



Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport
of Dangerous Goods

Sixtieth session

Geneva, 27 June–6 July 2022

Item 2 (g) of the provisional agenda

**Explosives and related matters: issues related to the
definition of explosives**

Sub-Committee of Experts on the Globally Harmonized
System of Classification and Labelling of Chemicals

Forty-second session

Geneva, 6–8 July 2022

Item 2 (a) of the provisional agenda

**Work on the Globally Harmonized System of
Classification and Labelling of Chemicals: work of the
Sub-Committee of Experts on the Transport of Dangerous
Goods on matters of interest to the Sub-Committee of
Experts on the Globally Harmonized System of
Classification and Labelling of Chemicals**

Exit from Class 1 for very low hazard energetic articles

**Submitted by the Council on Safe Transportation of Hazardous Articles
(COSTHA), and the Sporting Arms and Ammunition Manufacturers'
Institute (SAAMI)***

Introduction

1. At the fifty-eighth session of the Sub-Committee, COSTHA and SAAMI proposed a scientific and conservative method to reclassify very low hazard articles containing minute amounts of explosive substances. Based on testing and quantitative criteria applied with competent authority oversight, it can be verified on an ongoing basis that certain articles do not pose a mass explosion hazard under any circumstances, including upset conditions¹. We can further show that a single article does not explode². Combining these two parameters – a packaging independent article with a very low hazard magnitude – results in a hazard appropriate to a class other than Class 1. This knowledge is crucial to stakeholders and decision makers everywhere to manage the hazard appropriately.

2. This proposal may eventually affect the classification of explosives within the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). This might pertain to GHS section 2.1.1.2.3.2.

* A/75/6 (Sect.20), para. 20.51

¹ For example, testing without packaging may simulate a spill.

² See the definition of “explode” in the Glossary of Terms.

Discussion

3. The impediments which resulted in the reclassification of airbags to Class 9 continue to be real, e.g., police escorts for any shipment, transport rejections by common carriers, and import and storage restrictions. Many national and local authorities around the world consider that any division of Class 1 means that the product is capable of mass explosion in certain conditions and could be redirected to weapons or criminal use. This is not credible for articles having grams or milligrams of energetics which are individually evaluated and pass appropriate criteria.

4. The decision to reassign airbags to Class 9 was a risk trade-off to allow development of a new product with massive live-saving potential but with potential hazards in transport. Decades of subsequent transport proved the decision to be good. The original trade-off is now less relevant than the established safety record.

5. Tiny energetic articles hundred times smaller than airbags are also worthwhile and necessary to society. Applications include aircraft parts, construction, parachute deployment, power utility tools, circuit breakers, etc. Their distribution is being impeded by misrepresentation of their hazard potential because of their assignment to Class 1. These products merit their own classification system outside of airbags.

Definitions of explosive substances and Class 1

6. Per 2.1.1 of the Model Regulations, the term “explosive substance” is defined as “a solid or liquid substance (or a mixture of substances) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings...”.

7. Class 1 excludes explosives substances “where the predominant hazard is appropriate to another class”. As written, this exit from Class 1 includes explosive substances which are manufactured with a view to producing a practical explosive effect³. The amount of the explosive substance may be more critical than its intrinsic properties.

8. While this exit from Class 1 might only apply to substances, classification principles would support the exclusion of articles where the predominant hazard is appropriate to another class. This is because incorporation of a substance into an article either has no impact or relaxes the original classification of the substance⁴.

The explosives classification system

9. Explosives are not classified based on their intrinsic properties, but on how they react in a particular configuration. The per-unit quantity and the ability of the packaging or article to prevent propagation between units are the key parameters controlling mass explosion and whether an individual article may explode or not.

10. The overriding importance of the configuration to explosives classification was fundamental to the GHS 2.1 explosives chapter rewrite. Per GHS 2.1.4.2, explosives are classed into groups of high hazard, medium hazard and low hazard. The alignment between the Model Regulations and GHS is shown below:

³ 2.1.1.1 (c) of the Model Regulations does not apply to explosive substances in (a), including where the predominant hazard is appropriate to another class.

⁴ For example, an infinite quantity of unpackaged Division 1.2 articles in a pile are less dangerous than the same net explosive mass with the casings removed, which would result in a mass reaction of the total quantity. By definition, Division 1.2 may not mass explode, so the hazard magnitude is related to a fraction of the total quantity. The safety benefit of incorporation into an article increases with classification into 1.4, 1.4S or Not Class 1.

High Hazard			Medium Hazard	Low Hazard	Very Low Hazard	No Official Hazard
1.1	1.2	1.3	1.4	1.4S	4.1 or 9	Excluded from Dangerous Goods
Mass explosion; Projectile > 20 J; Fireball > 4 m			No mass explosion; Projectile > 8 J; Fireball > 1 m	No lower threshold	UN#-based solution; e.g. matches, “safety devices”	Surface temp. < 200 °C; No fragmentation; Movement < 1 m; Sound < 135 db; Limited flame propagation; Limited smoke
Criteria			Criteria	Criteria	Policy-based	Criteria

11. The idea that an explosive classification must be based on intrinsic properties is not consistent with the Model Regulations or competent authority practice. The sufficient presence of oxygen in a molecule and the intent for energetic use are entrance criteria to Class 1, but do not preclude an exit from Class 1. The exit is controlled by test results alone.

12. A particular explosive substance may be classified in any division or hazard group, or exit the regulations, based on the configuration and hazard magnitude. Examples are:

Example 1

All explosive substances as per-unit quantity rises: 1.1
Smokeless powder XYZ - encased in sufficient metal: 1.2
Smokeless powder XYZ - 20 kg: 1.3
Smokeless powder XYZ - 2 kg: 1.4
Smokeless powder XYZ - 50 grams: 1.4S
Smokeless powder XYZ - in ~0.1 gram article: Not Class 1

Example 2

Zirconium potassium perchlorate powder, unknown quantity: 1.1
Zirconium potassium perchlorate power device cartridge: 1.4
Zirconium potassium perchlorate ignitor: 1.4S
Zirconium potassium perchlorate handheld device – 100 mg plus a propellant: Not Class 1

Example 3⁵

PETN booster: 1.1
PETN bomb: 1.2
PETN detonating cord: 1.4
PETN detonator in cardboard tube – 1.4S
PETN standard, 5% diffused in an inert material –Not Class 1

Use of articles to control hazard level and security

13. An explosive substance may be compartmentalized into an article with the design and per unit quantity being such that there is no explosion even without packaging. Further, the blast, projectile or fire hazards of an individual article may be eliminated by continuing to

⁵ This example shows that the configuration controls the classification of Pentaerythritol tetranitrate (PETN), a well-known detonating explosive, from Division 1.1 to 1.4S. The “not class 1” example is based on a United States approval, but unlike the smokeless powder and zirconium potassium perchlorate (ZPP) examples which remain intentionally energetic, it is for a desensitized 5% mixture which might not be energetic.

reduce the per unit quantity. Many small explosive articles may be safely used in handheld tools by workers with no explosives training, carried in their hands or pockets.

14. The potential to recombine the substances in such articles is not feasible, whether accidentally or intentionally. Competent authorities responsible for security routinely exclude intentional explosive articles with negligible hazard from security requirements.

Current exit from Class 1

15. Currently, articles containing explosives may exit Class 1 if they demonstrate compliance with the criteria in 2.1.3.6.4 of the UN Model Regulations. Many competent authorities regularly remove intentionally energetic articles from Class 1 on this basis.

16. When there is a complex device with multiple classes of hazardous materials, and if the explosive component is “Not Class 1”, then the product is classified into another class.

17. However, in the many cases where the explosive is the only hazardous material present, the product cannot be self-classified into another class and exits the dangerous goods regulations. Explanations for each potential re-classification are as follows:

- Class 1: “Not Class 1” per 2.1.3.6.4.
- Class 2: By definition, an explosive may not be a gas.
- Class 3: A solid explosive is not a liquid. Liquid explosives compose a low percentage of explosives and an even smaller percentage (if they exist) of very small articles.
- Division 4.1: It is impossible to test articles for assignment to 4.1, as the applicable test method lays out a substance in a trough and measures the burn speed. Division 4.1 may not normally be self-assigned by industry. Certain policy exceptions exist, e.g., UN 1944, Matches, safety.
- Class 5: With the exception of certain ammonium molecules, explosives are generally not oxidizers and are not organic peroxides (which may explode but are not “explosives”).
- Class 6: Explosives are generally not toxic, based on regulatory criteria. The only exception with a UN number is a tear gas cartridge, and there a toxic substance is intentionally added.
- Class 7: Explosives are not radioactive.
- Class 8: Explosives generally are not corrosive, based on regulatory criteria.
- Class 9: Not possible without a UN number and regulatory pathway, which only exist in a few use-based scenarios.

18. Therefore, a classification of “Not Class 1” of an article only containing explosives results in exiting the dangerous goods regulations.

The gap between 1.4S and complete exit from the UN Model Regulations

19. Many very low hazard energetic articles fail the strict exclusion criteria for exiting the regulations. This results in controls upon those products which are not commensurate with the hazard level.

20. No quantifiable, scientific method exists for classifying very low hazard energetic articles outside of Class 1 but still within the dangerous goods regulations. A system that would do this was presented in ST/SG/AC.10/C.3/2021/15 at the fifty-eighth session of the Sub-Committee. Further discussion is welcome.

Meaning of “Explosion”

21. Chemicals that explode are not necessarily Class 1 explosives. In addition to the explicit references to explosions for self-reactive substances and organic peroxides, the term “explode” is defined in the Glossary of Terms as:

“the verb used to indicate those explosive effects capable of endangering life and property through blast, heat and projection of missiles. It encompasses both deflagration and detonation.”

22. Classes that may explode with lethal effects include:

- (a) Class 2 compressed gas cylinders, tanker trucks and rail wagons;
- (b) Class 3 flammable liquids in boiling liquid expanding vapour explosions (BLEVE);
- (c) Class 4 self-reactive substances;
- (d) Class 5 organic peroxides.

23. Class 1 is not intended to encompass all chemicals that may explode. The term “explosion” is used for Class 1 in the following ways:

- (a) Divisions 1.1 and 1.5 are defined to have a mass explosion hazard, i.e., an explosion which affects almost the entire load virtually instantaneously. The other divisions are defined to not have this hazard;
- (b) Division 1.4 explosives are so defined that “an external fire shall not cause virtually instantaneous explosion of almost the entire contents of the package”;
- (c) The notes on articles in compatibility groups D and E indicate that the initiating explosive substance may be functioned without there being an explosion of the article.

24. Articles should not be deemed to be in Class 1 when they exhibit negligible blast, heat and projection of missiles and are not capable of endangering life and property.

Dangerous goods in articles, apparatus and machinery

25. It may also be possible to consider classification of the articles under discussion when further encapsulated and diffused into larger non-hazardous articles. This further diffusion can result in the effects being indistinguishable in a fire.

26. Existing UN entries which might be adapted for this purpose include:

- (a) UN 3363, Dangerous goods in apparatus / Dangerous goods in articles / Dangerous goods in machinery
- (b) UN 3548, Articles containing miscellaneous dangerous goods, n.o.s.

27. These entries require competent authority approval in various instances, which might align with the need to employ oversight of classification of very low hazard articles containing explosive substances.

Concluding remarks

28. When an article cannot explode by design and this is validated with testing under competent authority oversight, communicating an explosion hazard is not accurate.

29. There is no credible possibility to re-educate the world population, including decision makers in government and transport chains, that a division of Class 1 does not pose an explosion hazard.

30. Removing articles from Class 1 that do not have the ability to react together regardless of packaging, and which individually pose a danger comparable to or less than other dangerous goods, would not be hiding explosives in another class. To the contrary an explosives classification miscommunicates the hazard and results in controls and burdens which are inappropriate to the hazard. Assignment into Class 9 would improve the accuracy of hazard communication and result in better outcomes in transport and downstream regulations.

Proposal

31. In alignment with the report of the fifty-eighth session, we propose a discussion within the Sub-Committee and evaluation of technical aspects of this working document by the Explosives Working Group.
