NORTH ATLANTIC TREATY ORGANIZATION
ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD

MILITARY AGENCY FOR STANDARDIZATION (MAS)
BUREAU MILITAIRE DE STANDARDISATION (BMS)
1110 BRUSSELS

Tel : 707.42.90

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See CNAD AC/310 STANAG distribution

STANAG 4432 (Edition 1) - AIR-LAUNCHED GUIDED MUNITIONS: PRINCIPLES FOR SAFE DESIGN

Reference: AC/310-D/136, dated 18th October 1996

1. The enclosed NATO Standardization Agreement which has been ratified by nations as reflected in page (iii) is promulgated herewith.

2. The references listed above are to be destroyed in accordance with local document destruction procedures.

3. AAP-4 should be amended to reflect the latest status of the STANAG.

ACTION BY NATIONAL STAFFS

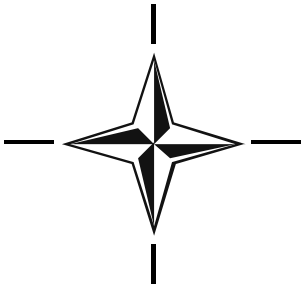
4. National staffs are requested to examine page (iii) of the STANAG and, if they have not already done so, advise the Defence Support Division through their national delegation as appropriate of their intention regarding its ratification and implementation.

A. GRØNHEIM
Major General, NOAF
Chairman, MAS

Enclosure:
STANAG 4432 (Edition 1)

STANAG No. 4432
(Edition 1)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)



MILITARY AGENCY FOR STANDARDIZATION
(MAS)

STANDARDIZATION AGREEMENT
(STANAG)

SUBJECT: AIR-LAUNCHED GUIDED MUNITIONS: PRINCIPLES FOR SAFE DESIGN

Promulgated on

A. GRØNHEIM
Major General, NOAF
Chairman, MAS

STANAG 4432
(Edition 1)

RECORD OF AMENDMENTS

No.	Reference/date of amendment	Date entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Chairman MAS under the authority vested in him by the NATO Military Committee.

2. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

4. Ratification is "In NATO Standardization, the fulfilment by which a member nation formally accepts, with or without reservation, the content of a Standardization Agreement" (AAP-6).

5. Implementation is "In NATO Standardization, the fulfilment by a member nation of its obligations as specified in a Standardization Agreement" (AAP-6).

6. Reservation is "In NATO Standardization, the stated qualification by a member nation that describes the part of a Standardization Agreement that it will not implement or will implement only with limitations" (AAP-6).

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

7. Page (iii) gives the details of ratification and implementation of this agreement. If no details are shown it signifies that the nation has not yet notified the tasking authority of its intentions. Page (iv) (and subsequent) gives details of reservations and proprietary rights that have been stated.

FEEDBACK

8. Any comments concerning this publication should be directed to NATO/MAS - Boulevard Leopold III, 1110 Brussels - BE

STANAG 4432
(Edition 1)

NAVY/ARMY/AIR

NATO STANDARDIZATION AGREEMENT (STANAG)

AIR-LAUNCHED GUIDED MUNITIONS: PRINCIPLES FOR SAFE DESIGN

Annexes:

A. Terms and Definitions
B. Associated National Documents
C. Electrical Connectors

Related Documents:

UN Manual of Tests and Criteria for Transport of Dangerous Goods.

AOP-7	Manual of Tests for Qualification of Explosive Materials for Military Use.
AOP-8	NATO Fuze Characteristics Data.
AOP-15	Guidance on the Assessment of the Safety and Suitability for Service of Munitions for NATO Armed Forces.
AOP-16	Fuzing Systems: Safety Design Guides
AOP-24	Electrostatic Discharge Test Procedures to Determine the Safety and Suitability for Service of EEDs and Associated Electronic Systems in Munitions and Weapon Systems.
AECP-1	Mechanical Environmental Conditions to Which Materiel Intended for Use by NATO Forces Could be Exposed.
STANAG 1307	Maximum NATO Naval Operational Electromagnetic Environment Produced by Radio and Radar.
STANAG 2895	Extreme Climatic Conditions and Derived Conditions for Use in Defining Design/Test Criteria for NATO Forces Materiel.
STANAG 3441	Design of Aircraft Stores.
STANAG 3525	Design Safety Principles and General Design Criteria for Airborne Weapon Fuzing Systems.
STANAG 4147	Chemical Compatibility of Ammunition Components with Explosives and Propellants (Non-nuclear Applications).
STANAG 4157	Development of Safety Test Methods and Procedures for Fuzes for Unguided Tube Launched Projectiles
STANAG 4170	Principles and Methodology for the Qualification of Explosive Materials for Military Use.
STANAG 4187	Fuzing Systems - Safety Design Requirements.
STANAG 4234	Electromagnetic Radiation (Radio Frequency) 200 KHz to 40 GHz

Environnement Affecting the Design of Materiel for Use by NATO Forces.

STANAG 4235	Electrostatic Environmental Conditions Affecting the Design of Materiel for Use by NATO Forces.
STANAG 4236	Lightning Environmental Conditions Affecting the Design of Materiel for Use by NATO forces.
STANAG 4238	Design Principles for Hardening Munitions /Weapon Systems Against Electromagnetic
STANAG 4239	Implementation of AOP-24. Electrostatic Discharge, Munition Test Procedures.
STANAG 4240	Liquid Fuel Fire Tests for Munitions
STANAG 4241	Bullet Attack Test for Munitions
STANAG 4297	Implementation of AOP-15. Guidance on the Assesment of the Safety and Suitability for Service of Munitions for NATO Armed Forces
STANAG 4325	Environmental and Safety Tests for the Appraisal of Air-Launched Munitions
STANAG 4368	Design Safety Requirements for Electro and Laser Ignition of Rocket Motors.
STANAG 4370	NATO Environmental Conditions and Test Procedures
STANAG 4404	Safety Design Requirements and Guidelines for Munition Related Safety CriticalComputing Systems
MIL-STD-2105A	Military Standard - Hazard Assessment Tests for Navy Non-nuclear Ordnance

AIM

1. The aim of this agreement is to provide within NATO, mutually acceptable principles for safe design applicable to air-launched guided munitions and their support equipment.

AGREEMENT

2. Participating nations agree to comply with the requirements of this STANAG and with applicable related documents listed in this STANAG in designing air-launched guided munitions. The agreement is applicable to the new developments initiated after ratification and subject to national implementation instructions.

3. This agreement applies to all air-launched guided munitions and to all devices, components and support equipment for those munitions.

4. The air-launched guided munitions shall be assessed for compliance with the principle in this STANAG by an appropriate national or service review authority. If the review authority determines the munition is less than fully compliant with those principles, that review authority shall document the reasons if approval for service use is granted. Compliance with the principles shall be confirmed by inspection or analysis or be demonstrated by testing to the satisfaction of the review authority.

DEFINITIONS

5. Terms specific to this document are defined in Annex A.

GENERAL

6. The goal of the requirements in this section is to optimize the safety of the air-launched guided munition system. The requirements are comprised of safety criteria and guidelines, background information, statements of good practice, logical methodologies and experience gained from past designs. The related documents listed in this STANAG should be used, when applicable, during the development of air-launched guided munitions covered by the scope of this document. Safety design principles, e.g., those in STANAG 4187, are mandatory if applicable.

DETAILS OF THE AGREEMENT

7. Staff Requirements

a. The munition and its associated system(s) shall be designed to meet and maintain the degree of safety defined by the staff requirement for all normal and abnormal but credible environments throughout its life cycle. Compliance with these criteria shall be demonstrated by tests and assessments to the satisfaction of the national authority. Design features shall, where feasible, be incorporated to prevent or limit to the level, degree or probability defined in the staff requirement hazardous conditions arising from:

(1) extraneous electromagnetic radiation, electric potential, chemical, mechanical, thermal or radioactive sources of energy, hazardous materials or products of reaction.

(2) inadvertent or premature functioning of batteries or other energy sources, ignition or initiation systems or energetic materials.

(3) inadvertent or premature launch or release of the munition from its launch platform.

(4) post launch trajectories that endanger the launch platform.

(5) operating characteristics that endanger unintended targets.

(6) munitions that fail to launch, drop or expel, when required to do so, either in the offensive, trial or practice design mode or for jettison purposes.

(7) launched munitions which fail to function after launch from the aircraft.

(8) munition containers attached to the launch platforms which, when no longer containing munitions, cannot be jettisoned when the system requirements include this function.

b. Telemetry munitions/exercise munitions

Operating characteristics of exercise/telemetry versions of the munition shall include an additional feature or features to protect the exercise targets and maintain range safety, where applicable. If a break-up system is included. This system shall be designed to preclude creating a hazard as described above. The design of exercise/telemetry units shall preclude, reduce or control hazards associated with recovery and refurbishment (turn-around).

c. Safety system program

The developing nation shall conduct a system safety program based on AOP-15 requirements. The intent of the program shall be to ensure compliance with applicable design criteria and to minimize safety risk through early program attention to safety design criteria. Methodologies used shall be based on accepted safety analytical tehniques applied as part of an iterative design process. The analyses and studies carried out under this system safety program shall consider all environmental influences, logistic conditions and operational phases anticipated for the munition. Analyses may include, but are not limited to: preliminary (pre-design) hazard analysis, subsystem hazards analysis, system hazards analysis, human factors analysis, sneak circuit analysis and operating and support hazards analysis.

8. Principles for safe design

The munition shall be designed according to the following principles.

a. Energetic and hazardous materials

Justification for use of any hazardous or energetic material in munitions shall be documented. For each use of energetic materials selected (e.g., main explosive charge, components of the explosive train, propulsion systems and recovery systems), energetic materials of the least sensitivity and sensitiveness, commensurate with the operational requirements, shall be used. A plan for the ultimate disposal of the energetic materials used in the munition shall be established. Safe disposal of hazardous waste produced by or generated because of the munition system shall be acknowledged and accounted for in overall service use plans.

(1) Selection of explosives

Qualification, Final (Type) Qualification and selection of explosive compositions used in munitions shall be in accordance with STANAGs 4147 and 4170 and AOP-7. The explosives used in munitions shall be the least sensitive explosives that can meet the documented operational requirements. Throughout the life cycle of the munition, the possibility of forming explosive compounds that are more sensitive than the original explosives should be minimised. Electric initiators shall be designed to comply with the criteria of STANAG 4187.

b. Fuze system

The arming train design shall be in accordance with STANAGs 3525 and 4187 unless otherwise specified in this document or its annexes.

c. Propulsion system

Selection of propellants shall satisfy the requirements of sub-paragraph 8a. Ignition safety devices for rocket motors shall be in accordance with STANAG 4368. The burst strength of the combustion chamber shall be demonstrated by testing.

d. Battery unit

When the battery is a type that shall be activated, the design of the activation system shall prevent premature or inadvertant activation. A technical evaluation of the battery and its intended use shall be the basis for any approval decision. Particular attention is to be given to the unusual hazards associated with batteries using lithium chemistry.

Lithium batteries shall be used only when other battery types cannot meet the operational requirements within the size constraints. Approval for usage of a lithium battery shall be based on hazard assessment testing to meet staff requirements.

e. Electronic/electrical components

(1) Electrical connectors

(a) Electrical connectors shall be designed to protect the conducting wire from external stimuli, prevent mismating and assure correct indexing, according to the guidelines given in annex C.

(b) Electrical connectors shall be designed or selected to be in accordance with STANAG 4187 and AOP-16.

(2) Computer program safety design

(a) Any computer system that controls safety related functions shall be designed to preclude functioning of the munitions system other than as intended. Documentation of the safety design and function of the computer controlling programs shall be made available for review.

(b) Software of such computers shall be subjected to a software hazard analysis.

(c) The requirements of STANAG 4404 shall be met.

f. Air launch platforms interface

The air launched guided munitions design shall consider hazards to the launch platform from explosion effects (shock, fragments, plume, ricochet, etc.), either during or after the launch cycle.

(1) Launch safety

The air launched guided munitions design shall consider safety to the launch platform by preventing impact with the munition during launch cycles. Factors such as various launch dynamics and delays in programmed operations are to be considered (i.e. computer hand shake).

(2) Safe separation - deployment

The air launched guided munition shall achieve safe separation by physically clearing the launch platform and preventing explosive functioning of the munition and activation of any non-contained energy sources until specified events have occured. Similar, the munition shall withstand the acceleration forces and ejection forces without explosive event and remain explosively safe until safe separation is achieved. This delay in functioning provides for the munition and the launching platform permits the establishment of a distance beyond which an acceptably low probability of injury or damage to the launch platform exists if the munition should function. Provisions of STANAG 4187 for fuzing systems and explosive selection are to be imposed during design.

(3) Recontact

The air launched guided munitions design shall consider means of preventing recontact with the launch platform after launch. The munition may require devices such as retardation devices to prevent ricochet on water impact. Such retardation devices shall be designed such that they do not deploy prematurely, e.g., while in captive flight on the aircraft or before safe separation.

(4) Safe jettison

The air launched guided munitions shall include provision for safe jettison and shall be prevented from arming during and subsequent to jettisoning. Safe jettison shall be demonstrated by trial.

g. Sterilization

Sterilization of the munition, when specified, shall be achieved through a planned, programmed process that renders the munition permanently incapable of normal activation after specified events and time when the weapon has served its useful purpose or is no longer capable of functioning as designed.

h. Explosive ordnance disposal

Air launched guided munitions shall incorporate explosive ordnance disposal features for enabling safe disposal of the munition when required. Those features shall not impose operational limitations on the munition.

i. Environmental exposure

The air launched-guided munition shall be designed to remain safe in all environments specified in staff requirements. Moreover, safety shall not be unacceptably degraded when the munition is subjected to unexpected but credible environments. Those environments shall be specified for the munition or otherwise identified in the profile developed in accordance with AOP-15, Annex A and defined in STANAGS 2895, 4234, 4235, 4236 and 4370 and AECP-1.

j. Materials

Materials used in the munition shall be chemically compatible in accordance with STANAG 4147, or such that no sensitive explosive compounds are formed.

(1) Corrosion and deterioration

All construction materials shall be selected in accordance with the electromotive series (electrochemical potential) of elements or treated in a manner as to render them adequately resistant to corrosion. Other factors to be considered include stress, hygroscopic characteristics and the ability to resist the effects of fungus or moisture which may contain salt or other corrosives ; organic materials are to exhibit resistance to hydrolysis, ozonolysis and other degradative chemical processes enhanced by exposure to anticipated environmental conditions; chemical compatibility between contacting materials ; non-toxic and non-reactive properties of decomposition products and volatile and leachable constituents. STANAG 4370 includes tests to aid in this verification.

(2) Toxicity

Non-toxic and non-reactive construction materials shall be selected in the design of the air-launched guided munition and its support equipment. When toxic or reactive materials must be used, appropriate warnings and procedures shall be established and included in the technical documentation to control the hazards. Toxic or reactive materials can cause health problems for personnel who handle or operate the munition.

k. Human factors

Human factors engineering principles and practices shall be applied in the design of the munition and its support equipment. Taking human factors into consideration when designing the munition system is part of ensuring the safe operation of that system.

l. Packaging

Packaging containers, storage, handling and transportation equipment selected or designed to protect the munition or its components during the life cycle shall be considered in the safety analysis of the system. The packaging of the munition system may protect the system from damage that could lead to a safety-related event or other mishap, during transport and handling, but the safety should never rely on the packaging alone.

m. Inspection and test

Air-launched guided munitions shall be designed and manufactured such that need for inspection and testing of the munition is minimized. The design of the system should facilitate the use of inspection and test equipment for visual, physical, or electronic monitoring of all characteristics which assure its safety and intended functioning at all appropriate stages. The design should facilitate, when necessary and practical, the use of automatic inspection and built-in test equipment. When inspection or testing of the munition is necessary, the design of inspection and test equipment shall ensure that its use will not compromise safety. For the concept of all-up-round munitions, the testing shall not cause a hazardous event or rely on procedures for safety during the test procedures.

Testing by the manufacturer and acceptance testing by NATO nations shall assure that safety features are intact and will remain so throughout the life cycle of the munition. The munition shall be designed such that there is no need to test safety features at the operational platform. Subject to operational conditions, it should be possible, at any time in service, to determine the safe state of the fuzing system.

9. Testing

Testing of the munition system can reveal failures and safety-related conditions that could occuring the manufacturer-to-target sequence. Therefore, the following areas of testing shall be done to assess hazards and to verify safety features as appropriate.

a. Environmental

Environmental testing of the munition shall be conducted according to STANAG 4325.

(1) Standard environmental tests

Standard environmental tests shall be performed in accordance with test methods STANAGS (e.g. STANAG 4370) to the limits defined by the environmental profile developed in accordance with AOP-15, Annex A, to the satisfaction of the national or service review authority.

(2) Extreme environmental tests

The basic safety tests listed in Annex A of STANAG 4325 which simulate extreme environmental conditions shall be performed as part of the safety and suitability testing of the weapon system for service use. In addition, supplemental tests may be selected from available STANAG requirements (or from annex B of STANAG 4325) to validate design safety, including considerations of combat induced environnements.

b. Hazard assessment

Hazard assessment tests shall be conducted on the munition or its components in accordance with STANAG 4325, Annex A. The testing may include, but is not limited to: slow cook-off, fuel fire, bullet/fragment impact, sympathetic detonation, 12 meter drop (following temperature, humidity and vibration conditioning), electrostatic discharge and electromagnetic radiation.

10. Handling/storage - Inadvertent initiation

All safety-critical stored energy devices shall be protected against inadvertant initiation from any cause to specified levels of acceptability agreed with national authorities.

11. Documentation

a. Service documentation

Documentation developed for operating forces must be validated to ensure inclusion of safety procedures, precautions, and warnings required to specify hazards identified by testing and analysis of the system safety program. Additionally, validation of the specification of proper handling test and other ancillary equipment shall be accomplished.

b. System safety program documentation

The tests and analyses conducted in the system safety program should be documented in the detail advised by AOP-15.

IMPLEMENTATION OF THE AGREEMENT

12. This STANAG is implemented by a nation when that nation has issued instructions to its forces that all future air-launched guided munitions and support equipment procured for its forces will be designed and manufactured in accordance with the principles detailed in this agreement. National orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification where available.

ANNEX A to
STANAG 4432
(Edition 1)

TERMS AND DEFINITIONS

The following terms and definitions are used for the purpose of this agreement only.

a. Safe Jettison

Deliberate release or ejection of a non-armed of munition in a manner which ensures that arming cannot occur.

b. Safe separation distance

A minimum distance between the delivery system or launcher and the munition beyond which the functioning of the munition shall not hazard the delivery system or personnel.

c. Waiver

Acceptance, by the appropriate national acceptance authority, of a munition, which does not meet all requirements for safety, producibility or effectiveness.

d. Safety

Acceptable degree of freedom from hazards to personnel and material at all times.

e. Demilitarization

The activity of making a munition harmless by removing or otherwise neutralizing the energetic materials contained in the munition. This is normally done at the munition's end of life.

f. Function

Execution of the arming and firing sequences, as designed, such that the explosive train is aligned and initiated or some other energy source is activated.

g. Launch safety

No unintended contact between the munition and the launch platform or other munitions during or after the launch cycle.

h. Sneak circuit

An unexpected path or logic flow within a system which, under certain conditions, can initiate and undesired function or inhibit a desired function. The path may consist of hardware, software or operator actions, or a combination of these. Such circuits are not the result of hardware failures but are latent conditions inadvertently designed into the system or coded into software programs causing the system to perform unwanted, unintended actions.

ANNEX B to
STANAG 4432
(Edition 1)

ASSOCIATED NATIONAL DOCUMENTS

FRANCE

IT DGA/DCN 9282 :	Slow Cook-off
IT DGA/DCN 9282-1:	Fuel fire
IT DGA/DCN 9282-2:	Bullet Impact
IT DGA/DCN 9282-3:	Drop Test
IT DGA/DCN 9282-4:	Heavy Impact
IT DGA/DCN 9282-5:	Sympathetic Detonation

UNITED KINGDOM:

Defence Standard 08-5: Design Requirements for Weapon Systems
Aviation Publication (AvP)32: Design Requirements for Guided Weapons
Defence Standard 08-3: Ordnance Board Safety Guidelines for Munitions
Ordnance Board Pillar Proceedings P101 - P102 - 42491 and 41779

UNITED STATES:

MIL-STD-2105: Military Standard Assessment Tests for Navy Non-nuclear Ordnance

ELECTRICAL CONNECTORS

Electrical connectors shall be designed to comply with the following guidelines:

Protection from external stimuli

Connector designs shall provide for maximum protection against electrical faults due to the presence of moisture or extraneous material trapped in connectors. Connectors shall be designed so as to shield out all electromagnetic radiation.

Mating

Electrical connectors shall be designed or selected to prevent improper mating of connectors. The system shall be analysed to ensure that connectors do not have similar keys or contact arrays or are not at locations in the assembly where they may be mismated or interchanged. Arrays of contacts or placement of keys in electrical connectors shall not be symmetrical. The chance of mismating can be further reduced by the use of hard connector inserts. Connector designs shall provide for ease of mating when connectors are in blind locations.

Pin arrangements

Pin arrangements shall not be used to provide for connector indexing or orientation. Connector design shall preclude misindexing the insert with respect to the shell during assembly by the manufacturer. Pin arrangement shall preclude the possibility of indesirable or hazardous conditions if adjacent pins are bent or shorted. The pins of a pug (male) shall not be connected to a "live" source unless it cannot be avoided, in which case the plug shall be shrouded.