



**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****Forty-fourth session**

Geneva, 25 November – 4 December 2013

Item 11 of the provisional agenda

Other business**Review of the Manual of Tests and Criteria****Transmitted by the Chairman of the Working Group on Explosives¹****Introduction**

1. At the thirty-ninth session of the Sub-Committee, the Working Group on Explosives discussed issues of difficulty in conducting tests outlined in the Manual of Tests and Criteria (Test Manual), and recommended to the Sub-Committee that the Working Group conduct a review of the tests mentioned in Parts I and II of the Manual with a view to:

- (a) Better defining the specifications of the tests;
- (b) Better defining the tolerances associated with those specifications; and
- (c) To remove any unnecessary or over-specifications.

2. The Sub-Committee agreed that this work should be carried out.

3. The Chairman of the Working Group on Explosives agreed to coordinate the work done by several volunteers.

I. Approach

4. Experts from the International Council of Chemicals Associations (ICCA) and the Netherlands discussed a possible approach to start the review of the Manual. It was agreed

¹ In accordance with the programme of work of the Sub-Committee for 2013–2014 approved by the Committee at its sixth session (see ST/SG/AC.10/C.3/84, para. 86 and ST/SG/AC.10/40, para. 14).

that the best way forward was to select a limited number of Test Series, to compare the test prescriptions with their own practical experience (keeping in mind indents (a) to (c) from paragraph 1) and to develop proposals to change and improve the prescriptions.

5. It was decided that the focus would be on Test Series A, C and E and the corresponding tests in Test Series 1, 2, 8 and Appendix 7.

6. Since the technical discussions are held within the Working Group on Explosives and the Working Group usually does not meet in November/December this subject is not scheduled for the 44th session. However, in order to give other users the maximum amount of time to review the proposals, to comment or submit additional proposals this paper is submitted to the 44th session.

7. Other work on similar subjects is underway (see for example informal document INF.10 submitted by the Institute of Makers of Explosives at the 43rd session) and can be discussed simultaneously at the 45th session in June 2014.

8. In the following paragraphs the general outline of the proposals are presented. The actually proposed changes to the test prescriptions are given in a separate document (informal document INF.6).

II. Detonation tests (Tests 1(a), 2(a) and Test Series A)

A. General

9. The reference to “...national and international definitions of an explosive substance...” in paragraph 11.1.1 (Introduction to test Series 1) seems irrelevant since Test Series 1 only applies to substances not manufactured with the view to producing a practical explosive or pyrotechnical effect. The reference can be deleted.

10. The second sentence of paragraph 21.1.2 states that a cavitated version of a Series A test “may be used” in case a liquid is being considered for transport in tank-containers or IBC’s with a capacity exceeding 450 litres. It is proposed to align with the wording given in paragraph 11.3.4 (Test Series 1) thus reading: “... a cavitated version of a Series A test should be performed (see Appendix 3).”

11. Table 21.1: the TNO 50/70 test is no longer used in the Netherlands. The test can be deleted. If the deletion is accepted the section numbers for tests A.5 and A.6 should be changed accordingly. For reasons of readability this is not yet done in INF.6.

B. Tests

1. Test conditions

12. In paragraphs 11.3.2; 12.3.2 and 21.3.2 provisions are given on how to deal with mixtures that can separate out during transport. Since the Manual also deals with GHS it is proposed to change this to “during transport, handling and storage”². Furthermore, it is not always known which part is the most explosive one. To avoid a lengthy description on how

² Since this might be the case throughout the whole Manual it may be useful to have a fundamental discussion on this subject.

to handle all possible scenario's it is proposed to add the words: “, if known” at the end of the paragraph.

13. Paragraphs 11.3.5 and 12.3.4 give guidance on when test 1(a) or 2(a) may be waived based on test results the explosive power tests F.1, F.2 or F.3. However, the text does not address what to do if the outcome of the F.1, F.2 or F.3 test is “Low”. To err on the safe side it is proposed to add the words ““Low” or” in the penultimate line of 11.3.5. The same addition applies to paragraph 12.3.4.

2. Apparatus and material (paragraphs 11.4.1.2.1; 12.4.1.2; 21.4.3.2 and 21.4.4.2)

14. Regarding the steel tube the requirement of “cold-drawn” tubes is proposed for deletion since availability may be limited in some regions. Since fragmentation is a solid criterion, the tube should be seamless. In Test Series A one of the criteria is a “Partial” based on the fragmentation length. It is our experience that reproducible results with fragmentation length can only be obtained when the steel tubes are annealed to remove residual stress and strain. It is therefore proposed to include annealed in paragraphs 21.4.3.2.and 21.4.4.2 and recommended for inclusion in 21.4.1.2. The expert from the United Kingdom is currently comparing results of different steel qualities, the results can be included in the future discussions.

15. It is unnecessary to specify number, thickness and material of the sheet closing the tube. Just a reference to plastics sheet and compatibility with the substance under test is sufficient.

16. Pressed PETN/TNT boosters can be used as well, the requirement for cast booster is deleted.

17. In analogy with the criteria in Test Series A, where fragmentation of the steel tube is the only criterion, it is proposed to delete the use of a witness plate in Test 1(a) and 2(a). It is physically impossible to have the tube fragmented completely and the witness plate intact when a detonation occurs. The other way around (tube not completely fragmented and the witness plate punched through) is also impossible. It is therefore proposed to use only the fragmentation of the tube as the criterion in all detonation tests. Subsequent changes in the description of “Test criteria and method of assessing results” are given in INF.6.

3. Procedure (paragraphs 11.4.1.3.1; 12.4.1.3.1; 21.4.3.3 and 21.4.4.3)

18. The procedure is aimed at obtaining the maximum tap density in the tube. This might conflict with the last sentence of the paragraph, stating that the density should be as close as possible to the shipping density. Delete this last sentence.

4. Examples of results (paragraphs 11.4.1.5 and 12.4.1.5)

19. Since it is proposed not to use a witness plate anymore, the columns giving the observations to the witness plate can be deleted.

5. Drawings (Figures 11.4.1.1; 12.4.1.1; 21.4.3.1 and 21.4.4.1)

20. References (A) and (B) can be deleted, the other references to be renumbered and the drawing changed accordingly. Current letter J can be deleted from Figure 21.4.3.1, current reference J in Figure 21.4.4.1 is optional.

III. Test Series C and corresponding tests 1(c)(i), 2(c)(i) and Appendix 7

A. General

21. Two small changes are proposed to the Introduction to Test Series C. In paragraph 23.2.1 the question is “Does it propagate a deflagration?” while in the flow chart in boxes 3, 4 and 5 the question is “Can it propagate a deflagration?” It is proposed to use the wording from the flow chart. In Table 23.1 the reference for the deflagration test in the third column should be 23.4.2.

B. Test C.1: Time/pressure test

1. Apparatus and materials

22. In paragraph 23.4.1.2.1, 8th line the figure of 55 mm does not correspond with Figure 23.4.1.1. It should be 59 mm. (Also applies to paragraph 11.6.1.2.1; 12.6.1.2.1 and paragraph 2.1 of Appendix 7)

23. The issue of using a lead washer was also brought up by IME in INF.10 of the 43rd session. It is proposed to state; “A deformable washer or rubber ring...” in paragraphs 23.4.1.2.2; 11.6.1.2.2; 12.6.1.2.2 and 2.2 of Appendix 7.

24. Instead of a fusehead a resistance wire can also be used to ignite the primed cambric. It is proposed in insert: ‘... or an insulated resistance wire,’ in the second line of 23.4.1.2.5; 11.6.1.2.5 and 12.6.1.2.5 (does not apply to Appendix 7). The corresponding procedure for working with a resistance wire is to be inserted in paragraph 23.4.1.2.6; 11.6.1.2.6 and 12.6.1.2.6.

25. The procedure for liquid samples can be significantly simplified by stating what is to be achieved and not how to do this exactly in paragraph 23.4.1.2.7; 11.6.1.2.7 and 12.6.1.2.7.

2. Procedure

26. Footnote 3: the word “burning” is still in square brackets, these brackets can be deleted.

27. The use of “an exploder dynamo” seems to be too specific and is changed to “power source”.

28. Transient and chart recorders are hardly used anymore. Make reference to “a suitable data acquisition system”.

C. Test C.2: Deflagration test

1. Apparatus and materials and procedure

29. Concerning the sample volume both an amount of 265 cm³ and filling to a height of 20 mm below the rim are used. This might lead to confusion. It is proposed to use the term “to a height of 20 mm below the rim” consistently in paragraphs 23.4.2.2.2 and 23.4.2.3.2.

30. It is questioned whether water is always the best liquid to determine half-time of cooling. Insert the words “or other suitable material”.

31. To give some more guidance on the closure of the Dewar vessel adding the words “tight fitting” before the word “cork” is proposed.

2. Examples of results

32. The results for Dicyetyl peroxydicarbonate in the fifth column should be “No”.

IV. Test Series E and corresponding tests 1(b), 2(b) and 8(c)

A. Test E.1: Koenen test

1. Apparatus and materials

33. The specifications of the steel sheet to deep draw the tube as well as the mass, dimensions and bursting pressure of the tube might be checked for current accuracy, e.g. by the expert from Germany. (paragraphs 25.4.1.2.1; 11.5.1.2.1; 12.5.1.2.1 and 18.6.1.2.1)

34. Orifices with other diameters than mentioned in paragraph 25.4.1.2.1 are available and are sometimes used for hazard assessment. It is proposed to include the sentence “In addition, other diameters can be used for hazard assessment.” This might not apply to test 8(c) since the Australian Explosives Industry Safety Group (AEISG) recently proposed (INF.19 of the 43rd session) to refer only to diameters 2.0 and 1.5 mm. (paragraphs 25.4.1.2.1; 11.5.1.2.1; 12.5.1.2.1 and possibly 18.6.1.2.1)

35. It might be useful to change the liquid to be used for calibrating the heating rate given the adverse properties of dibutyl phthalate. Some time ago the expert from France coordinated a round-robin test with several vegetable oils. The results might be used to specify a suitable replacement.

2. Procedure

36. Footnote 1 in paragraph 25.4.1.3.1: if the substance is impact sensitive, the tamping procedure should not be done as well. Insert the words: “impact and/or” before friction in the text of the footnote. (paragraphs 25.4.1.3.1; 11.5.1.3.1 and 12.5.1.3.1. Does not apply to 18.6.1.3.1)

37. The description of the filling procedure can be simplified considerably without changing the outcome. The proposed text is given in INF.6. (paragraphs 25.4.1.3.1; 11.5.1.3.1 and 12.5.1.3.1. Does not apply to 18.6.1.3.1)

38. It is not necessary to specify the diameter of the plate for the first test. Experience might result in another diameter for the first test. It is only important to state that when an “explosion” is observed subsequent tests need to be performed with larger diameters and when “no explosion” occurs with smaller diameters. (paragraphs 25.4.1.3.5; 11.5.1.3.5; 12.5.1.3.1 and 18.6.1.3.5, depending on AEISG proposals)

39. Although the current drawing is around for a very long time, it has always been confusing. The threaded collar should be drawn below the tube to illustrate that the collar slides from beneath the tube up to the flange and then the nut can be screwed onto the collar.

B. Test E.2: Dutch pressure vessel test

1. Apparatus and materials

40. Orifices with other diameters than mentioned in paragraph 25.4.2.2.1 are available and are sometimes used for hazard assessment. It is proposed to include the sentence “In addition, other diameters can be used for hazard assessment.” It might be useful to change the liquid to be used for calibrating the heating rate given the adverse properties of dibutyl phthalate.

2. Procedure

41. It is not necessary to specify the diameter of the plate for the first test in paragraph 25.4.2.3.1. Experience might result in another diameter for the first test. It is only important to state that when an “explosion” is observed subsequent tests need to be performed with larger diameters and when “no explosion” occurs with smaller diameters. The text in 25.4.2.3.3 should be changed accordingly, see INF.6.

42. Furthermore, placing the pressure vessel in a protective cylinder should be optional. Change to “may be placed inside a protective cylinder” in paragraph 25.4.2.3.1.

3. Test criteria and method of assessing results

43. As a consequence of the possibility of using other diameters the description of the “Medium” and “Low” reaction should be changed somewhat.

C. Test E.3: United States pressure vessel test

44. The authors have no experience with this test, the test description might be checked by the expert of the United States and/or other users.

V. Closing remarks

45. Experts are invited to study the proposals and provide comment or alternative proposals before the 45th session in 2014.

46. The current proposals nearly cover the whole Test Series 1, 2, A, C and E, with the following exceptions:

- Test 1(c)(ii) and Test 2(c)(ii): Internal ignition test;
- Test A.1: BAM 50/60 steel tube test; and
- Test E.3: United States pressure vessel test.

Users of these tests are invited to submit proposals for changes and/or improvement of these tests.
