

## 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

23 June 2011

### Thirty-ninth session

Geneva, 20–24 June 2011

Item 2 of the provisional agenda

**Explosives and related matters**

## Report of the Working Group on Explosives

Transmitted by the chairman of the Working Group

### Introduction

1. The working group met from 20 to 22 June 2011 in a parallel session to the plenary meeting of the Sub-Committee on the Transport of Dangerous Goods. This meeting of the working group was well attended with 31 experts in attendance from Australia, Belgium, Canada, China, France, Germany, Japan, the Netherlands, Norway, Spain, Sweden, the United Kingdom, the United States of America, AEISG, CLEPA, COSTHA, ICCA, IME, and SAAMI participating in the working group. A list of participants is provided in Annex 1 to the report. As no official papers had been submitted, the group was tasked to discuss technical matters related to information papers.

2. The following papers were discussed.

Document	Title
<u>Agenda Item 2(a)</u>	<u>Test Series 8</u>
<i>UN/SCETDG/39/INF.4 (IME)</i>	<i>Recommendation on miscellaneous changes to 18.5 Series 8 Type (b) Test prescription in the Ammonium Nitrate Emulsions, Suspensions and Gels: Series 8 Test (b)</i>
<i>UN/SCETDG/39/INF.5 (IME)</i>	<i>Recommendation on the use of 50/50 pentolite donor in the Ammonium Nitrate Emulsions, Suspensions and Gels: Series 8 Test (b)</i>
<i>UN/SCETDG/39/INF.6 (IME)</i>	<i>Recommendation on the use of cold-drawn, seamless carbon steel tube for confinement in the Ammonium Nitrate Emulsions, Suspensions and Gels: Series 8 Test (b)</i>
<i>UN/SCETDG/39/INF.7 (IME)</i>	<i>Recommendation on the use of Extruded PMMA Rod as an alternative to Cast PPMA in the Ammonium Nitrate Emulsions, Suspensions and Gels: Series 8 Test (b)</i>
<i>UN/SCETDG/39/INF.24 (AEISG)</i>	<i>UN Manual of Test and Criteria Test series 8 reviews</i>
<u>Agenda Item 2(b)</u>	<u>Screening test for substances that may have explosive properties</u>
<i>UN/SCETDG/39/INF.21 (Japan &amp; ICCA)</i>	<i>Change to screening test for substances that may have explosive properties</i>
<u>Agenda Item 2(c)</u>	<u>Desensitized explosives</u>
<i>None submitted</i>	

<b>Document</b>	<b>Title</b>
<u>Agenda Item 2(d)</u>	<u>DDT Test and Criteria for flash composition</u>
<i>ST/SG/AC.10/C.3/2010/31 (USA)</i>	<i>A proposed new DDT Test and Criteria for flash compositions</i>
<i>UN/SCETDG/39/INF.16 (Germany)</i>	<i>DDT Test and Criteria for flash compositions</i>
<i>UN/SCETDG/39/INF.22 (JAPAN)</i>	<i>Comments on a new DDT Test and Criteria for flash compositions proposed by the United States of America (ST/SG/AC.10/C.3/2010/31)</i>
<i>UN/SCETDG/39/INF.30 (UK)</i>	<i>A Comparison of the results obtained for a set of pyrotechnic compositions subjected to the HSL Flash Composition Test and the US Modified DDT Test</i>
<i>UN/SCETDG/39/INF.44 (USA)</i>	<i>Alternative Flash Composition Test</i>
<u>Agenda Item 2(e)</u>	<u>Additional criteria for Division 1.4 classification</u>
<i>UN/SCETDG/39/INF.23 (IME)</i>	<i>Comments and Recommendations Regarding Additional Criteria for Explosives in Division 1.4 other than Compatibility Group S</i>
<u>Agenda Item 2(f)</u>	<u>Miscellaneous</u>
<i>UN/SCETDG/39/INF.17 (Secretariat)</i>	<i>Amendments to packing instructions for explosives - Consequential amendments</i>
<i>UN/SCETDG/39/INF.25 (Canada)</i>	<i>Difficulties in carrying out TDG classification tests</i>
<i>UN/SCETDG/39/INF.26 (SAAMI)</i>	<i>Implementation of the definition of Division 1.4 Compatibility Group S</i>
<i>UN/SCETDG/39/INF.35 (UK)</i>	<i>Special Packing Provision PP70</i>
<i>UN/SCETDG/39/INF.43 (USA)</i>	<i>Possible Use of the 5(a) Cap Sensitivity Test as an Alternative to UN Test Series 6 for Certain Substances</i>
<i>UN/SCETDG/39/INF.47 (USA)</i>	<i>Considerations on Test Series 6</i>
<i>ST/SG/AC.10/C.3/2011/11</i>	<i>Packagings with a capacity exceeding 450 liters – 6.1.1.1 (e)</i>
<i>UN/SCETDG/39/INF.28 (Secretariat)</i>	<i>Exclusion of explosives from Class 1 (RID/ADR/ADN)</i>
<i>UN/SCEGHS/21/INF.11</i>	<i>Substances and mixtures with explosive properties which are exempted from classification as explosives</i>
<i>UN/SCEGHS/39/INF.53</i>	<i>Comments on the Koenen Test</i>

## Agenda Item 2(a) – Test Series 8

3. **Miscellaneous changes to TS 8(b).** In INF.4, IME described erroneous calibrations provided in Table 18.5.1.1 of the 8(b) test procedure and has proposed that the table be corrected or deleted. Additionally, IME observed that the mechanical properties specified for the mild steel plate described in Section 18.5.1.2.1(f) of the 8(b) test procedure are unnecessary as mechanical properties are not commonly specified for mild steel. To correct this IME, has proposed removal of the specification in Section 18.5.1.2.1(f) in favour of simply using the description “mild steel plate”. Finally, IME pointed out that there is a reference to a cardboard tube in Section 18.5.1.2.1(g) of the 8(b) test method; however, there are no further references to a cardboard tube in the procedure.

Sweden observed that the 7(b) and 8(b) tests are essentially the same, and inquired whether the proposals in INF.4 should also apply to the 7(b) test. The UK provided a note of caution about eliminating the table, because it could also be used to set criteria. Their preference was to correct the table.

Australia voiced concern that the witness plate specifications could be critical and requested further advice. The chair explained that this test and the 7(b) test only look for detonations, and that, in this observation, the properties of the steel are usually irrelevant. There was general agreement with the chairman and that simply specifying “mild steel” is acceptable.

**Conclusion.** The consensus was that the proposal in paragraph 11 of Section 3.1 of INF.4 could be adopted, that is Table 18.5.1.1 of the 8(b) test procedure should be corrected and not deleted. The working group also agreed that the proposals in Sections 3.2 and 3.3 of INF.4 could also be adopted. IME will prepare a formal proposal for consideration during the 41<sup>st</sup> Session.

4. **Recommendation regarding the 50/50 pentolite donor.** In INF.5, IME observed that pressed pentolite is difficult and very expensive to obtain and recommended removal of that specification, thus allowing use of pressed or cast pentolite. France observed that in Test Series 1 and 2 there is no reference to “pressed” or “cast”.

**Conclusion.** The working group agreed that the Section 18.5.1.2.1 (b) of the Test Manual should be amended as described below and IME will prepare a formal document for consideration at the 41<sup>st</sup> Session:

*95 mm diameter by 95 mm long 50/50 pentolite or 95/5 RDX/WAX pellet with densities of  $1\ 600\ \text{kg/m}^3 \pm 50\ \text{kg/m}^3$ .*

5. **Recommendation regarding cold-drawn carbon steel tube.** In INF.6, IME recommended that the wall thickness variation amount specified be changed from 10 to 15% and that the specifications at the end of the paragraph be removed. It was suggested that specifying a minimum inside diameter and minimum wall thickness may be more appropriate than specifying a wall thickness variation. It was observed that seamless steel tubing was not readily available as “cold drawn”, so the suggestion was made to remove those words from the paragraph. There was no agreement to this suggestion. The group agreed to remove the tensile strength, elongation, and Brinell hardness specifications.

**Conclusion.** The working group agreed that specifying a minimum wall thickness and a minimum ID was a way forward and, considering the comments from the working group, IME will prepare a document for consideration in the 41<sup>st</sup> Session.

6. **Recommendation on the use of Extruded PMMA Rod as an alternative to Cast PPMA.** The test procedure specifies a cast PMMA rod; however, cast PMMA is very difficult to obtain. Typically what is readily available is extruded PMMA. To allow for the use of either cast or extruded PMMA rods, IME proposed to drop the word “cast” in the specification contained in Section 18.5.1.2.1(e) of the test procedure. Also, IME proposed to amend Section 18.5.1.2.1(e) by rewording the reference to shock pressure to refer to the pressure incident at the ANE interface.

The Netherlands confirmed that there is no difference in performance coming from either cast or extruded PMMA and there should be no problem with the proposed change.

**Conclusion.** The working group agreed that the proposals by IME could be made and IME will submit a formal proposal for consideration at the 41<sup>st</sup> session.

7. **Test Series 8 Review.** In INF.24, AEISG raised several issues regarding Test Series 8 in order to gain a better understanding of how and why the test series was developed.

(a) TS 8(a) – AEISG observed that since ANEs are thermally stable, that the 8(a) test may be unnecessary. The working group was of the opinion that, although current ANEs may be thermally stable, the test still has applicability because other ANEs could be developed for which there is no experience that they are thermally stable.

(b) TS 8(b) – AEISG commented that there are materials that could fail 8(b) and yet could pass the 2(a) test. The effect of this is that by performing the 8(b) test, an ANE could be forced into class 1, yet that same material could be excluded from class 1 under the 2(a) test if it had been tested as an explosive. AEISG was of the opinion that the 2(a) might be the more appropriate test. However, the

chairman explained that critical diameter is the issue when classifying ANEs and that critical diameter isn't effectively examined for ANEs using the 2(a) test. This is why the ANE working group devised the 8(b) test. The working group agreed that the 8(b) test was the appropriate test when examining ANEs.

(c) TS 8(c) – AEISG observed that the 8(c) test was the same as the 2(b) test and that the 8(c) test might be unnecessary. The working group advised that Test Series 8 and the ANE flowchart were developed because ANEs have different properties than traditional explosives and; therefore, a different test scheme was deemed appropriate by the working group when UN3375 was developed.

(d) TS 8(d) – AEISG asked whether the test is being required for all products, or for all changes in formulation, site of manufacture, and ingredient source. In Australia every new formulation is required to be tested under Test Series 8. The USA confirmed that, domestically, it does not consider a change in the site of manufacture as a new formulation, so long as other factors are equivalent. Canada authorizes Class 1 products regardless of site of manufacture. On the other hand, France does consider site of manufacture a reason for re-examination and new approval.

**Conclusion.** It was generally accepted that retesting of products was not required unless changes to the approved formulation of the substances were involved. This would not generally involve variations in process normally controlled by management systems, e.g., plant site, ingredient source changes.

Additionally, the working group recognized the continuing importance of Test Series 8 in ensuring that ANEs are properly identified as dangerous goods.

## **Agenda Item 2(b) – Screening test for substances that may have explosive properties**

8. In INF.21, Japan and ICCA discuss why they believe that differential scanning calorimetry (DSC) is the best method for screening substances for energy release. Whereas in DSC the heat release is determined on the basis of previous calibration, the adiabatic method has to take thermal inertia into account, which is not constant for the relevant temperature range in many cases. They concluded that adiabatic methods such as accelerating rate calorimetry (ARC) cannot react fast enough to reliably measure decomposition energy. France commented that DSC is a more rough measurement and could often provide unreliable results. The UK also observed that there are advantages to adiabatic methods and would not like to see them eliminated as an alternative. On the other hand, Australia and other experts were supportive of the proposal in INF.21, but would like to see a formal proposal for consideration during the 41<sup>st</sup> Session. Even the revised text would allow for other methods to be used.

**Conclusion.** There was wide support of the proposal and a formal proposal for the 41<sup>st</sup> session is anticipated.

## **Agenda Item 2(c) – Desensitized explosives**

9. No papers were submitted for this agenda item.

## **Agenda Item 2(d) – DDT Test and Criteria for flash composition**

10. At the 37<sup>th</sup> Session, during the discussion on ... C.3/2010/31, some errors were noted and, in INF.44, USA has provided corrections. Additionally, INF.44 provides some additional test data for comparison. Germany, Japan, and the UK have also done some testing using the DDT method and have reported their findings in INF.16, INF.22, and INF.30 respectively. All of the testing done indicates general agreement with the results obtained by the USA. Since the DDT method proposed by the USA is easier to perform and utilizes larger samples, it was considered by the working group to be an attractive alternative test. Germany pointed out some safety issues related to the size of the mortar that could be encountered in performing the test. Germany also cautioned that the mass of the mortar could be an influencing factor on the outcome of the test and offered to investigate further. Japan and the UK observed that their work indicates that the degree of granularity of composition can affect results, and consideration should be given to expanding the method to include samples with granular material. They agree that the weight of the tube could be a safety or test outcome-influencing factor and support Germany's further research. Other experts such as the Netherlands and Australia also expressed the opinion that the sample mass could influence the outcome of the test and recommended that this potential effect should be studied further. The UK observed that the test was really straightforward to perform and supported its continued development. The Netherlands observed that the test only screens for detonation and that the criteria may not coincide with what would have been referred to as "flash powder" 15 years ago. AEISG would like to see a formal proposal and to have the time to review the proposal to try to identify any criteria that may have been over prescribed. The UK observed that acceptance of the test would be easier if the focus was fireworks rather than flash powder.

**Conclusion.** There was group consensus that the DDT test proposed by USA was a good way forward. Taking note of the working group's comments, the USA and others will continue their work to refine and prove the reliability of the test, particularly, concerns related to the weight of the tube, the sample mass, and results related to granulated material.

## **Agenda Item 2(e) – Additional criteria for Division 1.4 classification**

11. IME provided some historical background regarding the initial development of Test Series 6 and introduced its proposals regarding a risk-based approach to class 1 division and compatibility group assignments. The working group had differing opinions on this approach, with the UK and Germany expressing discomfort, and the USA observing that its process is to evaluate the hazards and make an assignment on that basis. ICCA pointed out that the GHS addresses intrinsic properties and is more comfortable following that approach. On the other hand, Canada sometimes accepts a risk-based approach, but only on a case-by-case basis, and not for transport classification. The Netherlands pointed out that the tests are used to evaluate what happens if accidental initiation occurs and not whether an accidental initiation occurs.

Canada reminded the working group that the current tests just address a portion of the definition of Division 1.4, other than compatibility group S, and that additional tests may be needed to address those portions of definitions that aren't currently covered by tests. This was the basis of their paper in the 37<sup>th</sup> session that introduced the idea of additional criteria for Division 1.4.

SAAMI observed that policy development must be risk based; however, hazard classification on that basis may be too complicated to be effectively completed. They also observed that the GHS philosophy based on intrinsic properties does not take into account the benefits of packaging that are used in transport and there may need to be a divergence in policy regarding transport classification vs. GHS classification.

In the end, there was very little support for a risk based approach for classification of explosives.

IME observed that an unintended result of developing additional tests could be the loss of Division 1.4 for some products, which would likely increase the amount of Division 1.1 explosives that will be transported. Canada acknowledged that this was a valid assessment of a potential unintended outcome and IME requested that the working group keep this in mind if it moves forward in development of additional criteria for Division 1.4.

Regarding the potential loss of the air transportation as a mode for transporting shaped charges, several experts observed that this should not be the intent of this work and Canada confirmed that shaped charges were not considered when developing their paper for the 37<sup>th</sup> session. Germany suggested that, instead of basing classification on risk, IME consider development of a special provision regarding classification for shaped charges that would allow continued assignment to Division 1.4 and use of the air mode for transportation. It was suggested that IME may want to do some tests to demonstrate the safety of transport of 1.4/not S items, including shaped charges.

**Conclusion.** IME will take into account the comments of the working group and may present an additional paper for consideration in the 41<sup>st</sup> Session.

## **Agenda Item 2(f) – Miscellaneous**

12. **Amendments to packing instructions for explosives - Consequential amendments.** The working group agreed with the recommendation for packing instruction P111 as it is written in INF.17 and that packing instruction P114(a) should not apply to UN0159 but should refer to UN0342, as indicated by the expert from China.

13. **Difficulties in carrying out TDG classification tests.** Canada reported on a survey regarding problems performing TDG tests in INF.25, the details of which will be provided to the members of the working group. The problems identified were largely those of difficulty in obtaining the materials specified in the test procedures. They have not proposed solutions to any of the problems, but recommended that the working group review the test specifications and come up with appropriate solutions. Australia suggested starting with Test Series 8, since work is already ongoing, and then proceed from there. France recalled the need of testing results for supporting significant changes and mentioned the possible consequences of such changes for harmonized EU standards derived from UN.

The working group agreed that the problem of specifications in the test procedures was real and should be corrected. They also agreed that there could be other problems such as errors in procedure, incorrect use of the examples in the procedures, and a difficulty in identifying the key parameters of the tests. The working group agreed with an observation by SAAMI that the examples provided in the test manual are only intended as examples and not as requirements or test criteria.

**Conclusion.** As an interim solution, the working group referred to Section 1.1.2 of the Test Manual that advises that the Competent Authority can and should use its discretion in applying the tests and allowing variations in test materials and procedures described in the Test Manual. The working group also agreed that it should conduct a review of the tests mentioned in Parts I and II of the manual with a view to:

- better defining the specifications of the tests,
- better defining the tolerances associated with those specifications, and
- to remove any unnecessary or over-specifications.

The review should first be focused on identifying errors and defining key parameters, tolerances and acceptable alternative materials. Additional review may also be necessary to evaluate the appropriateness of the tests and procedural details. Australia offered to coordinate a survey of experts on the basis of permitted variations to Test Series 8 and IME offered to coordinate the work, along with USA and Canada, on Test Series 6. Many other members of the working group expressed their willingness to work on this review and the chairman will coordinate these activities.

14. **Implementation of the definition of Division 1.4 Compatibility Group S.** In INF.26, SAAMI raised several issues about the definition of Division 1.4 Compatibility Group S and sought input from the working group on these issues as it considers the potential preparation of a proposal on the topic.

(a) SAAMI observed that certain 6(d) criteria are more restrictive than specified in the definition of 1.4S. For example the definition refers to hazardous effects, but the test criteria reject any projection effect outside the package with no regard to whether that projection may be hazardous or not. Canada reminded the working group that the criteria it proposed for the 6(d) test were somewhat less rigid, but that those criteria were tightened up to address concerns expressed by ICAO and IATA. The UK commented that it would be useful to better define what is meant by harmful (i.e., hazardous effects). Canada agreed that the projection criteria may be overly restrictive and suggested that consultation with aircraft industry experts might be appropriate to determine what level of projection energy might be considered non-hazardous. The 6(d) projection evaluation and criteria could then be adjusted accordingly. IME stated that the current 8 joule limit is designed to protect people from serious injury and SAAMI contemplated action to verify this as non-hazardous in aircraft.

(b) SAAMI inquired if any competent authorities have ever rejected a 1.4S candidate that passed all the test criteria for 1.4S based solely upon the basis that it would be unsafe for a person dressed in street clothes to stand next to the product if involved a fire. No one answered in the affirmative. Although it had not denied a 1.4S classification under the parameters described by SAAMI, the Netherlands has applied additional criteria (sound level) for classification of some fireworks. The UK confirmed that it approves based upon meeting test criteria.

(c) The group noted that the existing test criteria fully implement the 1.4S definition, particularly as it relates to emergency responders, and any additional criteria used at the discretion of a competent authority should be objective and not subjective.

15. **Special Packing Provision PP70.** UK questions in INF.35 whether the special packaging provisions that apply to shaped charges be applied to certain other explosives articles containing shaped charges. The working group agreed that this was a reasonable concept that should be developed further into a formal proposal. The working group was asked to provide any comments on the subject to the UK.

16. **Possible Use of the 5(a) Cap Sensitivity Test as an Alternative to UN Test Series 6 for Certain Substances.** When evaluating explosive substances for classification, in INF.43, the USA inquired whether the 5(a) test might be used as an alternative to the 6(a) and 6(b) tests, in certain limited instances. Sweden observed that the 6(a) and 6(b) tests were for packaged explosives and were examining for the potential of mass explosion,

whereas the 5(a) test was for substances and is used to determine the sensitiveness of a substance to intense mechanical stimulus. It was observed that most likely, any material that would have a negative 5(a) test result would probably also have a negative 6(a) test result; however, this is not always true, e.g. for pyrotechnic substances. The UK stated that to consider the 5(a) test as an alternative to the 6(a) test, they'd like to see wider test data demonstrating good correlation between the two tests. France observed that for gun propellants the degree of filling in packages is a key factor as regards the deflagrative or detonative behaviour.

**Conclusion.** There was no general consensus that this should be recommended.

17. **Considerations on Test Series 6.** In INF. 47, the USA inquired as to whether there may be gaps in the 6(a) and 6(b) tests by restricting the form of initiation used to only that of the intended method of function. They suggested that, in some instances, it might be necessary to perform these tests using both a detonator and an igniter on substances which initiate by both detonation and deflagration. SAAMI indicated that acceptance of this proposal would eliminate the possibility of some 1.3 and 1.4 propellants. The USA clarified that this was not their intention; rather they were only interested in further examining those propellants that pose a dual hazard. Some experts expressed support for applying this concept to candidates for 1.4 classifications. The UK observed that using detonators on igniter-intended substances and articles may not fully reflect the predominant hazard and could result in a substantial reclassification process in an instance where there was no accident data to support such reclassification.

**Conclusion.** Some working group members recognized that certain propellants may demonstrate detonative, deflagrative, and thermal hazards. However, there was general consensus that the current test scheme adequately addresses the hazard posed by such substances.

18. **Packagings with a capacity exceeding 450 liters – 6.1.1.1 (e).** The group felt that both proposals were beyond the remit of the working group, no decision was taken, and the issue was referred back to plenary.

19. **Exclusion of explosives from Class 1 (RID/ADR/ADN).** The issue in INF.28 regarding the definition of cartridges for tools, blank had already been resolved; therefore, no action was taken by the working group. The working group observed that in the UN the problem has been fully addressed; however, there may be consequential amendments necessary in RID/ADR/ADN.

20. **Substances and mixtures with explosive properties which are exempted from classification as explosives.** It was agreed that the proposal in UN/SCEGHS/21/INF.11 should be considered more fully by the working group during the 41<sup>st</sup> Session.

21. **Comments on the Koenen Test.** As an outcome of the recent IGUS/EPP meeting, AEISG began a detailed discussion of the Koenen test; however, time was insufficient to fully cover the subject. The working group was encouraged to review the paper in detail and to provide comments to David Kennedy (email address is provided in Annex 1).

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## Annex 1

### Working Group on Explosives (20 – 23 June 2011)

#### List of Participants

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