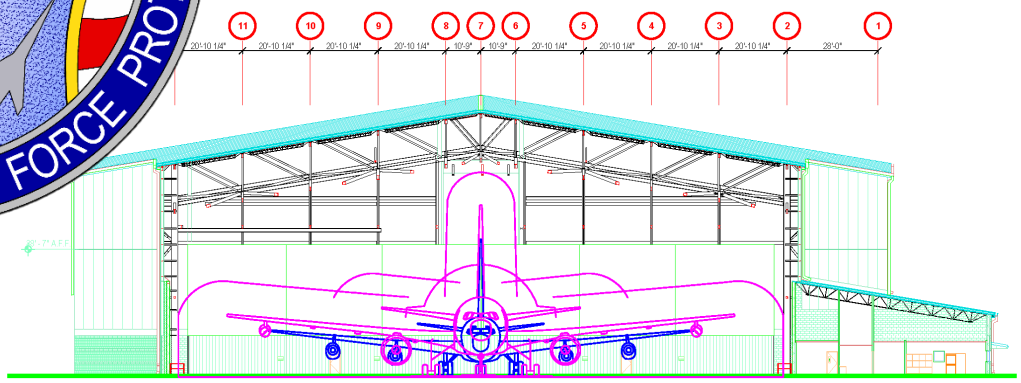
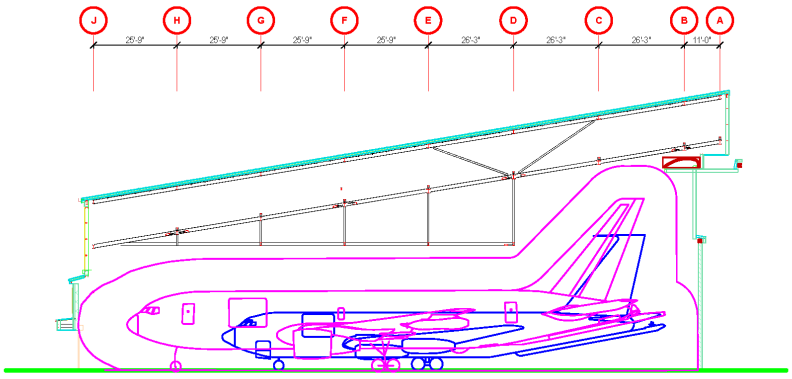
AIR NATIONAL GUARD MISSION GROUPED AIRCRAFT HANGAR SIZES





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AIR NATIONAL GUARD MISSION GROUPED HANGAR SIZES

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FOREWORD

For recapitalization and new construction hangar projects already in design, units are required to coordinate with NGB/A4 on any square footage adjustments based on this new guidance. The objective is to design hangars adaptable to similar mission changes without requiring modifications to the hangar bay itself. For instance, since C-130s are an enduring aircraft, a hangar designed for a C-130H should accommodate the dimensions of a C-130J-30 Stretched. The same principle applies to fighter aircraft. Refueling hangars should be designed to accommodate both the footprint and tail height of a C-17.

This publication provides detailed guidance for hangar construction and supersedes all previous versions. This guidance/instruction aligns with ANGH 32-1084 and implements DAFMAN 32-1084 requirements for the Air National Guard.

EXECUTIVE SUMMARY

Continue to use 211-111 for existing hangars and hangars that are not sized as a mission-grouped hangar. For all recapitalization and new construction of hangars, the use of CATCODE 211-173 (Large), 211-175 (Medium), or 211-177 (Small) is a replacement for 211-111. CATCODE 211-179 (Fuel Cell) is also adjusted to a mission-grouped hangar sizing for recapitalization and new construction. The ANG assigns square footage based on weapon system which is done in 211-111 and now for the 211-173/211-175/211-177. There is no longer a 15% overhead applied to the mission grouped hangar bays thus the square footage assigned is the actual hangar bay with hangar bay wall thickness, hangar door, and door pockets. Hangar restrooms and mechanical rooms have moved to companion CATCODE 211-152 (Gen Purpose Shops), 211-159 (Corrosion control), or 211-179 depending on the project. Mechanical room space required for the hangar bay will be constructed to the exterior of the bay. There is no co-use of clean/dirty transitions – the Fuel Cell will have a clean/dirty transition, and the corrosion/composites will also have a separate clean/dirty transition.

Table 1: Air National Guard Mission Grouped Maintenance Hangar Sizes[1]

Aircraft / Mission	Covered Spaces	CATCODE	Size	Bay (Gross SF)
C-17, KC-46, KC-135[2]	1	211-173	Large	**36,500**
F-15, F-16, F-22, F-35 (Single Door Hangar)	6			
F-15, F-16, F-22, F-35[3]	6	211-175	Medium	**30,000**
C-130 / C-130J-30 Stretched	1	211-177	Small	**20,000**
CRTC	1			
Predator - MQ-1 (published 16 Nov 2007)	6			
Reaper - MQ-9 (published 16 Nov 2007)	4			

1. The associated mechanical room will be constructed external to the hangar bay, ensuring no reduction of the bay's square footage. The mechanical room's area shall not exceed 3,000 square feet.

2. Must fit C-17 with square footage and elevation

3. Other aircraft configurations will fit into smaller size bay and should be considered to achieve best alternative meeting needs of the ANG (see Chapters 2 & 3 for details)

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Chapter 1: Large Aircraft Hangar Size

1.1 CATCODE 211-173, Large Aircraft Maintenance Dock (KC-135/KC-46/C-17)

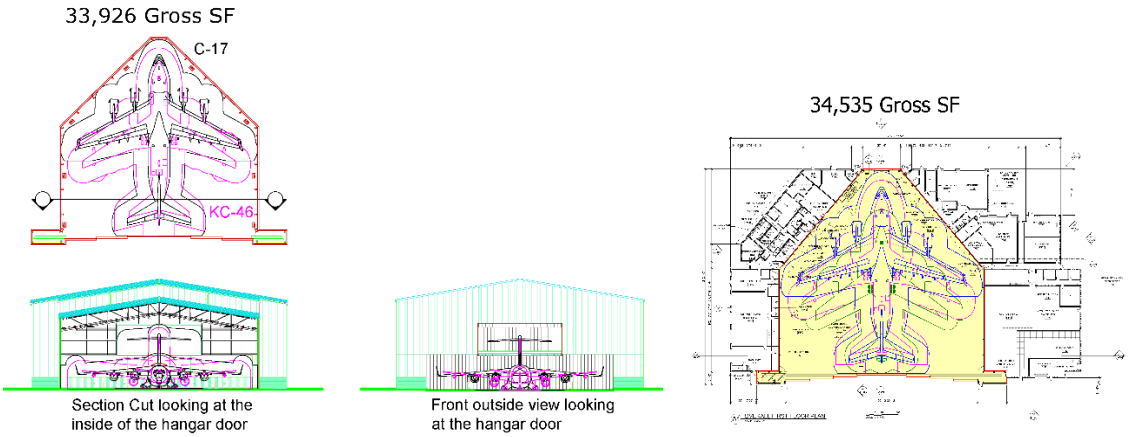
1.1.1 All new construction under the Large Aircraft Mx dock CATCODE must have sufficient square footage and elevation to house a C-17. The layout depicted in Figure 1-1 accounts for the hangar bay wall thickness, hangar door, and door pockets (hangar door scope).

Table 1-1: 211-173, Large Aircraft Maintenance Dock Summary[1]

Aircraft / Mission	Covered Spaces	Functional Standard (Gross SF)
C-17, KC-46, KC-135[2]	1	**36,500**
F-15, F-16, F-22, F-35 (Single Door Hangar)[3]	6	**36,500**

1. The associated mechanical room will be constructed external to the hangar bay, ensuring no reduction of the bay's square footage. The mechanical room's area shall not exceed 3,000 square feet.
2. Must fit C-17 with square footage and elevation.
3. Other aircraft configurations will fit into smaller size bay and should be considered to achieve best alternative meeting needs of the ANG (see Chapters 2 & 3 for details).

Figure 1-1: Airlift/Tanker Large Mx Hangar Bay Depiction

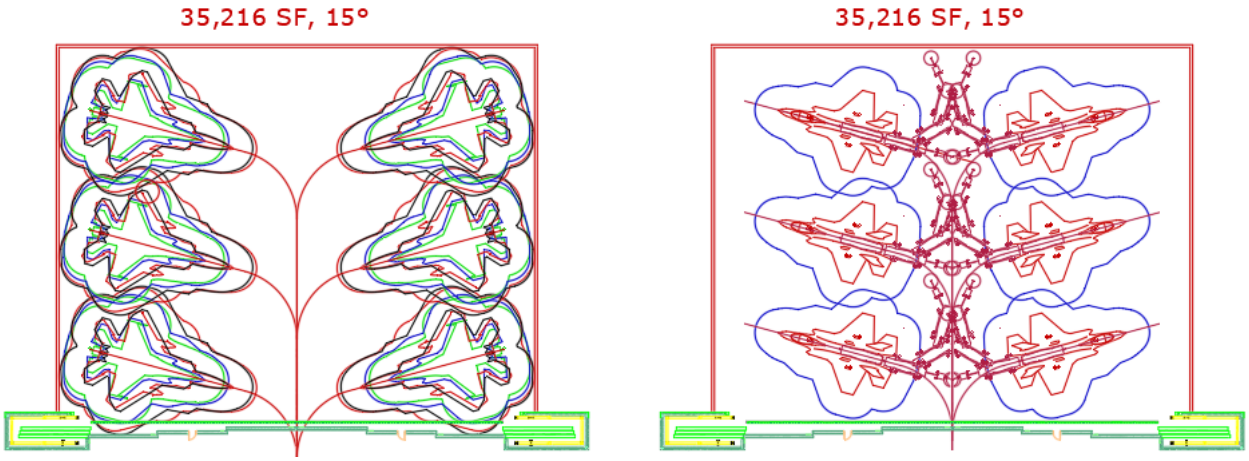


1.2 211-173, Large Aircraft Maintenance Dock, Six (6) Fighters

1.2.1 The universal fighter is based on the F-22 width and F-15 length, which are the controlling (largest) dimensions in the ANG Fighter Enterprise. Six (6) mission-grouped (universal) fighters will utilize CATCODE 211-173, Large Aircraft Maintenance Dock, with authorization 36,500 SF for a single door hangar.

1.2.2 A traditional single-door hangar can accommodate six (6) universal fighters, each with its own direct exit path within this authorization. The layouts depicted in Figure 1-2 account for the hangar bay wall thickness, hangar door, and door pockets.

Figure 1-2: Six (6) Universal Fighters (Single Door) Hangar Bay Depiction (Large)



Chapter 2: Medium Aircraft Hangar Size

2.1 CATCODE 211-175, Medium Aircraft Maintenance Dock, Fighters

2.1.1 The universal fighter is based on the F-22 width and F-15 length, which are the controlling (largest) dimensions in the ANG Fighter Enterprise. Six (6) mission-grouped fighters will utilize CATCODE 211-175, Medium Aircraft Maintenance Dock, with authorization 30,000 SF for a double door hangar.

2.1.2 A double-door hangar can accommodate six (6) universal fighters, each with its own direct exit path within this authorization. The layout depicted in Figures 2-1 and 2-2 accounts for the hangar bay wall thickness, hangar door, and door pockets.

2.1.3 Six universal fighters can be accommodated by the Medium Aircraft Maintenance Dock in either tail-to-tail or side-by-side configurations (double door).

Table 2-1: 211-175, Medium Aircraft Maintenance Dock Summary[1]

Aircraft / Mission	Covered Spaces	Functional Standard (Gross SF)
F-15, F-16, F-22, F-35 (Double Door)	6	**30,000**

1. The associated mechanical room will be constructed external to the hangar bay, ensuring no reduction of the bay's square footage. The mechanical room's area shall not exceed 3,000 square feet.

2. Recognizing aircraft configurations will fit into smaller size bay and should be considered to achieve best alternative meeting needs of the ANG.

Figure 2-1: Six (6) Universal Fighters (Double Door) Hangar Bay Depiction (Medium)

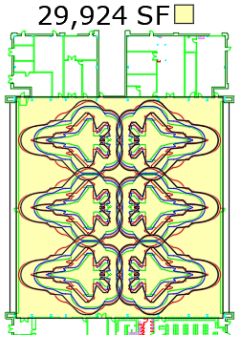
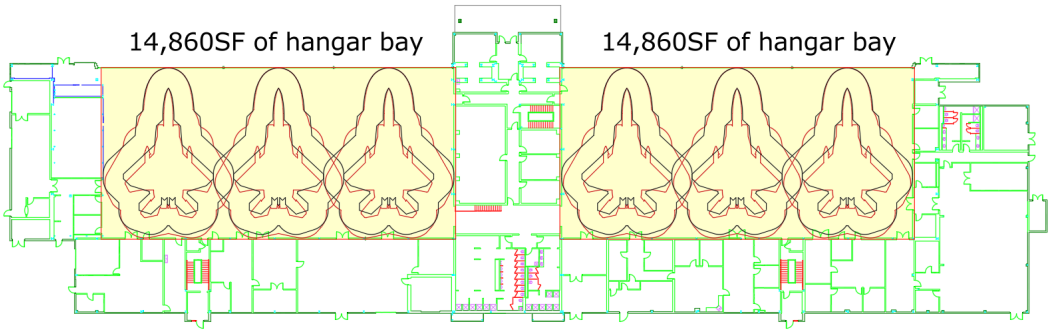


Figure 2-2: Six (6) Universal Fighters Side-by-side Configuration (Medium Hangar)



Chapter 3: Small Aircraft Hangar Size

3.1 211-177, Small Aircraft Maintenance Dock Summary

3.1.1 This Category Group is for all other flying missions C-130J-30 Stretched and smaller.

Table 3-1: CATCODE 211-177, Small Aircraft Maintenance Dock Aircraft[1]

Aircraft / Mission	Covered Spaces	CATCODE	Size	Bay (Gross SF)
C-130 / C-130J-30 Stretched	1	211-177	Small	**20,000**
CRTC	1	211-177	Small	**20,000**
HH-60G	2	211-177	Small	**20,000**
Predator - MQ-1	6	211-177	Small	**20,000**
Reaper - MQ-9	4	211-177	Small	**20,000**

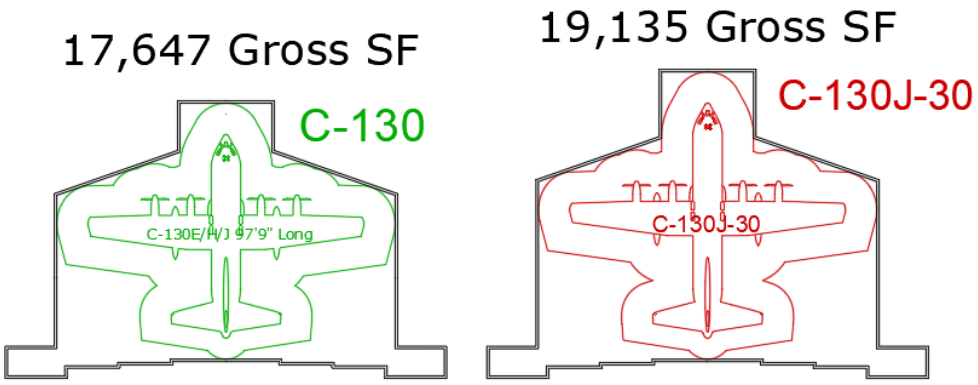
1. The associated mechanical room will be constructed external to the hangar bay, ensuring no reduction of the bay's square footage. The mechanical room's area shall not exceed 3,000 square feet.

3.2 C-130 and C-130J-30 Stretched Maintenance Hangar

3.2.1 The layout depicted in Figure 3-1 accounts for the hangar bay wall thickness, hangar door, and door pockets.

3.2.2 Plan for interior clear height of to allow for the C-130 jacked height + 10’ overhead setback.

Figure 3-1: C-130 and C-130J-30 Stretched Maintenance Hangar Size



3.3 CRTC Maintenance Hangar

3.3.1 The authorization for a CRTC multipurpose maintenance hangar is 20,000 GSF, capable of supporting a nose dock and housing three F-15 fighter aircraft. The total area includes the wall thickness, hangar door, and door pocket.

3.3.2 Must accommodate the interior clear height of the KC-46 + the 10’ overhead setback, depicted in Figure 3-4.

Figure 3-2: CRTC Maintenance Hangar

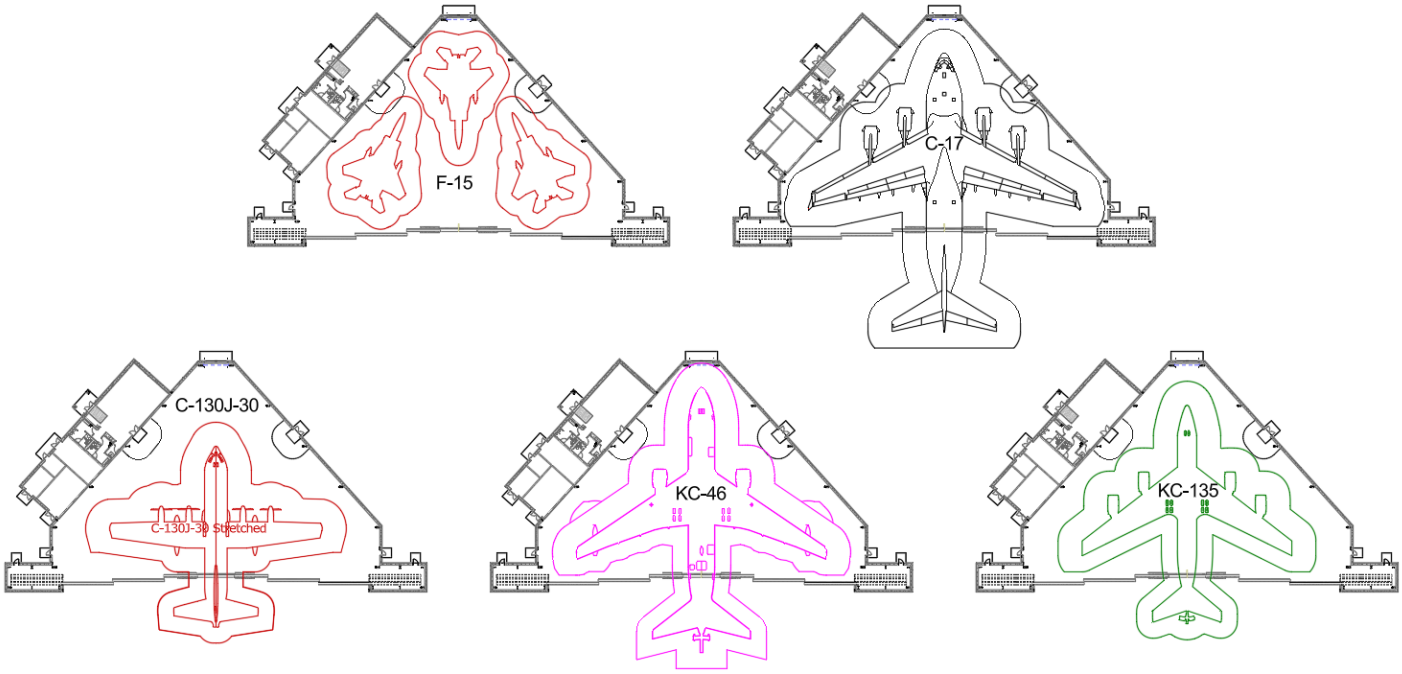
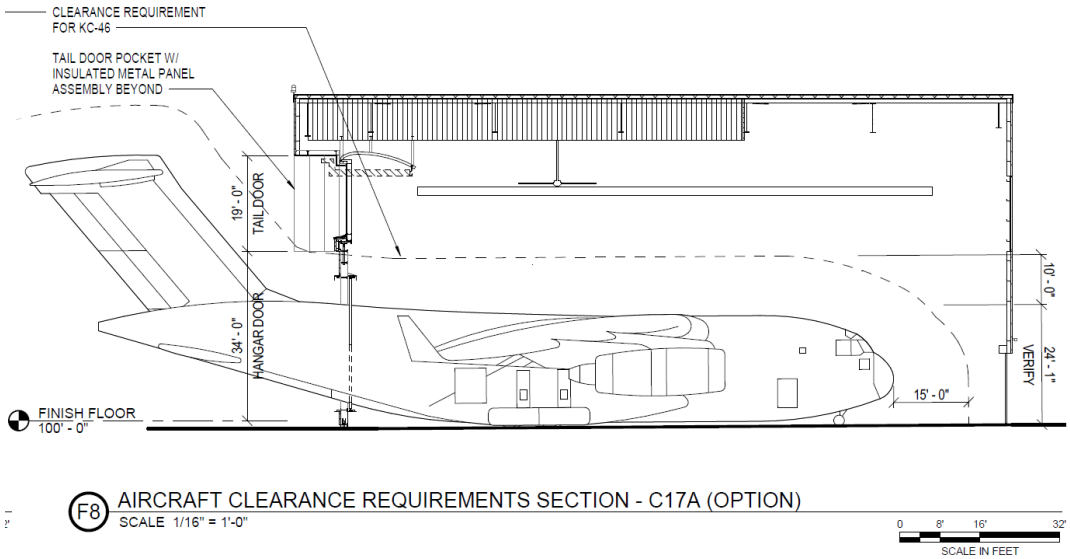


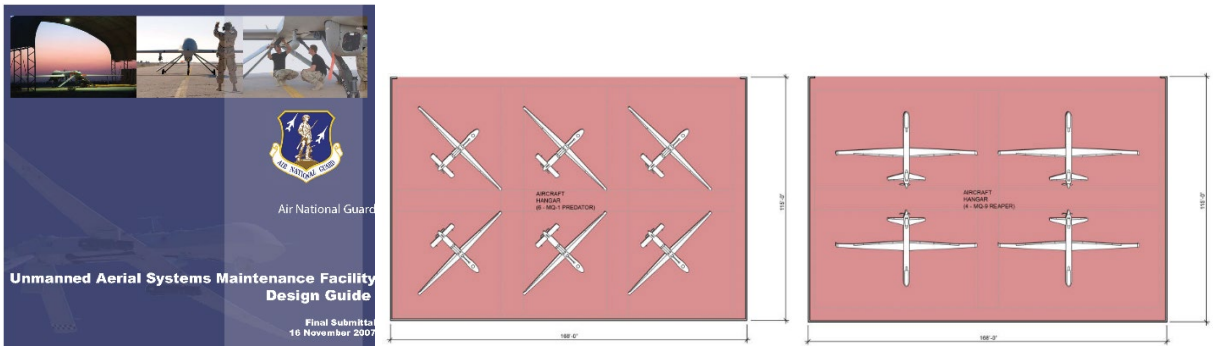
Figure 3-3: CRTC Maintenance Hangar vertical clearance requirement



3.4 MQ-1 and MQ-9 Hangar Bay Size

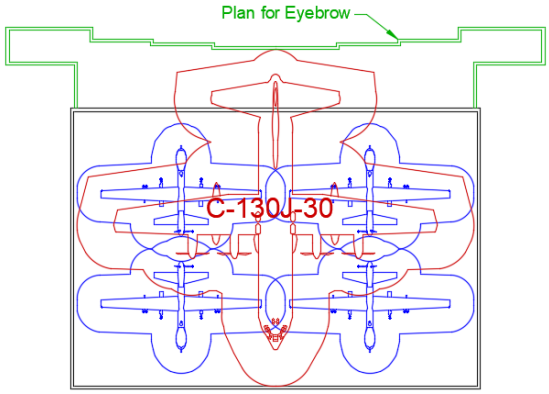
3.4.1 The ANG UAV Maintenance Final Design Guide, published 16 November 2007, specifies a hangar bay size of 168’ x 115’ (outside wall to outside wall), totaling 19,300 gross square feet (GSF). However, Air National Guard Handbook 32-1084 designates 20,000 SF for a Small Aircraft Maintenance Dock. To accommodate MQ-1 and MQ-9 aircraft, the requirement will remain at 20,000 SF.

Figure 3-4: MQ-1 and MQ-9, UAV Maintenance Final Design Guide



3.4.2 In accordance with the ANG UAV Maintenance Final Design Guide, site planning should account for the possibility of a future C-130 mission. This requires ensuring sufficient vertical clearance for a C-130 at its jacked height, plus a 10-foot overhead setback.

Figure 3-5: UAV Maintenance Final Design Guide C-130J-30 Stretched Expansion



Chapter 4: Fuel System Maintenance Dock

4.1 211-179, Fuel System Maintenance Dock.

4.1.1 Planning guidance for CATCODE 211-179, Fuel System Maintenance Dock, has been updated to improve clarity. The revisions specify that hangar bay sizing should now be based exclusively on the Mission Grouped Hangar Bay dimensions, with the Clean/Dirty Room treated as a separate, added component.

Figure 4-1: Fuel Cell Hangar Bay Depictions

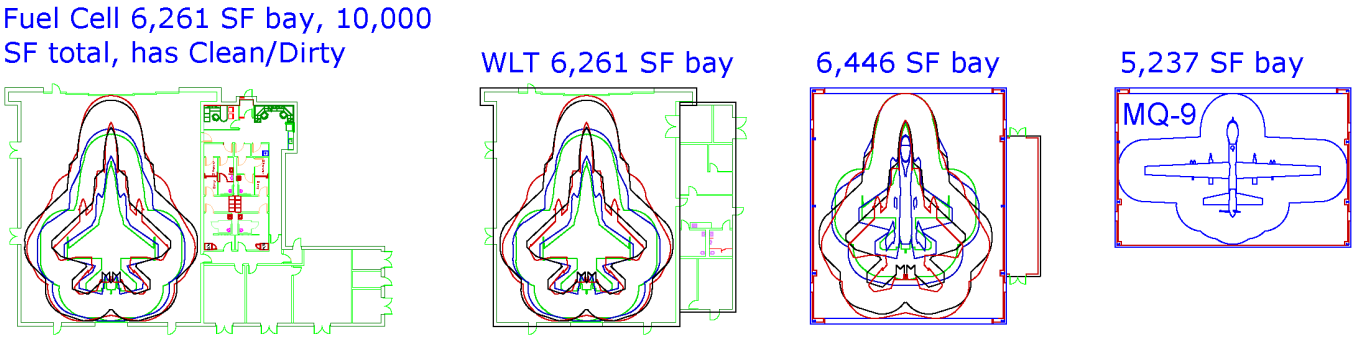


Table 4-1: Mission Grouped CATCODE 211-179, Fuel System Maintenance Dock Summary

Aircraft / Mission	Hangar Area (Gross SF)	Directly Related Mechanical & Clean Dirty Bathroom	Shop Area (Gross SF)	Functional Standard (Gross SF)
Fighter Aircraft	6,500	2,000	1,500	**10,000**
MQ-9	5,300	2,000	1,500	**8,800**
XX-130	20,000	2,000	1,700	**23,700**
KC-135, KC-46, and C-17[1]	36,500	3,000[2]	2,500	**42,000**

1. Must fit C-17 with square footage and elevation
2. Body Fuel Tanks storage of 1,000SF is included

Chapter 5: Background information

5.1 Hangar Maintenance Dock CATCODE and Aircraft Dimensions

The RegAF utilizes Category Codes 211-173, Large Aircraft Maintenance Dock, 211-175, Medium Aircraft Maintenance Dock, 211-177, Small Aircraft Maintenance Dock, and 211-179, Fuel System Maintenance Dock. Table 2 summarizes aircraft dimensions.

Table 2: Aircraft Dimensions for Mission Groups

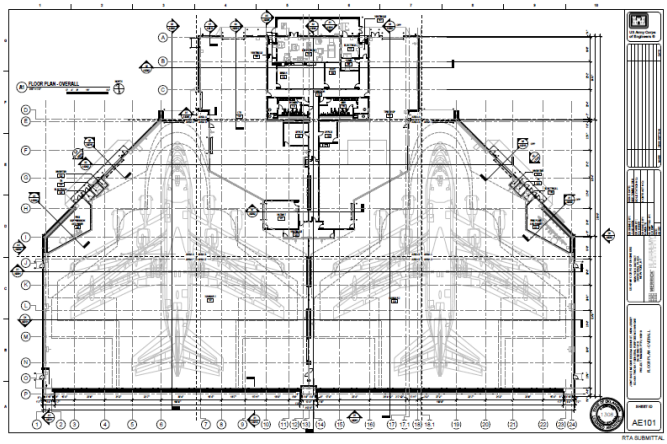
Aircraft	Wingspan	Length	Tail Height	Fuselage Height
C-17	169 feet, 10 inches	174 feet	55 feet, 1 inch	25 feet
C-130	132 feet, 7 inches	97 feet, 9 inches	38 feet, 5 inches	16 feet, 1 inch
C-130J-30	132 feet, 7 inches	112 feet, 9 inches	38 feet, 10 inches	16 feet, 1 inch
KC-135	130 feet, 10 inches	136 feet, 3 inches	41 feet, 8 inches	17 feet, 10 inches
KC-46	156 feet, 1 inch	165 feet, 6 inches	52 feet, 10 inches	24 feet, 7 inches
F-15	42 feet, 10 inches	63 feet, 9 inches	18 feet, 8 inches	
F-16	32 feet, 8 inches	49 feet, 5 inches	16 feet, 5 inches	
F-22A	44 feet, 6 inches	62 feet, 1 inch	16 feet, 8 inches	
F-35A	35 feet	51 feet, 5 inches	14 feet, 2 inches	

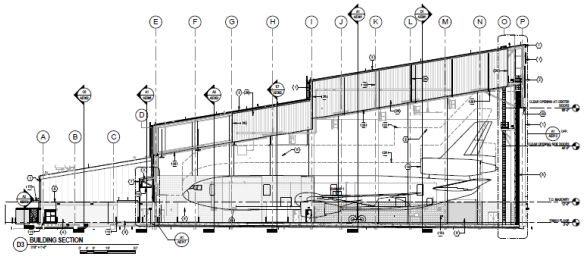
5.2 ANG Aircraft Hangar Layout Guidance and Recent AF Project

Air National Guard Handbook 32-1084 (ANGH 32-1084) specifies the use of nose-shaped hangars for airlift and refueling aircraft, considering both floor plan and elevation (see Figure 5-1). This design is standard practice for all ANG hangar projects and allows for associated maintenance shops to be constructed on either side of the nose. The RegAF is also adopting this approach, as demonstrated by the recently constructed AMC McGuire hangars (Figure 5.2). Conversely, nose and tail section-shaped hangars have not been favored due to anticipated cost increases associated with the additional structural steel required.

Figure 5-1: ANGH 32-1084 published graphic for airlift and refueling aircraft hangars

Figure 5-2: AMC KC-46 Hangars at McGuire sized for the KC-46, C-17, & DC-10/KC-10

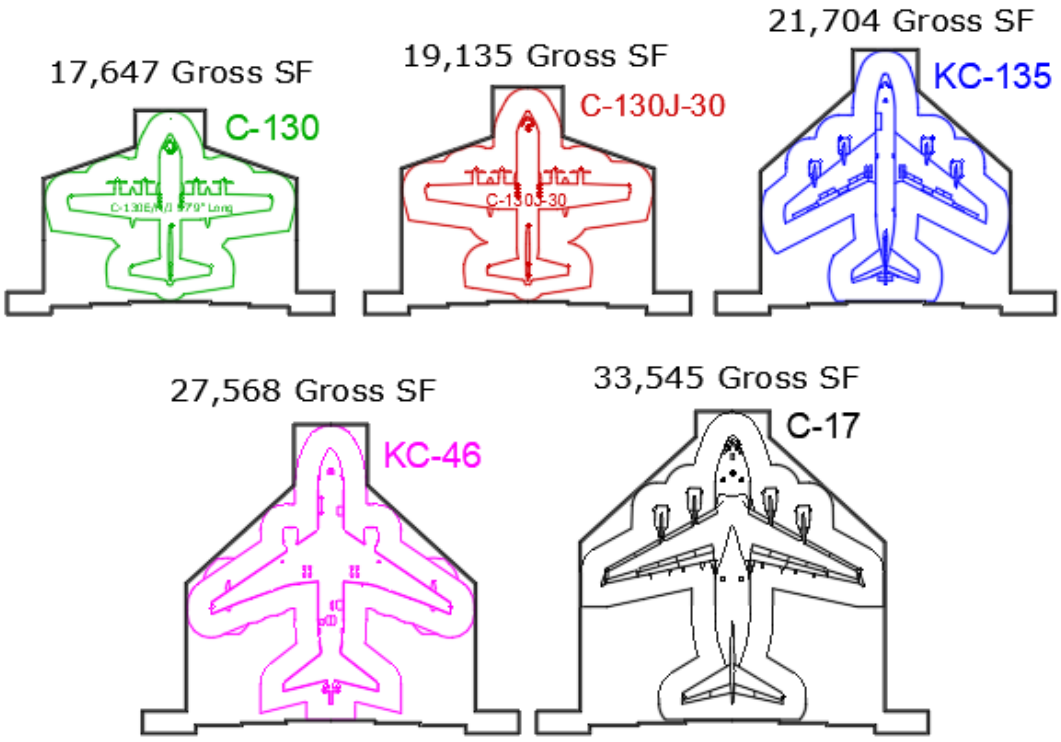




5.3 Airlift and refueling Aircraft Shaped Nose Area

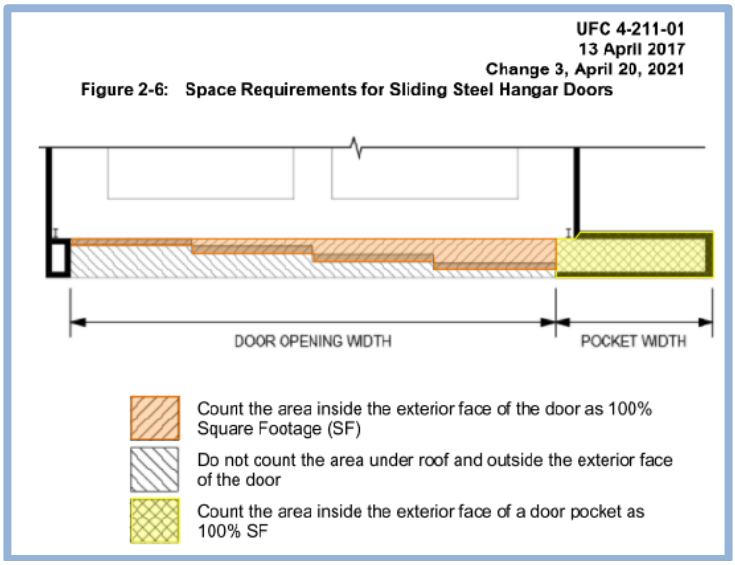
In accordance with ANGH 32-1084 and current DAF hangar layouts, nose-shaped hangar layouts will be considered for airlift and refueling aircraft. The gross square footage (GSF) presented in Figure 5-3 accounts for 16-inch wall thickness, 19-inch hangar door thickness, and any area occupied by the pocket door. GSF calculations *exclude* restrooms and mechanical rooms, which are now addressed under CATCODE 211-152, General Purpose Shops.

Figure 5-3: Airlift and refueling Aircraft Minimum Hangar Bay Sizes



5.3.1 Hangar door scope is defined in UFC 4-211-01: Count the area inside the exterior face of a door pocket as 100% SF.

Figure 5-4: Image from UFC 4-211-01 (April 20, 2021) hangar door scope



5.3.2 Limited use of Fabric Hangar Doors per UFC 3-301-01.

Figure 5-5: Image from UFC 3-301-01 (4 February 2022) hangar door limited use

1609.2.4 - Vertical Lift Fabric Hangar Doors (VLFD) [Addition]

Vertical Lift Fabric Doors are prohibited within windborne debris regions.

In addition to windborne debris regions, VLFD's are prohibited for use in aircraft maintenance hangars where risk category III wind speeds equal or exceed wind speeds defining a windborne debris region. Namely, 130 mph (58 m/s) within one mile of the coastal mean high-water line or 140 mph (63.6 m/s) anywhere.

[C] 1609.2.4 – Vertical Lift Fabric Hangar Doors (VLFD) [Addition]

VLFD's are currently prohibited for use in windborne debris regions due to failures experienced during hurricane Michael. These failures were predominately caused by wind driven debris. Additionally, \1\DoD has/1/ prohibited VLFD use where hangar design wind speeds are consistent with windborne debris regions, which provides commensurate design wind speed protection against windborne debris for Risk Category III hangar facilities.

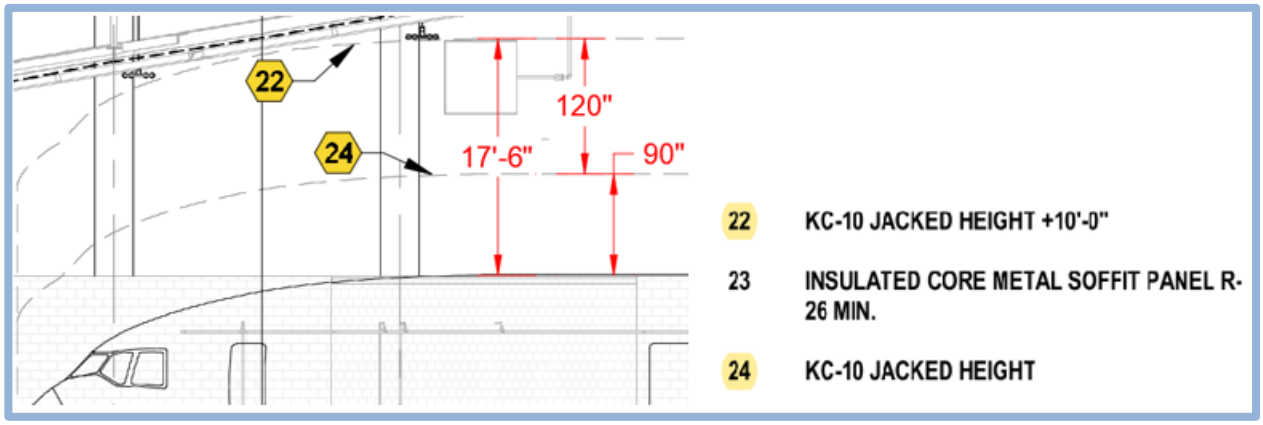
5.3.3 Per UFC 4-211-01 Section 2-3.3 add in jack height to overhead aircraft clearance.

Figure 5-6: Image from UFC 4-211-01 Section 2-3.3

2-3.3 Additional Clearances

Specific airframe or Service requirements may increase the minimum clearances required by Table 2-1: Minimum Aircraft Maintenance Bay Clearances to allow performance of certain maintenance operations. Coordinate with the maintenance unit staff to determine if additional space is required to maintain the aircraft. Provide additional clearances where required by an approved document such as the design aircraft's Facility Requirements Document (FRD) or a Service-specific standard design, defined Service hangar type, or other approved criteria. For example, the FRD may require additional space aft of the aircraft to remove the engine, or additional space above an aircraft to provide the crane hook height to perform maintenance operations such as pulling the rotor shaft out of a helicopter or maintaining the radar dome on an Airborne Warning and Control System (AWACS) aircraft. Jacking the design aircraft will reduce the overhead clearance below requirements in this UFC. Confirm jacking the design aircraft in the parking position does not require additional height to avoid conflict with an overhead obstruction. Minimum hook height is to the saddle of the hook.

Figure 5-7: McGuire setback added in 90 inches to account for a 120 Ton Tripod Jack



5.4 Aircraft Setback Bubble

Historically, purpose-built hangars have sometimes required waivers after completion due to inadequate setback planning during the design phase. To prevent this, designs must carefully consider the complete aircraft setback bubble throughout all design phases, including all vertical and horizontal framing members and the overhead rolling door hood. The NGB/A4 prefers that all designs utilize consistent aircraft drawings, sourced either from the manufacturer (e.g., Boeing, which provides DWG files) or from detailed Air Force Technical Orders (TOs). NGB/A4 can provide three-view aircraft drawings and welcomes feedback to ensure their accuracy. The figure below illustrates a case where the architect-engineer (A&E) firm constructed a hangar that ultimately conflicted with setback requirements, necessitating a waiver that could have been avoided with proper planning.

Figure 5-8: Hangar Example, Framing 18" Inside Setback Bubble