Form # P 04

DISPLAY THIS CARD ON PRINCIPAL FRONTAGE OF WORK

CITY OF PORTLAND

BUILDING INSPECTION

PERMIT

PERMIT ISSUED

Permit Number: 061588

CITY OF PORTLAND

Please Read Application And Notes, If Any, Attached

This is to certify that NORTHEAST AIR

has permission to ammend permit # 06-0061 c ge locat or m nical roo nd use existing portion of mezzanine

AT 1127 WESTBROOK ST L 207 B001002

provided that the person or persons rm or tion a epting this permit shall comply with all of the provisions of the Statutes of aine and of the O nances of the City of Portland regulating the construction, maintenance and e of buildings and uctures, and of the application on file in this department.

Apply to Public Works for street line and grade if nature of work requires such information.

ification of inspa on mus e en and w en perm on proc d ore this ilding o rt there s ed or herwi losed-in 4 UR NO REQUIRED.

A certificate of occupancy must be procured by owner before this building or part thereof is occupied.

OTHER REQUIRED APPROVALS

Fire Dept. _____

Health Dept. _____

Appeal Board _____

Other _____
Department Name

11/13/06

Director - Building & Inspection Services

PENALTY FOR REMOVING THIS CARD

City of Portland, Maine - Building or Use Permit Application

389 Congress Street, 04101 Tel: (207) 874-8703, Fax: (207) 874-8716

Permit No:	Issue Date:	CBL:
06-1588		207 B001002

Location of Construction:	Owner Name:	Owner Address:	Phone:
1127 WESTBROOK ST	NORTHEAST AIR	1011 WESTBROOK ST	
Business Name:	**Contractor Name:**	**Contractor Address:**	**Phone**
Lessee/Buyer's Name	**Phone:**	**Permit Type:**	**Zone:**
		Amendment to Commercial	IB

Past Use:	Proposed Use:	Permit Fee:	Cost of Work:	CEO District:
Commercial / aircraft hangar	Commercial / aircraft hangar ammend permit # 06-0061 change location of mechanical room and use existing portion of mezzanine		$0.00	3

FIRE DEPT: ☑ Approved ☐ Denied

Signature: Greg Cass

INSPECTION:
Use Group: S2 Type: 5B
IBC 2003
Signature:

Proposed Project Description:
ammend permit # 06-0061 change location of mechanical room and use existing portion of mezzanine

PEDESTRIAN ACTIVITIES DISTRICT (P.A.D.)
Action: ☐ Approved ☐ Approved w/Conditions ☐ Denied
Signature: Date:

Permit Taken By:	Date Applied For:
dmartin	10/30/2006

1. This permit application does not preclude the Applicant(s) from meeting applicable State and Federal Rules.
2. Building permits do not include plumbing, septic or electrical work.
3. Building permits are void if work is not started within six (6) months of the date of issuance. False information may invalidate a building permit and stop all work..

PERMIT ISSUED

CITY OF PORTLAND

Zoning Approval

Special Zone or Reviews	Zoning Appeal	Historic Preservation
☐ Shoreland	☐ Variance	☑ Not in District or Landmark
☐ Wetland	☐ Miscellaneous	☐ Does Not Require Review
☐ Flood Zone All previous conditions shall apply	☐ Conditional Use	☐ Requires Review
☐ Subdivision	☐ Interpretation	☐ Approved
☐ Site Plan	☐ Approved	☐ Approved w/Conditions
Maj ☐ Minor ☐ MM ☐	☐ Denied	☐ Denied
Date: 11/1/06	Date:	Date:

CERTIFICATION

I hereby certify that I am the owner of record of the named property, or that the proposed work is authorized by the owner of record and that I have been authorized by the owner to make this application as his authorized agent and I agree to conform to all applicable laws of this jurisdiction. In addition, if a permit for work described in the application is issued, I certify that the code official's authorized representative shall have the authority to enter all areas covered by such permit at any reasonable hour to enforce the provision of the code(s) applicable to such permit.

SIGNATURE OF APPLICANT | ADDRESS | DATE | PHONE

RESPONSIBLE PERSON IN CHARGE OF WORK, TITLE | DATE | PHONE

City of Portland, Maine - Building or Use Permit

389 Congress Street, 04101 Tel: (207) 874-8703, Fax: (207) 874-8716

Permit No:	Date Applied For:	CBL:
06-1588	10/30/2006	207 B001002

Location of Construction:	Owner Name:	Owner Address:	Phone:
1127 WESTBROOK ST	NORTHEAST AIR	1011 WESTBROOK ST	
Business Name:	**Contractor Name:**	**Contractor Address:**	**Phone**
Lessee/Buyer's Name	**Phone:**	**Permit Type:**	
		Amendment to Commercial	

Proposed Use:	Proposed Project Description:
Commercial / aircraft hangar ammend permit # 06-0061 change location of mechanical room and use existing portion of mezzanine	ammend permit # 06-0061 change location of mechanical room and use existing portion of mezzanine

Dept: Zoning **Status:** Approved with Conditions **Reviewer:** Marge Schmuckal **Approval Date:** 11/01/2006

Note: **Ok to Issue:** ☑

1) All previous conditions on the original permit are still in force.

Dept: Building **Status:** Approved **Reviewer:** Tammy Munson **Approval Date:** 11/13/2006

Note: after the fact permit **Ok to Issue:** ☑

Dept: Fire **Status:** Approved **Reviewer:** Cptn Greg Cass **Approval Date:** 11/02/2006

Note: **Ok to Issue:** ☑

409 Aircraft Hangers

Contents

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

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

3.2.4 Shall. Indicates a mandatory requirement.

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

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

3.3 General Definitions.

3.3.1 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 any part of which aircraft are housed or stored, and in which aircraft might undergo service, repairs, or alterations.

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 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.

3.3.6 Fire Wall. A wall separating buildings or subdividing a building to prevent the spread of fire and having a fire resistance rating and structural stability. [**221**:1.3]

3.3.7 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. When this valve opens, water flows into the piping system and discharges from all discharge devices attached thereto. [**16**:1.3]

3.3.8 Gross Wing Area. See 3.3.17, Wing Area.

3.3.9 Hangar Building Cluster. A group of buildings with more than one area for the storage and servicing of aircraft and all attached or contiguous structures, or structures not separated as specified in 8.3.1 of this standard, as appropriate.

3.3.10 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 5.2 or 8.2 of this standard, as appropriate.

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

3.3.12* 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.

3.3.13 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 5.2 or 8.2 of this standard, as appropriate.

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

3.3.15 Unfueled Aircraft. An aircraft whose fuel system has had flammable or combustible liquid removed such that no tank, cell, or piping contains more than ½ percent of its volumetric capacity.

3.3.16 Weathered-Membrane Material. Membrane material that has been subjected to a minimum of 3000 hours in a weatherometer in accordance with ASTM G 155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*, or approved equivalent. [***5000***:3.3]

3.3.17 Wing Area. Total projected area of clean wing (no projecting flaps, slats, and similar items) including all control surfaces and 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 similar items.

Chapter 4 Aircraft Hangar Groups

4.1 Aircraft Hangar Classification. For the purposes of this standard, aircraft hangars shall be classified as follows.

4.1.1 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 m^2 (40,000 ft^2)
(3) Provision for housing an aircraft with a tail height over 8.5 m (28 ft)

4.1.2 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 4.1.2

5.3.2.1 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.

5.3.2.2 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.

5.3.2.3* 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.

5.4 Floors.

5.4.1 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.

5.4.2* 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.

5.4.3 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.

5.5 Roofs.

5.5.1 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 when tested in accordance with NFPA 256.

5.5.2 Where insulated metal deck assemblies are used, they shall be equivalent to FM Class 1 or UL Fire Classified ratings.

5.5.3* 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.

5.5.4 Permanent exterior ladders to hangar roofs shall be provided on all hangars exceeding 2323 m^2 (25,000 ft^2) in area, or exceeding 12 m (40 ft) in height, or exceeding 30 m (100 ft) in their smallest dimension.

Exception: Permanent exterior ladders to hangar roofs shall not be required where enclosed stairs leading directly to the roof of aircraft storage and servicing areas are available from the exterior of the hangar.

5.6 Columns.

5.6.1 In aircraft storage and servicing areas of hangars housing other than unfueled aircraft, column protection shall be required in accordance with 5.6.2 through 5.6.4.

5.6.2 All main steel structural 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.

5.6.3* 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.

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

5.6.4 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.

5.7 Doors.

5.7.1 Hangar doors that accommodate aircraft shall be constructed of noncombustible or limited-combustible materials where hangars are of any Type I or Type II construction as specified in 5.1.1.

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

5.7.3* Vertical traveling doors shall be counterbalanced, and horizontal slide or accordion-type doors shall be arranged so that manual or auxiliary operation by means of winches or tractors, for example, is feasible.

5.7.4 In areas where freezing temperatures can occur, door tracks or the bottom edges of doors shall be protected by heating coils or equivalent means to prevent ice formation that might prevent or delay operation.

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

5.9 Landing Gear Pits, Ducts, and Tunnels.

5.9.1* 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.

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

5.9.3 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 normal operations and be designed to discharge externally to the hangar.

5.9.4 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.

5.9.5* 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 5.9.4 automatically upon detection of a specified

5.12.3.4 Each such duct shall be protected with a listed automatic fire damper or door.

5.12.3.5 All air for combustion purposes entering such separated rooms shall be drawn from outside the building.

5.12.4* In aircraft storage and servicing areas of hangars housing other than unfueled aircraft, heating, ventilating, and air-conditioning systems employing recirculation of air within aircraft storage and servicing areas shall have return air openings not less than 3 m (10 ft) above the floor. Supply air openings shall not be installed in the floor and shall be at least 152 mm (6 in.) from the floor measured to the bottom of the opening.

5.12.4.1 Where automatic fire protection systems are installed in aircraft storage and servicing areas, fans for furnace heating systems shall be arranged to shut down automatically by means of the operation of the interior automatic fire protection system.

5.12.4.1.1 One or more manual fan shutoff switches shall be provided.

5.12.4.1.2 Shutoff switches shall be accessible and clearly placarded.

5.12.5 Suspended or Elevated Heaters.

5.12.5.1 In aircraft storage and servicing areas of hangars housing other than unfueled aircraft, listed electric, gas, or oil heaters shall be permitted to be used if installed as specified in 5.12.5.2 through 5.12.5.4.

5.12.5.2 In aircraft storage and servicing areas, heaters shall be installed at least 3 m (10 ft) above the upper surface of wings or of the engine enclosures of the highest aircraft that might be housed in the hangar. The measurement shall be made from the wing or engine enclosure, whichever is higher from the floor, to the bottom of the heater.

5.12.5.3 In shops, offices, and other sections of aircraft hangars communicating with aircraft storage or servicing areas, the bottom of the heaters shall be installed not less than 2.4 m (8 ft) above the floor.

5.12.5.4 In all hangars, suspended or elevated heaters shall be located in spaces where they shall not be subject to injury by aircraft, cranes, movable scaffolding, or other objects. Provisions shall be made to ensure accessibility to suspended heaters for recurrent maintenance purposes.

5.12.6 Where a mechanical ventilating system is employed in hangars or shops, the ventilating system shall be installed in accordance with NFPA 90A.

5.12.7 Where blower and exhaust systems are installed for vapor removal, the systems shall be installed in accordance with NFPA 91.

5.13 Lighting and Electrical Systems.

5.13.1 Artificial lighting shall be restricted to electric lighting.

5.13.2* Electrical services shall be installed in compliance with the provisions for aircraft hangars contained in Article 513 of NFPA 70.

5.13.3 In aircraft storage and servicing areas of hangars housing other than unfueled aircraft, main distribution panels, metering equipment, and similar electrical equipment shall be located in a room separated from the aircraft storage and servicing areas by a partition having at least a 1-hour fire resistance rating. The partition shall not be penetrated except by electrical raceways, which shall be protected by approved sealing methods maintaining the same fire resistance rating as the partition.

5.14* Lightning Protection. Where provided, lightning protection shall be installed in accordance with NFPA 780.

5.15 Grounding Facilities for Static Electricity.

5.15.1* Aircraft storage and servicing areas of hangars housing other than unfueled aircraft shall be provided with grounding facilities for removal and control of static electrical accumulations on aircraft while aircraft are stored or undergoing servicing in a hangar in accordance with 5.15.2 and 5.15.3.

5.15.2 An adequate number of floor-grounding receptacles shall be provided. The receptacles shall be either grounded through individual driven electrodes or electrically bonded together in a grid system and the entire system grounded to underground metal piping, such as cold water or sprinkler piping, or driven electrodes. Where driven electrodes are used, they shall consist of 15.9 mm (⅝ in.) diameter or larger metal rods driven at least 1.5 m (5 ft) into the ground. Floor-grounding receptacles shall be designed to minimize the tripping hazard.

5.15.3* Grounding wires shall be bare and of a gauge that is satisfactorily durable to withstand mechanical strains and usage.

5.16 Exit and Access Requirements.

5.16.1 Means of egress from the aircraft hangar shall comply with NFPA *101*.

5.16.2 Aisles and clear space shall be maintained to ensure access to sprinkler control valves, standpipe hose, fire extinguishers, and similar equipment.

5.17* Draft Curtains.

5.17.1* Draft curtains shall be provided. Draft curtain areas shall be around each roof/ceiling fire suppression system and subdivided such that a single draft curtain area shall not exceed 697 m^2 (7500 ft^2). The maximum projected floor area under an individual sprinkler system shall be in accordance with Chapters 6 and 7.

5.17.2 Draft curtains shall be constructed of noncombustible materials not subject to disintegration or fusion during the early stages of a fire and shall be tightly fitted to the underside of the roof or ceiling. Any opening in draft curtains shall be provided with self-closing doors constructed of materials equivalent in fire resistance to the draft curtain itself.

5.17.3 Draft curtains shall extend down from the roof or ceiling of aircraft storage and servicing areas not less than one-eighth of the height from the floor to the roof or ceiling. Under curved or sloping roofs extending to grade level or close to grade level, draft curtains need not be continued below 4.8 m (16 ft) from the floor.

5.17.4 Structural features of a building that serve the purpose of draft curtains shall be permitted in lieu of specially constructed draft curtains provided they meet the dimensional requirements of 5.17.3.

6.2.2.10 The discharge devices shall have a minimum nominal 6.4 mm (¼ in.) orifice and shall be listed for use with the particular type of foam concentrate to be used in the system.

6.2.2.11 Strainers shall be installed in accordance with NFPA 16.

6.2.2.12 The discharge density from air-aspirating discharge devices using protein foam, fluoroprotein foam, or aqueous film-forming foam (AFFF) solutions shall be a minimum of 8.1 L/min/m^2 (0.20 gpm/ft^2) of floor area.

6.2.2.13 The discharge density from non-air-aspirating discharge devices using AFFF solution shall be a minimum of 6.5 L/min/m^2 (0.16 gpm/ft^2) of floor area.

6.2.3 Supplementary Protection Systems.

6.2.3.1* Hangars protected in accordance with 6.1.1(1) and housing aircraft having wing areas in excess of 279 m^2 (3000 ft^2) shall be protected with a listed supplementary protection system.

6.2.3.2* Each system shall be designed to cover a specified floor area beneath the aircraft being protected. The design objective shall be to achieve control of the fire within the protected area within 30 seconds of system actuation and extinguishment of the fire within 60 seconds.

6.2.3.3 Each supplementary protection system shall be designed, installed, and maintained in accordance with NFPA 11 or NFPA 11A.

6.2.3.4 Supplementary Low-Expansion Foam Systems.

6.2.3.4.1 Supplementary low-expansion foam systems shall employ AFFF, protein, or fluoroprotein foam–liquid concentrates and shall be designed for local application.

6.2.3.4.2* Where oscillating nozzles are used, the discharge pattern limits shall be established for the design. Positive securement of the limits of oscillation shall be provided by such devices as set screws, locking pins, or similar methods. When placed in service, the manual override feature, if any, shall be locked out to provide for automatic operation only.

6.2.3.4.3 Where protein- or fluoroprotein-based concentrates are used, the minimum application rate of foam solution shall be 6.5 L/min/m^2 (0.16 gpm/ft^2) of floor area beneath the wings and wing center section of the aircraft. Where AFFF concentrate is used, the minimum application rate shall be 4.1 L/min/m^2 (0.10 gpm/ft^2) of floor area beneath the wings and wing center section of the aircraft.

6.2.3.4.4 If any nozzles are removed to allow movement of the aircraft, removal of the nozzles shall not reduce the effectiveness of the remaining system.

6.2.3.4.5 Electric power reliability for oscillating nozzles shall be in accordance with electric fire pump requirements of NFPA 20.

6.2.3.4.6 Where monitor-type nozzles are used, an individual manual control valve shall be provided for each unit. This valve shall be supervised.

6.2.3.5 Supplementary High-Expansion Foam Systems.

6.2.3.5.1 Supplementary high-expansion foam systems shall utilize surfactants as the foaming ingredient and shall be designed for local application.

6.2.3.5.2* These systems shall be designed to discharge at a rate to cover the protected area to a depth of at least 0.9 m (3 ft) within 1 minute.

6.2.3.5.3 Discharge rates shall take into consideration the sprinkler breakdown factor required in 2.3.5.2(b) of NFPA 11A.

6.2.3.5.4 The foam generators shall be located at the ceiling or on exterior walls in such a way that only air from outside the aircraft storage and servicing area can be used for foam generation. Roof vents shall be located to avoid recirculation of combustion products into the air inlets of the foam generators.

6.2.3.5.5* Generators shall be powered by reliable water-driven or electric motors. Electric power reliability for generators shall be in accordance with electric fire pump requirements of NFPA 20.

6.2.4 Closed-Head Water Sprinkler Systems for Aircraft Storage and Servicing Areas.

6.2.4.1* Sprinkler systems shall be either wet pipe or preaction, designed and installed in accordance with the applicable sections of NFPA 13 and the provisions of this chapter.

6.2.4.2 Sprinkler piping shall be hydraulically sized in accordance with NFPA 13. The maximum system size shall not exceed 4831 m^2 (52,000 ft^2).

6.2.4.3 Sprinkler spacing shall be as specified in 6.2.2.3.

6.2.4.4 Where open hangar doors result in interference with the distribution of water from the hangar sprinkler systems, additional sprinklers shall be provided to ensure effective floor coverage.

6.2.4.5 The design density of water from sprinkler systems shall be a minimum of 6.9 L/min/m^2 (0.17 gpm/ft^2) over any 1394 m^2 (15,000 ft^2) area, including the hydraulically most demanding area as defined in NFPA 13.

6.2.4.6 Sprinklers shall be nominal K-5.6 or K-8.0 sprinklers.

6.2.4.7 Quick-response sprinklers having a temperature rating of 79.4°C (175°F) shall be used. Quick-response sprinklers having a temperature rating of 93.3°C (200°F) shall be permitted in areas subject to high ambient temperatures.

6.2.4.8 Sprinkler systems shall be flushed and tested in accordance with NFPA 13.

6.2.5 Low-Level Foam Protection Systems.

6.2.5.1 Hangars protected in accordance with 6.1.1(2) or 6.1.1(3) shall be protected with a listed low-level foam protection system.

6.2.5.2 Each low-level foam protection system shall be designed, installed, and maintained in accordance with NFPA 11 or NFPA 11A.

6.2.5.3* The low-level foam system shall be designed to achieve distribution of foam over the entire aircraft storage and service area. The design objective shall be to achieve coverage of the entire aircraft storage and servicing area to within 1.5 m (5 ft) of the perimeter walls and doors within 3 minutes of system actuation.

6.2.5.4 Low-Level Low Expansion Foam Systems. Foam systems shall be of the fixed type and shall be designed and installed in accordance with the requirements for fixed-type systems in NFPA 11.

6.2.8 Detection and Actuation System Design.

6.2.8.1 General.

6.2.8.1.1 Actuation systems shall be provided with complete circuit supervision and shall be arranged in accordance with Section 6.4.

6.2.8.1.2 These detectors shall be installed in accordance with *NFPA 72.*

6.2.8.1.3 Detection systems shall be provided with supervision as required by *NFPA 72.*

6.2.8.2 Deluge Foam–Water Sprinkler Systems.

6.2.8.2.1 Detectors for actuating the deluge foam–water sprinkler systems shall be rate-of-rise, fixed-temperature, or rate-compensation types.

6.2.8.2.2* Manual actuation stations shall be located so that each system can be individually operated from both inside and outside the aircraft storage and servicing area. The manual stations shall be installed so that they are unobstructed, readily accessible, and located in the normal paths of exit from the area.

6.2.8.3 Supplementary Protection Systems.

6.2.8.3.1* Actuation of any deluge foam–water sprinkler system shall simultaneously operate the supplementary protection system.

6.2.8.3.2 Manual actuation stations shall be provided for each supplementary protection system and shall be located both inside and outside the aircraft maintenance and servicing area. Stations shall be located as close as possible to the aircraft positions to facilitate early system actuation in the event of a fire.

6.2.8.4 Closed-Head Water Sprinkler Systems. Where preaction sprinkler systems are provided, detectors for actuating the systems shall be rate-of-rise, fixed-temperature, or rate-compensation type.

6.2.8.5 Low-Level Foam Protection Systems.

6.2.8.5.1* Actuation of any closed-head sprinkler system shall simultaneously operate the low-level foam protection system.

6.2.8.5.2 Manual actuation stations shall be provided for each low-level protection system and shall be located both inside and outside the aircraft maintenance and servicing area. Stations shall be located as close as possible to the aircraft postitions to facilitate early system actuation in the event of a fire.

6.2.9* Hand Hose Systems.

6.2.9.1 Hand hose systems shall be installed in every hangar to provide for manual fire control.

6.2.9.2 The hand hose systems shall be arranged to permit application of water or other extinguishing agents on each side and into the interior of the aircraft located in each aircraft storage and servicing area. At least two hose lines shall be considered to be operated simultaneously.

6.2.9.3 Foam–Water Hand Hose Systems.

6.2.9.3.1 Foam–water hand hose systems shall be installed in aircraft storage and servicing areas.

Exception: Where aircraft storage and servicing areas house only unfueled aircraft, as defined in 3.3.15, hand hose systems shall be provided in accordance with 6.2.9.4 of this standard.

6.2.9.3.2 The systems shall conform with the applicable portions of NFPA 14 and NFPA 11.

6.2.9.3.3 These hand hose systems shall be supplied from a connection to the sprinkler system header or from a direct connection to the water source.

6.2.9.3.4 Each hand hose connection shall be a minimum of 38 mm (1½ in.) in size and fitted with a control valve. The hose shall be of suitable length and diameter to provide a minimum flow of 227 L/min (60 gpm) at an adequate nozzle pressure. The stream range shall be calculated based on the volume and pressures available under maximum demand conditions.

6.2.9.3.5 The hose shall be properly racked or reeled. Hose shall be fitted with an approved foam-maker nozzle or a combination-type nozzle designed to permit foam application or water spray. Nozzles shall be of the shutoff type or shall have a shutoff valve at the nozzle inlet.

6.2.9.3.6 Foam–liquid concentrate shall be permitted to be supplied from a central distribution system, separate from or a part of a foam–water sprinkler system, or from stationary foam–liquid concentrate containers fitted with listed proportioning devices.

6.2.9.3.7 The minimum supply of foam–liquid concentrate shall be sufficient to provide operation of at least two hand hose lines for a period of 20 minutes at a foam solution discharge rate of 227 L/min (60 gpm) each.

6.2.9.4 Water Hand Hose Systems.

6.2.9.4.1 Water hand hose and standpipe systems shall be installed in accordance with NFPA 14 in all shop, office, and non-aircraft-storage areas in hangars, except where special hazards that require special protection exist.

6.2.9.4.2 Hoses shall be fitted with listed adjustable stream pattern nozzles designed to permit straight stream or water spray application.

6.2.10 Water Supply.

6.2.10.1* The total water supply shall be sufficient to satisfy the combination of systems as described in 6.1.1(1), 6.1.1(2), and 6.1.1(3) and the requirements for hose stream and other equipment as determined in 6.2.9. Water shall be available in sufficient quantity and pressure to supply the maximum number of discharge devices likely to operate simultaneously. Water shall be suitable for the production of foam.

6.2.10.2 Deluge Foam–Water Sprinkler Systems.

6.2.10.2.1* The water supply shall be capable of furnishing water for the largest number of systems that possibly could be expected to operate. Sufficient water supply requirements are determined by assuming that a fire at any point will operate all the systems in every draft-curtained area that is wholly or partially within a 30 m (100 ft) radius of that point measured horizontally.

6.2.10.2.2 The water supply shall be capable of maintaining water discharge at the design rate and pressure for a minimum of 60 minutes covering the entire area protected by systems expected to operate simultaneously, unless protection is provided as specified in 6.2.10.3.

density [6.5 L/min/m^2 (0.16 gpm/ft^2)], a proportionate reduction in the time of discharge shall be permitted but shall not be less than 7 minutes.

6.2.13.3 Converted systems shall be tested in accordance with 6.2.11.

6.3 Wheeled and Portable Extinguishers.

6.3.1 Wheeled and portable extinguishers shall be provided in accordance with NFPA 10.

6.3.2 In aircraft storage and servicing areas, the distribution of such devices shall be in accordance with the extra hazard classification outlined in NFPA 10.

6.3.3 The distribution of extinguishers in other areas of aircraft hangars shall be in accordance with light, ordinary, or extra hazard occupancy based on an analysis of each such room or area following the requirements of NFPA 10.

6.4* Protection System Alarms. In addition to local alarm service, alarms shall be transmitted to a constantly attended location.

Chapter 7 Protection of Group II Aircraft Hangars

7.1 General.

7.1.1 The protection of aircraft storage and servicing areas of Group II aircraft hangars, other than those housing unfueled aircraft, shall be in accordance with any one of the following:

(1) The provisions of Chapter 6

Exception: Where foam–water deluge systems utilizing air-aspirating discharge devices are installed for the protection of Group II aircraft hangars, the discharge rate specified in 6.2.2.12 of this standard shall be permitted to be reduced to a minimum of 6.5 L/min/m^2 (0.16 gpm/ft^2) of floor area.

(2) A combination of automatic sprinkler protection in accordance with Section 7.2 and an automatic, low-level, low-expansion foam system in accordance with Sections 7.3 and 7.4
(3) A combination of automatic sprinkler protection in accordance with Section 7.2 and an automatic, high-expansion foam system in accordance with Sections 7.3 and 7.5
(4) A closed-head foam–water sprinkler system in accordance with Section 7.6

7.1.2 Group II aircraft hangar storage and service areas housing unfueled aircraft shall be provided with automatic sprinkler protection as specified in Sections 7.2 and 7.8.

7.1.3 Automatic closed-head sprinkler protection shall be provided inside separate shop, office, and storage areas located inside aircraft maintenance and servicing areas. The design shall be in accordance with hazard classifications specified in NFPA 13.

7.1.4 In addition to the provision for sprinkler and foam extinguishing systems as required by this chapter, protection as required by 6.2.9 and Sections 6.3 and 6.4 also shall be provided.

7.2 Closed-Head Water Sprinkler System for Aircraft Storage and Servicing Areas.

7.2.1* Sprinkler systems shall be either wet pipe or preaction, designed and installed in accordance with the applicable sections of NFPA 13 and the provisions of this chapter.

7.2.2 Sprinkler piping shall be hydraulically sized in accordance with NFPA 13.

7.2.3 Sprinkler spacing shall be as specified in 6.2.2.3.

7.2.4 Where open hangar doors result in interference with the distribution of water from the hangar sprinkler systems, additional sprinklers shall be provided to ensure effective floor coverage.

7.2.5 The design density of water from sprinkler systems shall be a minimum of 6.9 L/min/m^2 (0.17 gpm/ft^2) over any 464.5 m^2 (5000 ft^2) area, including the hydraulically most demanding area as defined in NFPA 13.

7.2.6 Sprinklers shall be nominal K-5.6 or K-8.0 sprinklers.

7.2.7 Sprinklers shall have a temperature rating of 162°C to 190°C (325°F to 375°F).

7.2.8 Sprinkler systems shall be flushed and tested in accordance with NFPA 13.

7.3* Foam Concentrate — General. The friction losses in piping carrying foam concentrate shall be calculated using the Darcy formula, also known as the Fanning formula.

7.3.1 The foam concentrate supplied with the system shall be listed for use with the distribution equipment.

7.3.2 There shall be a reserve of foam concentrate of a compatible type directly connected to the system. The reserve supply shall be in the same quantity as the main supply. To prevent accidental depletion of this reserve supply, it shall be available to the system only by intentional manual operation.

7.3.3 Foam Concentrate Pumps.

7.3.3.1 Foam concentrate pump installations shall comply with the applicable provisions of NFPA 20, except as modified by this standard.

7.3.3.2 Where foam concentrate is introduced into the water stream by pumping, the total foam concentrate pumping capacity shall be such that the maximum flows and pressures can be met with the largest foam concentrate pump out of service. The reserve pump(s) shall be arranged to operate only upon failure of the primary pump(s).

7.3.3.3 Piping shall be arranged so that maximum foam concentrate demand can be supplied by any foam concentrate pump from either primary or reserve foam concentrate tanks.

7.3.3.4 Foam concentrate pumps shall be provided with means of pressure relief from the pump discharge to prevent excessive pressure and temperature. Discharge from the relief valve shall be piped back to the foam concentrate storage tank. Connection to the suction piping shall not be permitted.

7.3.3.5 The pressure-regulating valve shall not be considered as the pressure relief valve. Foam concentrate pumps shall be started automatically by either a pressure drop in the foam concentrate piping system or a signal from the detection system control panel.

7.3.3.6 A pressure maintenance pump shall be provided to maintain pressure in the foam concentrate piping system where foam concentrate lines to the protective system injection points are run underground or where they run aboveground for more than 15 m (50 ft).

7.6.1.1 AFFF shall be used.

7.6.2 The minimum discharge density shall be 6.5 L/min/m^2 (0.16 gpm/ft^2) of foam solution over the entire storage and service area.

7.6.3 Sprinkler spacing shall not exceed 9.3 m^2 (100 ft^2) as projected on the floor. The maximum distance between sprinklers either on branch lines or between branch lines shall be 3.7 m (12 ft).

7.6.4 In aircraft storage and servicing areas, the maximum projected floor area under an individual sprinkler system shall not exceed 1393 m^2 (15,000 ft^2).

7.6.4.1 Each individual system shall have its own foam concentrate proportioner.

7.6.5 Sprinklers shall have a temperature rating of 79.4°C to 107.2°C (175°F to 225°F).

7.6.6 Foam concentrate supply shall be in accordance with 6.2.6.

7.6.7* Branch lines shall be provided with provisions for periodic flushing.

7.6.7.1 Drains shall be a minimum of 25.4 mm (1 in.) in size.

7.7 Detection and Actuation Systems.

7.7.1 Detectors for actuating high- or low-expansion foam systems and for actuating preaction sprinkler systems shall be rate-of-rise, fixed-temperature, or rate-compensation type.

7.7.2 These detectors shall be installed in accordance with *NFPA 72*.

7.7.3 Detection systems shall be provided with supervision as required by *NFPA 72*.

7.7.4 Manual actuation stations shall be located so that each system can be individually operated from both inside and outside the aircraft storage and servicing area. The manual stations shall be installed so that they are unobstructed, readily accessible, and located in the normal paths of exit from the area.

7.8* Water Supply.

7.8.1 The total water supply shall be sufficient to satisfy the combination of systems and hose stations as described in 7.1.1(2), 7.1.1(3), and 7.1.3 for durations as specified in this section.

7.8.2 The water supply for closed-head water sprinkler systems in aircraft storage and servicing areas shall meet one of the following:

(1) In aircraft storage and servicing areas housing other than unfueled aircraft, the water supply shall have a minimum duration of 30 minutes at the rate specified in 7.2.5.
(2) In aircraft storage and servicing areas housing unfueled aircraft, the water supply shall have a minimum duration of 60 minutes at the rate specified in 7.2.5.

7.8.3 The water supply for low-expansion foam systems shall be capable of furnishing water at the rate specified in 7.4.2 for a period of time at least equal to twice the period of time used to calculate the quantity of foam liquid concentrate in 7.4.5. Water shall be suitable for the production of foam.

7.8.4 The water supply for high-expansion foam systems shall be capable of furnishing water at the rate specified in 7.5.3 for a minimum period of 24 minutes. Water shall be suitable for the production of foam.

7.8.5 The water supply for closed-head foam–water sprinkler systems shall have a minimum duration of 30 minutes at the rate specified in 7.6.2.

7.8.6 The water supply for hose stations shall be capable of satisfying the requirements of 6.2.9 of this standard, in addition to those requirements specified in 7.8.2 and either 7.8.3 or 7.8.4. The demand shall be calculated at the point where supply piping for the hose stations connects to the system piping or fire protection underground.

7.8.7 Where the water supply for the systems also serves as a supply for exterior hose streams, a hose stream allowance of 1893 L/min (500 gpm) shall be included in the water supply hydraulic calculations. Calculations for hose stream shall be in accordance with NFPA 13.

7.8.8 Where provided, fire pumps and suction reservoirs shall be designed and installed in accordance with 6.2.10.7 and 6.2.10.8.

Chapter 8 Group III Aircraft Hangars

8.1 Construction.

8.1.1* Group III hangars shall be constructed of any of the types of construction specified in NFPA 220.

8.1.2 Group III hangars shall be limited to one story. Where a Group III hangar as defined in 4.1.3 and 4.1.4 exceeds one story, the hangar shall be designated as a Group II hangar.

8.1.3 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.

8.1.4 Hangar aprons shall slope away from the level of the hangar floors to prevent liquid on the apron surfaces from flowing into the hangars.

8.1.5 In hangar building clusters and in row hangars, a minimum of 15 cm (6 in.) high curbing shall be provided between each aircraft space to prevent the flow of liquid from one space to adjacent spaces.

8.1.5.1 Open-bay hangars capable of housing multiple aircraft shall be provided with floor drainage in accordance with Section 5.11.

8.1.6 Roof coverings shall be listed as Class C or better, where tested in accordance with NFPA 256.

8.1.7 Exposed interior insulation attached to walls and roofs in an aircraft storage or servicing area of a hangar shall comply with the special provisions for aircraft storage hangars, interior wall and ceiling finish criteria of NFPA *101*.

8.2 Separation and Internal Subdivisions.

8.2.1 For single hangar buildings, the clear space distances specified in Table 8.2.1 shall be maintained on all sides of the single hangar. Where mixed types of construction are involved, the less fire-resistant type of construction shall be used to determine clear space required. Where the minimum clear spaces specified in Table 8.2.1 are not met, the buildings shall be considered a hangar building cluster.

stalled in the floor and shall be at least 152 mm (6 in.) from the floor measured to the bottom of the opening.

8.4.4.1 Where automatic fire protection systems are installed in aircraft storage and servicing areas, fans for furnace heating systems shall be arranged to shut down automatically by operation of the interior automatic fire protection system. One or more manual fan shutoff switches shall be provided. Shutoff switches shall be accessible and clearly placarded.

8.4.5 Suspended or Elevated Heaters.

8.4.5.1 Listed electric, gas, or oil heaters shall be permitted to be used if installed as specified in 8.4.5.2 through 8.4.5.4.

8.4.5.2 In aircraft storage and servicing areas, heaters shall be installed at least 3 m (10 ft) above the upper surface of wings or the upper surface of the engine enclosures of the highest aircraft that can be housed in the hangar. The measurement shall be made from the wing or engine enclosure, whichever is higher from the floor, to the bottom of the heater.

8.4.5.3 In shops, offices, and other sections of aircraft hangars communicating with aircraft storage or servicing areas, the bottom of the heaters shall be installed not less than 2.4 m (8 ft) above the floor.

8.4.5.4 Suspended or elevated heaters shall be located in all spaces of aircraft hangars so that they shall not be subject to injury by aircraft, cranes, movable scaffolding, or other objects. Provision shall be made to ensure accessibility to suspended heaters for recurrent maintenance purposes.

8.4.6 Where a mechanical ventilating system is employed in hangars or shops, the ventilating system shall be installed in accordance with NFPA 90A and in accordance with the applicable provisions of Section 8.4.

8.4.7 Where blower and exhaust systems are installed for vapor removal, the systems shall be installed in accordance with NFPA 91.

8.5 Lighting and Electrical Systems.

8.5.1 Artificial lighting shall be restricted to electric lighting.

8.5.2* Electrical services shall be installed in compliance with the provisions for aircraft hangars contained in Article 513 of NFPA 70.

8.6 Lightning Protection. Where provided, lightning protection shall be installed in accordance with NFPA 780.

8.7 Grounding Facilities for Static Electricity.

8.7.1* Grounding facilities shall be provided for removal and control of static electrical accumulations on aircraft while aircraft are stored or are undergoing servicing in a hangar.

8.7.2 An adequate number of floor-grounding receptacles shall be provided. The receptacles shall be either grounded through individual driven electrodes or electrically bonded together in a grid system and the entire system grounded to underground metal piping or driven electrodes. Where driven electrodes are used, they shall consist of 15.9 mm (⅝ in.) diameter or larger metal rods driven at least 1.5 m (5 ft) into the ground. Floor-grounding receptacles shall be designed to minimize the tripping hazard.

8.7.3* Grounding wires shall be bare and of a gauge that will be satisfactorily durable to withstand mechanical strains and usage.

8.8 Exit and Access Requirements.

8.8.1 Means of egress from the aircraft hangar shall comply with NFPA *101*.

8.8.1.1 Egress doors for personnel who do not require the opening of doors accommodating aircraft shall be provided in each partitioned space. Intervals between doors shall not exceed 45 m (150 ft) on all exterior walls or 30 m (100 ft) along interior walls.

8.8.2 Aisles and clear space shall be maintained to ensure access to sprinkler control valves, where provided, as well as standpipe hose, fire extinguishers, and similar equipment.

8.9 Fire Protection for Group III Hangars.

8.9.1* Where hazardous operations, including fuel transfer, welding, torch cutting, torch soldering, doping, and spray painting, are performed in any Group III hangar, the Group III hangar shall be protected with the fire protection specified in Chapter 7 and also shall meet the requirements specified in 5.4.2.

8.9.2 Portable fire extinguishers shall be provided in accordance with NFPA 10. Where portable extinguishers are locked up to preclude the possibility of theft, each tenant and aircraft owner shall be provided with a key for the locks.

8.9.2.1 In aircraft storage and servicing areas, the distribution of portable fire extinguishers shall be in accordance with extra hazard classification outlined in NFPA 10.

8.9.2.2 The distribution of extinguishers in other areas of aircraft hangars shall be in accordance with light, ordinary, or extra hazard occupancy based on an analysis of each room or area following the requirements of NFPA 10.

Chapter 9 Group IV Aircraft Hangars

9.1* Construction.

9.1.1 When membrane-covered rigid-steel-frame structures are used for the construction of aircraft hangars, they shall be constructed in accordance with Chapter 9.

9.1.2 The hangar shall be limited to one story.

9.1.3 The hangar shall be limited to a single hangar fire area.

9.1.4 Where provided, roof drains shall be equipped with electrical elements to protect against ice buildup, which would prevent the drains from functioning. Such heating elements shall be served by on-site standby electrical power in addition to the normal public service. In lieu of such heating elements, any other approved methods that protect against ice accumulation shall be permitted.

9.1.5 Membrane Materials.

9.1.5.1 Testing of membrane materials for compliance with the use of the categories of noncombustible and limited-combustible materials in accordance with 9.1.5 shall be performed on weathered membrane material.

9.1.5.2 Flame spread of all membrane materials exposed within the structure shall be Class A as defined in NFPA *101*.

9.1.5.3 Flame Resistance. All membrane structure fabric shall meet the requirements of both the small-scale and large-scale tests contained in NFPA 701.

9.10 Heating and Ventilating. Heating, ventilating, and air-conditioning equipment of membrane-covered rigid-steel-frame-structure hangars shall be installed, as applicable, in accordance with Section 5.12.

9.11 Lighting and Electrical Systems.

9.11.1 Artificial lighting shall be restricted to electric lighting.

9.11.2 Electrical services shall be installed in compliance with the provisions for aircraft hangars contained in Article 513 of NFPA 70.

9.11.3 In hangars with aircraft storage and servicing areas greater than 1115 m^2 (12,000 ft^2), housing other than unfueled aircraft, main distribution panels, metering equipment, and similar electrical equipment shall be located in a room separated from the aircraft storage and servicing area by a partition having at least a 1-hour fire resistance rating. The partition shall not be penetrated except by electrical raceways, which shall be protected by approved sealing methods maintaining the same fire resistance rating as the partition.

9.12 Grounding Facilities for Static Electricity.

9.12.1 Membrane-covered rigid-steel-frame-structure hangars housing other than unfilled aircraft shall be provided with grounding facilities for the removal and control of static electrical accumulations on aircraft while aircraft are stored or undergoing servicing in a hangar.

9.12.2 An adequate number of floor-grounding receptacles shall be provided. The receptacles shall be either grounded through individual driven electrodes or electrically bonded together in a grid system and the entire system grounded to underground metal piping, such as cold water or sprinkler piping, or driven electrodes. Where driven electrodes are used, they shall consist of 15.9 mm (⅝ in.) diameter or larger metal rods driven at least 1.5 m (5 ft) into the ground. Floor-grounding receptacles shall be designed to minimize the tripping hazard.

9.12.3* Grounding wires shall be bare and of a gauge that is satisfactorily durable to withstand mechanical strains and usage.

9.13 Exit and Access Requirements.

9.13.1 Mean of egress from membrane-covered rigid-steel-frame-structure hangars shall comply with NFPA *101*.

9.13.1.1 Egress doors for personnel that do not require the opening of doors accommodating aircraft shall be provided in each partitioned space. Intervals between doors shall not exceed 45 m (150 ft) on all exterior walls or 30 m (100 ft) along interior walls.

9.13.2 Aisles and clear space shall be maintained to ensure access to sprinkler control valves, standpipe hose fire extinguishers, and similar equipment.

9.14 Fire Protection for Membrane-Covered Rigid-Steel-Frame-Structure Hangars.

9.14.1 The protection of aircraft storage and servicing areas for membrane-covered rigid-steel-frame-structure hangars having a hangar fire area greater than 1115 m^2 (12,000 ft^2) and housing fueled aircraft shall be in accordance with any of the following:

(1) A low-expansion foam system as specified in 9.14.7.4
(2) A high-expansion foam system as specified in 9.14.7.5

9.14.2 The protection of aircraft storage and servicing areas for membrane-covered rigid-steel-frame-structure hangars having a hangar fire area greater than 1115 m^2 (12,000 ft^2) and housing unfueled aircraft shall be in accordance with any of the following:

(1) A low-expansion foam system as specified in 9.14.7.4
(2) A high-expansion foam system as specified in 9.14.7.5
(3) Automatic sprinkler protection that complies with the following and Section 7.8 (for water supply):
   (a) Closed-head water sprinkler system for aircraft storage and servicing areas. Sprinkler systems shall be either wet pipe or preaction, designed and installed in accordance with the applicable sections of NFPA 13 and the provisions of this chapter.
   (b) Sprinkler piping shall be hydraulically sized in accordance with NFPA 13.
   (c) Sprinkler spacing shall be as specified in 6.2.2.3.
   (d) Where open hangar doors result in interference with the distribution of water from the hangar sprinkler systems, additional sprinklers shall be provided to ensure effective floor coverage.
   (e) The design density of water from sprinkler systems shall be a minimum of 6.9 L/min/m^2 (0.17 gpm/ft^2) over any 464.5 m^2 (5000 ft^2) area, including the hydraulically most demanding area as defined in NFPA 13.
   (f) Sprinklers shall have a nominal orifice size of 12.7 mm (½ in.) or 13.5 mm ($^{17}/_{32}$ in.).
   (g) Quick-response sprinklers having a temperature rating of 79.4°C (175°F) shall be used. Quick-response sprinklers having a temperature rating of 93.3°C (200°F) or 28°C (50°F) above the highest ambient temperature shall be permitted in areas subject to high ambient temperatures.
   (h) Sprinkler systems shall be flushed and tested in accordance with NFPA 13.

9.14.3 The protection of aircraft storage and servicing areas for membrane-covered rigid-steel-frame-structure hangars having a hangar fire area less than 1115 m^2 (12,000 ft^2) and where hazardous operations, including fuel transfer, welding, torch cutting, torch soldering, doping, and spray painting, are performed shall be by an approved automatic sprinkler system in accordance with NFPA 13.

9.14.4 All mezzanines used for storage and all enclosed areas, including separate shops, offices, and storage areas, located in membrane-covered rigid-steel-frame-structure hangars shall be protected by an approved automatic sprinkler system in accordance with NFPA 13.

9.14.5 Protection Systems.

9.14.5.1 Aircraft storage and servicing areas shall be protected with listed protection systems.

9.14.5.2 Each system shall be designed to cover the entire floor area of the hangar. The design objective shall be to achieve control of the fire in the protected area in 30 seconds of system actuation and extinguishment of the fire within 60 seconds.

9.14.5.3 Each protection system shall be designed, installed, and maintained in accordance with NFPA 11 or NFPA 11A.

9.14.6 Plans and Specifications.

9.14.6.1 Before systems are installed, complete specifications and working plans shall be drawn to scale showing all essential details, and plans shall be easily reproducible to provide necessary copies.

disconnect the power supply to the foam concentrate pump feeder circuit.

9.14.9.3 Controllers for foam concentrate pumps shall be as follows:

(1) For electric-drive foam concentrate pumps greater than 30 horsepower, a listed fire pump controller shall be used.
(2) For electric-drive foam concentrate pumps greater than 15 horsepower but not exceeding 30 horsepower, a listed fire pump controller or listed limited service controller shall be used.
(3) For electric-drive foam concentrate pumps less than 15 horsepower, a listed limited-service controller shall be used.
(4) For diesel engine–drive foam concentrate pumps, a listed fire pump controller shall be used.

9.14.9.4 Piping shall be arranged so that maximum foam concentrate demand can be supplied from either primary or reserve foam concentrate tanks.

9.14.10 Detection and Actuation System Design.

9.14.10.1 General. Actuation systems shall be provided with complete circuit supervision and shall be arranged in accordance with 9.14.15.

9.14.10.2 Foam Fire Protection Systems.

9.14.10.2.1* An automatic detection system shall be provided for actuation of these systems. Detection systems shall be installed in accordance with *NFPA 72*.

9.14.10.2.2 Manual actuation stations shall be provided for each low-expansion protection system and shall be located both inside and outside the aircraft maintenance and servicing area. Stations shall be located as close as possible to the aircraft positions to facilitate early system actuation in the event of a fire.

9.14.11 Hand Hose Systems.

9.14.11.1 Hand hose systems shall be installed in every hangar, to provide for manual fire control.

9.14.11.2 The hand hose systems shall be arranged to permit application of water or other extinguishing agents on each side and into the interior of the aircraft located in the aircraft storage and servicing area. At least two hose lines shall be considered to be operated simultaneously.

9.14.11.3 Foam–Water Hand Hose Systems.

9.14.11.3.1 Foam–water hand hose systems shall be installed in the aircraft storage and servicing areas having a hangar fire area greater than 1115 m^2 (12,000 ft^2) housing other than unfueled aircraft.

9.14.11.3.2 The systems shall conform with the applicable portions of NFPA 14 and of NFPA 11 or NFPA 11A.

9.14.11.3.3 These foam–water hand hose systems shall be supplied from a connection to the low-expansion or high-expansion foam system header or from a direct connection to the water source.

9.14.11.3.4 Each foam–water hand hose connection shall be a minimum of 38 mm (1½ in.) in size and fitted with a control valve. The hose shall be of suitable length and diameter to provide a minimum flow of 227 L/min (60 gpm) at an adequate nozzle pressure. The stream range shall be calculated based on the volume and pressures available under maximum demand conditions.

9.14.11.3.5 The hose shall be racked or reeled. Hoses shall be fitted with an approved foam-maker nozzle or a combination-type nozzle designed to permit foam application or water spray. Nozzles shall be of the shutoff type or shall have a shutoff valve at the nozzle inlet.

9.14.11.3.6 Foam-liquid concentrate shall be permitted to be supplied from either a central distribution system, separate from or a part of a foam–water system, or from stationary foam-liquid concentrate containers fitted with listed proportioning devices.

9.14.11.3.7 The minimum supply of foam-liquid concentrate shall be sufficient to provide operation of at least two hand hose lines for a period of 20 minutes at a foam solution discharge rate of 227 L/min (60 gpm) each.

9.14.11.4 Water Hand Hose Systems.

9.14.11.4.1 Water hand hose and standpipe systems shall be installed in accordance with NFPA 14 in aircraft storage and servicing areas having a hangar fire area greater than 1115 m^2 (12,000 ft^2) and housing unfueled aircraft and all shop, office, and nonaircraft storage areas in hangars, except where special hazards that require special protection exist.

9.14.11.4.2 Water hand hoses shall be fitted with listed adjustable stream pattern nozzles designed to permit straight stream or water spray application.

9.14.12 Water Supply.

9.14.12.1 The total water supply shall be sufficient to satisfy the protection systems as described in 9.14.1(1), 9.14.1(2), 9.14.2(1) through 9.14.2(3), 9.14.3, and 9.14.4 and the requirements for hose stream and other equipment as determined in 9.14.11. Water shall be available in sufficient quantity and pressure to supply the maximum number of discharge devices likely to operate simultaneously. Water shall be suitable for the production of foam.

9.14.12.2 The total water supply duration shall be for a minimum of 45 minutes.

9.14.12.3 Hand Hose Systems. The water supply for hand hose systems shall be capable of satisfying the requirements of 9.14.11. The demand shall be calculated at the point where supply piping for the hand hose systems connects to the system piping or fire protection underground.

9.14.12.4 Exterior Hose Streams. Where the water supply for the systems also serves as a supply for exterior hose streams, a hose stream allowance of 1893 L/min (500 gpm) shall be included in the water supply hydraulic calculations. Calculations for hose stream shall be in accordance with NFPA 13.

9.14.12.5 Water Reservoirs. Where a single reservoir is used for the basic water supply, such reservoir shall be divided into approximately equal sections, arranged so that at least one-half of the water supply will always be maintained in service in order to increase the reliability of the water supply. The suction line from each section shall be sized to deliver the maximum water supply requirement.

9.14.13 Fire Pumps.

9.14.13.1 Fire pumps shall be installed in accordance with NFPA 20 and in accordance with the provisions of 9.14.13.2 through 9.14.13.6.

10.4 Electrical Equipment.

10.4.1 Electrical equipment in a paint hangar shall be in accordance with Article 513 and Article 516 of NFPA 70 and 10.4.2 through 10.4.5 of this standard.

10.4.2 The area around the aircraft perimeter, extending 3 m (10 ft) horizontally and 3 m (10 ft) vertically, shall be considered a Class I, Division 1 location. All electrical wiring and equipment in this area shall comply with the applicable provisions of Article 501 of NFPA 70.

10.4.3 The area around the aircraft perimeter, extending from 3 m to 9.1 m (10 ft to 30 ft) horizontally and 3 m to 6.1 m (10 ft to 20 ft) vertically, shall be considered a Class I, Division 2 location. All electrical wiring and equipment in this area shall comply with the applicable provisions of Article 501 of NFPA 70.

10.4.4 All lighting fixtures within a paint hangar shall be totally enclosed or constructed so as to prevent the escape of sparks or hot particles.

10.4.5* In addition to the grounding requirements in Chapter 5, grounding facilities shall be provided for the paint or other flammable or combustible liquid application system and the application system operator.

10.5 Operations. Flammable or combustible liquid operations inside a paint hangar shall be in accordance with the provisions of NFPA 30 and NFPA 410.

Chapter 11 Periodic Inspection and Testing

11.1 Fire Protection Systems.

11.1.1 Inspection and testing of fire protection systems in aircraft hangars shall be performed in accordance with NFPA 25 as modified by Table 11.1.1.

11.1.2 All preprimed closed-head AFFF systems shall be drained, flushed, and reprimed annually.

11.1.3 Records of inspections, tests, and test results shall be maintained.

Table 11.1.1 Inspection and Testing of Hangar Fire Protection Systems

	Type and Frequency of Inspections and Tests					
System Components	Weekly	Monthly	Semi-annually	Annually	Quarterly	Every 5 Years
Sprinkler heads	—	—	—	V	—	—
Piping	—	—	—	V	—	D
Pipe hangers	—	—	—	V	—	—
Sprinkler alarm valve	—	V	—	—	O[1]	—
Deluge valve	—	V	—	O	—	D
Shutoff valves	—	V	—	F	—	—
Fire pumps	F[4]	—	—	D	—	—
Water reservoirs	—	V	—	—	—	—
Hose stations	—	V	—	—	—	D
Strainers	—	—	—	V	—	—
Foam concentrate	—	—	—	F[2]	—	—
Concentrate storage tanks	—	V	—	—	—	—
Concentrate pump	F[4]	—	—	O	—	D
Concentrate control valve (automatic)	—	V	—	O	—	D
Concentrate shutoff valve	—	V	—	F	—	—
Foam proportioning device	—	V	—	—	—	D
Water-powered monitor nozzle	—	V	—	D	—	—
Electric-powered manual nozzle	—	V	—	F	—	D
Water-powered high-expansion-foam (HEF) generator	—	V	—	O	—	D
Electric-powered high-expansion-foam (HEF) generator	—	V	—	F	—	D
Pneumatic detector	—	—	F	O[3]	—	—
Electric detector	—	—	F	O[3]	—	—
Optical detector	V	—	F	O[3]	—	—
Control panels	—	V	F	O	—	—
Alarm transmission (local and remote)	—	F	—	—	—	—
Tamper switch	—	—	—	—	F	—
Flow indication switch	—	—	—	O	—	—
Supervisory alarms	—	—	F	—	—	—
Manual actuation stations	—	—	F	—	—	—
Hangar floor drain system and separators	—	V	—	—	—	D
Fire doors	—	V	—	F	—	—
Gas detectors	—	V	F	—	—	—
Ventilation system in pits, tunnels, and ducts	—	—	F	—	—	—
Grounding equipment	—	—	—	—	—	F

V: Visual inspection. F: Functional test, no flow. O: Operational test with flow, no discharge. D: Operational test with actual discharge.

Notes:

[1]For the purposes of this test, the inspector's flow valve is acceptable.

[2]A sample should be sent to the manufacturer for analysis.

[3]At this time it is necessary to check that the set points are the same as the original.

[4]Churn test.

Table A.3.3.2 *Continued*

Aircraft	Gross Wing Area		Overall Height	
	m^2	ft^2	m	ft–in.
Tupolev TU-154	201.5†	2169	11.4†	37–4
Boeing 757	185.2†	1994	13.5†	44–6
Tupolev TU-204	182.4†	1963	13.9†	45–7
Boeing 727-200	157.9†	1700	10.4†	34–0
Lockheed L-100J Hercules	162.1†	1745	11.6†	38–3
Yakovlev Yak-42	150.0†	1614	9.3†	32–3
Boeing 737-600, -700, -800, -900	125.0†	1345	12.5†	43–3
Airbus A-318, A-319, A-320, A-321	122.6†	1319	11.8†	38–8
Boeing MD 80	112.3†	1209	9.0†	29–7
MD 90			9.3†	30–7
Gulfstream V	105.6†	1137	7.9†	25–10
Boeing 737-300, -400, -500	105.4†	1135	11.1†	36–6
Tupolev TU-334, TU-354	100.0†	1076	9.4†	30–9
BAC 1-11-500	95.8†	1031	7.5†	24–6
NAMC YS-11	94.8†	1020	8.9†	29–5
Fokker 100, 70	93.5†	1006	8.5†	27–10
BAC 1-11-300, -400	93.2	1003	7.5†	24–6
Boeing 717	93.0†	1001	8.8†	29–1
DC-9-30	93.0†	1001	8.4†	27–6
Boeing 737-200	91.0†	980	11.3†	37–0
Gulfstream IV	88.3†	950	7.4†	24–5
DC 9-10	86.8†	934	8.4†	27–6
BAe 146, RJX-70, -85, -100	77.3†	832	8.6†	28–3
Fokker 50, 60	70.0†	753	2.7†	27–3
Canadair RJ-700	68.6†	738	7.6†	24–10
Dash 8 Q400	63.0†	679	7.5†	24–7
ATR 72	61.0†	656	7.6†	25–1
Airtech CN-235	59.1†	636	8.2†	26–10
Saab 2000	55.7†	600	7.7†	25–4
Canadair RJ-100, -200	54.5†	587	6.2†	20–5
ATR 42	42.5†	586	7.6†	24–10
Dash 8 Q100, Q200	54.3†	585	7.5†	24–7
Embraer ERJ-135, -145	51.1†	550	6.9†	22–1
Cessna 750	48.9†	527	5.8†	18–11
Cessna 680	47.9†	516	5.5†	19–2
Saab 340	41.8†	450	6.9†	22–1
Embraer EMB-120	39.4†	424	6.3†	20–10
Bell Boeing V-22	39.5†	382	6.6†	21–9
Britten-Norman BN2	30.2†	325	4.2†	13–8
Cessna 650	28.9†	312	5.1†	16–9
Beech 1900	28.8†	310	4.7†	15–6
Beech King Air C90	27.3†	294	4.3†	14–3

*Aircraft with wing areas in excess of 279 m^2 (3000 ft^2).

†Data from *Jane's All the World's Aircraft.*

A.5.9.8 Consideration should be given to the selection of an extinguishing agent that could also be used as a means of inerting the pit in the event that flammable vapors are present concurrent with the loss of use of the ventilation system due to power failure, maintenance, or other causes.

A.5.11.2.2 Aircraft hangars also might require floor trench drainage systems to effectively dispose of water used for cleaning aircraft and hangar floor surfaces and water accumulation from possible flooding due to high groundwater tables, and to drain away water discharged from the fire protection equipment provided within the structure. Reference can be made to NFPA 415 for information on drainage systems and to Annex B of NFPA 15 for information on drainage equipment and arrangements.

A.5.11.2.4 In general, this means that the design has to be adequate to ensure that the liquid level at the center of the drain is below the top surface of the drain inlet grating for grated round, rectangular, and long trench-type inlets or below the floor surface in the case of a slit trench.

A.5.12.1 It is recommended that hangar heating, ventilating, and air-conditioning equipment fired with gas, liquid, or solid fuel be located in a fire-resistive or noncombustible detached building wherever possible.

A.5.12.4 Personnel should be fully instructed that in the event of a serious gasoline or similar flammable liquid spill on the hangar floor, the fans should be shut off.

A.5.13.2 See also 5.7.2 for power supply to doors accommodating aircraft.

A.5.14 All aircraft hangars should be surveyed to determine the need for approved lightning protection. Where installed, such systems should be listed. See NFPA 780.

A.5.15.1 As low a resistance as possible should be secured and maintained. Ten thousand ohms is a practical recommended maximum where determined by standard procedures. For further details on this subject, see NFPA 407 and NFPA 77.

A.5.15.3 Speedometer, preformed steel, or equivalent cable will minimize danger of employee hand injury.

A.5.17 *Depth of Draft Curtains.* Draft curtains should extend down from the roof or ceiling of aircraft storage and servicing areas not less than one-eighth of the height from the floor to the roof or ceiling. Under curved or sloping roofs extending to grade level or close to grade level, draft curtains need not be continued below 4.8 m (16 ft) from the floor.

Installation of Draft Curtains. Draft curtains should be installed, preferably at right angles to the hangar doors, forming roof pockets that are rectangular in shape. Hangars that are long and narrow, however, might best be subdivided by a "grid" system of draft curtains that are both at right angles and parallel to the doors. In arch-type hangars, draft curtains can be hung on exposed interior roof supports running parallel to the doors. The method of installation should be based on obtaining maximum operational efficiency from the sprinkler protection, taking into consideration mean wind conditions, floor drains, floor pitch, and details of occupancy usage.

Roof Sections as Draft Curtains. Structural features of a building that serve the purpose of draft curtains (roof monitors, sawtooth roofs, etc.) can be permitted in lieu of specially constructed draft curtains.

A.5.17.1 The reason for limiting a draft curtain area to 697 m^2 (7500 ft^2) is to improve detection and sprinkler response times, not to limit the fire suppression system size.

A.6.2.1.1 It is highly important and expedient that all applicable areas of responsibility, such as those that cover adequacy of water supplies, design, suitability of agent, application rates used, area covered, testing, flushing, approvals, and so forth, be clearly defined in the contract documents. This is important where there is shared responsibility for various portions of the fire protection systems.

A.6.2.2.2 The manual control valve for each individual sprinkler system should be located outside aircraft storage and servicing areas.

A.6.2.2.7 This provision is for the purpose of addressing obstructions that can be caused by hangar door positions. It is not intended to address interference due to wind.

A.6.2.3.1 Supplementary protection systems for hangars containing several aircraft, each having a wing area less than 279 m^2 (3000 ft^2), can be warranted. Such systems are recommended under the following conditions:

(1) Rapid control of a fuel fire exposing a single aircraft is considered essential.
(2) Strategically important military aircraft or multiple high valued aircraft are accommodated.
(3) Arrangement of aircraft within a hangar results in congestion and limited access to individual aircraft.

A.6.2.3.2 In general, the specified floor area would be the area under the wings and wing center sections of the aircraft. Configuration of aircraft and positioning of aircraft and ground equipment within an aircraft storage and servicing area can compromise the effectiveness of any supplementary protection systems. Original design and testing of such systems should anticipate obstructions on the floor (such as those created by working platforms) in providing protection over the specified floor areas. The discharge from overhead hangar protection systems might not protect the aircraft from a fire in the shielded areas beneath the wings and the wing center sections. The supplementary system is intended to provide protection in those shielded areas by controlling such fires quickly and preventing extensive damage to the aircraft. The area to be protected depends on the configuration and the number of aircraft and their positioning arrangements, as well as the location of permanent service structures within the aircraft maintenance and servicing area. Protection of the entire aircraft maintenance and servicing area could be required because of the variety of possible aircraft positioning arrangements.

The total area to be protected by a single system depends on the number and configuration of aircraft and their proximity to one another and the drainage arrangements. If more than one aircraft is located in any drainage system, the supplementary foam system preferably should be capable of covering the floor area beneath all such aircraft.

A.6.2.3.4.2 Experience has shown that the mechanism for manual operation of automatic oscillating monitor nozzles is a major factor in the failure rate of these devices. A large percentage of these failures have been due to operators failing to change the device from the manual to the automatic mode after testing and maintenance. The most reliable device is considered to be one that is designed for automatic operation only and that has no manual operating mode.

A.6.2.3.5.2 To achieve the design principles, the rate of foam rise should be at least 0.9 m/min (3 ft/min) beneath the aircraft wings and wing center section. With large shielded areas, a higher rate of foam rise could be required.

rather than single pumps and the use of multiple sources of power in order to increase the reliability of pump drivers. Water supplies should be guarded against entry of foreign material that would clog sprinklers or piping. Waterworks connections, where used as an independent supply, should be capable of delivering water at the specified rate and pressure as determined by flow tests, with due consideration given to any conditions that could affect the design supply and pressure. Investigation should be made to determine the normal and emergency operation of the waterworks system, including domestic consumption and operation of the waterworks pumps at time of test, pressure-reducing valves, or other factors affecting adequacy of a public water supply. Automatic booster fire pumps should be used to provide effective pressure from waterworks connections.

A.6.2.10.8.4 Supplemental means for automatically starting the fire pumps should also be provided.

A.6.2.10.9 In connection with the flushing operation, preplanning should be made for means of disposing of the large quantities of water discharged.

A.6.2.11.9 System actuation is defined as actuation of the water control valve.

A.6.4 For further information, see *NFPA 72*.

A.7.2.1 A preaction standard sprinkler system should be used only if there is a possibility of freezing in an unheated hangar.

A.7.3 Experience has shown that different brands of foam might not be compatible and can have varying levels of firefighting effectiveness. Care should be utilized in the selection of foam concentrates. For further information, see NFPA 16.

A.7.3.6.3 System actuation is defined as actuation of the automatic water control valve.

A.7.4 Experience has shown that different brands of foam might not be compatible and can have varying levels of firefighting effectiveness. Care should be utilized in the selection of foam concentrates. For further information, see NFPA 16.

A.7.4.3 This design criterion can be achieved by means of multiple nozzles of the same or different capacities aimed to discharge toward the aircraft parking area. The fluidity of the foam will achieve coverage of the entire floor area.

A.7.4.5 Actual flow rates are often higher than calculated, which will often result in a reduction in foam supply duration.

A.7.5.8 System actuation is defined as actuation of the automatic water control valve.

A.7.6.7 This should be accomplished by providing manifolded drains.

A.7.8 See A.6.2.10.1.

A.8.1.1 Group III hangars for small aircraft either are prefabricated assemblies or are locally constructed of unprotected steel or aluminum, light wood framing, or cement or cinder blocks. The majority of the prefabricated types are unprotected steel structures with sheet steel or aluminum roof coverings and sidings. Other prefabricated hangars have wood or cement sidings and wood or plywood doors. Except in unusual circumstances, construction types other than Type II (000) and Type V (000) are unlikely because of cost factors. Earth floors are common. Floor drainage is not required for single-unit or row hangars, although utility drains are useful and should be provided. The airport operator should have a master key for the Group III hangars on the airport premises so as to provide emergency access in case of fire. *(See A.5.1.1.)*

A.8.4.4 Personnel should be fully instructed that in the event of a serious gasoline or similar flammable liquid spill on the hangar floor, the fans should be shut off.

A.8.5.2 See also 5.7.2 for power supply to doors accommodating aircraft.

A.8.7.1 As low a resistance as possible should be secured and maintained. A practical recommended maximum is 10,000 ohms (Ω) where determined by standard procedures. For further details on this subject, see NFPA 407 and NFPA 77.

A.8.7.3 Speedometer, preformed steel, or equivalent cable should minimize the danger of employee hand injury.

A.8.9.1 Fire loss history has shown that in aircraft hangars, regardless of size, if the fire event involves aircraft fuels, there is a significantly increased potential for loss of the hangar and contents if an automatic fire suppression system is not provided.

A.9.1 Membrane-covered rigid-steel-frame structures (Group IV hangars) are an evolving construction technology that is recognized by the model building codes and is being used for a variety of occupancies, including warehouses and hangars. The use of membrane-covered rigid-steel-frame structures for providing weather protection covering for aircraft has become a viable alternative to the traditional construction techniques that have been used for aircraft hangars. The fire protection scheme considered for these structures anticipates that, in the event of a fire, the structure will be self-venting.

A.9.12.3 Speedometer, preformed steel, or equivalent cable should minimize the danger of employee hand injury.

A.9.14.7.4.2 There is little concern for a large volume of water being associated with a high-expansion foam solution. In an aggregation of mechanically expanded foam, the ratio of air or other gases to foam–water solution ranges from 200:1 to approximately 1000:1.

A.9.14.10.2.1 Additional guidance pertaining to detection systems can be found in *NFPA 72*. The selection of fire detectors should take into account factors such as the following:

(1) The anticipated fuel
(2) The ability of the detectors to sense fire in the fire zone
(3) The speed at which the detector will sense the fire
(4) Potential sources of stimuli that could be falsely detected as a fire

Detection systems for low-level systems should be either a radiation (infrared or ultraviolet) or a heat-responsive (continuous strip–type or thermistor-type) system. Spacing of detection devices should be no greater than the maximum recommended by the manufacturer.

A.9.14.13.8.8 System actuation is defined as actuation of the automatic water control valve.

A.9.14.15 For further information, see *NFPA 72*.

A.10.3.3.1 The airflow velocity at every point should be within ±20 percent of the mean velocity across the cross-sectional area of the filters.

A.10.3.3.2 Where the provisions of 10.3.3.2 require shutting down the recirculation system, the exhaust system should remain in operation. In this event, recirculation air could be

Table B.2 Fire Resistance Ratings (in hours) for Type I through Type V Construction

	Type I		Type II			Type III		Type IV	Type V	
	443	332	222	111	000	211	200	2HH	111	000
Exterior Bearing Walls										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0[1]	2	2	2	1	0
Supporting one floor only	4	3	2	1	0[1]	2	2	2	1	0[1]
Supporting a roof only	4	3	1	1	0[1]	2	2	2	1	0
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[2]	1	0
Supporting one floor only	3	2	2	1	0	1	0	H[2]	1	0
Supporting roofs only	3	2	1	1	0	1	0	H[2]	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[2]	1	0
Supporting one floor only	3	2	2	1	0	1	0	H[2]	1	0
Supporting roofs only	3	2	1	1	0	1	0	H[2]	1	0
Floor Construction	3	2	2	1	0	1	0	H[2]	1	0
Roof Construction	2	1½	1	1	0	1	0	H[2]	1	0
Exterior Nonbearing Walls[3]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]

Those members that shall be permitted to be of approved combustible material.

[1]See NFPA 220, A-3-1 (table).

[2]"H" indicates heavy timber members; see NFPA 220 for requirements.

[3] Exterior nonbearing walls meeting the conditions of acceptance of NFPA 285, *Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus*, shall be permitted to be used.

[**220:** Table 3]

B.6 Type V (111 or 000). Type V construction shall be that type in which exterior walls, bearing walls, columns, beams, girders, trusses, arches, floors, and roofs are entirely or partially of wood or other approved combustible material smaller than material required for Type IV construction. In addition, structural members shall have fire resistance ratings not less than those specified in Table B.2. [**220:**3.5]

Annex C Informational References

C.1 Referenced Publications. The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not part of the requirements of this document unless also listed in Chapter 2.

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

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2001 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2003 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2003 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2003 edition.

NFPA 68, *Guide for Venting of Deflagrations*, 2002 edition.

NFPA 72®, National Fire Alarm Code®, 2002 edition.

NFPA 77, *Recommended Practice on Static Electricity*, 2000 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1999 edition.

NFPA 220, *Standard on Types of Building Construction*, 1999 edition.

NFPA 285, *Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus*, 1998 edition.

NFPA 407, *Standard for Aircraft Fuel Servicing*, 2001 edition.

NFPA 410, *Standard on Aircraft Maintenance*, 2004 edition.

Index

NEPTUNE PROPERTIES, INC.

120 EXCHANGE STREET PORTLAND, MAINE 04101

October 28, 2006

Tammy Munson, Code Enforcement Officer
389 Congress Street
Portland, ME 04101

Re: Neptune Hangar, 1111-1127 Westbrook Street

Dear Tammy:

Thanks for the "pre-final" inspection of the hangar project 2 weeks ago.

We have addressed all the issues you noted during the inspection such as the fire extinguishers (reviewed with the Chief), sheet rocking under the stairs, etc.

Concerning the issue you raised in your subsequent phone call to me regarding IBC 412.2.4 "heating equipment for hangars", I have reviewed this situation with Bill Hopkins and offer the following for your review:

The single interior door exception has been met since the ignition sources are 18" above the floor.

The mechanical room was constructed with a 1-hour fire rating (however the door is 90 minute) vs. the 2-hour rating called for in 412.2.4. Changing this construction at this time would be very disruptive and expensive as well. The mechanical equipment and associated plumbing has already been installed. I offer the following as mitigating factors to this particular situation:

1) The hangar floor is pitched to drain to the center catch basin and the mechanical room door is at the highest most remote point of the floor, thus preventing fuel from ever reaching this area.
2) The heating system in the mechanical rooms do not serve the hangar space, but rather the office space (i.e. no ductwork / return air connections).
3) The boiler and furnace are both full condensing models with no open ignition or flame. The exhaust gas as well as the combustion air is a closed system vented directly to the exterior of the building.
4) There is no aircraft storage within 5' of the rear wall that would put fuel tanks or engines in this area. This is due to the electrical code (and is placarded accordingly).

OFFICE: 207-775-2100 FAX: 207-874-6988

5) The building has a full fire alarm system although not required by code, with heat and/or smoke detectors inside and outside the mechanical rooms.

In addition I propose to:

1) Install a sprinkler head (13R) in each mechanical room along with a flow switch tied to the fire alarm panel.
2) Install a shunt trip breaker so that any activation of the fire alarm system would kill all power to the mechanical room.
3) Install gasketed thresholds on the mechanical room doors to prevent any vapors from entering from the hangar space.

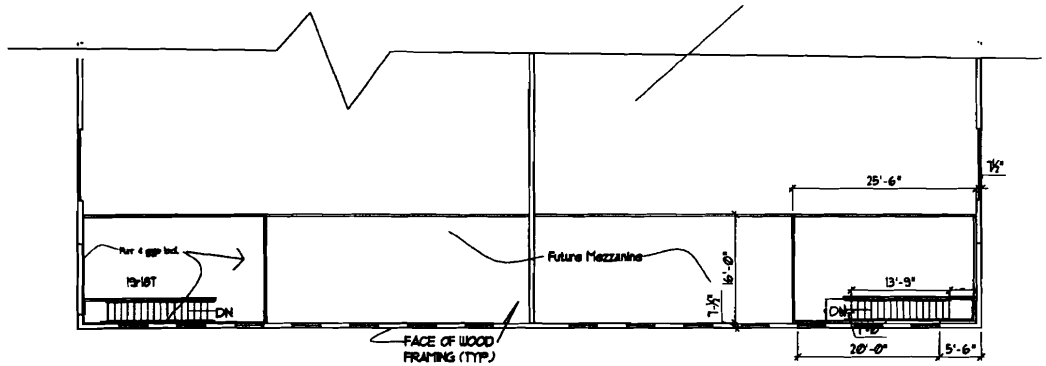
I trust that you will see this as a reasonable alternative to the 2 hour rating.

Thanks for your cooperation on this project.

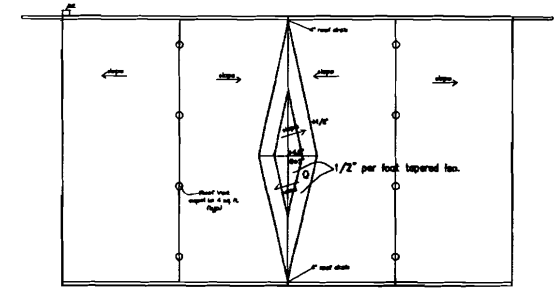
Sincerely,

Mike Scarks, President

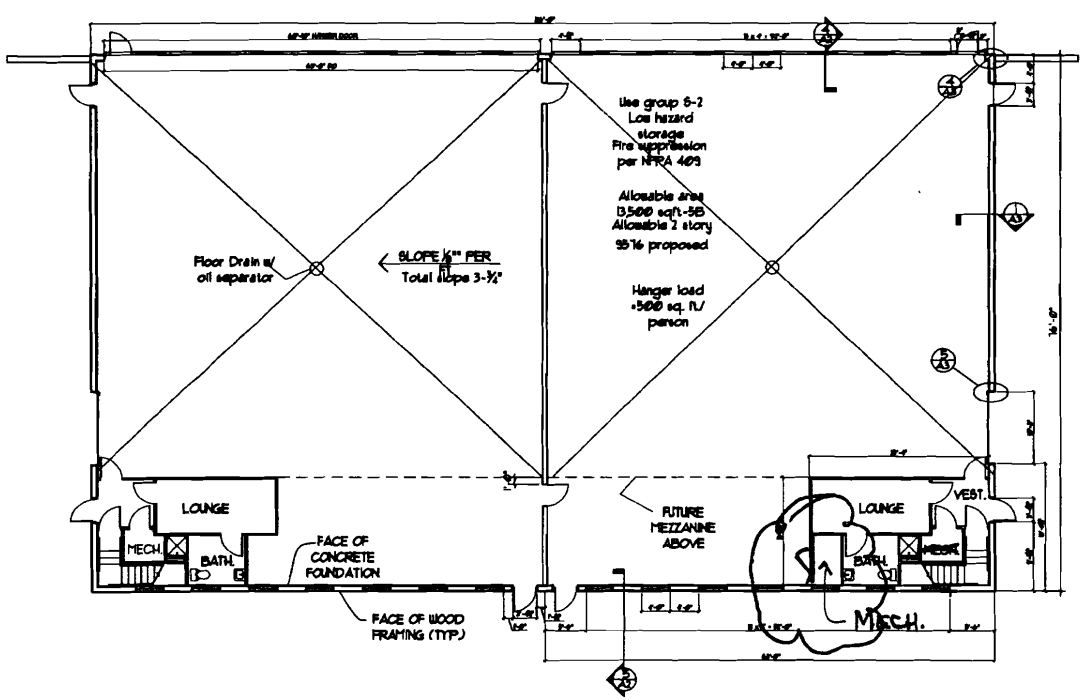
c.c. Bill Hopkins



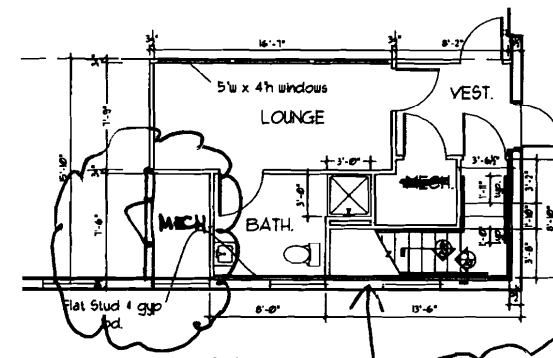
(2) 2nd FLOOR PLAN
SCALE : 1/8" = 1'-0"



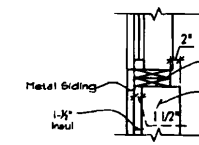
(3) ROOF PLAN
SCALE : 1/8" = 1'-0"



(1) 1st FLOOR PLAN
SCALE : 1/8" = 1'-0"



(4) STAIR
SCALE : 1/4" = 1'-0"



(5) DETAIL
SCALE : 1" = 1'-0"

MEZZANINE/OFFICE ABOVE TO BE OCCUPIED.

Note: All dimensions to interior face of foundation wall

OWNER:	NEPTUNE PROPERTIES LLC 120 Exchange, Portland, Maine 04101 (207) 775-2100 Fax (207) 874-6988
	ARCHETYPE, P.A. ARCHITECTS 48 Union Wharf Portland, Maine 04101 (207) 772-4022 Fax (207) 772-4056
Scale: AS NOTED Checked By:	
Date: NOV 11, 2005 Revisions: 1-1-06 issued for Permit	
Project:	PLANS AIRPLANE HANGAR WESTBROOK STREET PORTLAND, MAINE
	A01

General Building Permit Application

If you or the property owner owes real estate or personal property taxes or user charges on any property within the City, payment arrangements must be made before permits of any kind are accepted.

Location/Address of Construction: 1111-1127 WESTBROOK ST.		
Total Square Footage of Proposed Structure: 9600 SF	Square Footage of Lot: 24,000 SF +/-	
Tax Assessor's Chart, Block & Lot Chart# 207 Block# B Lot# 1	Owner: NEPTUNE PROPERTIES LLC 120 EXCHANGE ST. PORTLAND, ME	Telephone: 7752100
Lessee/Buyer's Name (If Applicable) SAME	Applicant name, address & telephone: SAME FAX 874 6988	Cost Of Work: $ UNDER ORIGINAL PERMIT Fee: $ C of O Fee: $
Current Specific use: UNDEVELOPED If vacant, what was the previous use? AIRCRAFT HANGAR PARKING LOT Proposed Specific use: Project description: AMEND TO CHANGE LOCATION OF MECHANICAL ROOM AND USE EXISTING PORTION OF MEZZANINE (2ND FLOOR ABOVE OFFICE)		
Contractor's name, address & telephone: Who should we contact when the permit is ready: MICHAEL SCARKS Mailing address: Phone: 775 2100		

Please submit all of the information outlined in the Commercial Application Checklist. Failure to do so will result in the automatic denial of your permit.

In order to be sure the City fully understands the full scope of the project, the Planning and Development Department may request additional information prior to the issuance of a permit. For further information visit us on-line at www.portlandmaine.gov, stop by the Building Inspections office, room 315 City Hall or call 874-8703.

I hereby certify that I am the Owner of record of the named property, or that the owner of record authorizes the proposed work and that I have been authorized by the owner to make this application as his/her authorized agent. I agree to conform to all applicable laws of this jurisdiction. In addition, if a permit for work described in this application is issued, I certify that the Code Official's authorized representative shall have the authority to enter all areas covered by this permit at any reasonable hour to enforce the provisions of the codes applicable to this permit.

Signature of applicant:	**Date:** 10/30/06

This is not a permit; you may not commence ANY work until the permit is issued.

BUILDING PERMIT INSPECTION PROCEDURES
Please call 874-8703 or 874-8693 to schedule your inspections as agreed upon

Permits expire in 6 months, if the project is not started or ceases for 6 months.

The Owner or their designee is required to notify the inspections office for the following inspections and provide adequate notice. Notice must be called in 48-72 hours in advance in order to schedule an inspection:

By initializing at each inspection time, you are agreeing that you understand the inspection procedure and additional fees from a "Stop Work Order" and "Stop Work Order Release" will be incurred if the procedure is not followed as stated below.

A Pre-construction Meeting will take place upon receipt of your building permit.

N/A	**Footing/Building Location Inspection:**	Prior to pouring concrete
N/A	**Re-Bar Schedule Inspection:**	Prior to pouring concrete
N/A	**Foundation Inspection:**	Prior to placing ANY backfill
Call	**Framing/Rough Plumbing/Electrical:**	Prior to any insulating or drywalling
Call	**Final/Certificate of Occupancy:**	Prior to any occupancy of the structure or use. NOTE: There is a $75.00 fee per inspection at this point.

Certificate of Occupancy is not required for certain projects. Your inspector can advise you if your project requires a Certificate of Occupancy. All projects **DO** require a final inspection

_____ **If any of the inspections do not occur, the project cannot go on to the next phase, REGARDLESS OF THE NOTICE OR CIRCUMSTANCES.**

_____ **CERIFICATE OF OCCUPANICES MUST BE ISSUED AND PAID FOR, BEFORE THE SPACE MAY BE OCCUPIED**

Linda Clark — 11/22/06
Signature of Applicant/Designee — Date

[illegible] — 11/22/06
Signature of Inspections Official — Date

CBL: 207 B001 001 Building Permit #: 061588

City of Portland, Maine - Building or Use Permit

389 Congress Street, 04101 Tel: (207) 874-8703, Fax: (207) 874-8716

Permit No:	Date Applied For:	CBL:
06-1588	10/30/2006	207 B001002

Location of Construction:	Owner Name:	Owner Address:	Phone:
1127 WESTBROOK ST	NORTHEAST AIR	1011 WESTBROOK ST	
Business Name:	**Contractor Name:**	**Contractor Address:**	**Phone**
Lessee/Buyer's Name	**Phone:**	**Permit Type:**	
		Amendment to Commercial	

Proposed Use:	Proposed Project Description:
Commercial / aircraft hangar ammend permit # 06-0061 change location of mechanical room and use existing portion of mezzanine	ammend permit # 06-0061 change location of mechanical room and use existing portion of mezzanine

Dept: Zoning **Status:** Approved with Conditions **Reviewer:** Marge Schmuckal **Approval Date:** 11/01/2006

Note: **Ok to Issue:** ☑

1) All previous conditions on the original permit are still in force.

Dept: Building **Status:** Approved **Reviewer:** Tammy Munson **Approval Date:** 11/13/2006

Note: after the fact permit **Ok to Issue:** ☑

Dept: Fire **Status:** Approved **Reviewer:** Cptn Greg Cass **Approval Date:** 11/02/2006

Note: **Ok to Issue:** ☑