

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

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Item 2 (j) 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**

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Item 2 (b) of the provisional agenda

**Classification criteria and related hazard
communication: review of Chapter 2.1**

**Amendments to the definition of explosive substance and
definition of Class 1**

Transmitted by the expert from Sweden

Background

1. The definition of “class 1” and the definition of “explosive substance” are fundamental concepts in the Model Regulations, as they determine the application scope of Mode Regulations for dangerous goods in Class 1.
2. These two definitions have undergone significant revisions in the history of development of UNMR but have remained unchanged since 1977¹.
3. For the historical reasons, it seems that these definitions have been developed solely for the purpose of transport and were initially formed as recommendations rather than legal text. However, they now form the basis of legally binding texts throughout the world, and are applied also beyond the realms of transport, e.g. in storage. The same definitions are also used in the Globally Harmonized System (GHS), which forms the basis of e.g. the European CLP-regulation² that governs the classification, labelling and packaging of chemicals placed on the market. Sophisticated knowledge about explosive substance is required in order to use or interpret these definitions correctly, which creates ambiguities especially in legal applications.
4. During recent years, the expert from Sweden has brought up concerns about these two definitions to the Working Group on Explosives (EWG) under TDG and to the International Group of Experts on the Explosion Risks of Unstable Substances (IGUS) on various occasions. Examples of previous proposals to TDG are informal document INF.39 (53rd session), ST/SG/AC.10/C.3/2018/81 and informal document INF.22 (54th session). During these discussions, the expert from Sweden has obtained undocumented information from

¹ Ken Price, “Fifty years of explosives classification”. SAFEX Newsletter No. 66, September 2018.

² Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

various sources, which is helpful in understanding the background and the actual intentions behind these definitions.

5. Also in the on-going revision of Chapter 2.1 of the GHS (lead by another expert from Sweden), the definitions and their scope have been discussed. In this context, the definitions have also proven to be a challenge due to the heritage from transport regulations and issues about explosives not accepted in Class 1 because they are too dangerous for transport (the “Unstable explosives”).

6. More than 40 years have passed since the last revision of these two definitions. Over the years, the definitions in Model Regulations are in practice no longer recommendations but are adopted as legal texts. They are no longer used only for transport but also for other regulative areas including the GHS.

7. The expert from Sweden believes it is appropriate to revise these two definitions so that they are technically adequate and legally strict, so that the definitions can be used correctly even for those who do not have advanced knowledge about explosives.

The distinguishing technical features of explosive substances

8. Compared to other substances, an explosive substance has three distinguishing technical properties.

- Property 1: The substance must be able to undergo a self-sustained exothermic chemical reaction. Here, the “self-sustained chemical reaction” means chemical change without an outside supply of oxygen.
- Property 2: The self-sustained chemical reaction must take place at a high speed.
- Property 3: The substance must be sufficiently sensitive so that the self-sustained chemical reaction can be initiated.

9. These three properties are so-called “explosive properties”. To be qualified as explosive substance, the substance must have all three properties.

10. The first property is an intrinsic property of the substance, determined by the chemical structure. This property is the very basic property of an explosive substance. It is, however, not limited to explosive substances only – for instance also organic peroxides and self-reactive substance have this property.

11. The second and the third property are also intrinsic properties of the substance. But, these two can be affected by the conditions under which the properties are measured. Therefore, to discriminate explosive substances from other substances, test conditions and qualification thresholds must be pre-determined to quantify these two properties. Consequently, substances, which according to the pre-determined test conditions and qualification thresholds are not qualified as explosive substances, may still have explosive properties and may be able to undergo a self-sustained chemical reaction, although at lower reaction speed and/or with lower sensitivity to initiation. In reality, such substances may still be used to perform work as explosives, when they are used in other circumstances than the discrimination test conditions. This fact is captured in the qualification “substances manufactured with a view to producing a practical explosive effect”, which includes such substances into Class 1 in the present classification scheme, even though they are slowly reacting or insensitive.

The test scheme in UN Manual of Tests and Criteria (MTC) to discriminate explosive substances from others

12. The scheme in MTC to discriminate explosive substance from other substances consists of screen procedures in Appendix 6, Test Series 1 and Test Series 2. Test Series 2 defines the borderline between explosive substances and those not considered “sufficiently” explosive.

13. The test scheme (including the screening procedure) examines all three explosive properties described in paragraph 8 above. Namely, screening procedures, UN gap test and Koenen test examine whether the substance is able to undergo a self-sustained chemical reaction; UN gap test and Koenen test examine the sensitivity of the substance to initiation and Koenen test and Time/pressure test examine the speed of the chemical reaction. Therefore, the test scheme is appropriate from a technical point of view.

The test scheme for classification into Class 1

14. The test scheme for classification into Class 1 is described in section 2.1.3 of UNMR and in section 10.3 of MTC. The principle is that a substance is first tested by Test Series 1 and/or Test Series 2 to determine whether the substance has sufficient explosive properties to be considered an explosive substance. If so, the substance or article containing the substance is then tested by Test Series 3 respectively Test Series 4 to determine whether the substance or the article is too sensitive for transportation. Those products which have demonstrated to be too sensitive are not accepted into Class 1. In other words, not all explosive substances and articles are accepted into Class 1, only those which are not too sensitive to be transported.

Problems

Defects in the present definition of explosive substance

15. “Explosive substance” is defined in 2.1.1.3 (a) of UNMR. To facilitate reading, the definition is duplicated below:

16. *“Explosive substance is 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. Pyrotechnic substances are included even when they do not evolve gases;”*

17. Compared to the three explosive properties that an explosive substance must have as described in paragraph 8, this definition covers only two of three explosive properties; the first and the second. The third property, i.e. the sensitivity of the substance to initiation, is missing. By this definition, all substances which are able to undergo a self-sustained rapid chemical reaction are explosive substances, no matter how insensitive to initiation. This would mean that many substances which are determined by the test scheme not to be explosive due to their low sensitivity, are explosive substances according to the definition. Therefore, this definition is technically deficient and inconsistent with the test scheme. No need to mention, the adverse consequences for the industry and the legislation this definition may cause, when it is used for legal purposes.

Defects in the present definition of Class 1

18. “Class 1” is defined in 2.1.1.1 of UNMR. To facilitate reading, the definition is duplicated below:

19. "Class 1 comprises:

(a) Explosive substances (a substance which is not itself an explosive but which can form an explosive atmosphere of gas, vapour or dust is not included in Class 1), except those that are too dangerous to transport or those where the predominant hazard is appropriate to another class;

(b) Explosive articles, except devices containing explosive substances in such quantity or of such a character that their inadvertent or accidental ignition or initiation during transport shall not cause any effect external to the device either by projection, fire, smoke, heat or loud noise (see 2.1.3.6); and

(c) Substances and articles not mentioned under (a) and (b) which are manufactured with a view to producing a practical explosive or pyrotechnic effect."

20. At first glance, this is a clumsy, lengthy and unstructured text. After further reading, the structure of the text appears. That is, the definition of Class 1 is made of three partial definitions. Part (a) deals with explosive substances, Part (b) deals with explosive articles and Part (c) is intended to capture those exceptional cases which are not captured by either Part (a) or Part (b). A product that meets any of the three partial definitions is Class 1.

21. According to the expert from Sweden, there are serious defects in this definition.

22. Part (a). In Part (a), there is no logic or reason to include the explaining text in the brackets.

23. This explanatory text states that a substance, which in itself is not an explosive substance but when mixed with oxygen in the air can form an explosive atmosphere, does not belong to Class 1. However, if a substance itself is not an explosive substance, it is obviously not Class 1 by definition, no matter what can be formed when the substance is mixed with other substances. The same logic can be applied other examples such as oxidizing substances. Oxidizing substances are not explosive substances in themselves, and, hence, are not Class 1. When mixed with fuel, an oxidizing substance can form a pyrotechnical composition which is an explosive substance that could end up in Class 1. However, the classification of pyrotechnical compositions does not affect the fact that the oxidizing substances are not Class 1. Therefore, the definition is clear enough as it stands without the text inside the brackets, which is more confusing than helpful.

24. Part (b). According to the test scheme for Class 1, explosive articles which are too sensitive for transport are excluded from Class 1. Logically, this definition should be included in Part (b), but it is not here. Instead, an exemption of some articles with very low hazard is included here in the definition.

25. Part (c). Part (c) is the most confusing part of the definition of Class 1. Some uncertainties that Part (c) may cause are illustrated below.

- Pure primary explosive substances are too sensitive to be transported and are therefore excluded from Class 1 according to the definition in Part (a). However, in contrary to Part (a), by application of the definition in Part (c), these primary explosive substances are still to be considered Class 1.
- Explosive articles which contain very small amount of explosive substances and cause no effects outside the articles are excluded from Class 1 according to the definition in Part (b). However, by applying the definition in Part (c), these articles are again considered Class 1.
- Since the phrase "a practical explosive or pyrotechnic effect" is not defined, it can be interpreted arbitrarily, especially by those who do not have specific knowledge about explosives but apply the definition literally. For example, heat, gases, smokes or noise

produced by burning fuels may be interpreted as “practical explosive or pyrotechnic effects”. Following this interpretation, fuels are Class 1 according to the definition in Part (c), since fuels are not explosive substances mentioned in Part (a), nor explosive articles mentioned in Part (b) but produce “a practical explosive or pyrotechnic effect”.

Summary of the discussion

26. To summarize the above discussions, the expert from Sweden concludes that both test schemes for explosive substances and for Class 1 are technically adequate, which means they are constructed to examine all technical features of explosive substances respectively the suitability of product for transport. However, both definitions of “explosive substance” and “Class 1” in Chapter 2.1 of UNMR are incorrect in this regard. They are neither consistent with the technical features of explosive substance nor consistent with the test schemes for the determination of explosive substances and Class 1.

Proposal to amend the definitions

27. The expert from Sweden has for a long time searched for simple solutions to remedy the defects in these two definitions, for example by rewording some phrases or parts of the definitions. However, no satisfactory solution has been found. Therefore, the expert from Sweden suggests a replacement of the definitions in 2.1.1.1 and 2.1.1.3 (a) of UNMR by new definitions which are technically adequate and consistent with the practiced test schemes.

Proposal 1

New definition of explosive substance

28. Amend 2.1.1.3 (a) of UNMR to read as follows:

“*Explosive substance* is a solid or liquid substance which is in itself capable to undergo a self-sustained exothermic chemical reaction, provided that

(a) at the pre-determined test conditions, such a reaction can be initiated and the reaction after initiation is rapid, or

(b) the substance is manufactured with a view to producing a practical explosive and pyrotechnic effect,

except those where the predominant hazard is appropriate to another class of substance.”

Proposal 2

New definition of Class 1

29. Amend 2.1.1.1 of UNMR to read as follows:

“Class 1 comprises explosive substances and explosive articles which are not too sensitive to be transported.

Exception from Class 1: devices containing explosive substances in such quantity or of such a character that their inadvertent or accidental ignition or initiation during transport shall not cause any effect external to the device either by projection, fire, smoke, heat or loud noise (see 2.1.3.6).”

Justification

Comments to the proposed definitions

30. The proposed new definition of explosive substance includes all the explosive properties described in paragraph 8 and the definition corresponds to the test scheme practiced to discriminate explosive substances. The “pre-determined test conditions” in the definition refers in practice to Test Series 2. The phrase “the substance is manufactured with a view to producing a practical explosive and pyrotechnic effect” refers to those substances which have explosive properties, yet are not qualified as explosive substances at the test conditions (Test Series 2) but are intended to be used as explosives in practice, as described in paragraph 11.

31. As a consequence of the new definition of explosive substance, the new definition of Class 1 is concise, logic and stringent. It remedies all defects the present definition has, as exemplified in paragraphs 22 – 25.

Influence on GHS

32. Since GHS has taken over the definitions used in Class 1 for transport and the definitions in GHS need to be aligned, this proposal will have significant impacts to GHS. Naturally, the expert from Sweden is aware of the on-going revision of Chapter 2.1 of the GHS, and any changes to the definitions could be made within this context. The expert from Sweden has noticed a discussion paper on this topic to the 37th session of the SCEGHS, ST/SG/AC.10/C.4/2019/7.
