



The Voice of Aviation Business

The Future of Hangar Fire Protection

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10:55-11:35 am

Panel



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NATA TOOLKIT | Aircraft Hangar Fire Protection Guidance

Applicable Codes and Hangar Classification

Code Exceptions How to Avoid Foam

If Foam is Required Other Considerations

Foam System Recommendations

Most Frequently Asked Questions

AIRCRAFT HANGAR FIRE PROTECTION GUIDANCE

FOAM CODE COMPLIANCE

Publication of National Fire Protection Association (NFPA) 409, *Standard on Aircraft Hangars*, 2022 edition, has created confusion on foam fire suppression system requirements. The flow chart (below) provides guidance on various options to achieve code compliance relative to fire suppression systems based on the International Building Code® (IBC), 2021 edition; International Fire Code® (IFC), 2021 edition; and NFPA 409, 2016 edition. NFPA 409, 2022 edition will not be referenced by the IBC or IFC until the 2024 edition.

This document is intended to provide general understanding of hangar foam suppression system requirements, options and alternatives. It is highly recommended that the services of a licensed and experienced design professional be utilized for the design and permitting process to achieve best success for the project.



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AIRCRAFT HANGAR FIRE PROTECTION GUIDANCE



GROUP I >28 FT. DOOR HEIGHT OR >40,000 SF	GROUP II >28 FT. DOOR HEIGHT OR >12,000 SF OR <40,000 SF	GROUP III <28 FT. DOOR HEIGHT OR <12,000 SF, may be up to 30,000 SF (see note in Step 2)
Foam Required	Foam Required	Any Hazardous Operations? <ul style="list-style-type: none"> Yes No
Foam fire suppression system required. See next page for potential alternatives to the foam requirement.		
Hazardous operations are defined as fuel transfer, welding, torch cutting, torch soldering, welding, oxygen services, composite repairs, fuel system or fuel tank maintenance, aircraft cabling, wiring changes or initial electrical system testing.		
Group II Hangar: Foam may be eliminated if none of the following hazardous operations are performed within the hangar: fuel transfer, welding, torch cutting, torch soldering, welding, oxygen services, composite repairs, fuel system or fuel tank maintenance, aircraft cabling, wiring changes or initial electrical system testing.		
Decrease the fire area of a single hangar by creating multiple hangars separated by 2-hour fire walls, thus limiting the hangar to Group II or Group III. (IBC 412.3.6.2)		
Separate accessory spaces, such as offices and shops, by a 1-hour fire barrier wall (gypsum board, concrete block or concrete) to reduce the hangar fire area. Accessory spaces can then be excluded from the hangar area used to determine the hangar "group". (IBC 412.3.6.2)		
Use high-expansion foam (no PFAS) with foam generator on the ceiling or synthetic fluorine free foam (no PFAS) with monitors (cannons) along the perimeter. In a Group II or Group III hangar, consider a closed-head sprinkler system using synthetic fluorine free foam.		
Most importantly, engage the services of a qualified Fire Protection Engineer and/or Architect to start discussions with the AHI. The design professional must have experience with aircraft hangars, current protection methods and applicable codes/standards.		

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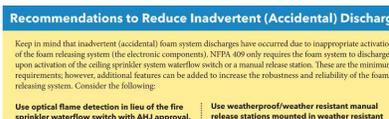
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- Utilize the services of a licensed and experienced design professional (Fire Protection Engineer and/or Architect) to develop an alternative design approach in lieu of foam. Both the IBC/IFC and NFPA provide for alternative approaches if the prescriptive requirements of the code cannot be achieved.
- Discuss the use of NFPA 409, 2022 edition with the Authority Having Jurisdiction (AHJ). If acceptable:
 - Group I or II Hangar: Utilize the Fire Risk Assessment (Chapter 4) or the Performance-Based Design (Chapter 5) approach to eliminate foam.
 - Group III Hangar: Foam may be eliminated if none of the following hazardous operations are performed within the hangar: fuel transfer, welding, torch cutting, torch soldering, welding, oxygen services, composite repairs, fuel system or fuel tank maintenance, aircraft cabling, wiring changes or initial electrical system testing.
- Use the Alternative Means and Methods Request (AMMR) process permitted by the IBC/IFC and the local AHJ. These alternative approaches typically require the integration of a Fire Protection Engineer and/or Architect to assist in evaluation, assembly of the reports and coordination with the AHJ.
 - Evaluate if the fire rating of the hangar can be increased. For example, a 20,000 square foot Group II hangar (typically required to have foam) can be downgraded to a Group III hangar (without foam) by increasing the fire rating of the structure. (IBC Table 412.3.6)
 - Decrease the fire area of a single hangar by creating multiple hangars separated by 2-hour fire walls, thus limiting the hangar to Group II or Group III. (IBC 412.3.6.2)
 - Separate accessory spaces, such as offices and shops, by a 1-hour fire barrier wall (gypsum board, concrete block or concrete) to reduce the hangar fire area. Accessory spaces can then be excluded from the hangar area used to determine the hangar "group". (IBC 412.3.6.2)
 - Use high-expansion foam (no PFAS) with foam generator on the ceiling or synthetic fluorine free foam (no PFAS) with monitors (cannons) along the perimeter. In a Group II or Group III hangar, consider a closed-head sprinkler system using synthetic fluorine free foam.
- Most importantly, engage the services of a qualified Fire Protection Engineer and/or Architect to start discussions with the AHJ. The design professional must have experience with aircraft hangars, current protection methods and applicable codes/standards.

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- Use optical flame detection in lieu of the fire sprinkler waterflow switch with AHJ approval.**
 - Less prone to inadvertent activation
 - More robust device
 - Can be sequenced to require activation of two flame detectors before releasing foam
 - Use multi-spectrum infrared flame detectors with no UV component
 - Some landing lights utilize a light within the UV spectrum that could cause an inadvertent activation
 - Use weatherproof/weather resistant manual release stations mounted in weather resistant covers.**
 - Provide gasketing around the cover to reduce water entry
 - Install with conduit entering from the bottom of the manual release station to reduce water/condensation entry into the device
 - Use a foam releasing control unit (panel) separate from the building fire alarm system.**
 - Reduces potential for discharge when testing the fire alarm system
 - Isolates all foam initiating features in one separate location
 - Discuss the use of abort/stop stations with the AHJ.**
 - Abort stations can hold discharge when first activation signal occurs
 - Stop stations (combined with special valves) located adjacent to manual release stations can stop the flow of foam once started
- Most importantly, engage the services of a qualified design professional (Fire Protection Engineer or Architect), experienced in aircraft hangars and current fire protection methods.**

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- Are Fire Marshals required to use the 2022 edition of NFPA 409?** A: Each local authority adopts new versions of NFPA standards at different cycles. Since NFPA 409 is typically adopted by reference in the IBC/IFC, these codes still reference the 2016 NFPA 409. The 2022 edition may not be adopted until the 2024 IBC/IFC are adopted.
- Why are Fire Marshals still enforcing the 2016 edition of NFPA 409?** A: NFPA 409 is typically adopted through reference with the IBC/IFC and these codes will not adopt the 2022 edition until the 2024 edition is released.
- How often does the NFPA 409 standard get updated?** A: Every five years.
- How often does the IBC/IFC get updated?** A: Every three years.
- Does the IBC/IFC take precedence over NFPA 409?** A: Yes, the IBC/IFC reference NFPA 409 for fire suppression requirements. Where NFPA 409 provides more prescriptive design requirements in conflict with the IBC/IFC, the IBC/IFC shall govern unless the contrary of NFPA 409 has been adopted by the local AHJ. It is advised to consult the local AHJ if a conflict occurs.
- What is the relationship between the IBC/IFC and NFPA 409?** A: The IBC/IFC provide reference to NFPA 409 for fire suppression requirements.
- When should I use the AMMR process?** A: An AMMR should be used if a prescriptive approach to code compliance, or "by the book," cannot be used to eliminate foam.
- When should I consider using a high-expansion foam system?** A: Whenever foam is required. High-expansion (Hi-ex) foam does not contain PFAS and typically requires less foam concentrate than other foam systems. In addition, high-expansion foam systems use generators that mount up in the ceiling area so they do not take up floor area in the hangar.
- Do high-expansion foam systems use AFFF?** A: No. AFFF (aqueous film-forming foam) contains PFAS, which has become an environmental hazard, and makes very small bubbles that float on the hangar floor. Hi-ex does not contain PFAS, discharges through a generator at the ceiling level, and drops bubbles down to the hangar floor. Hi-ex systems are designed to fill the hangar to at least a meter of foam bubbles.

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Applicable Codes

AIRCRAFT HANGAR FIRE PROTECTION GUIDANCE

FOAM CODE COMPLIANCE

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STEP 1 Determine applicable codes and standards, adopted editions, and local amendments.

International Building Code, International Fire Code

NFPA 409, Standard on Aircraft Hangars

STEP 2 Determine Hangar Group Type Per NFPA 409 and IBC Table 412.3.6.

GROUP	DOOR HEIGHT	HANGAR BAY	FOAM
GROUP I	28 feet or higher	over 40,000 sf	Typically required. Go to Step 4.
GROUP II	28 feet or less	typically 12,000–40,000 sf	May not be required. Go to Step 3.
GROUP III	28 feet or less	typically less than 12,000 sf, may be up to 30,000 sf (see Note)	May not be required. Go to Step 3.

Note: Hangar construction type and fire rating may allow hangar bay area increases (IBC Table 412.3.6)

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2021 IBC and IFC

- 2016 NFPA 409 is adopted via Reference
- Section 412 “Aircraft Related Occupancies”
- 2024 I-Codes will adopt 2022 NFPA 409

Codes will typically be adopted by Authority Having Jurisdiction (AHJ) in 2025

NFPA 409: *Standard on Aircraft Hangars*

- Fire Suppression Standards
- Referenced Standard to IBC and IFC
- Which Code Takes Precedence?

Always Verify Code Requirements with AHJ

- Local Amendments
- Varying Adoption Dates

Hangar Classification

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STEP 1 Determine applicable codes and standards, adopted editions, and local amendments.

International Building Code, International Fire Code

NFPA 409, Standard on Aircraft Hangars

STEP 2

Determine Hangar Group Type Per NFPA 409 and IBC Table 412.3.6.

GROUP I DOOR HEIGHT: 28 feet or higher OR HANGAR BAY: over 40,000 sf
FOAM: Typically required. Go to Step 4.

GROUP II DOOR HEIGHT: 28 feet or less AND HANGAR BAY: typically 12,000–40,000 sf
FOAM: May not be required. Go to Step 3.

GROUP III DOOR HEIGHT: 28 feet or less AND HANGAR BAY: typically less than 12,000 sf, may be up to 30,000 sf (see note)
FOAM: May not be required. Go to Step 3.

Note: Hangar construction type and fire rating may allow hangar bay area increases (IBC Table 412.3.6)



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- Hangar Group I – **Foam Typically Required**
 - Door over 28’ or Hangar Bay over 40,000 SF
- Hangar Group II – **Foam May Not be Required**
 - Door 28’ or less and Hangar Bay 12,000-40,000 SF
- Hangar Group III – **Foam May Not be Required**
 - Door 28’ or less and Hangar Bay less than 12,000 (may be up to 30,000 SF with Building Fire Rating)

[F] TABLE 412.3.6 HANGAR FIRE SUPPRESSION REQUIREMENTS^{a, b, c}

MAXIMUM SINGLE FIRE AREA (square feet)	TYPE OF CONSTRUCTION								
	IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
≥ 40,001	Group I	Group I	Group I	Group I	Group I	Group I	Group I	Group I	Group I
40,000	Group II	Group II	Group II	Group II	Group II	Group II	Group II	Group II	Group II
30,000	Group III	Group II							
20,000	Group III	Group III	Group II						
15,000	Group III	Group III	Group III	Group II	Group III	Group II	Group III	Group II	Group II
12,000	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group II	Group II
8,000	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group II
5,000	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group III	Group III



Typical Code Exceptions

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STEP 3

If a Group II hangar and IBC is applicable:

Is this an FBO with separate repair facilities on site and used for storage of transient aircraft?

YES

STOP. Foam fire suppression not required (IBC Section 412.3.6 "Exception").

Fire sprinklers may still be required due to building area. Verify with local code requirements.

NO

Continue to Step 4.

STEP 4

Determine if foam is required by hangar group and operations.

GROUP I >28 FT. DOOR HEIGHT OR >40,000 SF	GROUP II >28 FT. DOOR HEIGHT OR >12,000 SF OR < 40,000 SF	GROUP III <28 FT. DOOR HEIGHT OR <12,000 SF may be up to 30,000 SF (see note in Step 2)
Foam Required	Foam Required	Any Hazardous Operations?
Foam fire suppression system required. See next page for potential alternatives to the foam requirement.		Hazardous operations are defined as fuel transfer, welding, torch cutting, torch soldering, doping or spray painting.
		YES
		Foam Required
		NO
		No Foam Required (IBC 412.3.1 and NFPA 409 8.8.1.2)
<p><i>Note: NFPA 409's use of "hazardous operations" in a Group III hangar is NOT the same as "hazardous operations" in a Group II hangar.</i></p>		



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2

- Group I Hangar
 - Limited Exceptions to Foam Requirement
- Group II Hangar
 - 2022 NFPA 409: Operations-Based Exception
 - 2021 IBC: Exception if FBO + Separate Repair Facilities + Transient
- Group III Hangar
 - Typically, No Foam Requirement unless for Hazardous Operations
 - Hazardous Operations = Fuel Transfer, Welding, Torch Cutting + Soldering, Doping or Spray Painting, Fuel Limitations = Fire Suppression per Group II (Foam)

If Foam is Required: Building Considerations



- Hangar Separations: Fire Walls and Setback
- Increase Building Fire Rating
- Separate Accessory Spaces with Fire Barriers

Alternate Code Approaches:

- Alternate Materials and Methods Request (AMMR)
 - IBC allows for Alternate Materials and Methods Approach
 - Prepared by Fire Protection Engineer or Design Professional
- Risk-Based Approach | 2022 NFPA 409
 - Fire Risk Assessment or Performance-Based Design

Foam System Recommendations

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Recommendations to Reduce Inadvertent (Accidental) Discharge

Keep in mind that inadvertent (accidental) foam system discharges have occurred due to inappropriate activation of the foam releasing system (the electronic components). NFPA 409 only requires the foam system to discharge upon activation of the ceiling sprinkler system waterflow switch or a manual release station. These are the minimum requirements; however, additional features can be added to increase the robustness and reliability of the foam releasing system. Consider the following:

Use optical flame detection in lieu of the fire sprinkler waterflow switch with AHJ approval.

- Less prone to inadvertent activation
- More robust device
- Can be sequenced to require activation of two flame detectors before releasing foam
- Use multi-spectrum infrared flame detectors with no UV component
- Some landing lights utilize a light within the UV spectrum that could cause an inadvertent activation

Use two methods of activation to eliminate a single point of failure with AHJ approval. Methods include:

- Two optical detectors
- One optical detector and a sprinkler waterflow switch
- One optical detector and a ceiling heat detector
- One ceiling heat detector and a sprinkler waterflow switch

Use weatherproof/weather resistant manual release stations mounted in weather resistant covers.

- Provide gasketing around the cover to reduce water entry
- Install with conduit entering from the bottom of the manual release station to reduce water/condensation entry into the device

Use a foam releasing control unit (panel) separate from the building fire alarm system.

- Reduces potential for discharge when testing the fire alarm system
- Isolates all foam initiating features in one separate location

Discuss the use of abort/stop stations with the AHJ.

- Abort stations can hold discharge when first activation signal occurs
- Stop stations (combined with special valves) located adjacent to manual release stations can stop the flow of foam once started

Most importantly, engage the services of a qualified design professional (Fire Protection Engineer or Architect), experienced in aircraft hangars and current fire protection methods.

RESOURCES | LINKS

Click on report names below to view online.

- NATA Fire Marshal Toolkit >
- Review of Foam Fire Suppression System Discharges in Aircraft Hangars, November 2019 >
- Review of Foam Fire Suppression System Discharges in Aircraft Hangars, February 2021 >
- Performance Criteria for Aircraft Hangar Fire Protection Systems, January 2022 >
- NFPA 409, Standard on Aircraft Hangars, 2022 edition >
- US Air Force Foam Shutdown Policy, November 2021 >



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- Use High Expansion Foam (no PFAS)
- Group II: Consider Closed-Head Sprinkler System with Synthetic Fluorine-Free Foam
- Use Optical Flame Detection in Lieu of Fire Sprinkler Waterflow Switch
- Use Two Methods of Activation to Eliminate a Single Point of Failure
- Use Weatherproof/Weather-Resistant Manual Release Stations
- Use a Foam Releasing Control Unit Separate from Building Fire Alarm System
- Discuss the use of Abort/Stop Stations with AHJ

Foam System Removal Assessment Process



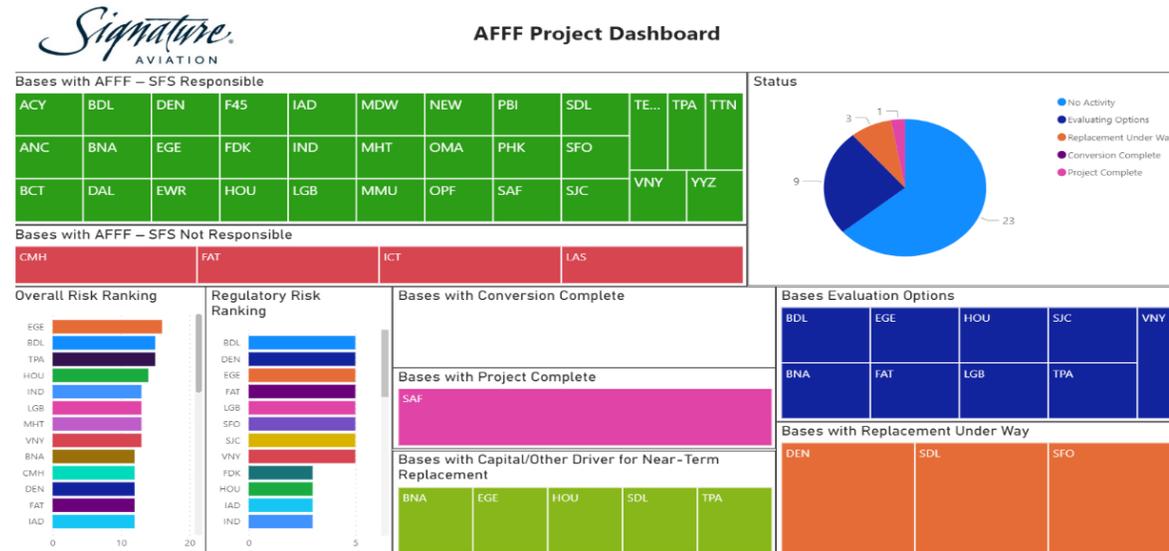
Site Prioritization and Risk Assessment



Identification of Conversion Options and Request Conversion Approvals



Strategic Base Specific Implementation Plan



Environmental Considerations – Disposal

EPA's Interim Guidance on the Destruction and Disposal of PFAS (December 18, 2020)

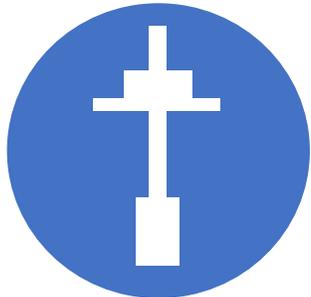
Uncertainties are linked with all technologies and the ability to control migration of PFAS to the environment.



**Thermal
Treatment**



Landfill



**Class I Deep Well
Injection**



Interim Storage

- USEPA is required to issue final disposal guidance by late 2023
- Pressure to ensure that disposal is not accepted at traditional hazardous waste landfills and hazardous waste incinerators
 - PFAS specific tailored solutions
- Only way to deal with PFAS is to turn off the tap

The Future of Hangar Fire Protection

Questions:



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