NATO STANDARD

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GROUND FIT AND COMPATIBILITY CRITERIA FOR AIRCRAFT STORES

Edition A Version 1

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NORTH ATLANTIC TREATY ORGANIZATION

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

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NATO LETTER OF PROMULGATION

3 December 2019

1. The enclosed Allied Engineering Publication AEP-3899, Edition A, Version 1, GROUND FIT AND COMPATIBILITY CRITERIA FOR AIRCRAFT STORES, which has been approved by the nations in the AC/224 – NATO AIR FORCE ARMAMENTS GROUP, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 3899.

2. AEP-3899, Edition A, Version 1, is effective upon receipt.

4. This publication shall be handled in accordance with C-M(2002)60.

Zoltán GULYÁS
Brigadier General, HUNAF
Director, NATO Standardization Office

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RESERVED FOR NATIONAL LETTER OF PROMULGATION

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS

Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
BGR	The standard's requirements will be implemented only for MiG-29, Su-25, L-39 ZA, Mi-17 and Mi-24 aircraft.
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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CHAPTER 1 INTRODUCTION

1.1. REFERENCES

a. **Related Documents**

(1) STANAG 3575 – AIRCRAFT STORES EJECTOR RACKS

(2) STANAG 3605 – COMPATIBILITY OF ARMING UNITS AND EXPENDABLE AIRCRAFT STORES

1.2. PURPOSE

The purpose of this standard is to provide a standardized set of criteria to define acceptable fit of aircraft stores on aircraft, and a test method for determining the fit compatibility of the stores.

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CHAPTER 2 GROUND FIT AND COMPATIBILITY CRITERIA FOR AIRCRAFT STORES – SPECIFIC DETAILS

2.1. CLEARANCES

a. Clearance for Loading. Sufficient clearances shall be provided to enable movement of the store into position when the aircraft is fully serviced and is in its normal attitude on a normal landing or servicing surface. For the purpose of determining this clearance, use of standard handling equipment shall be assumed unless other specified equipment is designated for use with the store or aircraft.

b. External Carriage Clearance. A minimum clearance of 1 inch (25.4 mm) shall be maintained:

(1) Between stores and aircraft surfaces (including movable surfaces such as flaps, speed brakes, ailerons, elevators/stabilators, etc, deflected to the point of closest proximity).

(2) Between adjacent stores (whether on the same rack or on adjacent pylons). Additional clearance may be required to account for an installed fuze when the store is mounted on the aircraft stores suspension equipment. This clearance shall be maintained with any movable surface or component of the store which is normally free or controlled to move while the store is in its installed position, or deflected to the point of closest proximity to the adjacent store.

NOTE: Adherence to clearances per this STANAG will not preclude store-to-store or store-to-aircraft contact during store separation from the aircraft. Analysis and/or flight testing is required to establish and/or validate safe separation.

c. Internal Carriage

(1) Static clearance. A minimum clearance of 1 inch (25.4 mm) shall be provided between stores and aircraft stores bay structure, hydraulic equipment, electrical equipment, fuel lines, and any other attached bay equipment with which stores could make contact during captive carriage. The specified minimum clearance applies to the stores and mechanisms which move during normal aircraft operation, including bay doors (and their swept volumes), door actuator systems (and their swept volumes), spoiler systems (and their swept volumes), and any other applicable mechanisms

which may contact the stores in the bay. The specified minimum clearance also applies between aircraft components and the volume which stores sweep during a trapeze or rotary suspension equipment translation. The clearance requirements of paragraph 2.1.b(2) apply to internal stores as well.

(2) Ejection clearance. Except for the closed bay doors and side rails, no part of the aircraft nor any other obstructions (except sway braces, displacing gear, etc., which are automatically removed from their obstructive positions during store release) shall lie within the clearance space envelope bounded by the imaginary plane surfaces defined as follows:

(a) The plane tangent to the uppermost extremity of the store parallel to the armament roll axis and parallel to the aircraft pitch axis (see Annex B).

(b) Four planes tangent to the foremost, rearmost, right and left extremities of the store, and parallel to the store pitch axis at an angle 10 degrees away from the vertical, expanding in the direction of the ground (see Annex C).

(3) Fuze clearance. For stores that are normally made safe by removal of fuzes, adequate clearance shall be provided to remove or install fuzes on the loaded stores without requiring removal of the stores from their loaded position.

(4) Minimum ground clearance. Ensure that the minimum clearance between the ground and the maximum composite envelope of all stores carried externally will not be less than 3 inches (76.2 mm) in the worst-case condition of flat tire(s) and a completely depressed strut, with the aircraft in either a static, takeoff, or landing attitude at maximum allowable gross weight. For aircraft designed to operate from rough terrain or ships, the minimum clearance should be 6 inches (152.4 mm). Weapon designers should strive for a maximum degree of interoperability between military services and nations when developing new weapons, and the criteria which provides the most critical case should be used whenever possible.

(5) Hoisting gear clearance. Minimum clearance between all required stores and hoisting equipment of the aircraft shall be 1 inch (25.4 mm).

(6) Intake duct clearance. An assessment shall be made concerning whether the store installation would cause engine compressor stall or flameout due to exhaust, shock or pressure wave

interference. The probability of ingestion of arming wire clips, wire, spent cartridges or other debris in the airstream due to store release shall be noted.

(7) Landing gear clearance. A minimum clearance of 1 inch (25.4 mm) shall be provided between all stores and any portion of the aircraft landing gear. This clearance shall apply both to the landing gear in the down-and-locked position as well as throughout the entire retraction and extension cycle.

(8) Engine heat, jet, and munitions blast clearance. Adequate insulation shall be provided to protect stores from engine heat. Permissible store temperatures shall be those identified in the ordnance specification. Adequate clearance for exit cone blast or muzzle blast shall be provided to protect adjacent stores from either blast or corrosive damage.

(9) Propellor and rotor disk clearance.

(a) Guns: On propeller and rotor-equipped aircraft, a minimum clearance of 6 inches (152.4 mm) shall be provided between the worst-case propeller/rotor disk position, or any part of the aircraft, and the bullet trajectory (bullet trajectory should be the worst-case position in the firing envelope and the worst-case gun dispersion).

(b) Rockets/missiles: The clearance during launch for guided and unguided rockets and missiles shall be a five-degree half cone angle measured from the trajectory of the outermost surface of the ordnance to the worst-case rotor plane or aircraft structure (see Annex D). Clearance shall be sufficient to preclude induced damage from spent cases or any loose items under a worst-case release condition. (The worst case rotor plane cannot always be located accurately in a static condition and should also be measured in a dynamic situation).

(10) RAM air turbine clearance. A minimum clearance of 1 inch (25.4 mm) shall be provided to prevent contact between stores and deployed or extended RAM air turbines. An assessment shall be made concerning the potential for the store to affect, adversely, the RAM air turbine performance.

(11) Store arming control system clearance. Adequate clearance must be provided to ensure correct operation of the arming control system during separation. The store arming control system (such as arming loops or connectors) shall not be susceptible to

jamming or to being caught on the aircraft, pylon, launcher, or ejector rack, so that inadvertent initiation of the store arming sequence is prevented. Upon store release, clearance shall exist to ensure remaining elements of the store arming control system do not adversely affect aircraft surfaces or systems.

2.2. ACCESSIBILITY

a. General. Access shall be provided to enable safe and efficient loading of stores and to adjust, maintain, and “safe” the suspension and release equipment and loaded stores.

b. Maintenance Access. Convenient access shall be provided for performance of maintenance, which is permitted with the store in its loaded position.

c. Access for Store Adjustment. Access shall be provided to enable operation of the necessary hand tools required to make adjustments on store and rack fittings, fuzes, arming wires, etc., when the store(s) are mounted on the suspension and release equipment.

2.3. MISCELLANEOUS

a. Sway Bracing. Sway bracing or other means shall be provided to restrain the store against impact with the aircraft and against relative motion with respect to the aircraft. The contact area of the sway braces bearing on the store shall be sufficiently large to preclude damage to the store. Additional sway brace requirements are defined in STANAG 3575.

b. Ejection Mechanism. Where a displacing or ejection mechanism is used for store separation, it shall make contact with the store at the appropriate reinforced or hardback points as defined in STANAG 3575.

c. Release System, Electrical Devices, and Wiring. Electrical equipment, adequate for control, operation, and release, shall be included to provide for the proper release of the store. Special attention shall be given to ensure the electrical connections are adequately protected from damage or short circuits resulting from movement in the airstream, moisture, or from mechanical interference with moving parts of the store.

d. Ground Handling Equipment Compatibility. Ground handling equipment required during store loading shall fulfill intended purposes with respect to mechanical and functional characteristics without restrictions to mobility, impairment of usefulness, or durability imposed by peculiarities of the test item.

e. Special Tools. Store design shall permit installation, disassembly, reassembly, and service maintenance with tools and maintenance equipment normally available as commercial standards.

f. Store Cradling or Handling Area. A common area on the store shall be provided to ensure transporting, handling, and hoisting compatibility with various trucks, cradles, skids, and hoists. The strength and size of this area is defined in STANAG 3441.

g. Store Variants. Ideally all variants of the operational store shall be cleared, including drill and training versions. If all, or any, variants cannot be cleared to the requirements of this STANAG, the limitation must be clearly defined.

2.4. SAFETY

a. General. Store installations shall provide maximum protection against inadvertent release as a result of either human error, carelessness, or the material failure of components of the suspension and release equipment.

b. Ground Safety Device. The store release system shall be equipped with a positive safety device or devices to preclude functioning, dropping, launching, or ejecting of suspended stores, or activation of ejector devices when the aircraft is on the ground, even if the release or actuation system is energized.

c. Erroneous Switch Selection and Single Component Failure. The control of store stations shall be such that no single operation on the part of any crew member will result in the inadvertent release or function of a store. No single component failure in the function or release control system shall result in the inadvertent function or release of a store.

d. Safetying. Parts which may cause a hazardous condition by working loose in service shall be made safe or shall have other approved locking means applied.

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ANNEX A TEST PROCEDURES FOR THE DETERMINATION OF AIRCRAFT STORE FIT COMPATIBILITY

A.1. GENERAL

For each specific store, applicable portions of the requirements for assuring proper fit and operation shall be selected for verification of compliance based on a review of the general and detailed specifications for that store. Dependent on their specific functional and operational characteristics, suitable performance tests shall be included for particular items and components. All applicable test procedures shall be performed unless reference can be made to an identical or more critical store installation which has been demonstrated satisfactorily. No explosive ordnance will be used for the test described herein. During all testing, suitability of safety provisions shall be verified and uconditions reported. It is essential to ensure that compatibility demonstrations are not unique to test aircraft alone, but are applicable also to all models and series of operational aircraft. If this cannot be accomplished, deviations will be recorded and reported. Approved modifications will be required to authorize carriage of all non-standard stores on test aircraft.

A.2. TEST STORES

Test stores shall be fleet or production representative. The store shall be examined to confirm adherence to the detail requirements of the store specifications, including adherence to dimensional and weight provisions (including center of gravity), workmanship, safety, and maintenance and human engineering provisions. Inert stores, functionally and operationally complete with all accessories including suspension parts, electrical fittings, vent fittings, and other external protuberant fins, fuzes, and arming wires which are necessary to make a complete installation on the applicable aircraft and pylon shall be installed with the aircraft in its normal ground attitude. The aircraft shall be fully serviced and the gear strut extension within the allowable limits for the aircraft. For bombs, dispensers, and launcher-type stores, simulated stores may be used if the actual inert test items are not available. These stores shall have all exterior dimensions and configurations equivalent to the actual store, and shall be dummy fuzed and equipped with arming wires if applicable. The total weight and general weight distribution of the test store shall be equivalent to the actual store.

A.3. INSTALLATION TEST METHODS

a. Store loading. The stores shall be prepared, handled, and loaded in accordance with established loading procedures. Only tools and equipment generally available to aircraft and armament personnel should be required for the loading; however, it is not intended to preclude the use of special tools or equipment which are to be an integral part of the

store associated equipment. The most practical means of loading the store – such as bomb hoists, and powered and non-powered weapons loaders – will be utilized. The store should be capable of being positioned beneath the suspension equipment on a cradle, skid, munitions transporter, munitions trailer or dolly without the necessity of jacking-up or lifting the aircraft, or resorting to loading pits or other special provisions.

b. Loading procedures test. Determination of the most efficient procedure for loading the aircraft shall be made by testing the complete loading procedure. The test shall begin with the store(s) on ground handling equipment outside the circular area which encompasses the extremities of the aircraft. The store(s) shall be moved into position, hoisted, and loaded properly on the appropriate release equipment. The loading procedures test shall include proper alignment and simulated operational checks including systems capable of adjustable firing angles. Data shall be recorded to define the most efficient procedure and the time required for each major action in loading the stores in the required configurations. The loading procedures test shall be conducted during the original fit test and during subsequent loadings, if required. Where installation conversion (aircraft reconfiguration) is required due to peculiarities of the store being installed, conversion time will be recorded. In computing installation conversion time, reconfigurations shall be performed by a single crew without special tools or equipment, other than items which will be available to operational crews performing similar functions.

c. Clearance tests. The store installation shall be visually inspected and verified to the clearance requirements of this STANAG. Satisfactory operation of all external movable equipment (such as flaps, slats, speed brakes, or armament systems capable of adjustable firing angles) shall be demonstrated to their limits. In cases of marginal ground clearances, further investigation and study shall be given to the effect of emergencies or unnatural conditions such as deflated struts, flat tires, etc. on runway clearances of suspended stores. Whenever marginal clearance between the external store and the aircraft landing gear system (including the envelope described by parts of the landing gear during retraction/extension) is suspected, the aircraft will be placed on jacks and a landing gear retraction/extension test performed to determine actual clearances.

d. Accessibility tests. Accessibility requirements will be verified by performance of all operations required for checking, filling or loading, installing and removing of safety pins, and adjusting the stores. The operations will be performed with the aircraft in its normal ground attitude and in the sequence determined by the loading procedures test (see paragraph A.3.b. above). The appropriate hand tools will be utilized to make adjustment on the store fittings, fuze installation, arming wire

attachments, and any other equipment maintenance. Hand and tool space shall be evaluated for ability to perform operations, adjustments, etc. considering protective clothing worn by operational loading personnel.

e. Store reinforced area test. The store shall be checked for proper alignment between the ejection mechanism and the store reinforced area. Applicable preloads shall be introduced to the store through the sway braces. The store structure shall be inspected to verify support of the installation loads without permanent set in any portion of the store structure.

f. Electrical function test. Functional tests or calibrations to demonstrate proper operation of the equipment being tested shall be performed.

(1) Electrical interface. All electrical connections between the store and the pylon/aircraft structure shall be checked for possible sources of mechanical and electrical failure caused by improper cable routing. Particular attention shall be given to wiring that could be susceptible to strains or short circuits resulting from movement induced by airstream forces, and all connections shall be reviewed with an understanding of electromagnetic interference, bonding and hazardous radiation requirements as identified in appropriate specifications. Electrical connectors shall be checked to ensure that they cannot be mated to the wrong pylon or rack plug, and that suitable provisions exist to secure and protect unused cables and connectors.

(2) Store functional check. Functional checks shall be conducted to ensure proper continuity of all electrical circuits and proper operation of all electrical/electronic equipment. The actual or simulated operation evaluations may be made utilizing special test equipment. This includes validation and verification of store software.

(3) Armament control system check. Functional checks on each installation of the control and monitor circuits shall be made. Where possible, it shall include functioning of power sources, functioning of all circuits up to release of firing mechanisms, functioning of all safety devices and checking of all armament indicator lights. This includes a check of the software used in the operational flight program to control the store. Armament systems which are capable of adjustable firing angles (elevation, depression, azimuth) shall be checked to ensure positive stops and for clearances to prevent damage to the aircraft structure or rotor/propeller disk. Sufficient tests shall also be conducted to ensure that inadvertent release does not occur as a result of

cockpit switch selection procedures or hardware/software deficiencies.

g. Ground handling equipment (GHE) compatibility test. Ground handling equipment compatibility shall be verified by performance of all operations required during transporting, filling, loading/downloading the stores and other weapons components, containers, etc. intended for use in the weapon logistic system.

(1) Test conditions. Compatibility with GHE shall be determined under normal field operating conditions existing at the test site. Consideration shall be given to any limitations due to adverse weather conditions. Standard military or government equipment shall be used wherever feasible.

(2) Documentation of observation. A report documenting the conduct and the results of the ground fit and compatibility testing shall be prepared for the certification agency. The written report shall contain the test objectives, test plan, a detailed description of the test articles and test aircraft, including electrical wiring interface, facilities, other required equipment, conditions, procedures and sequences used, test results, observations, photographs documenting the overall test configurations and all necessary separation/clearances or anomalies, data accuracy, and, if requested by the certification agency, conclusions about the utility of the data. Test articles and equipment shall be identified by model and serial numbers, with any deficiencies clearly identified, as necessary, to repeat the test at a later date. The specific size and type of GHE auxiliary equipment used in preparation, handling, loading, and removing shall be recorded. A preliminary store or store/container and support equipment flow chart shall be prepared and shall show store/container flow through each storage and handling phase of the installation test. The specific functional operations performed on the store and all equipment, tools, and other devices required to accommodate the store to determine unusual strains, overloads, and wear occurring during handling shall be recorded. Similarly, all replacements, alterations, modifications, or adjustments other than those considered normal for the equipment or store shall be recorded.

A.4. SAFETY STANDARDS

The following safety standards shall be considered in the evaluation of the store and its installation procedure:

a. There shall be positive measures to prevent inadvertent or accidental arming, launching, firing, actuating or releasing. As a minimum, a separate, guarded, master armament switch shall be provided which provides a positive control of electrical power to all armament circuits.

b. Components and circuitry shall be provided which will “fail safe” in the event of failure or malfunction.

c. Every possible safety precaution shall be provided to make installation of the store a safe operation.

d. The store installation shall provide positive safety lock and latching mechanisms which can readily be checked for secure and proper installation by direct visual and mechanical means on the ground.

e. Administrative controls such as safety rules and directives, issued by competent authority, shall be provided.

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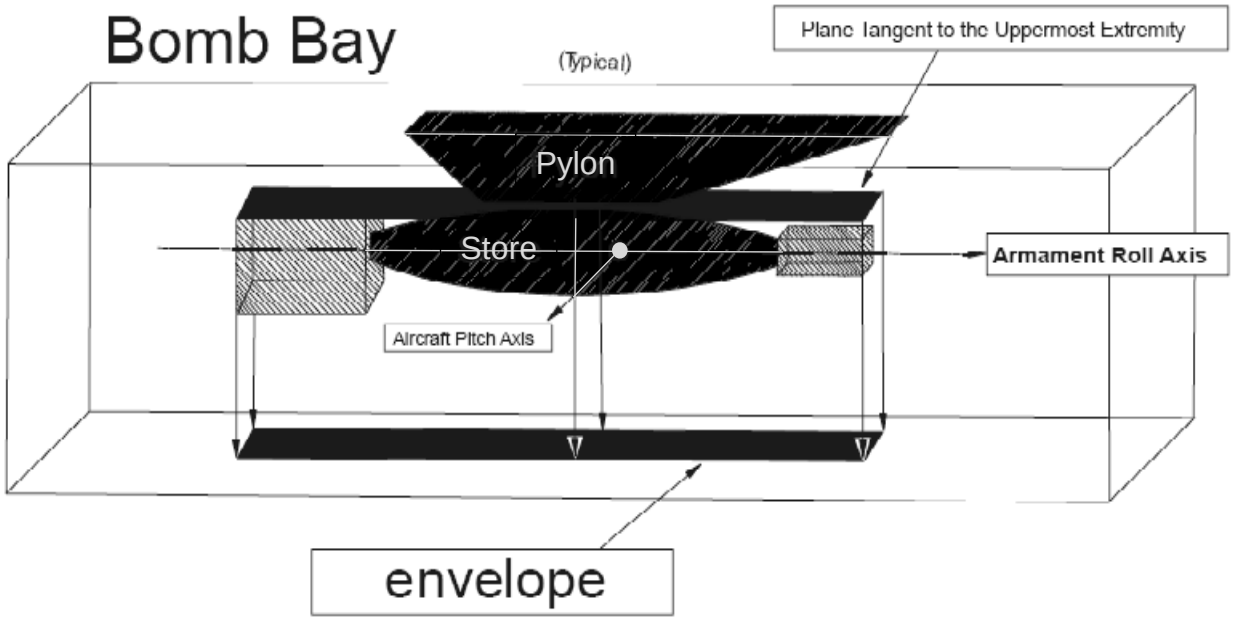
ANNEX B INTERNAL CARRIAGE STORE CLEARANCE SPACE ENVELOPE



Note: The plane tangent to the uppermost extremity of the store parallel to the armament roll axis and parallel to the pitch axis of the aircraft.

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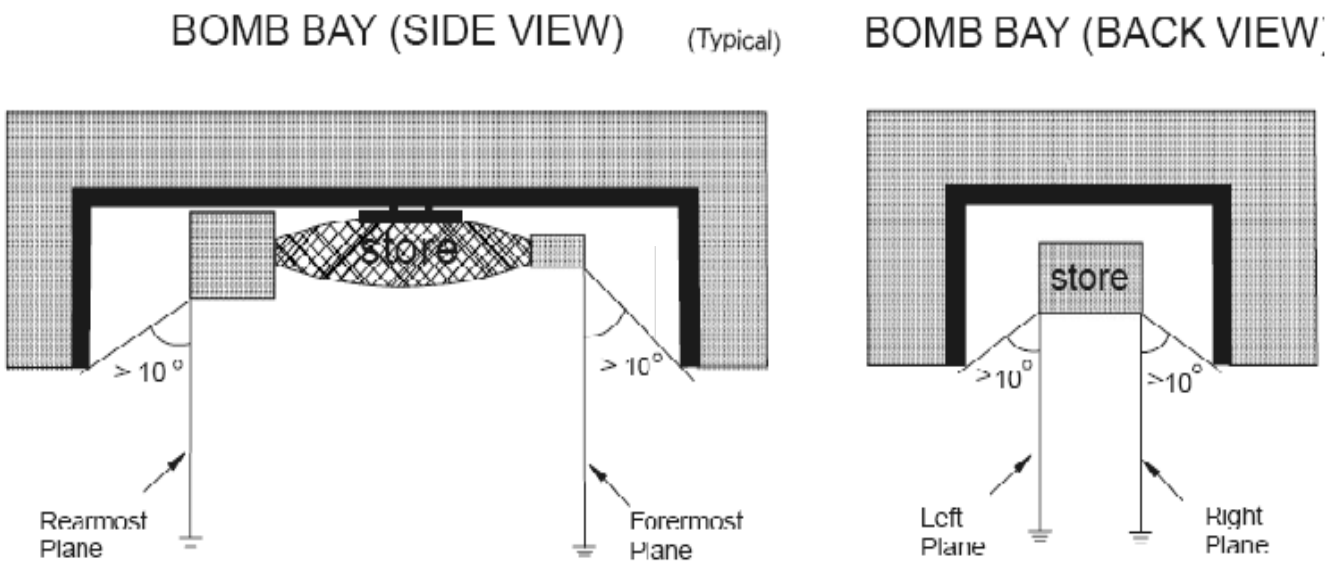
ANNEX C INTERNAL CARRIAGE STORE EJECTION CLEARANCE ENVELOPE



Note: Four planes tangent to the foremost, rearmost, right, and left extremities and parallel to the pitch axis of the store at an angle 10 degrees away from the vertical, expanding in the direction of the ground.

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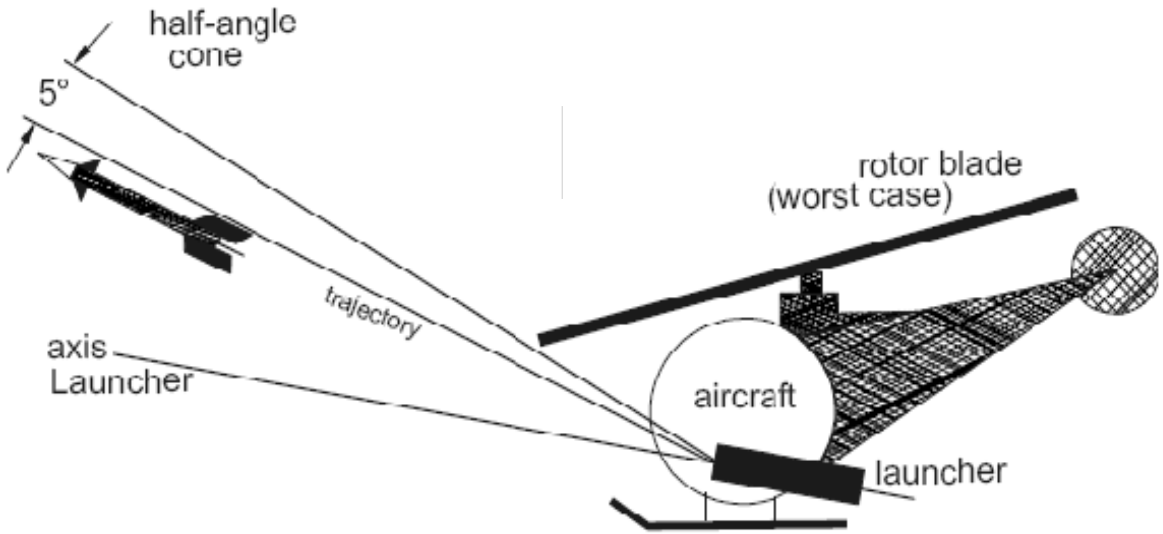
ANNEX D DEPICTION OF FIVE DEGREE HALF CONE ANGLE CLEARANCE



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