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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

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Item 3 of the provisional agenda
Listing, classification and packing

Categorization and clarification of the term “hermetically sealed” in the Model Regulations

Submitted by the expert from the Kingdom of the Netherlands*

I. Introduction

1. At the sixty-second, sixty-third and sixty-fifth sessions of the Sub-Committee, the expert from the Kingdom of the Netherlands submitted a number of informal documents, on identified safety problems concerning hermetically sealed packagings where dangerous goods were found to have egressed from approved and supposedly intact packagings. The port inspections verified that the egress was not caused by closures that had loosened during transport.

2. At the sixty-fifth session it was proposed to solve the problems with these packagings in a stepwise approach. The first step has been discussed during the last session. From the report of the sixty-fifth session it is clear that the Sub-Committee agreed on the need to review the term “hermetically sealed” in the *Model Regulations*. Furthermore, experts were invited to reach out to discuss in the meantime this matter.

3. The wording “hermetically sealed” suggests a certain level of safety (i.e., no egress or ingress of the package). It also suggests a distinction between packing instructions that use the term and packing instructions that do not, and thereby between substances that require a stricter packaging instruction (i.e., hermetically sealed) as an additional level of assurance and substances that do not require this additional assurance.

4. The overall goal of this work is to achieve safe transport conditions through a clear understanding and interpretation of the term ‘hermetically sealed’, with clear criteria and tests, and a meaningful distinction compared to other packing requirements. This document will carry on with steps two and three of the stepwise approach as proposed in informal document INF.12 of the sixty-fifth session of the Sub-Committee and offer discussion on the last step:

* A/79/6 (Sect. 20), Table 20.6.

- Categorization of the various packing instructions that currently use the term “hermetically sealed”, and identify how these differ from other packing instructions.
- Proposals to achieve a clear and more meaningful distinction between packing instructions that use “hermetically sealed” and packing instructions that do not.
- Discuss criteria and tests on how to achieve a “hermetically sealed” packaging.

5. The expert from the Kingdom of the Netherlands organised an intersessional meeting with interested participants to discuss the usage of the term “hermetically sealed” in the *Model Regulations*. Experts from Belgium, Germany, Spain, United Kingdom, Cefic and DGAC participated in the meeting or provided written input. Three topics were discussed during the session: (1) usage and possible ranking of different terminology with regard to type of substances and thus the hazards they apply to, (2) interpretation of “hermetically sealed” and possible references or standards that can be used to achieve this, and (3) what terminology to use in which part of the *Model Regulations*. The expert from the Kingdom of the Netherlands is very grateful for the fruitful discussion and the valuable input.

6. During the discussion it was mentioned that the packing requirements for liquids are stricter than for solids and, if “hermetically sealed” applies to liquids, the safety issues might already be covered by the current packing provisions. Furthermore, the usage of single packings or inner packagings may also make a difference because of the different and stricter requirements for single packagings than for inner packagings. On standards and references, it was suggested to investigate the possible use of short-term exposure limits (STEL) for obtaining an indication of the maximum acceptable leakage rate of a packaging. Lastly, a number of Divisions were identified where the usage of “hermetically sealed” is required as an extra level of safety.

II. Categorization of “hermetically sealed” and other terminology

7. As discussed during the sixty-fifth session, for Divisions 6.1 (Toxic substances) and 4.2 (Substances liable to spontaneous combustion) packing group I, there seems to be a rationale for assigning a packing instruction containing a “hermetically sealed” requirement. For the other Divisions and Classes it is unclear why the requirement “hermetically sealed” has been assigned to some of the UN Nos. and not to others with seemingly similar properties.

8. To find out if there is indeed a difference in the usage and application of terminology used in packing instructions, a number of terms used in the *Model Regulations* have been identified and analyzed. These are: “sift(-)proof”, “gas(-)tight”, “vapour tight”, “prevent the ingress of water”, “prevent evaporation”, “prevent the loss of water”, “leakproof(ness)” and “leak(-)tight(ness)”. The spelling of some terminology differs throughout the *Model Regulations*. All known spelling options of the same term have been used in the analysis, and the Divisions and packing groups the terms apply to have been analyzed. The analysis is shown in informal document INF.13.

9. From the analysis it becomes clear that “hermetically sealed” applies to other Divisions, packing groups and substances than other terminology, except for “gas-tight” which applies, amongst others, to very toxic and pyrophoric gases. “Siftproof” applies to solid substances, mostly of Class 1, or for packing groups II and III whereas “leakproof” applies to liquids and gases. The remaining terminology is used sporadically throughout the *Model Regulations* without clear patterns, with the exception of “the loss of water or alcohol content” which applies to all desensitized explosives.

10. Although the current usage of terminology may also partly be due to the use of “legacy terms” that have been in the regulations for a long time, its current application does seem to imply an intentional differentiation in terminology being assigned to the respective divisions. For that reason it is proposed to keep the term “hermetically sealed” as an extra level of safety and to use the terminology analysis as a basis for where to apply it.

11. This document focuses solely on the “P” packing instructions and not on instructions for IBCs and large packagings, even though some UN numbers that are assigned a

"hermetically sealed" packing instruction may also be assigned an IBC or LP instruction without "hermetically sealed" requirements.

12. Furthermore, in some packing instructions, "hermetically sealed" applies to all packagings, as is the case for P601, P602 and P804. Whereas in P201, P400, P403, P404 and P405 it applies to (most of) the inner packagings when combination packages are used and not to other packagings mentioned in that packing instruction.

III. Clarification of "hermetically sealed" and the associated packing instructions

13. In the twenty-third revised edition of the *Model Regulations*, "hermetically sealed" is used in the following packing instructions and special provisions: P001/PP31, P200, P201, P400, P403, P404, P405, P601, P602 or P804 and special provisions 239 and 379. As shown in informal document INF.12 of the sixty-fifth session, various packing instructions and special provisions are assigned to a total of 150 UN entries (excluding P200) and seven Classes or Divisions. These are, in descending order in number of UN numbers: Division 6.1 Toxic substances, Division 4.3 Substances which in contact with water emit flammable gases, Division 4.2 Substances liable to spontaneous combustion, Class 8 Corrosive substances, Division 2.3 Toxic gases, Division 2.1 Flammable gases and Class 3 Flammable liquids.

14. In the paragraphs below, for every Class or Division it is discussed whether the term "hermetically sealed" should be maintained or replaced by a more appropriate one. The starting point is to maintain the term, as it provides an additional assurance of the packaging used in relation to the hazards posed by the transported substances. It is only proposed to change it when it is deemed inappropriate, considering the hazard and physical state of the substance. If "hermetically sealed" is considered inappropriate, it is proposed to replace it with other terminology that seems more appropriate, based on the terminology analysis provided in informal document INF.13. This will contribute to the clear usage of "hermetically sealed" in the *Model Regulations*. Furthermore, only the usage of "hermetically sealed" in the packing instructions will be discussed, not the UN numbers to which the packing instruction was assigned and whether that is appropriate or not.

15. This proposal is meant to provide clarification about the term "hermetically sealed". For the other terminology used in the *Model Regulations*, mentioned in paragraph 8, similar steps may be required for clear understanding and interpretation of these terms.

Division 6.1 packing group I – Toxic vapours

16. As shown in the previous analysis in informal document INF.12 of the sixty-fifth session "hermetically sealed" applies to Division 6.1 PG I vapours. Considering the hazard such substances pose, an extra packing assurance through "hermetically sealed" seems in place here. Additionally, the associated packing instructions P601 and P602 already provide extra requirements for the closures of the packagings. It is therefore proposed to maintain "hermetically sealed" here.

Division 4.2 packing group I – Pyrophoric solids and liquids

17. "Hermetically sealed" applies to both solids and liquids of Division 4.2 PG I. The liquids are assigned packing instructions P400, P405 and P601, the solids are assigned P404. In all packing instructions "hermetically sealed" applies to the inner packagings. It is proposed to maintain "hermetically sealed" here considering the hazards of pyrophoric substances.

18. Additionally, while writing this document, it became clear that P404 lists a number of UN numbers to which the packing instruction applies. One UN number (UN 2005) does not exist in the Dangerous Goods List. It is therefore proposed to delete UN 2005 from P404 (see proposal 1 below).

Class 3 packing group I – Flammable liquids

19. There is only one Class 3 substance assigned a “hermetically sealed” packaging, UN1131 CARBON DISULPHIDE, through special packing provision PP31. It is a highly flammable and highly volatile substance with a subsidiary toxic hazard. Packing provision PP31 is used abundantly throughout the International Maritime Dangerous Goods (IMDG) code and consequently assigned to different UN numbers than in the *Model Regulations*. Considering the chemical properties and hazards of carbon disulphide and the impact any changes in packing provision PP31 may have on the IMDG code, it is proposed to maintain the current wording for packing provision PP31.

Class 8 packing group I – Corrosive substances

20. Of the five Class 8 substances, four are assigned packing instruction P602, one is assigned P804. The latter packing instruction has an extensive list of requirements including criteria regarding the closures which are quite similar to the criteria listed in packing instruction P602. Since this packing instruction only applies to one UN number, and was thus specifically written for this substance, it is proposed to maintain the current wording in P804.

Class 2 – Gases

21. Five Class 2 UN numbers require a “hermetically sealed” packaging; three UN numbers through a packing instruction (P201) and two through a special provision. This particular packing instruction only applies to these three UN numbers. The provided instructions are less extensive than other “hermetically sealed” packing instructions and do not mention additional provisions for the closures. Furthermore, the packagings required shall conform to a packing group III performance level. Lastly, these three gases are the only gases that are assigned a “hermetically sealed” packaging. Alternative wording therefore seems to be in place here.

22. Appropriate wording may be either “gas-tight” or “leak-tight”. “Gas-tight” is mostly applicable to gases that are either very toxic (LC50 ≤ 200 ppm) or pyrophoric. Since that is not the case here, it is proposed to change “hermetically sealed” in packing instruction P201 to “leak-tight”. This is reflected in proposal 2 below.

23. Two UN numbers (UN 1005 and UN 3516) are assigned “hermetically sealed” through special provision (SP) 379. According to SP 379, receptacles shall be fitted with a device that allows for gas evacuation when necessary, which seems to contradict the requirement of “hermetically sealed”. Other terminology such as “gas-tight” or “leak-tight” seems more in place here. “Gas-tight” is mostly used for very toxic (LC50 ≤ 200 ppm) or pyrophoric gases, which does not apply to SP 379. “Leak-tight” is therefore more appropriate here. This is reflected in proposal 3 below.

24. There is one other gas that may be packed (i.e. it is optional) in a “hermetically sealed” packaging, which is UN 1040 ETHYLENE OXIDE, or ETHYLENE OXIDE WITH NITROGEN up to a total pressure of 1 MPa (10 bar) at 50 °C, through packing instruction P200 (l). For the same reasons mentioned in paragraph 21 above, it is proposed to change the wording here to “leak-tight”, especially since this is a requirement of the “hermetically sealed” inner packaging of that same packing instruction. See proposal 4 below.

Division 4.3 packing group I – Substances which in contact with water emit flammable gases

25. Contrary to other “hermetically sealed” Divisions, this is the only one where the packing instructions apply solely to solid substances through packing instruction P403 and SP 239. Packing instruction P403 authorizes combination packagings and single packagings, where the requirement “hermetically sealed” applies only to the inner packagings. Considering the hazard of these substances, an extra safety assurance through “hermetically

sealed" for the inner packagings seems in place here and it is therefore proposed to maintain the term in packing instruction P403.

26. Special provision 239 mentions "hermetically sealed" and applies solely to UN 3292 BATTERIES, CONTAINING METALLIC SODIUM OR SODIUM ALLOY, or CELLS, CONTAINING METALLIC SODIUM OR SODIUM ALLOY. There are no other types of cells or batteries that use "hermetically sealed" as a requirement. However, this is also the only battery type that is classified as Division 4.3. The packing requirements of P408 apply, which is exclusively applicable to UN 3292. The "hermetically sealed" requirement in SP 239 applies to cells, and not to batteries, as follows:

> "… Cells shall consist of hermetically sealed metal casings which fully enclose the dangerous goods and which are so constructed and closed as to prevent the release of the dangerous goods under normal conditions of transport. …"

27. Other terminology like "gas-tight" or "leak-tight" does not seem to be in place here because the requirement applies to articles, i.e. cells and batteries, and not to gases or liquids. However, "gas-tight" is mentioned in packing instruction P911, for transporting damaged or defective cells or batteries, as an example of a gas management system. Although it is clear that any release of contents poses a possible hazard, it is unclear whether the extra assurance of the usage of "hermetically sealed" is necessary here, especially since this is the only article the requirement applies to. It is therefore proposed to delete the term "hermetically sealed" in SP 239 while ensuring the requirement of "no release of contents" remains intact. See proposal 5 below.

Clarification and interpretation of "hermetically sealed"

28. In the paragraphs above it has been analyzed where the usage of "hermetically sealed" is appropriate and which packing instructions or special provisions should use different terminology. This will facilitate a more clear interpretation and usage of the term. Furthermore, the requirements in packing instructions P601, P602 and P804 also provide a clear guidance on how to achieve "hermetically sealed" closures. The existing provisions can thereby provide practical guidance for the interpretation and understanding of "hermetically sealed" packagings.

29. Another aspect in conjunction to "hermetically sealed" packagings concerns the permeation of the packaging. This is not mentioned specifically in any packing instruction although this could also be a possible source of leakage. The current general requirements mentioned in various paragraphs in the *Model Regulations* state that: "Any permeation of the substance contained in the packaging shall not constitute a danger under normal conditions of transport". For "hermetically sealed" packagings one can imagine that any permeation of the substance should not be allowed.

30. To provide general practical guidance on the interpretation of "hermetically sealed" it is proposed to incorporate a new paragraph in 4.1.1 of the *Model Regulations*. This paragraph emphasizes the testing requirements and elaborates on the type of closures and permeability that are required for "hermetically sealed" packagings. Acceptable tests and criteria for egress and ingress of the packaging (including permeation) will be discussed in future proposals. This is indicated as a place holder between square brackets in the text below.

31. Incorporate the following text in 4.1.1 as follows (see also proposal 6):

> "Where the term hermetically sealed is used, this means a packaging that is designed and constructed in such a way that there is no egress from or ingress into the package under normal conditions of transport. Packagings shall meet the testing requirements of [6.1.5.x]. The closures shall be physically held in place by any means capable of preventing back-off or loosening by impact or vibration during transport and, when necessary, provided with a cap seal. [The maximum permissible permeability of the packaging shall be [x] g/l.h at 23 °C.]"

IV. Criteria and tests for “hermetically sealed” packagings

32. As discussed in the intersessional session, it was proposed to look into short-term exposure limits (STEL) as a measure of acceptable exposure or maximum allowable leakage from a package. Although time is taken into account in the derivation of STEL values, it is not taken into account when considering leakage from a package. It is therefore not possible to indicate an acceptable permeability of the packaging before it has been offered for transport. Only after transporting it, it will be clear if the STEL value has been exceeded. Furthermore, STEL values are not available for all substances. One way to incorporate the time factor into permeation criteria is through tests as, for example, set out in the Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) paragraph 6.1.5.7 which applies to certain flammable liquids. For these tests, packagings shall be stored for 28 days and weighed before and after storage. The packagings pass the test if the permeability does not exceed 0.008 g/l.h. A similar approach can also be applied to “hermetically sealed” packagings in the *Model Regulations*. This would then provide extra assurance that the packaging type conforms to “hermetically sealed” and distinguishes the requirements from other types of packaging terminology.

33. The expert from the Kingdom of the Netherlands is interested in hearing the views of the Sub-Committee on this matter.

V. Proposals

A. Proposal 1 – P404

34. In packing instruction P404, delete UN 2005 as follows (deleted text in ~~strikethrough~~):

“This instruction applies to pyrophoric solids: UN Nos.: 1383, 1854, 1855, ~~2005,~~ 2008, 2441, 2545, 2546, 2846, 2881, 3200, 3391 and 3393.”

B. Proposal 2 – P201

35. As explained in paragraph 21, amend the wording in P201 as follows (deleted text in ~~strikethrough~~ and new text in **bold**):

“Inner packagings:

(a) For non-toxic gases, ~~hermetically sealed~~ **leak-tight** inner packagings of glass or metal with a maximum capacity of 5 litres per package;

(b) For toxic gases, ~~hermetically sealed~~ **leak-tight** inner packagings of glass or metal with a maximum capacity of 1 litre per package.”

C. Proposal 3 – Special provision 379

36. In special provision 379, apply the following changes (deleted text in ~~strikethrough~~ and new text in **bold**):

“(d) Receptacles containing adsorbed or absorbed ammonia shall meet the following conditions:

(i) Receptacles shall be made of a material compatible with ammonia as specified in ISO 11114-1:2020;

(ii) Receptacles and their means of closure shall be ~~hermetically sealed~~ **leak-tight** and able to contain the generated ammonia;

(iii) …”

D. Proposal 4 – P200 gas specific provision (l)

37. Amend the wording in P200, gas specific provision (l) as follows (deleted text in ~~strikethrough~~ and new text in **bold**):

"Gas specific provisions

l: UN 1040 ethylene oxide may also be packed in ~~hermetically sealed~~ **leak-tight** glass or metal inner packagings suitably cushioned in fibreboard, wooden or metal boxes meeting the packing group I performance level. The maximum quantity permitted in any glass inner packaging is 30 g, and the maximum quantity permitted in any metal inner packaging is 200 g. After filling, each inner packaging shall be determined to be leak-tight by placing the inner packaging in a hot water bath at a temperature, and for a period of time, sufficient to ensure that an internal pressure equal to the vapour pressure of ethylene oxide at 55 °C is achieved. The maximum net mass in any outer packaging shall not exceed 2.5 kg."

E. Proposal 5 – Special provision 239

38. Delete the requirement "hermetically sealed" in special provision 239:

"… Cells shall consist of hermetically sealed metal casings which fully enclose the dangerous goods and which are so constructed and closed as to prevent the release of the dangerous goods under normal conditions of transport. …"

F. Proposal 6 – Guidance on "hermetically sealed" packagings

39. In 4.1.1 of the *Model Regulations*, insert a new 4.1.1.8 as follows, and renumber the subsequent paragraphs:

"4.1.1.8 Where the term hermetically sealed is used, this means a packaging that is designed and constructed in such a way that there is no egress from or ingress into the package under normal conditions of transport. Packagings shall meet the testing requirements of [6.1.5.x]. The closures shall be physically held in place by any means capable of preventing back-off or loosening by impact or vibration during transport and, when necessary, provided with a cap seal. [The maximum permissible permeability of the packaging shall be [x] g/l.h at 23 °C.]"

VI. Sustainable Development Goals

40. Clarifying the meaning of the term "hermetically sealed" and distinguishing it from other terminology used in packing instructions, helps to develop clearer legal texts and to avoid different criteria among different countries and inspection services, and thus helps to implement the United Nations Sustainable Development Goal number 16*: Peace, justice and strong institutions*. Furthermore, it improves transport safety, thereby contributing to Sustainable Development Goal number 3: *Ensure healthy lives and promote well-being for all at all ages*. Finally, this work also contributes to Sustainable Development Goal 12: *Ensure sustainable consumption and production patterns*, and specifically its Target 12.4: *achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.*