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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****Fifty-eighth session**

Geneva, 28 June-2 July 2021

Item 2 (a) of the provisional agenda

**Explosives and related matters: review of test series 6****Report of the 6d-ICG****Submitted by the Sporting Arms and Ammunition Manufacturers'  
Institute (SAAMI) on behalf of the 6(d) Test Informal Correspondence  
Group (6d-ICG)\*****Introduction**

1. In June 2020 SAAMI presented document ST/SG/AC.10/C.3/2020/4 to inform the Sub-Committee of the results of a survey conducted within the 6(d) Test Informal Correspondence Group (6d-ICG). While a formal session did not occur in June 2020, comments were received through the UN online platform. Given certain limitations at the time, SAAMI did not request an informal session in June, and did not request an extended discussion of the working document during the formal hybrid session at the fifty-seventh session in December 2020. Given the broad support for the work of the 6d-ICG mentioned in the recent comments, SAAMI recommends that the UN Working Group on Explosives continue their discussion based on the survey and the additional comments received. This discussion would occur in the next virtual session of the Working Group on Explosives and will be supplemented by a preparatory intersessional meeting in May 2021.

2. As a basis for discussion, SAAMI proposes that the group develop possible solutions to the survey conclusions. Where comments were subsequently received which may modify the survey results, those comments have been incorporated below. SAAMI also takes this opportunity to pose some new questions and suggestions.

**Background**

3. The background of the 6(d) test was discussed in document ST/SG/AC.10/C.3/2019/11. Compatibility group S may only be assigned to Division 1.4 based on meeting safety criteria which exceed other compatibility groups in Division 1.4. The definition of compatibility group S is:

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

“Substance or article 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 fire fighting or other emergency response efforts in the immediate vicinity of the package.”

4. The evolution of the Canadian proposals resulting in the addition of the Test 6(d) is as follows:

(a) The 6(c) (bonfire) test was formerly the only test used to determine the division of a 1.1 – 1.4 explosive and whether it qualifies for inclusion in compatibility group S based on safety performance. Canada began their initiative by noting that the 6(c) test does not evaluate whether “hazardous effects arising from accidental functioning are confined within the package” when not degraded by fire, so they contended that there was a gap between the definition and the tests. Furthermore, their work determined that a fire may not always be the worst-case scenario. For example, small amounts of detonating explosive sometimes burn in a fire rather than explode, but they may detonate when initiated as intended, possibly producing hazardous effects outside the packaging when not degraded by fire. To give an idea of the magnitude of hazard driving the proposal, photos were provided in document ST/SG/AC.10/C.3/2006/62, paragraph 18 of packages completely destroyed (not a minor disruption, Figure 2) and a 1 cm hole in a steel witness plate (Figure 4). A non-transport, unpackaged explosive injury was mentioned in paragraph 6.<sup>1</sup>

(b) The Working Group on Explosives did not support using the test for all articles since it would require too much testing - consider the default classification scheme created to provide relief from testing of fireworks. The working group focused on the obvious problematic cases, e.g., for shaped charges and other articles containing detonating explosives. Canada proposed a test with four criteria to assess accidental functioning in a package undegraded by fire. The criteria were based on those of the 6(a) and 6(c) tests, with the criteria thresholds borrowed from the 6(c) test being a 1 meter flame ball or jet and a metallic projection of 8 joules.<sup>2</sup>

(c) Ultimately the above proposal was not accepted. Canada determined to use the test nationally but was convinced to approach the UN again on the basis of similar manufacturing assembly injuries resulting in the loss of fingers or hands.<sup>3</sup> Norway had previously approached in 2004 the Sub-Committee of Experts on the Globally Harmonized System (GHS) of Classification and Labelling of Chemicals and successfully added the exploding bomb pictogram to Division 1.4 in the GHS to increase hazard communication in assembly operations, and they stated (emphasis added):

“Regarding the explosives classified under 1.4, the classification given for transport will in most cases be dependent on the transport packaging. When used at the workplace or by the consumer, the possibility of an explosion will not be apparent by the present pictogram requirements. A particular problem in this respect is that there is no test series existing within the GHS today that can be used for the classification of such products outside the transport packaging. Even running the Test Series 6 tests on unpackaged articles will not give information that will be coherent with the ability of certain small explosive article to e.g. actually blow your hand off! In Norway’s opinion, there is a flaw in the GHS system as regards the consumer safety issue when it comes to explosives. The present system is based on transport needs, and is working sufficiently well for its purpose, but does not work well when transferred to the workplace and consumer safety regime. As a first step to rectify this situation, Norway is of the opinion that introducing the GHS pictogram also for these explosives will increase the understanding in workers

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<sup>1</sup> See ST/SG/AC.10/C.3/2006/62.

<sup>2</sup> See ST/SG/AC.10/C.3/2007/29.

<sup>3</sup> Conversations at the time with the delegates of Canada and Norway.

and consumers of the inherent risk from these explosives. Norway nevertheless is of the opinion that the work on a future system for classification of explosives for workplace and consumer safety should be put on the work-plan for the GHS”<sup>4</sup> (emphasis added.)

(d) It should be noted that the suggestion of Norway in 2004 to revise GHS Chapter 2.1 has recently been finalized under the leadership of Sweden. From a workplace standpoint, the particular concerns about shaped charges which were a key driver in the 6(d) test have now been addressed, and regardless of packaging, detonating explosives are now a GHS Category 2A high hazard chemical.<sup>5</sup>

(e) Final deliberations led to the adoption of more stringent quantitative criteria, other than the criterion (a) for the witness plate.<sup>6</sup> The more stringent criteria include: (b) a flash or flame that ignites an adjacent material at a distance of 25 cm from the package, as opposed to a 1 meter flame ball or jet; (c) Disruption of the package causing (any) projection of the explosives contents; and (d) a projection which passes completely through the packaging, as opposed to a metallic projection of 8 joules. It is recognized by the Explosives Working Group that criterion (c) is augmented by an example in the test procedure where uninitiated detonators exiting a package at low energy are considered to be consistent with compatibility group S, and “judged that there were no hazardous effects outside the package”.<sup>7</sup>

(f) Discussions in the Explosives Working Group (EWG) indicate that no transport incidents have occurred before or after implementation of the 6(d) test.

(g) SAAMI submitted document ST/SG/AC.10/C.3/2019/11 in reaction to recurring comments from session to session on ambiguities of the thresholds of criteria 6(c) and (d) and their larger impact on the 1.4S classification. The resulting report of the EWG stated that “an informal correspondence group (ICG) will examine the issue further and develop guidance as to what are to be considered hazardous effects and to refine the 6(d) criteria if appropriate”, with SAAMI chairing. The discussion portion stated: “SAAMI noted that the 6(d) criteria applied typically to only twelve of thirty-five classification code 1.4S entries (those to which SP 347 applies). In their opinion, this, in effect, creates two types of 1.4S explosive products: (i) those that are required to and (ii) those that are not required to pass UN Test Series 6(d) and that a solution is needed. The EWG agreed that the 6(d) test is intended to identify hazardous effects outside of the package resulting from an accidental initiation but that the current criteria may be identifying any effects rather than just hazardous effects. Clear guidance is needed as to what hazardous effects the 6(d) test is meant to identify, and then the criteria should be reviewed and updated so that they relate solely to hazardous effects as opposed to effects in general.”<sup>8</sup>

## General comments received for discussion

5. Overarching comments were received which require discussion to determine the level of support for each comment:

(a) The entire test procedure should be reviewed to ensure that adequate instructions are provided for the required materials, test set up, and test performance to adequately address the observations described in 16.7.1.3.4 of the UN Manual of Tests and Criteria (MTC) and evaluated in 16.7.1.4.

(b) Before addressing the criteria, the current 1.4S definition should be examined regarding who or what it is intended to protect and what hazard should be expected from a 1.4S package. In other words, what are “hazardous effects” outside the package

<sup>4</sup> See ST/SG/AC.10/C.4/2004/12.

<sup>5</sup> See ST-SG-AC10-48a3, Table 2.1.1 of the new GHS Chapter 2.1.

<sup>6</sup> See ST/SG/AC.10/C.3/2008/89.

<sup>7</sup> See the UN Manual of Tests and Criteria, section 16.7.1.5.

<sup>8</sup> See UN/SCETDG/55/INF.55 from July 2019.

as mentioned in the definition of 1.4S? Would it be appropriate to conclude that the purpose of the 6(d) test is to protect people, including those without personal protective equipment, located adjacent to the package?

(c) A “hazardous effect” is not defined. Resulting classifications may be contradictory based on differing interpretations of the test. Classifications may also be contradictory based on whether the special provision is applied.

(d) Some are of the opinion that the criteria of the 6(d) test are intentionally more conservative than the 6(c) test since the packaging should be capable of more fully mitigating effects when not degraded by fire. Canada originally noted this in document ST/SG/AC.10/C.3/2006/62, paragraph 13: “... *The solution is not to change criteria to allow these (editor’s note: detonating) substances or articles into this classification but to change the packaging so that they do meet the intentions of the definition, or to reclassify them.*”

(e) SAAMI notes that the level of packaging above might require specialty plywood, plastic or metal protective features compared to fibreboard outer packagings with fibreboard and plastic inner packagings, potentially impacting the market for non-detonating explosives. It is recalled that, as noted in the example from Canada in document ST/SG/AC.10/C.3/2006/62 paragraph 6, the 6(d) test was (in a large part) originally conceived to address detonating explosives which did not detonate in a fire but detonated when functioned as intended, exceeding the criteria thresholds of the 6(c) test for 1.4S. Canada’s intent in document ST/SG/AC.10/C.3/2006/62, paragraph 11, is that the new test would be an optional tool, and that intent is now established in a special provision originally applied to eight, and now to twelve, of approximately thirty-five potential entries. They stated:

“This test would be an optional one, intended for use in cases where the functioning of the product might be expected to produce effects more severe than those obtained in the 6(c) Test, e.g. where detonating explosives are involved, or where the 1.4S classification is packaging-dependent. It is not envisaged for materials that are inherently Division 1.4S, such as small arms ammunition.”

For practical purposes of retaining a predictable level of hazard for the 1.4S classification, SAAMI asks whether there may be any usefulness for a tiered approach based on detonability? A similar comment by another delegation was made under the discussion of criterion 6(d).

## Comments received on the criteria in need of resolution

6. Criterion #1: MTC 16.7.1.4 (a) “Denting or perforation of the witness plate beneath the package;”

The survey established that while the criterion is unanimously supported as being useful for identifying a hazardous effect, there is a need for additional clarity on what constitutes a dent, e.g., how to differentiate superficial damage such as a scratch in a simple, practical way. One possible way forward is to use the new wording developed for Chapter 2.1 of the GHS, “a significant change in the witness plate shape, such as perforation, gouge, substantial dent or bowing”. However, a comment was received in opposition to this approach and more discussion is necessary.

7. Criterion #2: MTC 16.7.1.4 (b) “A flash or flame that ignites an adjacent material such as a sheet of  $80 \pm 3$  g/m<sup>2</sup> paper at a distance of 25 cm from the package;”

(a) While all respondents consider a substantial flame ball to be a hazard, a difference of opinion seems to exist on the magnitude of the flame necessary to constitute a hazardous effect that would prevent a 1.4S classification. Some believe that the current threshold is too low (the relevant primary criterion for 1.4S materials not subject to the 6(d) test is a 1 metre flame ball). Others believe that even a delayed

fire caused by ignition of the packaging which later ignites the witness paper should be considered, perhaps subject to a time limitation.

(b) Clarity is desired as to the orientation of the witness paper.

(c) The survey identified that additional materials could be added to MTC 16.7.1.2 and setup information to 16.7.1.3.3 or a new paragraph. Thought should be given to aligning the materials with those used in 2.1.3.6.4 (d), Model Regulations, for exclusion of explosive articles from Class 1.

8. Criterion #3: MTC 16.7.1.4 (c) “Disruption of the package causing projection of the explosives contents;”

(a) A disruption does not “cause” a projection. What is the intent?

(b) Given that projections are dealt with in criterion (d), what is the hazardous effect?

(c) Is there enough redundancy between the criteria in (c) and (d) that they could be consolidated?

(d) The word “projection” is normally interpreted as an object having hazardous energy and velocity, but a literal meaning is anything coming out of the package, in contradiction of one of the examples in 16.7.1.5. The term should be modified (perhaps, “projectile”?) to avoid the literal interpretation causing a positive (failing) result.

(e) Certain explosives classified outside of Class 1 may not pass this criterion.

9. Criterion #4: MTC 16.7.1.4 (d) “A projection which passes completely through the packaging (a projection or fragment retained or stuck in the wall of the packaging is considered as non hazardous).”

(a) The criterion could be improved by developing a quantified threshold for the energy of a projection. In relation to the general comment about protecting people adjacent to the package who are not wearing personal protective equipment, would it be appropriate to apply the Test 6(c) threshold to 6(d) criteria (c) and (d) to limit projections to 8 joules, perhaps at 25 cm (for purposes of practical test set-up, the same as the witness paper distance)?

(b) An additional way to differentiate hazardous effects may be to limit the degree of potential hazard. For example, a government expert noted that small arms ammunition (a deflagrating explosive) is of less concern than shaped charges or detonators (detonating explosives). A two-pronged approach might help, where (i) the existing approach continues to apply to explosives which detonate, because they have a greater potential for effects varying upwards to higher energies, and (ii) a quantitative threshold is applied to deflagrations with less potential energy, e.g., the effects of many power device cartridges.

## Proposal

10. SAAMI proposes that the 6d-ICG continue its discussion at the next EWG meeting. An advance intersessional meeting in May 2021 is also planned.