

# HAZARD CLASSES OF AMMUNITION AND EXPLOSIVES AND THEIR CHARACTERISTICS

Štefan PIVKO<sup>1\*</sup>

<sup>1</sup>Ing. Štefan Pivko, PhD., Faculty of Special Technology, Alexander Dubcek University of Trencin, Pri parku 19, 911 06 Trencin, Slovakia

\*Corresponding author E-mail address: stefan.pivko@tnuni.sk

## Abstract

In order to promote the safe storage and transport of dangerous goods, an International System for Classification has been devised. The system consists of 9 classes (1-9) of which Class 1 comprises ammunition and explosives. Class 1 is divided into divisions. The hazard division indicates the type of hazard to be expected primarily in the event of an accident: mass explosion (Division 1.1), projection effects (Division 1.2), fire and radiant heat (Division 1.3), no significant hazard (Division 1.4), mass detonation with very low probability of initiation (Division 1.5) and detonation of a single article, with low probability of initiation (Division 1.6). Ammunition and explosives must be classified in accordance with STANAG 4123. National authorities competent for the classification of ammunition and explosives are given in AASTP-3.

**Keywords:** Transport, hazard division, classification code.

## 1 Definitions of the hazard divisions

### a) Hazard Division 1.1

Substances and articles which have a mass explosion hazard (a mass explosion is one which affects the entire load virtually instantaneously.)

1. The major hazards of this division are blast, high velocity projections and other projections of relatively low velocity.
2. The explosion results in severe structural damage, the severity and range being determined by the amount of high explosives involved. There may be a risk from heavy debris propelled from the structure in which the explosion occurs or from the crater[1].

### b) Hazard Division 1.2

Substances and articles which have a projection hazard but not a mass explosion hazard

1. The explosion results in items burning and exploding progressively, a few at a time. Furthermore fragments, firebrands and unexploded items may be projected in considerable numbers; some of these may explode on impact and cause fires or explosions. Blast effects are limited to the immediate vicinity.
2. For the purpose of determining quantity-distances a distinction, depending on the size and range of fragments, is made between those items which give small fragments of moderate range (for instance projectiles and cartridges from 20 to 60 mm) and those which give large fragments with a considerable range (for instance projectiles and cartridges exceeding 60 mm, rockets and rocket motors in a propulsive state which do not have a mass explosion hazard).

### c) Hazard Division 1.3

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.

1. This division comprises substances and articles:
  - (a) which give rise to considerable radiant heat, or
  - (b) which burn one after another, producing minor blast or projection effects or both.
2. This division includes some items which burn with great violence and intense heat emitting considerable thermal radiation (mass fire hazard) and others which burn sporadically. Items in this division may explode but do not usually form dangerous fragments. Firebrands and burning containers may be projected.

### d) Hazard Division 1.4

Substances and articles which present no significant hazard

1. This division includes items which have primarily a moderate fire hazard. They do not contribute excessively to a fire. The effects are largely confined to the package. No fragments of appreciable size or range are to be expected. An external fire does not cause the simultaneous explosion of the total contents of a package of such items.

2. Some but not all of the above items are assigned to Compatibility Group S. These items are so packed or designed that any explosive effect during storage and transportation is confined within the package unless the package has been degraded by fire.

*e) Hazard Division 1.5*

Very insensitive substances which have a mass explosion hazard

This division comprises substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions.

NOTE 1: The probability of transition from burning to detonation is greater when large bulk quantities are transported or stored.

NOTE 2: For storage purposes, such substances are treated as Hazard Division 1.1 since, if an explosion should occur, the hazard is the same as for items formally assigned to Hazard Division 1.1 (i.e. blast).

*f) Hazard Division 1.6*

Extremely insensitive articles which do not have a mass explosion hazard.

This division comprises articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation [3].

## 2 Further division

All the information necessary for hazard classification of ammunition and explosives will be found in AASTP-3. Ammunition which does not contain any explosive or other dangerous goods (for instance dummy bombs, cartridges and projectiles) is excluded from the system of hazard classification.

### 2.1 Depleted Uranium (DU) Ammunition

Ammunition containing DU in the form of a penetrator or projectile is assigned to the Hazard Classification appropriate to the explosives content of the ammunition only. The normal storage rules associated with the Hazard Classification may need to be modified to take account of the slight radioactivity and chemical toxicity of DU and therefore rules may be prescribed for DU ammunition as a separate class of ammunition, or for specific types of DU ammunition (see Part I, Chapter 9).

### 2.2 Effect of Package on Classification

As the packaging may have a decisive effect on the classification, particular care must be taken to ensure that the correct classification is determined for each configuration in which ammunition and explosives are stored or transported. Therefore every significant change in the packaging (e.g. degradation) may well affect the classification awarded [2].

## 3 Compatibility Groups

General Principles

- a) Ammunition and explosives are considered to be compatible if they may be stored together without significantly increasing either the probability of an accident or, for a given quantity, the magnitude of the effects of such an accident.
- b) Ammunition and explosives should not be stored together with other goods which can hazard them. Examples are highly flammable materials, acids, corrosives.
- c) The safety of ammunition and explosives in storage would be enhanced if each kind was kept separate. However, a proper balance of the interests of safety against other factors may require the mixing of several kinds of ammunition and explosives.
- d) The principles of mixing compatibility groups may differ in storage and transport circumstances. Detailed information on mixing compatibility groups is to be found in AASTP-3.

### 3.1 Determination of Compatibility Groups

On the basis of the definitions in paragraph 1.3.2.3. ammunition and explosives are formally grouped into thirteen Compatibility Groups: A to H, J, K, L, N and S.

#### *Definitions of the Compatibility Groups*

Group A Primary explosive substance.

Group B Article containing a primary explosive substance and not containing two or more effective protective features.

Group C Propellant explosive substance or other deflagrating explosive substance or article containing such explosive substance.

Group D Secondary detonating explosive substance or black powder or article containing a secondary detonating explosive substance, in each case without means of initiation and without a propelling charge, or article containing

a primary explosive substance and containing two or more effective protective features. Group E Article containing a secondary detonating explosive substance, without means of initiation, with propelling charge (other than one containing a flammable liquid or gel or hypergolic liquids).

Group F Article containing a secondary detonating explosive substance with its own means of initiation, with a propelling charge (other than one containing a flammable liquid or gel or hypergolic liquids) or without a propelling charge.

Group G Pyrotechnic substance, or article containing a pyrotechnic substance, or article containing both an explosive substance and an illuminating, incendiary, tear- or smoke-producing substance (other than a water-activated article or one containing white phosphorus, phosphides, a pyrophoric substance, a flammable liquid or gel, or hypergolic liquids).

Group H Article containing both explosive substance and white phosphorus.

Group J Article containing both an explosive substance and a flammable liquid or gel.

Group K Article containing both an explosive substance and a toxic chemical agent.

Group L Explosive substance or article containing an explosive substance and presenting a special risk (e.g. due to water activation or presence of hypergolic liquids, phosphides or a pyrophoric substance) and needing isolation of each type.

Group N Articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.

Group S Substances or articles so packed or designed that any hazardous effects arising from accidental functioning are confined within the package unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not significantly hinder or prohibit firefighting or other emergency response efforts in the immediate vicinity of the package [5].

#### 4 Conclusion

The classification code is composed of the number of the hazard division (see Section I) and the letter of the compatibility group (see this Section) for example "1.1 B". Guidance on the practical procedure of classifying an item by hazard division and compatibility group is given in AASTP-3 [2].

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#### References

- [1] K. Swiatkowski, R. Hatalak: Study of the new floating-plug drawing process of thin-walled tubes, *Journal of Materials Processing Technology*, Vol. 151, 2004, No. 1-3, p. 105–114.
- [2] Standard: NATO - Stanag 4442, ed. 1 application of risk analysis to the storage and transport of military ammunition and explosives, 2010, p. 53.
- [3] Standard: NATO – AASTP-1, Manual of NATO safety principles for the storage of military ammunition and explosives, 2009, p. 287. [4] T. Kvačkaj: Metallurgical and geometrical substance of quality development in flat rolled products, 1st ed., Štroffek, 1999, (in Slovak).
- [5] Standard: NATO - Stanag 4657, NATO guidelines for the storage, maintenance and transport of ammunition on deployed missions or operations, 2009, p. 14.
- [6] P. Viceník: Zásady bezpečnosti pro přepravu vojenské munice a výbušnin, Úřad pro obrannou standardizaci, katalogizaci a státní ověřování jakosti, Praha, 2007, p. 32.
- [7] L. Kučera: Bezpečná likvidace munice – Konstrukční principy a požadavky, hodnocení bezpečnosti, Úřad pro obrannou standardizaci, katalogizaci a státní ověřování jakosti, Praha, 2005, p. 6.
- [8] L. Kučera: Pokyny pro skladování, údržbu a přepravu munice v rámci rozvinutých sil nebo při operacích, Úřad pro obrannou standardizaci, katalogizaci a státní ověřování jakosti, Praha, 2010, p. 22-23.
- [9] AASTP – 1: Manual on Safety principles for the Storage of Ammunition and explosives, 2010.
- [10] V.Cibulka: Charakterizovanie podmienok prevádzkových skúšok malokalibrového streliva po dlhodobom skladovaní, ICMT 2018, Medzinárodná konferencia o vojenských a špeciálnych technológiách, ISBN 978-8075-806-6.
- [11] V.Cibulka: Možnosti aplikovania metódy desaťstupňového hodnotenia funkcie a nasadenia vojenského materiálu z hľadiska požiadaviek predĺženia jeho životnosti, ICMT 2018, Medzinárodná konferencia o vojenských a špeciálnych technológiách, ISBN 978-8075-806-6.