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NATO Standards and Practice for Munitions Safety and Insensitive Munitions

Ernest BAKER[*], Martijn van der VOORT, Martin POPE,

Munitions Safety Information Analysis Center, NATO HQ,
Rue Léopold III, B-1110 Brussels, Belgium
[*]*Corresponding author's e-mail address: e.baker@msiac.nato.int*

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Abstract. The NATO Munitions Safety Information Analysis Center (MSIAC) is a multinational collaboration that collects, stores, and analyses technical information related to Munitions Safety (MS) and Insensitive Munitions (IM). MSIAC supports its member nations through a variety of products and services. Poland is becoming a MSIAC member nation during 2018. MSIAC has a diverse programme of work aimed at developing and sharing the related underpinning scientific knowledge. This is then applied to support policy implementation and development related to munition safety. This paper provides an overview of: NATO policies for MS related to the storage and transport of munitions; NATO IM requirements and testing; and how they relate to Poland. In particular, a comparison of NATO munitions storage policy with Poland munitions storage regulations has identified some differences. These differences are discussed.

Keywords: NATO, standards, munitions, safety, Insensitive Munitions

1. INTRODUCTION

The NATO Munitions Safety Information Analysis Center (MSIAC) is a multinational collaboration that collects, stores, and analyses technical information related to Munitions Safety (MS) and Insensitive Munitions (IM). MSIAC supports its member nations through a variety of products and services. Poland is becoming a MSIAC member nation during 2018. In addition to the core responsibility of addressing technical questions related to Munitions Safety posed by nations, MSIAC has a diverse programme of work aimed at developing and sharing the related underpinning scientific knowledge. This is then applied to support policy implementation and development related to MS, including IM. This paper provides an overview of: NATO policies for MS related to the storage and transport of munitions; NATO IM requirements and testing; and how they relate to Poland.

2. NATO MS STANDARDS

2.1. Munitions Safety Management

The Conference of National Armaments Directors (CNAD) is the senior NATO committee responsible for promoting cooperation between countries in the armaments field. It brings together the top national officials responsible for defence procurement in NATO member and partner countries. It is tasked with identifying collaborative opportunities for research, development and production of military equipment and weapons systems. It reports directly to the North Atlantic Council, which is the principal political decision-making body within NATO, and oversees the political and military process relating to security issues affecting the whole Alliance.

CNAD has delegated Ammunition life cycle safety responsibility to Allied Committee (AC)/326, Ammunition Safety Group (also referred to as CASG, which is the shortened acronym for CNAD ASG). CASG is responsible for ammunition life cycle safety in support of CNAD priorities. Through its three Sub-Groups (SGs), CASG provides the forum to develop common standards and procedural guidance on munitions and explosive safety in order to foster interoperability in NATO led operations, promote the potential for interchangeability of ammunition, and establish a basis for safety aspects of coordinated procurement of munitions and explosives. SG/A is Energetic Materials (EMT) and Initiation Systems (IST) (in practice two sub-groups). SG/B is Ammunition Systems Design and Assessment. SG/C is In-Service and Operational Safety Management.

2.2. Munitions Storage Policy (AASTP-1)

The Allied Ammunition Storage and Transport Publications AASTP-1 [1] and AASTP-5 [2] are the NATO policies for ammunition and explosives storage. They fall under the pervue of CASG SG/C. AASTP-1 is for permanent storage, whereas AASTP-5 is for the storage, maintenance and transport of ammunition on deployed mission or operations. AASTP-1 is the result of successive revisions of explosive safety policy and procedures, over a period of 30 years. The implementing NATO a STANdardization AGreement (STANAG) for AASTP-1 is STANAG 4440 [3], entitled NATO Guidelines for the Storage of Military Ammunition and Explosives – AASTP-1. STANAG 4440 includes the interoperability statement: "This document has been developed based on the requirement to ensure that munitions used by NATO forces are safe. Safe munitions ensure high user confidence, enhancing military operations and especially interoperability between national forces participating in NATO multi-national operations. This includes the following life cycle aspects: design, manufacture, suitability for service, packaging, storage, transportation, and disposal.". It includes the ratification agreement: "Participating nations agree to implement the following standard – AASTP-1, Edition B".

AASTP-1 is divided into four parts. Part I sets out general ammunition safety guidelines for all explosives storage and quantity distance (QD) for aboveground storage. Part II provides technical details for design of explosives storage magazines and operational guidelines for explosives facilities. Part III deals with underground explosives storage. Part IV addresses NATO munitions risk management aspects in operations and when NATO requirements in the preceding Parts cannot be met and provides NATO requirements for special situations involving explosive safety that are not specifically storage related (e.g., military airfields).

The defined storage requirements depend on many factors, with the associated assigned Hazard Division (HD) and Compatibility Group (CG), being very important factors.

2.3. Hazard Divisions

STANAG 4123 and Allied Ammunition Storage and Transport Publication AASTP-3 [4] are the documents that delineates ammunition Hazard Classes (HC) and Compatibility Groups (CG) testing and assignment policy. AC/326 implement the recommendations in the UN Orange Book [5] for testing and classification of ammunition and explosives (AE) for transport, and also for storage. The UN Orange Book defines Dangerous Goods Class 1 through 9. Class 1 comprises ammunition and explosives (AE).

Class 1 is divided into Hazard Division (HD) 1.1 through HD 1.6. HD 1.1 is defined to be substances and articles which have a mass explosion hazard. HD 1.2 is defined to be substances and articles which have a projection hazard but not a mass explosion hazard. HD 1.3 is defined to be substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. HD 1.4 is defined to be substances and articles which present no significant hazard. HD 1.5 is defined to be very insensitive substances which have a mass explosion hazard. HD 1.6 is defined to be extremely insensitive articles which do not have a mass explosion hazard. AASTP-3 defines additional Storage Subdivisions (SsD) within UN Hazard Division 1.2 based on the Net Explosive Mass of th item or responses to specified IM tests. NATO policy also implements UN recommendations on compatibility groupings between different specified types of munition and how different Hazard Divisions stored or transported together, should be aggregated to determine the governing Hazard Division. The storage safety distances (known as Quantity Distances) differ for each of the different HDs and SsD.

3. POLAND STORAGE POLICY COMPARISON

At the request of the Poland Inspectorate for Armed Force Support, Ammunition Supply Department, we have carried out a comparison between the Poland munitions storage regulation [6] and AASTP-1. The comparison focussed on QDs and had the aim to identify the most significant differences and trends. The comparison details have been provided to the Poland Inspectorate for Armed Force Support, Ammunition Supply Department.

An important difference is that [6] uses the hexogen (RDX) explosive equivalent quantity to determine QDs, while AASTP-1 requires the Net Explosive Quantity (NEQ), irrespective of the energetic material to determine QDs. This means that [4] will be either more or less conservative than AASTP-1 depending on the explosive NEQ compared to RDX.

For Hazard Division (HD) 1.1, in relation to Inter Magazine Distance (IMD), [6] normally prescribes larger (i.e. more conservative) IMDs than AASTP-1. Also for HD1.1, in relation to explosive workshops, roads, inhabited buildings, and vulnerable buildings, [6] generally prescribes smaller (i.e. less conservative) QDs than AASTP-1. For HD1.2, [6] prescribes larger (i.e. more conservative) IMDs, Public Traffic Route Distances (PTRDs), and IBDs than AASTP-1, with a few exceptions. For HD1.3, [6] uses almost identical QD relations as AASTP-1. Nevertheless there are a large number of details which cause differences.

4. INSENSITIVE MUNITONS POLICY

The NATO standards for IM policy and procedures fall under the prevue of CASG SG/C. The overarching NATO policy for IM is STANAG 4439 [7] covering Allied Operational Procedure (AOP)-39 [8]. The primary threats associated with IM assessments are Fast Cook-Off (FCO) [9] from being in a fire and Slow Cook-Off (SCO) [10] from being heated by a nearby fire event. Impact threats include Bullet Impact (BI) [11] from rifle fire and Fragment Impact (FI) [12] from nearby exploding munitions. Another concern is that Sympathetic Reaction (SR) [13] could occur if one munition detonates in a storage configuration. Finally Shaped Charge Jet Impact (SCJI) could potentially cause detonation if attacked by a shaped charge weapon. For each of the six IM threats, there is an associated standardized test procedure. AOP-20 defines the response Type required from each of the tests necessary to meet the NATO IM requirement. Table 1 presents the test procedure NATO STANAG for each of the IM threats, as well at the required response type.

Table 1. IM threats, testing procedures and required response types

IM Threat	STANAG	Required Response
Fast Cook-Off (FCO)	STANAG 4240	V
Slow Cook-Off (SCO)	STANAG 4382	V
Bullet Impact (BI)	STANAG 4241	V
Fragment Impact	STANAG 4496	V
Sympathetic Reaction (SR)	STANAG 4396	III
Shaped Charge Jet Impact (SCJI)	STANAG 4526	III

The response types are defined within AOP-39 [8] and are reproduced here.

Type I Response – “Detonation”

The most violent type of explosive event. A supersonic decomposition reaction (detonation) propagates through the energetic material to produce an intense shock in the surrounding medium (e.g. air or water) and a very rapid plastic deformation of metallic cases followed by extensive fragmentation. All energetic materials will be consumed. The effects will include large ground craters for munitions on or close to the ground, perforation, plastic deformation or fragmentation of adjacent metal plates, and blast overpressure damage to nearby structures.

Type II Response – "Partial Detonation"

The second most violent type of explosive event. Some but not all the energetic material reacts as in type I response. An intense shock occurs; a part of case is broken into small fragments; a ground crater can be produced, the adjacent metal plates can be damaged as in type I response and there will be blast overpressure damage to nearby structures. A type II response can also produce large case fragments as in a violent pressure rupture (brittle fracture). The amount of damage, relative to a Type I response, depends on the portion of material that detonates.

Type III Response – "Explosion"

The third most violent type of explosive event. Ignition and rapid burning of the confined energetic material build up high local pressure leading to violent pressure rupture of the confining structure. Metal cases are fragmented (brittle fracture) into large pieces that are often thrown long distances. The non-reacted and/or burning energetic material is also scattered about. Air shocks are that can cause damage to nearby structures. Fire and smoke hazards will exist. The blast and high velocity fragments can cause minor ground craters and damage (break-up, tearing, gouging) to adjacent metal plates. Blast pressures are lower than for Type I or Type II responses.

Type IV Response – "Deflagration"

The fourth most violent type of explosive event. Ignition and burning of the confined energetic material lead to non-violent pressure release as a result of a low strength case or venting through the case wall (outlet gap, initiation capsule, etc). The case may rupture but does not fragment; orifice covers may be expelled and non-burnt or burning energetic material may be scattered about and spread the fire. Pressure releases may propel an unsecured test item causing additional hazard. No blast effect or significant fragmentation damage to the surroundings, only heat and smoke damage from the burning energetic material.

Type V Response – "Burning"

The least violent type of explosive event. The energetic material ignites and burns without propulsion. The case may split up non-violently; it may melt or weaken sufficiently to allow slow release of combustion gases; the internal pressure may dislodge the case covers. Debris stays in the area of the fire although covers may be thrown up to 15 metres. This debris is unlikely to cause fatal wounds to personnel.

Type VI Response – "No Reaction"

A non-explosive event in which there is no perceptible reaction of the energetic material to the applied stimulus.

5. CONCLUSION

The CNAD: Conference of National Armaments Directors, AC/326: Allied Committee 326, Ammunition Safety Group is responsible for developing NATO ammunition safety criteria. Munitions storage and transport policy is managed by CASG SG/C. Insensitive munitions policy is manage by CASG SG/B.

Allied Ammunition Storage and Transport Publications AASTP-1 and AASTP-5 are the NATO policies for ammunition and explosives storage. AASTP-1 is for permanent storage, whereas AASTP-5 is for the storage, maintenance and transport of ammunition on deployed mission or operations. The storage regulations in Poland appear to differ significantly from the NATO policies.

The overarching NATO policy for Insensitive Munitions is STANAG 4439 covering Allied Operational Procedure (AOP)-39. This policy has been ratified and implemented by the nations of Australia, Canada, Czech Republic, Denmark, France, Germany, Hungary, Netherlands, Norway, Romania, Spain, Slovakia, Turkey, the United Kingdom and the United State of America.

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