10.4 automatically upon detection of a specified flammable vapor concentration that is below the lower flammable limit (LFL). The detection system shall have sensors located throughout all ducts and tunnels.

7.10.6 Because entry of fuel, oil, and water into landing gear pits is inevitable, drainage or pumping facilities shall be provided.

7.10.6.1 Water-trapped vapor seals and separator fuel traps shall be provided.

7.10.6.2 Where automatic pumping facilities are necessary, they shall be listed for use with aviation fuel and water.

7.10.6.3 The drainage shall be fully enclosed pipe runs if drainage is routed through ventilation or access tunnels to external discharge points.

7.10.7* Explosion protection shall be provided in landing gear pits, communicating ducts, and tunnel areas in the form of pressure-relief venting or by a listed explosion prevention system installed in accordance with NFPA 69.

7.10.8* An approved fire protection system shall be installed to protect each pit unless the hangar fire protection required by either Chapter 8 or Chapter 9 is designed to protect each pit.

7.11 Exposed Interior Insulation. Exposed interior insulation attached to walls and roofs in an aircraft storage or servicing area shall comply with the requirements of NFPA 101 special provisions for aircraft storage hangars and interior wall and ceiling finish criteria.