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DEPARTMENT OF DEFENSE
TEST METHOD STANDARD

**HAZARD ASSESSMENT TESTS
FOR NON-NUCLEAR MUNITIONS**



AMSC N6037

AREA SAFT

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FOREWORD

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Address any beneficial comments (recommendations, additions, deletions) and any pertinent data that may be of use in improving this document to: Commander, Indian Head Division, Naval Surface Warfare Center, Standardization Branch (Code 8420), Indian Head, MD 20640-5035, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. This document contains a description of tests or references to NATO Standardization Agreements (STANAG's) for the assessment of munition safety and insensitive munitions (IM) characteristics of non-nuclear munitions. Historically, this standard was used primarily for the assessment of explosive safety. The standard was later revised to add additional IM tests as called out by the Joint Service Requirement for Insensitive Munitions (JSRIM), and now by various NATO STANAG's. This revision makes a distinction between explosive safety tests and the IM tests, even though these tests may often be contained in the same system hazard assessment test program.

4. Three sets of tests are commonly used to assess munitions with respect to hazards: IM tests as contained or contained in this standard; hazard classification tests used to classify munitions for transportation and storage purposes; and system specific tests used to assess munition safety and suitability response or system vulnerability. In order to best utilize limited resources and avoid test redundancy, tailor IM test plans to the maximum extent possible, so that all three sets of tests can be addressed in one coordinated test program with the minimum number of samples. It is recommended that test plans be coordinated with the appropriate service hazard classifier and the Department of Defense Explosives Safety Board (DDESB), 2461 Eisenhower Avenue, Alexandria, VA 22331-0600, when a DOD hazard classification for an item is to be obtained in accordance with TB 700-2¹.

5. Additional or modified hazard testing may be required to fully assess the tactical and logistical vulnerability of the given weapon system against the probable threats to which the system may be subjected. Accordingly, project managers and munition developers will conduct a threat hazard assessment to determine the adequacy of IM

¹ TB 700-2, "Department of Defense Ammunition and Explosives Hazard Classification Procedures," is also known as NAVSEAINST 8020.8, TO 11A-1-47, and DLAR 8220.1.

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tests as referenced or specified in this standard. If the assessment indicates that different environmental hazards or threats to the weapon system pose additional vulnerability problems, tailor the tests to meet those requirements and provide rationale to support the assessment.

6. Program managers are responsible for planning and executing a hazard assessment test program. The hazard assessment test program includes a test plan based on a realistic life cycle environmental profile. Program managers should establish safety design goals for the test plan and have these goals approved by the service review organization within the applicable department. Program managers should generate a test report for submission to their service review organization.

7. The service review organization should review the test plan and test report and examine the results of the hazard assessment test program to ensure that safety and insensitive munitions requirements are met. The service review organization should produce a final recommendation for or against service use of the weapon system. For joint programs, all affected service review organizations should conduct this review and examination and develop a final recommendation.

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1. SCOPE

1.1 Scope. This standard provides or references tests and test procedures for the assessment of safety and insensitive munitions (IM) characteristics for all non-nuclear munitions, munition subsystems and explosive devices.

1.2 Purpose. The purpose is to provide a framework for the development of a consolidated safety and IM assessment test program for non-nuclear munitions. The tests are to characterize the munitions and provide the service review organization information with which to make a decision.

1.3 Application. This standard applies to all non-nuclear munitions (i.e., all-up missiles, rockets, pyrotechnics), and munitions subsystems (e.g., warheads, fuzes, cartridge actuated devices, propulsion units, safe and arm devices, pyrotechnic devices, chemical payloads), and other explosive devices. In all likelihood, it may not be possible to test against all threats. In this case, select the most probable, credible stimuli that is expected to cause the greatest damage to life, property, or combat effectiveness.

MIL-STD-2105C**2. APPLICABLE DOCUMENTS**

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents specified in sections 3 and 4 of this standard, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplements thereto, cited in the solicitation (See 6.2).

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-167/1	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II – Internally Excited)
MIL-STD-167/2	Mechanical Vibrations Of Shipboard Equipment (Reciprocating Machinery And Propulsion System And Shafting) Types III, IV, AND V
MIL-STD-331	Fuze and Fuze Components, Environmental and Performance Tests for
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-882	Standard Practice for System Safety_Program Requirements
MIL-STD-1670	Environmental Criteria and Guidelines for Air-Launched Weapons

HANDBOOKS

DEPARTMENT OF DEFENSE

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MIL-HDBK-310 Global Climatic Data for Developing Military Products

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

NORTH ATLANTIC TREATY ORGANIZATION

STANAG 2895	Extreme Climatic Conditions and Derived Conditions for Use in Defining Design Test Criteria for NATO Forces Materiel
STANAG 4370	Environmental Testing
AECTP 100	Allied Environmental Conditions and Test Procedures (AECTP) 100, Environmental Guidelines for Defence Materiel (under STANAG 4370)
AECTP 200	Allied Environmental Conditions and Test Procedures (AECTP) 200, Environmental Conditions (under STANAG 4370)
AECTP 300	Allied Environmental Conditions and Test Procedures (AECTP) 300, Climatic Environmental Tests (under STANAG 4370)
AECTP 400	Allied Environmental Conditions and Test Procedures (AECTP) 400, Mechanical Environmental Tests (under STANAG 4370)
STANAG 4240	Liquid Fuel/External Fire, Munition Test Procedures
STANAG 4241	Bullet Impact, Munition Test Procedures
STANAG 4382	Slow Heating, Munition Test Procedures
STANAG 4396	Sympathetic Reaction, Munition Test Procedures

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STANAG 4439	Policy for Introduction, Assessment and Testing for Insensitive Munitions (MURAT)
STANAG 4496	Fragment Impact, Munition Test Procedure
AOP-38	Glossary of Terms and Definitions Concerning the Safety and the Suitability for Service of Munitions, Explosives and Related Products
AOP-39	Guidance on the Development, Assessment and Testing of Insensitive Munitions (MURAT)

(Application for copies should be addressed to NATO/MAS, BvdLeopold 111, 1110 Brussels, BE.)

UNITED NATIONS (UN)

UN Orange Book	ST/SG/AC.10/11/Rev 1, Second Edition, Recommendations on the Transport of Dangerous Goods, Tests and Criteria, United Nations, New York, 1990
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(Application for copies should be addressed to United Nations Publications, Sales & Marketing Section, Room DC2-0853, New York, NY 10017)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Y14.3	Multi and Sectional View Drawings (DOD Adopted)
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(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 170	Electrical Performance Standards - Monochrome Television Studio Facilities
EIA 330	Electrical Performance Standards for Closed Circuit Television Camera 525/60 Interlaced 2:1

(Address applications for copies to the Electronic Industries Association, 2001 Eye Street, NW, Washington, DC 20006.)

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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E-1742 Inspection, Radiographic

(Application for copies of ASTMs should be sent to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

MIL-STD-2105C**3. DEFINITIONS**

3.1 All-up-round (AUR). This refers to the completely assembled munition as intended for delivery to a target or configured to accomplish its intended mission. This term is identical to the term all-up-weapon.

3.2 Bare round or configuration. A munition with no external protection or shielding from the environment such as a container, barrier or shield.

3.3 Explosive. An explosive is a solid or liquid energetic substance (or a mixture of substances) which is in itself capable, by chemical reaction, of producing gas at such temperature, pressure and speed as to cause damage to the surroundings. Included are pyrotechnic substances even when they do not evolve gases. The term explosive includes all solid and liquid energetic materials variously known as high explosives and propellants, together with igniter, primer, initiation and pyrotechnic (e.g., illuminant, smoke, delay, decoy, flare and incendiary) compositions.

3.4 Explosive device. An item that contains explosive material(s) and is configured to provide quantities of gas, heat, or light by a rapid chemical reaction initiated by an energy source usually electrical or mechanical in nature.

3.5 Exudation. A discharge or seepage of material. The material may be a component of a chemical payload, a component of an explosive/propellant payload, or a reaction product from incompatibility or aging of munition components.

3.6 Hazardous fragment. For personnel, a hazardous fragment is a piece of the reacting weapon, weapons system or container having an impact energy of 79 N·m (58 lbf·ft) (see 6.8) or greater.

3.7 Insensitive munitions (IM). Munitions which reliably fulfill (specified) performance, readiness and operational requirements on demand, but which minimize the probability of inadvertent initiation and severity of subsequent collateral damage to the weapon platforms, logistic systems and personnel when subjected to unplanned stimuli.

3.8 Munition. An assembled ordnance item that contains explosive material(s) and is configured to accomplish its intended mission.

3.9 Munition subsystem. An element of an explosive system that contains explosive material(s) and that, in itself, may constitute a system.

3.10 Propulsion. A reaction whereby adequate force is produced to impart flight to the test item in its least restrained configuration as determined by the life cycle analysis.

MIL-STD-2105C**3.11 Reaction types.**

- a. Type I (Detonation Reaction).** The most violent type of explosive event. A supersonic decomposition reaction propagates through the energetic material to produce an intense shock in the surrounding medium, air or water for example, and very rapid plastic deformation of metallic cases, followed by extensive fragmentation. All energetic material will be consumed. The effects will include large ground craters for munitions on or close to the ground, holing/plastic flow damage/fragmentation of adjacent metal plates, and blast overpressure damage to nearby structures.
- b. Type II (Partial Detonation Reaction).** The second most violent type of explosive event. Some, but not all of the energetic material reacts as in a detonation. An intense shock is formed; some of the case is broken into small fragments; a ground crater can be produced, adjacent metal plates can be damaged as in a detonation, and there will be blast overpressure damage to nearby structures. A partial detonation can also produce large case fragments as in a violent pressure rupture (brittle fracture). The amount of damage, relative to a full detonation, depends on the portion of material that detonates.
- c. Type III (Explosion Reaction).** The third most violent type of explosive event. Ignition and rapid burning of the confined energetic material builds up high local pressures leading to violent pressure rupturing of the confining structure. Metal cases are fragmented (brittle fracture) into large pieces that are often thrown long distances. Unreacted and/or burning energetic material is also thrown about. Fire and smoke hazards will exist. Air shocks are produced that can cause damage to nearby structures. The blast and high velocity fragments can cause minor ground craters and damage (breakup, tearing, gouging) to adjacent metal plates. Blast pressures are lower than for a detonation.
- d. Type IV (Deflagration Reaction).** The fourth most violent type of explosive event. Ignition and burning of the confined energetic materials leads to nonviolent pressure release as a result of a low strength case or venting through case closures (loading port/fuze wells, etc.). The case might rupture but does not fragment; closure covers might be expelled, and unburned or burning energetic material might be thrown about and spread the fire. Propulsion might launch an unsecured test item, causing an additional hazard. No blast or significant fragmentation damage to the surroundings; only heat and smoke damage from the burning energetic material.
- e. Type V (Burning Reaction).** The least violent type of explosive event. The energetic material ignites and burns, non-propulsively. The case may open,

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melt or weaken sufficiently to rupture nonviolently, allowing mild release of combustion gases. Debris stays mainly within the area of the fire. This debris is not expected to cause fatal wounds to personnel or be a hazardous fragment beyond 15 m (49 ft).

3.12 Service review organization. The various organizations within the services which are responsible for the assessment of explosive safety or IM characteristics (see 6.6).

3.13 Sympathetic reaction. The reaction of a munition or an explosive charge induced by the detonation of another like munition or explosive charge.

3.14 Threat hazard assessment (THA). An evaluation of the munition life cycle environmental profile to determine the threats and hazards to which the munition may be exposed. The assessment includes threats posed by friendly munitions, enemy munitions, accidents, handling, environmental lifecycle conditions, etc. Base the assessment on analytical or empirical data to the extent possible. The THA should also contain the potential reaction of the munition to the threats identified as well as the likely resulting collateral damage. The THA should be updated as the exposure environment changes.

3.15 Weapon system. A munition and those components and equipment required for its operation and support.

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4. GENERAL REQUIREMENTS

4.1 General. A hazard assessment test program includes a test plan generated in concert with an environmental profile, and a THA. Provide rationale for not including any hazards or tests contained or referenced in this document to the service review organization for review and approval prior to executing the test program.

4.1.1 Test plan. Develop a test plan (see 6.3), and base it on the life cycle environmental profile. Include in the test plan provisions for the conduct and sequence of tests, and any environmental conditioning as illustrated on figure 1 (see paragraph 6.3). A review and concurrence is required by the appropriate service review organization(s) prior to conduct of the tests, and the review organization(s) may authorize deviations to the tests and procedures in this document when justified. The test plan may include additional tests selected from other sources or devised to investigate hazardous conditions and environments identified by hazard analyses performed as part of the system safety program described in MIL-STD-882.

4.1.2 Environmental profile. Develop a life cycle environmental profile (LCEP) using the guidance available in other documents for establishing such profiles, e.g., MIL-STD-1670 for air launched weapons, or MIL-STD-810 for general applications. Included in the LCEP are the worst case environmental conditions and limits that munitions will encounter throughout the life cycle, such as temperature, humidity, and vibration. MIL-STD-210 contains information to assist in developing the climatic portion of an environmental profile. Use the environmental profile in performing the THA, and cite it in the test plan. A review and concurrence of the LCEP is required by the appropriate service review organization(s) prior to conduct of the tests.

4.1.3 Threat hazard assessment (THA). Develop a THA (see paragraph 6.3) and ensure it contains an analysis of the munition life cycle. In the THA identify potential hazards, both qualitatively and quantitatively, and their causes and effects. Submit the THA to the appropriate service review organization(s) for approval.

4.2 Test parameters. Determine the safety and sensitivity characteristics of the item under conditions that simulate or duplicate the hazards of credible normal, abnormal or combat situation(s) identified by the THA (see paragraph 6.3). Select the test parameters to reflect maximum stress levels forecasted by the THA, e.g., bullet impact velocity, maximum storage temperature.

4.2.1 Test item temperature. Unless otherwise specified (see 6.4), ensure all ambient temperature test items are at 25 ± 10 degrees Celsius ($^{\circ}\text{C}$) (77 ± 18 degrees Fahrenheit ($^{\circ}\text{F}$)).

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4.3 Passing criteria. Passing criteria for the tests are in section 5 or STANAG 4439. Failure to meet all predetermined test criteria is not necessarily grounds for automatic rejection of that weapon system for service use.

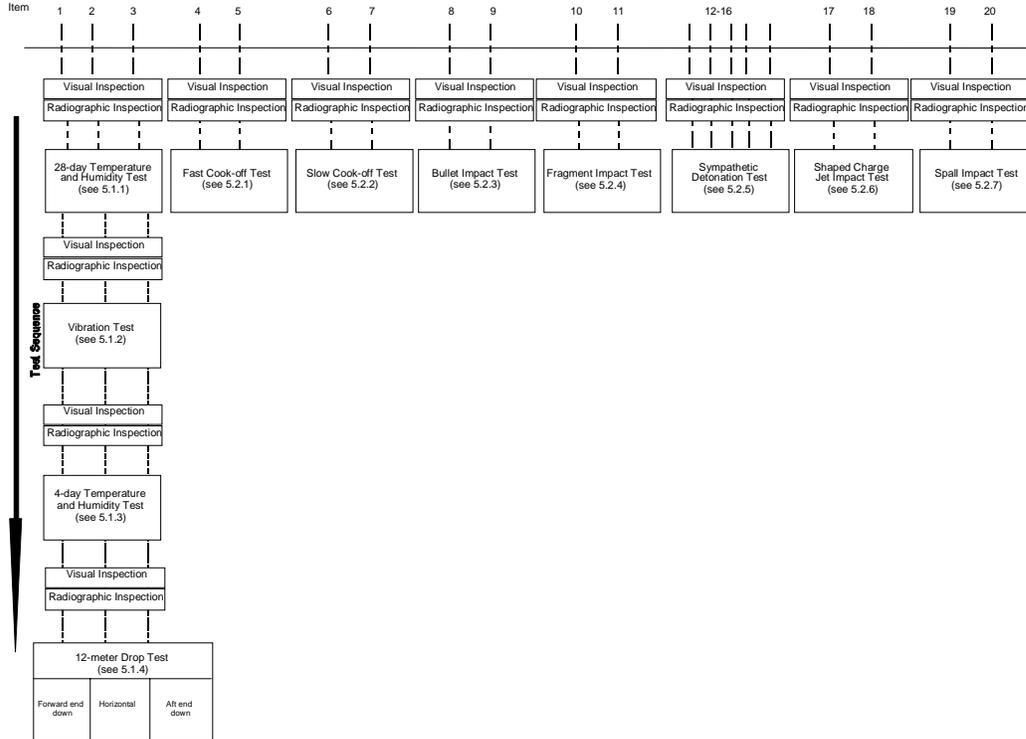


FIGURE 1. "Typical" item number and test sequence

4.4 Hazard assessment test report. Develop a hazard assessment test report (see paragraph 6.3) that contains detailed information specified herein (see section 5), and is consistent with the test plan (see paragraph 4.1.1). Include in the report, rationale for deviations from the test plan, test item configuration and identification, test date, test results, and safety and vulnerability related conclusions that may be drawn from the test results.

4.5 Hardware. Ensure the item to be tested is either production hardware or a representative of production hardware. Use of simulated components for non-explosive components is acceptable providing they accurately simulate the thermal, confinement, mass and retention characteristics of their counterparts. When the item differs from production hardware, describe the configuration in the test plan.

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4.6 Test facilities. Ensure the test chamber or test fixtures used do not interfere with the test stimulus being imposed on the test item or influence the subsequent reaction of the item. Unless otherwise specified, use tolerances of test conditions and instrumentation calibrations in accordance with MIL-STD-810.

4.6.1 Witness plates. Witness plates are used to "witness" a reaction by providing an impact surface for fragments and shock waves. Design witness plates to survive a reaction and provide post-test physical evidence of its severity. Information regarding the degree of test item fragmentation may be obtained by locating witness plate(s) away from the test item.

Use relatively thin plates to permit sufficient data collection of impacting fragments. Alternatively, information regarding the shock pressure produced by the reacting explosive(s) may be obtained by placing witness plate(s) in direct contact with the test item. Use plates of sufficient thickness, hardness, and strength to withstand detonation of the test item without fracturing.

Determination of the specific number, types, sizes, and location of the witness plates is the responsibility of the testing activity. However, the testing activity must ensure the witness plates are integrated into the test setups in a manner that will not influence the response of the test item, and does not compromise the collection of other required data while performing their function. Witness plate use and configuration should be included in detailed test plans submitted to the appropriate service IM review organizations for approval.

4.7 Configuration. Ensure the test item configuration accurately represents the configuration of the item in the life cycle phase being duplicated by the test. For fast cook-off, slow cook-off, bullet impact, sympathetic reaction, shaped charge jet and 12 meter (40 ft) drop testing, refer to the respective STANAG's for test item configuration. Temperature and humidity, fragment impact, shaped charge jet spall impact tests may be done on the major munition subsystem level. The electronic or other sections not containing explosives may be mechanically, geometrically and thermally simulated for any test. Specify the test item configuration to be used in detail in the test plan, and have it approved by the service review organization. Mount the test items so they do not affect the munition response to the given test.

4.8 Pre-test examination. Unless otherwise specified (see 6.4), prior to each test (see figure 1), conduct a visual and radiographic inspection of the test item, in accordance with ASTM E-1742, to ensure no unusual conditions exist that might invalidate the tests. Set or adjust all unit safety mechanisms and devices to a safe condition. Take photographs of the test setup (see paragraph 6.3), and include identification information (such as nomenclature, MK, Mod, serial number, test facility, date, etc.) in the field of view.

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4.9 Post-test requirements. Provide a complete description of significant post-test remains of the munition. Document the location (distance from original test position), dimensions and weight of each significant recovered part on the appropriate test data sheet. The appropriate service review organization determines the official reaction violence level. Provide data sheets with the test report and photograph the test remains (see paragraph 6.3). In the field of view include identification information (nomenclature, MK, Mod, test facility, date, etc.).

4.10 Photographic requirements. Select the photographic media to be used from the following (see paragraph 6.3):

4.10.1 Still photograph coverage. Take black and white or color still photographs or digital stills (with a minimum image resolution of one megapixel) as specified in the contract, and use the film format size and the number of original prints and negatives as specified in the contract. When negative color material is used, include the original color negative and one matching positive color transparency. Place all negatives in negative preservers.

4.10.2 Video coverage. EIA 170 and EIA 330 describe the video quality. Use a video tape recorder with magnetic video tape as the video media. For normal speed video coverage, use a frame rate of 18 to 30 frames per second include synchronous sound recording. For high speed video coverage, use a minimum frame rate of 400 frames per second.

4.10.3 Motion picture coverage. For motion picture coverage, utilize professional quality footage and do not edit the footage. For normal speed motion picture coverage, use a frame rate of 18 to 30 frames per second and include synchronous sound recording. For high speed motion picture coverage, use a minimum frame rate of 400 frames per second, or as required by the test plan (see paragraph 4.1.1). The sympathetic detonation test shall be recorded using high speed motion picture cameras capable of photographing 32,000 images per second, minimum, or as required by the test plan (see 4.1.1).

For video or motion picture coverage, ensure that the means chosen (quality, speed, type) will adequately capture the reaction event so that a detailed analysis can be conducted.

4.10.4 Instrumentation photography. For instrumentation photography, utilize professional quality color positive film with a time base recorded on the film preferably in the sprocket area rather than the image area.

MIL-STD-2105C**5. DETAILED REQUIREMENTS**

5.1 Basic safety tests. Consider all of the following tests for inclusion in the hazard assessment test program. Unless otherwise specified (see 6.4), test three test items sequentially as shown in figure 1.

5.1.1 28-day temperature and humidity (T&H) test.

5.1.1.1 Description of test. The 28-day T&H test consists of exposing the test item to alternating 24-hour periods (no period lasting less than 24 hours) of high and low temperatures for a total of 28 days. Derive the temperature range and relative humidity from the environmental profile of paragraph 4.1.2. Test a minimum of three test items.

5.1.1.2 Test procedure. Develop test procedures (see paragraph 6.3) that reflect the temperature and humidity conditions measured or forecast. Visually examine each test item prior to testing, and record the appropriate critical dimensions. Unless otherwise specified (see paragraph 6.4), prior to testing, radiographically examine the test items determine material condition.

5.1.1.2.1 Test facilities. Use chambers that are capable of producing the required temperatures and humidity over the time spans specified in paragraph 5.1.1.1, and that do not obstruct the free flow of air in contact with the item under test. Recommend using separate chambers for each test environment specified.

5.1.1.2.2 Temperature cycling. Begin the test by subjecting the test item to either the high or low temperature environment for a 24-hour period. At the end of this period, transfer the test item to the other environment. Perform the transfer in less than 30 minutes, but if the transfer time exceeds 30 minutes, document the actual time in the test data report (see paragraphs 5.1.1.5 and 6.3). At the end of each high and low temperature cycle change, inspect the test item for damage and collect any exudate for chemical analysis. Continue testing and inspecting for the number of periods specified for the test.

5.1.1.2.3 Test interruptions. Minimize interruptions of the test. If the test is interrupted by slack labor periods (weekends, holidays), maintain the last test environment encountered prior to the slack period. Extend the test period as necessary to complete at least 20 temperature changes (hot/cold) or 10 full cycles. A full cycle consists of two temperature changes, e.g., hot-to-cold-to-hot.

5.1.1.3 Instrumentation. Continuously monitor and record the temperature and humidity levels of the test chamber.

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5.1.1.3.1 Photography. Use still photographs to record the condition of the test item and test setup prior to and after the test (see paragraph 6.3).

5.1.1.4 Passing criteria. These criteria are based on the final observation.

- a. No reaction of the explosive.
- b. No exudation containing explosive material.
- c. Explosives do not crack or separate in a manner which would create a hazardous condition.
- d. All safety devices remain in the safe position or safe condition.
- e. The structural integrity of the item is not compromised by corrosion, loosening of joints or other physical distortions.

5.1.1.5 Documentation. Develop a data sheet documenting the test results (see paragraph 6.3).

5.1.2 Vibration test.

5.1.2.1 Description of test. The vibration test consists of exposing the test item to the most intense vibration environment that it will encounter during the life cycle as determined by the THA. Test a minimum of three items which have undergone testing in accordance with paragraph 5.1.1.

5.1.2.1.1 Vibration orientation. Conduct vibration tests along the appropriate mutually perpendicular axes.

5.1.2.1.2 Vibration schedule. Determine the vibration schedule from the environmental profile of paragraph 4.1.2.

5.1.2.1.3 Changes in vibration schedule. Changes in the selected schedule of vibration levels, frequency ranges, and time duration of the test can be effected by the program manager or the procuring activity with the approval of the service review organization.

5.1.2.1.4 Test temperatures. Conduct vibration tests at low and elevated temperatures or ambient temperature if the anticipated life cycle environment so dictates.

5.1.2.2 Test procedures. Develop test procedures (see paragraph 6.3) that reflect vibration modes and temperatures anticipated in the item's environment. Consider

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vibration environments as specified in MIL-STD-167 and MIL-STD-810 including one or more of the following:

5.1.2.2.1 Transportation vibration. If the item is always containerized when transported, vibrate the item in the container. Vibrate the item in the normal configuration as shipped. The item may be vibrated in the bare configuration if it can be shown that testing in the bare configuration produces an equivalent environment. If the item is stowed in a ready service configuration, vibrate the item in a fixture and orientation representative of that configuration.

5.1.2.2.2 Aircraft vibration. Vibrate the item in the configuration utilized for aircraft combat carriage.

5.1.2.2.3 Shipboard vibration. Vibrate the item in its shipboard stowage configuration. Should the item be carried on a launcher or in a ready service configuration, vibrate the item in a fixture and orientation representative of that configuration also.

5.1.2.3 Instrumentation. Record the test equipment inputs and test item responses. Record test item temperatures at both the skin and internal free space.

5.1.2.3.1 Photography. Use still photographs to record the condition of the test item and setup prior to and after the test (see paragraph 6.3).

5.1.2.4 Passing criteria. These criteria are based on the final observation.

- a. No reaction of the explosive.
- b. No exudation containing explosive material.
- c. Explosives do not crack or separate in a manner which would create a hazardous condition.
- d. All safety devices remain in the safe condition.
- e. The structural integrity of the item is not be compromised by corrosion, loosening of joints or other physical distortions.

5.1.2.5 Documentation. Develop a data sheet documenting the test results (see paragraph 6.3).

5.1.3 4-day temperature and humidity (T&H) test.

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5.1.3.1 Description of test. The 4-day T&H test is a 4-day version of the 28-day T&H test, and consists of exposing the item to alternating 24-hour periods of temperature and relative humidity as derived from the environmental profile of paragraph 4.1.2. All data relative to the 28-day T&H test is required for the 4-day T&H test (see paragraphs 5.1.1 and 6.3). Test a minimum of three items which have undergone testing in accordance with paragraphs 5.1.1 and 5.1.2. Subject the test items to two complete cycles.

5.1.3.2 Passing criteria. These conditions are based on the final observation.

- a. No reaction of the explosive.
- b. No exudation containing explosive material.
- c. Explosives do not crack or separate in a manner which would create a hazardous condition.
- d. All safety devices remain in the safe condition.
- e. The structural integrity of the item is not be compromised by corrosion, loosening of joints or other physical distortions.

5.1.3.3 Documentation. Develop a data sheet documenting the test results (see paragraph 6.3).

5.1.4 12-meter (40-foot) drop test. Perform this test in accordance with STANAG 4375.

5.1.4.1 Passing criteria. No reaction of the explosives in the item. No rupture of the test item that dislodges or disrupts explosive material. The item is safe to handle and be disposed by normal explosive ordnance disposal (EOD) procedures. All safety devices remain in a safe condition.

5.2 Insensitive munitions (IM) tests. The tests contained in, or referenced in this section provide a basis to test munitions against meaningful, credible, potential threats and evaluate munition response against criteria which reflect the services IM vulnerability and hazard reduction goals. Threats have not been fully standardized for all operational configuration tests since the threat may be different for each weapon platform. In all cases, use the THA and a system threat analysis to determine particular test and test parameters for the operational configuration test.

5.2.1 Fast cook-off (liquid fuel/external fire) test. Perform this test in accordance with STANAG 4240.

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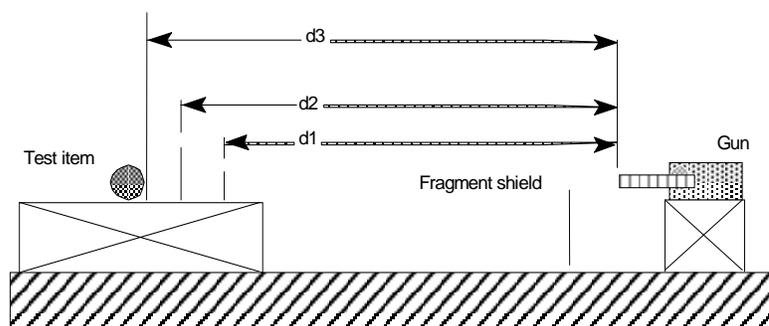
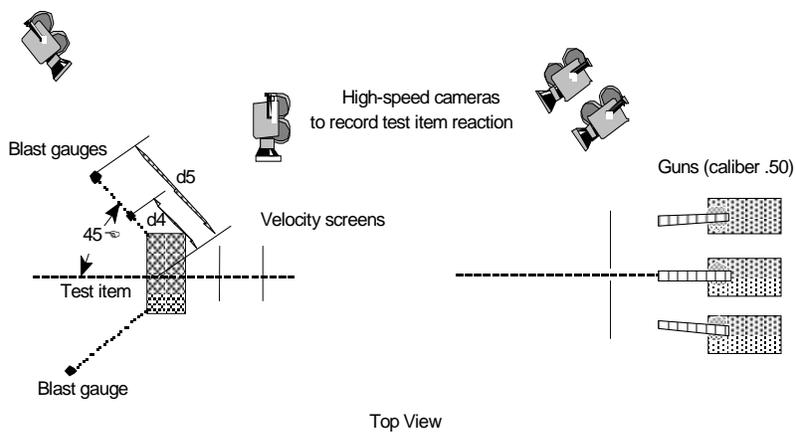
5.2.1.1 Passing criteria. See STANAG 4439 for passing criteria and AOP-39 for reaction definitions.

5.2.2 Slow cook-off (slow heating) test. Perform this test in accordance with STANAG 4382.

5.2.2.1 Passing criteria. See STANAG 4439 for passing criteria and AOP-39 for reaction definitions.

5.2.3 Bullet impact test. Perform this test in accordance with STANAG 4241. See figure 2.

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Where:

- d1 = Distance to first velocity screen
- d2 = Distance to second velocity screen
- d3 = Distance to test item
- d4 = Distance to first blast gauge
- d5 = Distance to second blast gauge(s)

NOTE: Interpret views in accordance with ANSI Y14.3.

FIGURE 2. "Typical" bullet impact test setup.

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5.2.3.1 Passing criteria. See STANAG 4439 for passing criteria and AOP-39 for reaction definitions.

5.2.4 Fragment impact test. Perform this test in accordance with STANAG 4496. See figure 3.

5.2.4.1 Passing criteria. See STANAG 4439 for passing criteria and AOP-39 for reaction definitions.

5.2.5 Sympathetic detonation (sympathetic reaction). Perform this test in accordance with STANAG 4396.

5.2.5.1 Passing criteria. See STANAG 4439 for passing criteria and AOP-39 for reaction definitions.

5.2.6 Shaped charge jet impact test. Perform this test in accordance with STANAG 4526.

5.2.6.1 Passing criteria. See STANAG 4439 for passing criteria and AOP-39 for reaction definitions

5.2.7 Spall impact test.

5.2.7.1 Description of test. The spall impact test is conducted to determine the response of munitions to the impact of hot spall fragments. Determine applicability of the test based upon the THA.

5.2.7.2 Test procedure.

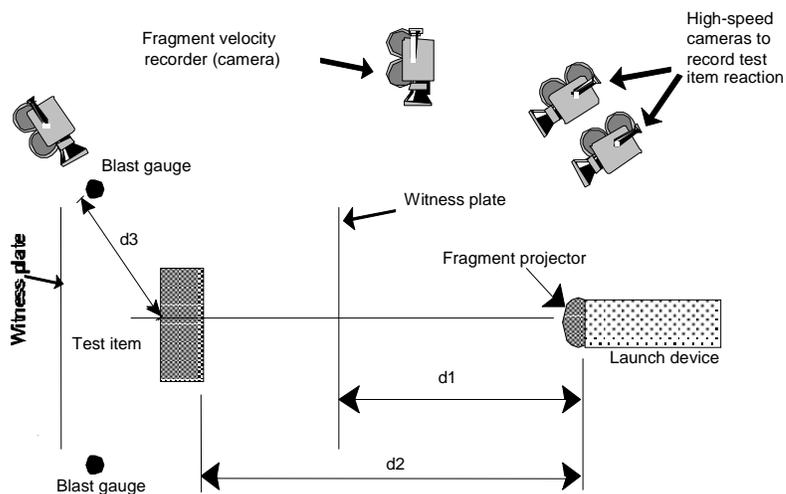
5.2.7.2.1 Test setup. A typical test setup is illustrated on figure 4. The spall fragments are produced by impacting a 25-mm (1-in) thick rolled homogeneous armor (RHA) plate with the shaped charge jet of an 81-mm precision shaped charge. Ensure the standoff distance between the shaped charge and the RHA plate is 147 mm (5.8 in). Select the placement of the test item behind the RHA plate so that it is impacted by spall fragments only. Ensure a minimum of 4 spall fragments/6,450 mm² (4 spall fragments/10 in²) of presented area (up to 40 fragments total) impact the test item. The test activity is responsible for calibrating the test setup to determine the placement of the test item that will provide the required hit density.

5.2.7.2.2 Test item configuration. Use a bare munition configuration as the test item. Test a minimum of two test items.

5.2.7.3 Photography. Use closed-circuit video, real time motion picture photography (with sound) or both to document the test events (see paragraph 6.3).

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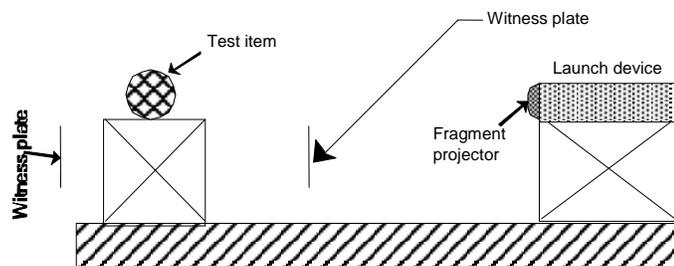
Where:

$d1$ = Distance from fragment mat to witness plate

$d2$ = Distance from fragment mat to test item

$d3$ = Distance from test item to blast gauge(s)

Top View

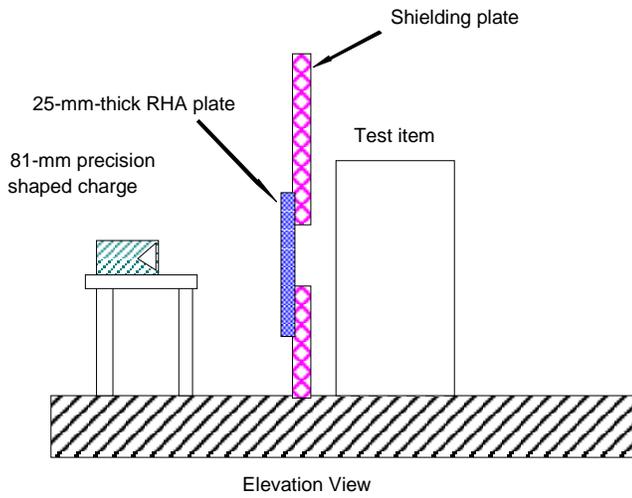
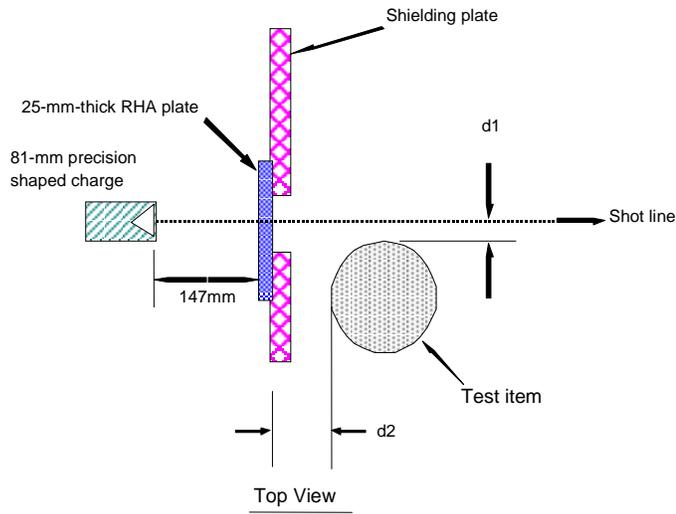


Elevation View

Note: Interpret views in accordance with ANSI Y14.3.

FIGURE 3. "Typical" fragment impact test setup.

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NOTE: Interpret views in accordance with ANSI Y14.3.

FIGURE 4. "Typical" spall impact test configuration.

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5.2.7.4 Passing criteria. No sustained burning occurs as a result of the spall impact test. For Army test items, the passing criteria depends on system vulnerability requirements and the THA.

5.2.7.5 Documentation. Develop a data sheet documenting the test results (see paragraph 6.3) and provided it with the final test report.

5.3 Additional tests. In addition to the tests of 5.1 and 5.2, tests are to be developed or selected from other test document sources to form the test plan to assess the safety of the weapon system as determined by the system safety program. Consider the following non-inclusive list of factors in performing the hazard analyses required as the basis for developing the test plan.

- Acceleration
- Accidental Release
- Acoustical
- Aerodynamic Heating
- Atmospheric Lightning
- Altitude
- Catapult and Arrested Landing
- Double Feed of Ammunition
- Drop
- Dust
- Electromagnetic Interference
- Electromagnetic Radiation
- Electromagnetic Pulse
- Electromagnetic Vulnerability
- Electrostatic Discharge
- Explosive Atmosphere
- Faulty Unit
- Flooding
- Fungus
- HERO - Hazards of Electromagnetic Radiation to Ordnance
- Hot Gun Cook-Off
- Humidity
- Jettison
- Jolt
- Jumble
- Leak Detection - Halogen-helium
- Leakage - Immersion
- Materials Compatibility
- Muzzle Impact/Impact Safe Distance
- Pressurization
- Proof Pressure Firings

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Radiography
Rain
Salt Fog
Shock
Solar Radiation - Sunshine
Space Simulation - Unmanned Test
Static Detonator Safety
Time to Airburst
Toxicity
Vibration

MIL-STD-2105C**6. NOTES**

(This section contains information of a general or explanatory nature that may be helpful but is not mandatory.)

6.1 Intended use. The tests described herein or referenced are used to assess the safety and insensitive munitions characteristics of non-nuclear ordnance. The ordnance covered by these tests is designed for military use only, thus this standard has no commercial application.

6.2 Issue of DODISS. When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1 and 2.2).

6.3 Associated Data Item Descriptions (DIDs). This standard is cited in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), as the source document for the following DIDs. When it is necessary to obtain the data, the applicable DIDs must be listed on the Contract Data Requirements List (DD Form 1423), except where the DOD Federal Acquisition Regulation Supplement exempts the requirement for a DD Form 1423.

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Reference Paragraph	DID Number	DID Title
4.1.1	DI-T-30714	Master Test Plan/Program Test Plan
4.1.1, 5.1.1.2, 5.1.2.2, 5.2.5.2, 5.2.6.2	DI-NDTI-80603	Test Procedure
4.1.3, 4.2	DI-SAFT-81124	Threat Hazard Assessment
4.4	DI-SAFT-81125	Hazard Assessment Test Report
4.8, 4.9, 4.10, 5.1.1.3.1, 5.1.2.3.1, 5.1.3.1, 5.1.4.1, 5.2.1, 5.2.2, 5.2.3, 5.2.4.3.4, 5.2.5, 5.2.6, 5.2.7.3	DI-SAFT-81126	Photographic Requirements
5.1.1.5, 5.1.3.3	DI-SAFT-81127	Temperature and Humidity Test Data
5.1.2.5	DI-SAFT-81128	Vibration Test Data
5.1.4.1	DI-SAFT-81129	40-Foot Drop Test Data
5.2.1	DI-SAFT-81130	Fast Cook-Off Test Data
5.2.2	DI-SAFT-81131	Slow Cook-Off Test Data

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5.2.3	DI-SAFT-81132	Bullet Impact Test Data
5.2.4.5	DI-SAFT-81133	Fragment Impact Test Data
5.2.5	DI-SAFT-81134	Sympathetic Detonation Test Data
5.2.6	DI-SAFT-81135	Shaped Charge Jet Impact Test Data
5.2.7.5	DI-SAFT-81136	Spall Impact Test Data

The above DIDs were those cleared as of the date of this standard. The current issue of AMSDL must be researched to ensure that only current and approved DIDs are cited on the DD Form 1423.

6.4 Tailoring guidance. To ensure proper application, invitations for bids, requests for proposals, and contractual statements of work should tailor the requirements in sections 4 and 5 of this standard to exclude any unnecessary requirements. Contractual documents must specify the following:

- a. Ambient test item temperature if other than as specified (see paragraph 4.2.1).
- b. When a pre-test examination is not required (see paragraphs 4.8 and 5.1.1.2).
- c. The number of test items to be tested if other than as specified (see paragraph 5.1).

6.5 Submission of test reports and results. Submit copies of test reports and results to the following address for storage in the National Insensitive Munitions Information System (NIMIS-II):

Navy/Marine Corps—(for IM):

Commanding Officer
 Naval Ordnance Safety & Security Activity
 Attn: NOSSA, N6
 Indian Head, MD 20640-5555

6.6 Service review organizations. The following service contacts are responsible for the assessment of explosive safety and IM characteristics:

Army - (for explosive safety):

Director

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U.S. Army Technical Center for Explosives Safety
Attn: SOSAC-EST
1 C Tree Road, Bldg 35
McAlester, OK 74501-9053

Army - (for IM):

Commander
U.S. Army TACOM
Armament Research, Development and Engineering Center
Attn: AMSTA-AR-ASL Army Insensitive Munitions Board
Picatinny Arsenal, NJ 07806-5000

Navy/Marine Corps - (for explosive safety):

Commanding Officer
Naval Ordnance Safety & Security Activity
Attn: NOSSA, N3
Indian Head, MD 20640-5555

Navy/Marine Corps - (for IM):

Commanding Officer
Naval Ordnance Safety & Security Activity
Attn: NOSSA, N6
Indian Head, MD 20640-5555

Air Force - (for explosive safety):

AFSA/SEWV
9700 G Street
Kirtland AFB, NM 87117-5670

Air Force - (for IM):

ASC/YOX
Eglin AFB, FL 32542-6808

6.7 Tests for hazard classification. The following tests referenced herein have potential application for hazard classification but some specifics of testing may require approval by service review organizations and the DDESB prior to testing:

12-m (40-ft) drop
Fast cook-off
Slow cook-off

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Bullet impact
Sympathetic detonation

6.8 Units of measurement and abbreviations. Units of measurement are expressed in metric or SI (Le Système International d'Unités). The corresponding English equivalent follows in parentheses. Standard abbreviations used throughout this document are as follows:

<u>Metric (SI)</u>	<u>English</u>
°C - degrees Celsius	°F - degrees Fahrenheit
mm - millimeters	in - inches
m - meters	ft - feet
m/s - meters per second	ft/s - feet per second
N·m - newton meter	lb·ft - pound-force foot
kPa - kilopascal (gauge)	psig - pounds per square inch (gauge)

6.9 Subject term (key word) listing.

Bullet impact test	Shaped charge jet impact test
Drop test	Slow cook-off test
Fast cook-off test	Spall impact test
Fragment impact test	Sympathetic detonation test
Humidity test	Temperature test
Insensitive munitions	Vibration test
Munitions, insensitive	
Safety test	

6.10 International standardization agreements. Certain provisions of this standard are the subject of international standardization agreements. These are:

<u>MIL-STD-2105B</u>	<u>NATO STANAG</u>
12-m (40-ft) drop test	4375
Fast cook-off test	4240
Slow cook-off test	4382
Bullet impact test	4241
Sympathetic detonation test	4396
Fragment impact test	4496
Hazard assessment tests for munitions	4439

When change notice, revision, or cancellation of this standard is proposed that will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including

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departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.11 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - AR

Navy - OS

Air Force - 11

Preparing activity:

Navy - OS

(Project SAFT-0041)

Review activities:

Army - TE

Navy - AS

Air Force - 18

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

2. DOCUMENT DATE (YYMMDD)

MIL-STD-2105

030714

3. DOCUMENT TITLE

HAZARD ASSESSMENT TESTS FOR NON-NUCLEAR MUNITIONS

4. NATURE OF CHANGE (*Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.*)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (*Last, First, Middle Initial*)

b. ORGANIZATION

c. ADDRESS (*Include Zip Code*)d. TELEPHONE (*Include Area Code*)

7. DATE SUBMITTED

(1) Commercial

(YYMMDD)

(2) DSN

(If applicable)

8. PREPARING ACTIVITY

a. NAME

b. TELEPHONE (*Include Area Code*)

Commander, Indian Head Division

(1) Commercial

(2) DSN

Naval Surface Warfare Center

301-744-1973

354-1973

c. ADDRESS (*Include Zip Code*)

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Defense Standardization Program Office (DLSC-LM)

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8725 John J. Kingman Road, Suite 2533

Indian Head, MD 20640-5035

Fort Belvoir, VA 22060-6221