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See CNAD AC/326 STANAG distribution

STANAG 4608 JAS (EDITION 1) – AMMUNITION BELOW 12.7 MM CALIBRE – DESIGN SAFETY REQUIREMENTS AND SAFETY SUITABILITY FOR SERVICE (S3) EVALUATION

Reference: PFP(AC/326)D(2004)0012 dated 16 June 2004

1. The enclosed NATO Standardization Agreement, which has been ratified by nations as reflected in the **NATO Standardization Document Database (NSDD)**, is promulgated herewith.

2. The reference listed above is to be destroyed in accordance with local document destruction procedures.

ACTION BY NATIONAL STAFFS

3. National staffs are requested to examine **their ratification status of the STANAG** and, if they have not already done so, advise the Defence Investment Division through their national delegation as appropriate of their intention regarding its ratification and implementation.

J. MAJ
Brigadier General, POL(A)
Director, NSA

Enclosure:
STANAG 4608 (Edition 1)

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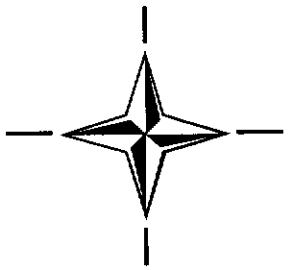
STANAG 4608
(Edition 1)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)



NATO STANDARDIZATION AGENCY
(NSA)

STANDARDIZATION AGREEMENT
(STANAG)

SUBJECT: AMMUNITION BELOW 12.7 MM CALIBRE – DESIGN SAFETY REQUIREMENTS AND SAFETY SUITABILITY FOR SERVICE (S3) EVALUATION

Promulgated on 10 July 2006

J. MAJ
Brigadier General, POL(A)
Director, NSA

RECORD OF AMENDMENTS

No.	Reference/date of Amendment	Date Entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Director NATO Standardization Agency under the authority vested in him by the NATO Standardization Organisation Charter.

2. No departure may be made from the agreement without informing the tasking authority in the form of a reservation. 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.

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

4. Ratification, implementation and reservation details are available on request or through the NSA websites (internet http://nsa.nato.int; NATO Secure WAN http://nsa.hq.nato.int).

FEEDBACK

5. Any comments concerning this publication should be directed to NATO/NSA – Bvd Leopold III - 1110 Brussels - BE.

STANAG 4608
(Edition 1)

NATO STANDARDISATION AGREEMENT
(STANAG)

AMMUNITION BELOW 12,7 MM CALIBRE - DESIGN SAFETY REQUIREMENTS AND SAFETY SUITABILITY FOR SERVICE (S^3) EVALUATION

ANNEXES:

A. Design Safety Requirements and Assessment Criteria for Ammunition below 12,7 mm Calibre.
B. Test Requirements for the Assessment of the Safety and Suitability for Service of Ammunition below 12,7 mm Calibre.

Related Documents:

STANAG 2310	Small Arms Ammunition (7,62mm).
STANAG 2401	Weapon Danger Areas/Zones for Unguided Weapons for use by NATO Forces in a ground role: Factors and Processes – ARSP-1.
STANAG 2895	Extreme Climatic Conditions and Derived Conditions for Use in Defining Design/Test Criteria for NATO Forces Materiel.
STANAG 2953	The Identification of Ammunition – AOP-2(B).
STANAG 4090	Small Arms Ammunition (9mm Parabellum).
STANAG 4110	Definition of Pressure Terms and Their Interrelationship for Use in the Design and Proof of Cannon, Mortars and Ammunition.
STANAG 4123	Methods to Determine and Classify the Hazards of Military Ammunition and Explosives.
STANAG 4147	Chemical Compatibility of Ammunition Components with Explosives and Propellants (Non Nuclear Applications).
STANAG 4170 with AOP 7	Principles and Methodology for the Qualification of Explosive Materials for Military Use.
STANAG 4172	5,56mm Ammunition (Linked or Otherwise).
STANAG 4187 with AOP 16	Fuzing Systems – Safety Design Requirements.
STANAG 4224	Large Calibre Artillery and Naval Gun Ammunition Greater than 40 mm, Safety and Suitability for Service Evaluation.
STANAG 4234	Electromagnetic Radiation (Radio Frequency) - 200 kHz to 40 GHz Environment - 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 4239	Electrostatic Discharge Munitions Test Procedures.

STANAG 4240	Liquid Fuel Fire Test for Munitions.
STANAG 4241	Bullet Attack Test for Munitions.
STANAG 4242	Vibration Test Methods and Severities for Munitions Carried in Tracked Vehicles – AOP 34 Vibration Test Procedures for Munitions Carried in Tracked Vehicles.
STANAG 4297 with AOP 15	Guidance on the Assessment of Safety and Suitability for Service of Non-nuclear Munitions for NATO Armed Forces.
STANAG 4340	NATO Standard Packaging Test Procedure.
STANAG 4370	Environmental Testing (incl. AECTP 100 – 500).
STANAG 4375	Safety Drop Munition Test Procedure.
STANAG 4382	Slow Heating, Tests for Munitions.
STANAG 4396	Sympathetic Reaction Munition Test Procedures.
STANAG 4439 with AOP 39	Policy for Introduction, Assessment and Testing for Insensitive Munitions (MURAT).
STANAG 4509	5.7 X 28mm Small Arms Ammunition.
STANAG 4518	Safe Disposal of Munitions, Design Principles and Requirements, and Safety Assessment.
AC/225(LG/3-SG/1)D/14	Evaluation Procedures for Future NATO Small Arms Weapon Systems.
UN Document	UN recommendations on the Transport of Dangerous Goods.
AECP 1	Mechanical Environmental Conditions to Which Materiel Intended for Use by NATO Forces Could Be Exposed.
AOP 38	Glossary of Terms and Definitions Concerning the Safety and Suitability for Service of Munitions, Explosives and Related Products.
AOP 48	Explosives, Nitrocellulose based Propellants, Stability Test Procedures and Requirements using Stabilizer Depletion. Implemented through STANAG 4620 (in ratification)

AIM

1. The aim of this agreement is to provide a uniform method for establishing the Design Safety Requirements and for the assessment and testing of the Safety and Suitability for Service (S^3) of ammunition below 12,7mm calibre within NATO.

AGREEMENT

2. Participating nations that Ratify this STANAG, and who develop and/or modify ammunition below 12,7mm calibre, agree:

a. for Design Safety Requirements:

(1) to incorporate the design safety requirements outlined in this STANAG in ammunition below 12,7 mm calibre developed after ratification.

(2) to incorporate, as far as practicable, the design safety requirements of this STANAG when modifying existing ammunition below 12,7 mm calibre.

(3) to identify details of any design safety requirements that have not been incorporated in this STANAG and inform the custodian of the omission.

b. for S^3 evaluation:

(1). that the developing nation conducts the S^3 evaluation procedures outlined in this STANAG on ammunition below 12,7 mm calibre adopted for use by own forces after ratification.

(2) that procuring nations may conduct additional evaluation procedures or trials to meet national safety requirements.

(3) to maintain a record of all trials conducted and their outcome.

c. Data developed in accordance with this STANAG shall be made available to other NATO Nations participating in a collaborative weapon development or procurement programme upon receipt of a request submitted through appropriate national channels.

Likewise, data developed in accordance with this STANAG shall be made available to nations procuring or otherwise acquiring the ammunition.

Nations may carry out additional trials at their own expense, either to ensure national safety requirements are met or to establish whether the Small Arms Ammunition is suitable in an environment not covered by the developing nation.

DEFINITIONS

3. Please refer to AOP-38 Glossary of Terms and Definitions Concerning the Safety and Suitability for Service of Munitions, Explosives and Related Products.

The following additional definitions are provided for the purpose of this STANAG:

Weapon Danger Area/Zone. The 3-dimensional space around/extending from a weapon where the risk from the weapons projectile, submunitions, fragments, as well as blast overpressure, heat or other effects is not acceptable. Weapon danger area/zones are dealt with in STANAG 2401.

DESIGN SAFETY REQUIREMENTS

4. **The Aim**. The aim of the design safety assessment is to review the design of the ammunition in order to ascertain to what extent the relevant design safety requirements have been met. It is also to identify potential failure modes and areas of technical risk. The assessment should be conducted as early as possible in the design process, but on a build standard that is sufficiently representative of the production standard to ensure validity of the analysis. All the main components and sub-assemblies of the cartridge and its packaging shall be considered. The assessment shall take account of the climatic, mechanical, chemical, electrical and radiological environments, the intended uses of the ammunition as identified in the Allied Ordnance Publication (AOP) 15 Environmental Questionnaire as well as, where relevant, any predictable unintended uses of the ammunition.

5. **General Considerations**. In appraising the design safety aspects of the ammunition, it must be remembered that ammunition below 12,7mm calibre is carried by individual soldiers and on vehicles, and as a consequence will almost certainly be exposed to severe combinations of climatic and rough handling (mechanical) conditions.

6. **Design Safety Requirements**. The design safety requirements and assessment criteria are given in Annex A.

ASSESSMENT OF SAFETY AND SUITABILITY FOR SERVICE

7. **Purpose**. The purpose of the assessment of S^3 is to identify from the design assessment, test results, and any other relevant information, all of the significant risks that might be presented by the ammunition being used in its defined service environment. The risks should then be specified to determine whether they have been reduced to an acceptable level. Where appropriate, the S^3 assessment should consider predictable unintended use of the ammunition. Where appropriate to the scope of the task, the assessment should consider system safety (ammunition + weapon) as well as the safety of the ammunition alone, including the performance of the packaging associated with the ammunition.

8. **Procedures.** Each nation will be responsible for the safety and suitability for service assessments of ammunition to be used by its own services and, for this purpose, will require copies of relevant design parameters, assessments, and test reports from the nation developing the ammunition. The data needed to conduct this assessment shall be made available as specified in the agreement at paragraph 2.

9. **S^3 Test Requirements**. The tests required for each type of ammunition may vary depending on the design, the design safety assessment, the degree of commonality with types already tested, and the specified service environment(-s). The spectrum of weapons, that use ammunition below 12.7mm in calibre, means that the test program and individual test parameters will likely need to be tailored. The developing nation shall provide full details of the environment against which a munition has been tested, and in addition, details of the parameters of the tests which have been conducted. The tests and analyses that may be needed to provide the evidence required by the National Authority to assess the S^3 of ammunition below 12.7mm in calibre are in Annex B and can be broadly grouped into the following categories:

a. **Preliminary functioning and safety tests**. The aim of the preliminary functioning and safety tests is to demonstrate, that the strength of design of the cartridge is satisfactory, that it is free from the possibility of premature functioning, that the pressures generated are safe with respect to both weapon and projectile, to obtain ballistic data and to establish the weapon danger area/zone.

b. **Sequential environmental tests**. The aim of sequential environmental tests is to verify, that the ammunition can survive the expected environments in a safe and satisfactory manner. Ammunition, packaged and unpackaged as appropriate, will be subjected to the manufacture to target or disposal sequence (MTDS) environments; individual cartridges may be withdrawn at various points to ascertain the effects of specific environments. The sequence of tests will vary from munition to munition, and shall be designed to reflect the specific MTDS. Guidelines on environmental testing may be found in STANAG 4370 and associated AECTP's.

c. **Functioning tests and critical examination**: The aim of the functioning tests and the critical examination is to establish the ballistic and functional reliability of the ammunition, including after exposure to stressed environments.

d. **Non-sequential safety tests**. The aim of the non-sequential safety tests is to verify that the ammunition can survive expected individual environments in a safe and satisfactory manner. The selected tests will vary from munition to munition, depending on the expected environment(-s) of the MTDS.

e. **UN Hazard Classification**. Where possible the statutory tests to establish UN hazard classification will form part of the safety and suitability test program.

f. **Packaged tests**. The packaged tests are performed to verify that the packaged ammunition will safely withstand logistic environments, typically experienced during transportation.

g. **Unpackaged tests**. The unpackaged tests are performed to verify that the bare ammunition will safely withstand environments to which it will typically be exposed when carried by troops or on vehicles.

h. **Service life assessment**. Using data from environmental and other tests, to give an initial assessment of the expected storage and operational lifetimes of the ammunition.

10. **Insensitive Munitions test requirements**. The Insensitive Munition properties of the ammunition are to be assessed according to STANAG 4439 and AOP 39.

GUIDANCE ON THE ASSESSMENT OF S^3

11. **Guidance**. Guidance on the assessment of S^3 for ammunition below 12.7mm calibre can be found in AOP-15. Further details of ammunition testing are to be found in AC/225(LG/3-SG/1)D/14, as well as in the Manuals of Proof and Inspection (MOPI) for the individual ammunition calibres and STANAG 4439 with AOP 39.

12. **Additional testing.** Notwithstanding the intention to avoid duplication of testing, each nation reserves the right to repeat tests conducted by the developing nation and carry out additional testing if considered necessary and to bear the financial, technical and safety consequences of conducting such tests. Nations requiring additional test may obtain assistance, under conditions to be negotiated, from the developing nation.

13. **Test selection.** There may be inherently different environmental hazards and operational philosophies that affect safety and suitability for service assessments by particular nations. A specific test program need not be limited to or include all tests described in this document except in the case of mandatory tests, as given in Annex B of this STANAG. The selection of supplemental (non-mandatory) tests and test parameters shall be based on the measured or analytically forecasted MTDS (life cycle) environmental profile, using guideline documents such as STANAG 2895, STANAG 4370 with associated AECTP's, AECP-1 and AOP-15. It should be noted that if the forecasted MTDS indicates, that a test in section II of Annex B is appropriate, then this test is to be considered mandatory to that specific ammunition, with the given MTDS (life cycle). Also, whether a test is mandatory or supplemental, it may need to be repeated for various parts of the MTDS (packaged, unpackaged, during handling, etc.). Read-across may be acceptable, provided that sufficient confidence in the results can be established.

14. **Test assessment.** No individual test or group of tests can be assessed in isolation; therefore, to make a valid assessment of the ammunition in its expected service life environment, the final S^3 assessment recommendation needs to consider both development tests as well as the individual national evaluation procedures.

15. **Proof of interoperability.** The test requirements to ensure interoperability of the ammunition, as specified in the relevant Manual of Proof and Inspection, may be used to supplement/compliment the safety and suitability for service assessment requirements defined in this STANAG. Other calibre ammunition may be assessed by related type standards. Read-across may be acceptable, provided that sufficient confidence in the results can be established.

16. **Test items.** Tests should be conducted on the final design of the ammunition and packaging, which have been manufactured to full production standards and is ready to be deployed. Deviations and waivers from this design shall be identified. Design or production changes after deployment shall be identified and supporting information to confirm the validity of original tests as affected by these changes shall be provided. Non-functional items may substitute items within the ammunition provided this does not detract from the purpose of the test or test sequence. The configuration shall be specified in detail in the test plan and reported in the test report.

17. **Explosive Qualification and Final (Type) Qualification.** Evidence shall be provided by the developing nation that the explosive and propelling charge compositions used in the ammunition have been assessed and qualified to the requirements of STANAG 4170 and AOP-7. These include propellant stability tests in accordance with AOP-48, and chemical/physical compatibility of ammunition components with explosives and propellants in accordance with STANAG 4147, where appropriate.

18. **UN Classification.** Evidence shall be provided by the developing nation that the ammunition has been given a UN Hazard Classification valid to its design and packaging in accordance with UN recommendations on the Transport of Dangerous Goods and STANAG 4123. Guidance may also be found in STANAG 4340.

19. **Marking.** The ammunition packaging shall be marked in accordance with STANAG 2953 and AOP-2(B).

IMPLEMENTATION OF THE AGREEMENT:

20. This STANAG is implemented by the ratifying nation when that nation:

a. Has revised or issued applicable national documents to agree with the provisions of the STANAG.

b. Has issued the necessary orders/instructions to its services that all new ammunition below 12.7mm calibre will be developed in accordance with the requirements and procedures detailed in this agreement.

c. Has issued the necessary orders/instructions to its services that the requirements and procedures detailed in this agreement will be incorporated as far as practicable in modifications of ammunition below 12.7mm calibre.

ANNEX A
STANAG 4608
(Edition 1)

DESIGN SAFETY REQUIREMENTS AND ASSESSMENT CRITERIA FOR AMMUNITION BELOW 12,7 MM CALIBRE

Serial	Design Safety Requirements	Assessment Criteria / Remarks
COMPLETE CARTRIDGE		
1	The structural integrity of the complete cartridge shall be sufficient to withstand cycling through the feed system and mechanism of the specified weapons(s) during the loading and unloading process.	Successful completion of mandatory tests in Annex B, tests according to relevant Manual of Proof and Inspection (MOPI), where available, and field trials.
2	The cartridge shall be sufficiently robust to withstand thermal and mechanical stresses arising from the expected service environment.	The term "expected service environment" includes the environment (-s) within the specified weapon(s).
3	The cartridge shall remain waterproof throughout its expected service life.	Successful completion of mandatory tests in Annex B, tests according to relevant MOPI, where available, and field trials.
4	Sealants, adhesives and paints used in the ammunition shall neither render explosive compositions unsafe, nor cause unacceptable degradation in performance during the life of the ammunition.	Testing according to STANAG 4147 Chemical Compatibility of Ammunition Components with Explosives and Propellants (Non Nuclear Applications). The efficiency of sealants and adhesives will be assessed during sequential environmental testing.

Serial	Design Safety Requirements	Assessment Criteria / Remarks
5	Materials used in the construction of the cartridge and protective finishes, such as paints, sealants and lacquers, shall not be degraded by the service environment and/or exposure to contaminants likely to be encountered in service use, such that the cartridge becomes unsafe or unserviceable.	The resistance of any exposed components, such as the cartridge case or case-mouth or primer sealants, to damage and degradation is to be assessed.
6	Toxicity To assess the toxic hazards produced when firing.	a. Each type of ammunition is to be considered; read across may be acceptable. b. This is not normally required for aircraft weapons unless mounted in the main fuselage. c. A range of wind speeds/directions and training/operational variations of field emplacements are to be considered. d. Samples are to be collected on crew positions. e. This test is to be undertaken in accordance with AC/225 (LG/3-SG/1), Document D14. Toxic hazards produced when firing may influence the Weapon Danger Area/Zone, as described in STANAG 2401.
7	The design of the cartridge, and where appropriate, its packaging, shall minimise the violence of the reaction to externally applied stimuli.	Guidance on Insensitive Munition (IM) tests and criteria are contained in STANAG 4439 and AOP 39.

Serial	Design Safety Requirements	Assessment Criteria / Remarks
8	The future safe and environmentally responsible disposal of the ammunition shall be considered in the design phase.	The ammunition shall be designed in accordance with STANAG 4518.
CARTRIDGE CASE		
9	When fired, the cartridge case (supported by the chamber of the weapon) shall be capable of withstanding the projectile design pressure.	To be demonstrated during the preliminary functioning and safety tests.
10	The cartridge case shall provide satisfactory rearward obturation/sealing of weapon chamber to prevent hazardous or damaging blow-back of propellant gases.	Any gas wash shall be insufficient to result in a hazard to the operator or cause significant damage to weapon components.
PRIMER ASSEMBLY		
11	The sensitivity of the primer assembly to mechanical shock and electrical or radio frequency induced stimuli outside the design tolerances, and under all specified conditions of storage, transportation, handling, and feeding through the specified weapons, shall not be sufficient to cause accidental initiation of the cartridge.	a. Where Electro Explosive Devices (EED) are included, the No Fire Threshold (NFT) shall be established by the manufacturer to the 0.1% power energy level at 95% single sided lower level of confidence. b. As part of the critical examination after sequential environmental testing, it shall be verified that the EED properties have not changed, and that the cartridge functions correctly.

Serial	Design Safety Requirements	Assessment Criteria / Remarks
12	The primer assembly shall be adequately secured in the cartridge case to withstand firing loads at extreme service conditions.	To be demonstrated during the Preliminary Functioning and Safety Test.
13	Energetic material used in primer assemblies must be compatible with the associated propellant if there is any possibility of contact between them.	The manufacturer must provide evidence, where appropriate, of the compatibility of such substances with the propellant.
14	In un-cased or caseless ammunition, where the primer becomes exposed during the firing cycle, the exposed primer must be designed so that if ejected, it is not at a temperature high enough to cause injury to the operator or, where relevant, to ignite an unpackaged combustible cartridge case.	Testing in accordance with national procedures.
SAFETY OF PROJECTILE		
15	Projectile Strength of Design. To determine whether the non-explosive parts of the projectile can successfully withstand the maximum firing stress.	To be demonstrated during preliminary functioning and safety tests.
16	Projectile Safety. To determine whether projectiles loaded with hazardous fillings (high explosives, pyrotechnics or other) are bore and flight safe.	To be demonstrated during preliminary functioning and safety tests.

Serial	Design Safety Requirements	Assessment Criteria / Remarks
17	Worn Barrel. To determine: a. Whether the non-explosive parts of the projectile can successfully withstand the maximum firing stress in a worn barrel. b. Whether projectiles loaded with HE, other hazardous fillings, submunitions with HE or other hazardous fillings, and low hazardous projectiles which may or may not contain explosive or pyrotechnic components are bore and flight safe and do not produce erratic flight when fired from a worn barrel.	To be tested in accordance with national procedures.
18	Obturator Band. To determine whether the pressure of an obturator band adversely affects the safety and suitability for service of a projectile.	Note that most conventional natures of ammunition below 12.7mm calibre have no obturator band. Certain special types of ammunition, e.g. some armour-piercing types, may have this feature. This test can be performed as part of test serial no. 15 and/or 16.
19	Muzzle Blast. To determine impulse noise caused by firing the ammunition, so that physiological effects on the operator and other personnel in the vicinity can be assessed.	To be tested in accordance with national procedures.

Serial	Design Safety Requirements	Assessment Criteria / Remarks
EXPLOSIVE COMPOSITIONS		
20	Explosive compositions included in a cartridge shall remain safe after the cartridge has been subjected to the specified thermal and mechanical stressing and firing loads.	a. Explosive compositions shall be fully defined in terms of percentage compositions of the constituents, function (e.g., delay, booster, propellant), weight and source. b. Compositions shall be qualified for service use in accordance with STANAG 4170. c. Where explosives are used that are not qualified, the results of Hazard Data Sheet (HDS) tests shall be supplied, together with details of other stores in which they have been used.
21	Lifetime assessment, to arrive at a preliminary (expected) lifetime of the ammunition in the given life cycle.	To be determined using data from sequential environmental tests and comparison with similar ammunition types.

ANNEX B
STANAG 4608
(Edition 1)

TEST REQUIREMENTS FOR THE ASSESSMENT OF THE SAFETY AND SUITABILITY FOR SERVICE OF AMMUNITION BELOW 12,7 MM CALIBRE

This annex is divided into two sections, section I listing mandatory tests and section II listing supplemental tests.

SECTION I, MANDATORY TESTS:

Test Ser. No	Test	Purpose	Remarks
PRELIMINARY FUNCTIONING AND SAFETY TESTS			
1.1	Safe functioning and ballistics	1. To demonstrate that the internal, intermediate, and external ballistics are satisfactory before ammunition is subjected to further testing. 2. Verify ballistic data for the ammunition, including the establishment of the weapon danger area/zone.	a. Tests are to be conducted using ammunition loaded with standard charge weights for service use. b. Tests are to include firings undertaken with ammunition conditioned at 21°C as well as Upper Firing Temperature (UFT) and Lower Firing Temperature (LFT), to establish the propellant temperature coefficient. Test b. is to be conducted in accordance with relevant Manual of Proof and Inspection (MOPI), if such is available. If not, national procedures are to be used. c. A charge weight assessment test may be required to identify the effects of incremental changes of propelling charge. d. Weapons are to be check-zeroed in accordance with the manufacturer's instructions.

Test Ser. No	Test	Purpose	Remarks
1.1 (cont.)	Safe functioning and ballistics		e. Weapons are to be fired from a mount designed to simulate manual firing as closely as possible. f. Weapons are to be fired single shot and, if relevant, in automatic mode with ammunition conditioned at 21°C. The following data are to be recorded: (1) Rate of fire (automatic weapons). (2) Muzzle velocity (3) Point of aim in relation to mean point of impact. (4) Consistency. (5) Ejection pattern. g. The following criteria are also to be assessed: (1) Wind effects. (2) Effect on zero of gunfire shock, including that related to dual systems. (3) Sight calibration marks and trajectory variations for specified ammunition natures. (4) Rear arc debris from muzzle attachments. Read across may be feasible. Tests d.-g. are to be conducted in accordance with AC/225 Document D14 and relevant MOPI, if such is available.

Test Ser. No	Test	Purpose	Remarks
1.1 (cont.)	Safe functioning and ballistics		h. Establishment of the Weapon Danger Area/Zone (WDA/Z). Guidance on WDA/Z may be found in STANAG 2401 and ARSP-1.
1.2	Strength of design	To demonstrate the strength of design of the cartridge case and projectile assemblies.	Ammunition to be loaded with special or overpressure charge to give projectile design pressure. Test in accordance with national procedures.
1.3	Gun cycling and functioning	To demonstrate that the ammunition is sufficiently robust to be cycled through the gun mechanism without damage, and to subsequently function satisfactorily.	Testing in accordance with relevant MOPI, if such is available. If not, national procedures are to be used.
SEQUENTIAL ENVIRONMENTAL TESTS			
1.4	A Sequential environmental evaluation, using tests selected from Section II of this annex.	To assess whether the ammunition is safe and suitable for service when subjected to environmental conditions representative of service use.	The ammunition, packaged and unpackaged as appropriate, shall be subjected to the manufacture to target or disposal sequence (life cycle) environments. Examples can be found in relevant MOPI.
1.5	Service life assessment.	To give an initial assessment of the expected storage and operational lifetimes of the ammunition.	Assessed using data from sequential environmental tests and comparison with similar ammunition types.

Test Ser. No	Test	Purpose	Remarks
FUNCTIONING TESTS AND CRITICAL EXAMINATION			
1.6	Functioning and reliability	To establish the ballistics and functional reliability of environmentally stressed ammunition.	a. Supplementary reliability data may be obtained by utilising unstressed ammunition in parallel firings to enhance the statistical sample and to obtain comparative ballistic data. b. Pressure barrel firings are required to provide direct comparison of internal, intermediate and external ballistics of environmentally stressed and unstressed ammunition from the same production lot. c. A series of firing tests with service weapons will be required which may include: (1) Firing at ambient conditions. (2) Firing hot conditioned ammunition. (3) Firing cold conditioned ammunition. (4) Tracer functioning. (5) Accuracy firings to validate ballistic predictions. (6) Barrel wear and erosion rates for the specified firing cycle.

Test Ser. No	Test	Purpose	Remarks
1.6 (cont.)	Functioning and reliability		(7) Firing with a worn barrel. Reliability tests and pressure barrel firing according to relevant MOPI.
1.7	Critical examination	To assess the effects of environmental stressing on the component parts of the ammunition.	a. A proportion of cartridges should be subjected to a Sealing Test (See Ser. 2.1). b. The examination may include: (1) External condition - loadability, (2) Bullet pull (described in MOPI). (3) Propellant weight, moisture content and stabiliser content. (4) Primer functioning and sensitivity parameters, where applicable (described in MOPI); Fire and No Fire energy thresholds and electrical resistance. (5) Condition of explosive/pyrotechnic compositions (some guidance in MOPI). (6) Metallurgic condition of cartridge case and projectile body. c. The need to examine other features may be identified during environmental and firing tests.

Test Ser. No	Test	Purpose	Remarks
NON-SEQUENTIAL SAFETY TESTS			
1.8	Double feed	To identify the potential safety hazard when one cartridge is fed to impact the base of a live cartridge, or a fired case, already in the chamber.	Only required if the design safety assessment identifies such an event to be credible. Dependent on the weapon/ammunition combination.
1.9	Fuze safety	Where relevant, to verify the safety of the fuze in credible accident scenarios and in the specified environmental conditions.	a. The applicable tests in STANAG 4187 are to be carried out. b. Some tests may need to be repeated with environmentally stressed cartridges/fuzes. Note that ammunition below 12,7mm calibre will not normally be equipped with fuzes.
1.10	Pressure verification/Propellant safety.	To verify that the maximum operating pressure is lower than the weapon permissible maximum pressure.	a. Ammunition must be subjected to preliminary environmental stressing, and conditioned and fired at the temperature giving rise to the extreme service condition pressure. Ammunition that has been subjected to the sequential environmental tests may be used for this purpose. b. Test ammunition to contain propellant from 2 production lots. c. Tests to be fired from 2 pressure barrels, on 2 occasions.

Test Ser. No	Test	Purpose	Remarks
1.10 (cont.)	Pressure verification/Propellant safety.		d. A minimum of 10 cartridges per occasion shall be fired. e. The internal form of the pressure barrel shall be the same as that of the weapon for which the ammunition is being assessed. f. Maximum operating pressure to be calculated in accordance with STANAG 4110. Guidance can be found in relevant MOPI).
1.11	Cookoff	To determine the temperature at which the ammunition will cook off when fed into a hot breech, the time to cook off, and the pressures generated.	Results to be related to the weapon heating/cooling characteristics established during the safety assessment of the weapon. Guidance on test found in AC/225 Document D14.
1.12	Levels of airborne toxic substances produced on firing.	To determine the level of toxic elements that could be a health hazard to the shooter or crew when the weapon is mounted on/in a weapon platform.	a. Not normally required for aircraft weapon ammunition unless the weapon is mounted internally in the main fuselage of the aircraft. b. Worst case wind speed and direction to be established prior to the tests. c. For turreted weapons, tests to be repeated with possible training and operational variations of hatches open/shut and NBC conditioning on/off. d. Samples to be collected in selected crew locations.

Test Ser. No	Test	Purpose	Remarks
1.12 (cont.)	Levels of airborne toxic substances produced on firing.		e. Test may be carried out as part of other test series using representative weapons(-s) to fire the ammunition. Note that the levels of airborne toxic substances may influence the Weapon Danger Area/Zone (see ser. 1.1 (h)).
1.13	Safety drop	To demonstrate that the ammunition will remain safe for disposal following impact from high accidental free drops.	Test procedures to be in accordance with STANAG 4375.
1.14	Burst safety distance	To identify, where relevant, the fragment hazard from the projectile to be applied for establishing the Weapon Danger Area/Zone (WDA/Z)	Guidance on WDA/Z may be found in STANAG 2401 and ARSP-1.
1.15	Ricochet characteristics	To establish the ricochet characteristics of both inert and explosive projectiles to be applied when determining the Weapon Danger Area/Zone.	Guidance on Weapon Danger Area/Zone may be found in STANAG 2401 and ARSP-1. Read-across from other ammunition types may be used.
1.16	Worn Barrel test	To determine: a. Whether the non-explosive parts of the projectile can successfully withstand the maximum firing stress in a worn barrel.	Test in accordance with national procedures.

Test Ser. No	Test	Purpose	Remarks
1.16 (cont.)	Worn Barrel test	b. Whether projectiles loaded with explosive, sub-projectiles and/or pyrotechnic components are bore and flight safe and do not produce erratic flight when fired from a worn barrel.	Guidance on test b. can be found in relevant MOPI (Barrel Erosion Test) if available.
1.17	Electromagnetic/electrostatic/ lightning environment test	To verify the safety of the ammunition in relevant electromagnetic environments.	Tests according to STANAG 4234, 4235, 4236 and 4239.
UN HAZARD CLASSIFICATION TESTS			
1.18	UN Hazard classification	To assign a proper UN Hazard Classification (hazard division and compatibility group) to the ammunition.	Testing in accordance with STANAG 4123.

SECTION II, SUPPLEMENTAL TESTS:

Test Ser. No	Test	Purpose	Remarks
NON-SEQUENTIAL SAFETY TESTS			
2.1	Sealing	To verify that the cartridge is adequately sealed against the ingress of moisture.	Test in accordance with relevant MOPI, if available. If not, national procedures are to be used.
2.2	Fragment impact	To determine the reaction of the ammunition to impact by a fragment.	Test according to national procedures.
2.3	Recoil	To verify that weapon recoil is within tolerable limits.	a. The manufacturer is to provide recoil data for all relevant natures of ammunition and muzzle launched projectiles. Read across between similar natures may be acceptable. b. This test is only conducted where satisfactory data is not otherwise available. c. The effect of recoil on consistency is to be assessed during endurance firing and user trials.

Test Ser. No	Test	Purpose	Remarks
PACKAGED TEST			
2.4	Vibration (transportation)	To demonstrate that the packaged store can sustain transportation by sea, road, rail, and air.	Vibration testing to be selected to represent the principal transportation modes.
2.5	Bounce	To demonstrate that the packaged store can sustain shock loadings likely to be experienced during transportation.	
2.6	Drop	To demonstrate that the packaged store can sustain handling impacts likely to arise when on or off-loading ammunition during transportation.	Drop height and orientations to be representative of those likely to be experienced in service.
2.7a	Hot diurnal cycling	To demonstrate that the packaged store can sustain storage in temperate, hot humid, or dry conditions.	Conditioning cycles to be appropriate to the specified worst case Climatic Categories in accordance with STANAG 2895.
2.7b	Cold diurnal cycling	To demonstrate that the packaged store can sustain storage in cold humid, or dry conditions.	Conditioning cycles to be appropriate to the specified worst case Climatic Categories in accordance with STANAG 2895.

Test Ser. No	Test	Purpose	Remarks
2.8a	Vibration (logistic)	To demonstrate that the packaged store can sustain vibration likely to be experienced during operational carriage of ammunition.	Includes tracked vehicle and aircraft/helicopter transport. Exact testing sequence to be determined from the ammunition life cycle.
2.8b	Vibration (tactical)	To demonstrate that ammunition loaded into operational stowage facilities can sustain the vibration likely to be experienced.	Ammunition to be stowed in representative racking/ loading boxes/bays. Gunfire shock may be included, particularly for weapons installed in aircraft or carried on cannon- or gun-armed vehicles.
2.9	Driving rain	To demonstrate that the packaged store can sustain exposure to driving rain.	
2.10	Salt mist/fog	To demonstrate that the packaged store can sustain exposure to salt mist/fog atmosphere likely to be experienced in service use.	Test may need to be repeated for unpackaged stores.
2.11	Dust and sand	To demonstrate that the packaged store can sustain exposure to dust and sand.	

Test Ser. No	**Test**	**Purpose**	**Remarks**
2.12	Parachute delivery	To demonstrate that the packaged store can sustain the shock loading likely to be experienced during parachute delivery.	
2.13	Underwater shock	To demonstrate that the ammunition, when embarked on a naval vessel, will remain safe and suitable for service after subjection to shock from an underwater explosion.	
UNPACKAGED TESTS			
2.14	Drop	To demonstrate that the unpackaged store can safely sustain a free fall drop from a height likely to be experienced in service.	Stores that exhibit visible damage must remain safe for disposal.
2.15	Simulated flight	To demonstrate that the unpackaged store loaded into an aircraft can satisfactorily sustain exposure to temperature, humidity and pressure variations likely to be experienced in flight.	
2.16	Contamination by fluids	To demonstrate that the ammunition will remain serviceable following exposure to fluids typical of those likely to be encountered in service.	