Aircraft Hangar Fire Protection

**Group I**
Group I hangars are those with at least one of the following conditions:
- An aircraft access door height of more than 28 feet
- A single fire area in excess of 40,000 square feet
- Provision for housing an aircraft with a tail height more than 28 feet

**Group II**
Group II hangars have both of the following conditions:
- An aircraft access door height of 28 feet or less
- A single fire area that measures up to the maximum square footage permitted for specific types of construction in accordance with Table 4.1.2 (see Table 1)

**Group III**
Group III hangars have both of the following conditions:
- An aircraft access door height of 28 feet or less
- A single fire area that measures up to the maximum square footage permitted for specific types of construction in accordance with Table 4.1.3 (see Table 2)

**Group IV**
A Group IV aircraft hangar is a structure constructed of a membrane-covered rigid steel frame.

**Protection Options**
Firefighting foam originally was developed in the 1930s to fight flammable liquid fires. Since huge discharges of water alone will not suppress an enormous pool fire on the floor of a hangar, a mixture of foam and water is used to suppress such fires using a blanket effect that smothers the flames and provides vapor suppression.

Once the type of hangar classification has been determined, the fire protection requirements can be established. The suppression system may consist of automatic sprinklers, foam/water deluge, low-level, low-expansion foam, high-expansion foam, and foam/water hand hoseline systems.

### Automatic Sprinklers
Sprinkler systems shall be designed in accordance with NFPA 13: Standard for the Installation of Sprinkler Systems. Sprinklers can be included in shops, offices, and service or maintenance bays, and the layout and spacing of the system shall be in accordance with the hazard requirements of the area being protected. A sprinkler system may be wet pipe, dry pipe, or preaction, and the piping shall be hydraulically calculated. Since hangar doors may interfere with the sprinkler water spray, additional sprinklers may be required.

### NFPA 409 (2011): Standard on Aircraft Hangars
NFPA 409 (2011): Standard on Aircraft Hangars is the technical document on fire safety for the construction and protection of airport facilities, including construction engineering but excluding airport fixed-fueling systems. The standard applies only to buildings or structures used for aircraft storage, maintenance, or related activities. Other uses within an aircraft hangar shall be protected in accordance with other applicable NFPA standards. The purpose of this standard is to provide a reasonable degree of protection from fire for life and property in aircraft hangars, based on sound engineering principles, test data, and field experience.

### HANGAR CLASSIFICATIONS
The first step in the process is determining the type of hangar or classification. NFPA divides hangars into four categories: Group I, II, III, and IV.

**Group I**
Group I hangars are those with at least one of the following conditions:
- An aircraft access door height of more than 28 feet
- A single fire area in excess of 40,000 square feet
- Provision for housing an aircraft with a tail height more than 28 feet

**Group II**
Group II hangars have both of the following conditions:
- An aircraft access door height of 28 feet or less
- A single fire area for specific types of construction in accordance with Table 4.1.2 (see Table 1)

**Group III**
Group III hangars have both of the following conditions:
- An aircraft access door height of 28 feet or less
- A single fire area that measures up to the maximum square footage permitted for specific types of construction in accordance with Table 4.1.3 (see Table 2)

**Group IV**
A Group IV aircraft hangar is a structure constructed of a membrane-covered rigid steel frame.

### NFPA 409 TABLE 4.1.2: FIRE AREAS FOR GROUP II AIRCRAFT HANGARS

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Single Fire Area (inclusive), ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I (443) and (332)</td>
<td>30,001–40,000</td>
</tr>
<tr>
<td>Type II (222)</td>
<td>20,001–40,000</td>
</tr>
<tr>
<td>Type II (111), Type III (211), and Type IV (2HH)</td>
<td>15,001–40,000</td>
</tr>
<tr>
<td>Type II (000)</td>
<td>12,001–40,000</td>
</tr>
<tr>
<td>Type III (200)</td>
<td>12,000–40,000</td>
</tr>
<tr>
<td>Type V (111)</td>
<td>8,001–40,000</td>
</tr>
<tr>
<td>Type V (000)</td>
<td>2,001–40,000</td>
</tr>
</tbody>
</table>

Note: For further explanation of construction types, consult NFPA 220: Standard on Types of Building Construction.

### NFPA 409 TABLE 4.1.3: FIRE AREAS FOR GROUP III AIRCRAFT HANGARS

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Maximum Single Fire Area, ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I (443) and (332)</td>
<td>30,000</td>
</tr>
<tr>
<td>Type II (222)</td>
<td>20,000</td>
</tr>
<tr>
<td>Type II (111), Type III (211), and Type IV (2HH)</td>
<td>15,000</td>
</tr>
<tr>
<td>Type II (000)</td>
<td>12,000</td>
</tr>
<tr>
<td>Type III (200)</td>
<td>12,000</td>
</tr>
<tr>
<td>Type V (111)</td>
<td>8,000</td>
</tr>
<tr>
<td>Type V (000)</td>
<td>5,000</td>
</tr>
</tbody>
</table>

Note: For further explanation of construction types, consult NFPA 220: Standard on Types of Building Construction.
may be needed to protect the building and contents when the doors are open.

**Foam/Water**

A foam/water deluge system is an arrangement of open sprinkler heads and piping throughout the hangar area, so when a fire event occurs, all of the sprinkler heads operate. Because of the large volume of water required, the maximum projected floor area of an individual deluge system shall not exceed 15,000 square feet. The maximum area of sprinkler coverage shall not exceed 130 square feet, and the distance between branch lines and sprinklers on branch lines shall be a maximum of 12 feet.

**Low-level, Low-expansion Foam**

Low-level, low-expansion foam systems can extinguish a fire with only a few inches of foam. Low-expansion foams expand one to 20 times greater than their original volume, and they are designed to spread over a liquid surface. Foam distribution shall occur over the entire hangar floor and service area to within 5 feet of the perimeter walls and doors within three minutes of system activation. If the sprinkler system in the area activates, the low-level foam system shall activate simultaneously.

**High-expansion Foam**

High-expansion foam expands 200 to 2,000 times greater than its original volume. High-expansion foams are best suited for three-dimensional fires, but they also are utilized to suppress liquid spill fires. Foam generators are located high along the perimeter walls or on the roof, situated so only outside air can be used for foam generation.

**Foam/Water Hand Hoselines**

Foam/water hand hoseline systems are required in every hangar area to provide manual fire control. They must be located so the extinguishing agent can reach each side of the aircraft and enter the interior of the aircraft. A minimum of two hoselines shall be designed to be operated concurrently, and the minimum hose size shall be 1½ inches in diameter. Each system must flow at a minimum of 60 gallons per minute (gpm) at sufficient nozzle pressure, with a foam solution discharge duration of 20 minutes.

**RESOURCES**

1. NFPA 11: Standard for Low-, Medium-, and High-expansion Foam
2. NFPA 13: Standard for the Installation of Sprinkler Systems
3. NFPA 14: Standard for the Installation of Standpipes and Hose Systems
5. NFPA 16: Standard for the Installation of Foam/Water Sprinkler and Foam/Water Spray Systems
8. NFPA 30: Flammable and Combustible Liquids Code
9. NFPA 409: Standard on Aircraft Hangars

James Stenqvist, CPD, LEED AP, is a project engineer with Diversified Technology Consultants in Hamden, Conn. For more information or to comment on this article, e-mail articles@psdmagazine.org. This article is meant to provide some basic guidelines. Always check all relevant codes and resources for a particular project.

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CHECKLIST FOR AIRCRAFT HANGAR FIRE PROTECTION

Plans and Specification Requirements
☐ Design purpose of the system
☐ Discharge densities and period of discharge
☐ Hydraulic calculations
☐ Details of tests on the available water supply
☐ Details of proposed water supplies
☐ Detailed layout of the piping and detection systems
☐ Make and type of discharge devices, operating equipment, and foam concentrate to be installed
☐ Location and spacing of discharge devices
☐ Pipe hanger and bracing location and installation details
☐ Location of draft curtains
☐ Accurate and complete layout of the area to be protected, including drainage layout
☐ Details of any foam concentrate, its storage and injection, and other pertinent data to provide a clear explanation of the proposed design
☐ Location and spacing of supplementary or low-level agent distributors, showing the area of coverage
☐ Installation layout of the actuation systems
☐ Detailed layout of water supply piping, agent storage, pumping and piping, power sources, and location and details of mechanical foam/liquid concentrate injection equipment

Group I Hangar Protection
☐ Option 1: A foam/water deluge system. In addition, supplementary protection systems shall be provided in hangars housing single aircraft having wing areas greater than 3,000 square feet.
☐ Option 2: A combination of automatic sprinkler protection and an automatic low-level, low-expansion foam system
☐ Option 3: A combination of automatic sprinkler protection and an automatic, high-expansion foam system

Group II Hangar Protection
☐ Option 1: A foam/water deluge system. In addition, supplementary protection systems shall be provided in hangars housing single aircraft having wing areas greater than 3,000 square feet. If air-aspirating discharge devices are installed, the discharge rate is permitted to be reduced to a minimum of 0.16 gpm per square foot of floor area.
☐ Option 2: A combination of automatic sprinkler protection and an automatic, low-level, low-expansion foam system
☐ Option 3: A combination of automatic sprinkler protection and an automatic, high-expansion foam system
☐ Option 4: A closed-head foam/water sprinkler system

Group III Hangar Protection
☐ Fixed fire protection systems shall be installed where required by and in accordance with locally adopted building codes.
☐ Where hazardous operations (e.g., fuel transfer, welding, torch cutting, torch soldering, doping, and spray painting) are performed in any Group III hangar, the hangar shall be protected the same as a Group II hangar.

Group IV Hangar Protection
The protection of aircraft storage and servicing areas for membrane-covered, rigid steel-frame structure hangars having a hangar fire area greater than 12,000 square feet and housing fueled aircraft shall be in accordance with any of the following:
☐ A low-expansion foam system
☐ A high-expansion foam system

The protection of aircraft storage and servicing areas for membrane-covered, rigid steel-frame structure hangars having a hangar fire area greater than 12,000 square feet and housing unfueled aircraft shall be in accordance with any of the following:
☐ A low-expansion foam system
☐ A high-expansion foam system
☐ Automatic sprinkler protection with specific water supply requirements

The protection of aircraft storage and servicing areas for membrane-covered, rigid steel-frame structure hangars having a hangar fire area less than 12,000 square feet and where hazardous operations (e.g., fuel transfer, welding, torch cutting, torch soldering, doping, and spray painting) are performed shall be in accordance with the following:
☐ Automatic sprinkler protection in accordance with NFPA 13