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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 2 of the provisional agenda

EXPLOSIVES AND RELATED MATTERS

Additional test for 1.4S classification

Transmitted by the expert from Canada*

Introduction

1. At the twenty-ninth session of the Sub-Committee, the expert from Canada made a proposal for an additional test for determining 1.4S classification (ST/SG/AC.10/C.3/2006/62). The Working Group on Explosives reviewed and supported the proposal. It was requested that the expert from Canada prepare a new proposal, including additional text to be inserted in the Manual of Tests and Criteria (UN/SCETDG/29/INF.65). At the thirty-first session of the Sub-Committee, the expert from Canada submitted (a) an information paper containing a detailed example of the application of the proposed test to perforating charges (UN/SCETDG/31/INF.43) and (b) a working paper containing new text for Section 16 (ST/SG/AC.10/C.3/2007/29). The working paper stated that, if the new test were accepted, there would need to be modifications made to Section 10 of the Manual of Tests and Criteria "Introduction to Part I". The majority of the Working Group was in favour of provisional acceptance of the proposal from Canada, while waiting for further results or proposals from other

* In accordance with the programme of work of the Sub-Committee for 2007-2008 approved by the Committee at its third session (refer to ST/SG/AC.10/C.3/60 para. 100 and ST/SG/AC.10/C.3/34, para. 14)

countries. If no new results or proposals are submitted, the square brackets around the Canadian text are to be removed (UN/SCETDG/31/INF.45). The present document represents the new proposal for the additional text in Section 10, as well as slight modifications to Section 16 to address some of the comments received from the members of the working group. In addition, more examples of test results are provided.

Comments

2. The sections referred to below are those in the Manual of Tests and Criteria, Fourth revised edition. Since the proposal for a 6 (d) test was accepted, it is necessary to make the appropriate revisions to Section 10 of the Manual of Tests and Criteria "Introduction to Part I".

Proposal

3. Replace Section 10.4.2.3 with the following:

"10.4.2.3 The results from the four types of series 6 tests are used to determine which division, amongst Divisions 1.1, 1.2, 1.3 and 1.4, corresponds most closely to the behaviour of a product if a load is involved in a fire resulting from internal or external sources, or an explosion from internal sources (boxes 26, 28, 30, 32 and 33 of Figure 10.3). The results are also necessary to assess whether a product can be assigned to Compatibility Group S of Division 1.4 and whether or not it should be excluded from Class 1 (boxes 35 and 36 of Figure 10.3). The four types of test are:

Type 6 (a): A test on a single package to determine if there is mass explosion of the contents;

Type 6 (b): A test on packages of an explosive substance or explosive articles, or non-packaged explosive articles, to determine whether an explosion is propagated from one package to another or from a non-packaged article to another;

Type 6 (c): A test on packages of an explosive substance or explosive articles, or non-packaged explosive articles, to determine whether there is a mass explosion or a hazard from dangerous projections, radiant heat and/or violent burning or any other dangerous effect when involved in a fire; and

Type 6 (d): A test on an unconfined package of an explosive substance or explosive articles, to determine if there are severe effects outside the package following accidental ignition or initiation of the contents."

4. Replace Section 10.4.3.4 with the following:

"10.4.3.4 Test types 6 (a), 6 (b), 6 (c) and 6 (d) are performed in alphabetical order. However, it is not always necessary to conduct all four types of test. Test type 6 (a) may be waived if explosive articles are carried without packaging or when only one article is in the package. Test 6 (b) may be waived if, in each type of 6 (a) test:

- (a) The exterior of the package is undamaged by internal detonation and/or ignition; or
- (b) The contents of the package fail to explode, or explode so feebly as would exclude propagation of the explosive effect from one package to another in test type 6 (b).

Test type 6 (c) may be waived if, in a type 6 (b) test, there is practically instantaneous explosion of virtually the total contents of the stack. In such cases the product is assigned to Division 1.1. Test type 6 (d) is a test used to determine whether a 1.4S classification is appropriate and is only used if:

- (a) The results of test series 6 (a), 6 (b) or 6 (c) indicate that a 1.4S classification may be applicable; and
- (b) The functioning of the product as intended would be expected to produce effects more severe than those obtained in the 6 (c) test (e.g., where detonating explosives are present)."

The results of test 6 (d) indicate if 1.4S is appropriate, otherwise the classification is 1.4 other than S.

5. Replace Figure 10.3 with the following:

Replace the content of Box 33 with: "In the event of ignition or initiation, are there hazardous effects outside the package ? "

6. Replace Figure 10.8 with the following:

Replace the content of Box 33 with: "In the event of ignition or initiation, are there hazardous effects outside the package? "

7. Replace Section 16.1 with the following:

"16.1 Introduction

16.1.1 The results from the four types of series 6 tests are used to determine which division, amongst Divisions 1.1, 1.2, 1.3 and 1.4, corresponds most closely to the behaviour of a product if a load is involved in a fire resulting from internal or external sources, or an explosion from internal sources (boxes 26, 28, 30, 32 and 33 of Figure 10.3). The results are also necessary to assess whether a product can be assigned to Compatibility Group S of Division 1.4 and whether or not it should be excluded from Class 1 (boxes 35 and 36 of Figure 10.3). The four types of test are:

Type 6 (a): A test on a single package to determine if there is mass explosion of the contents;

Type 6 (b): A test on packages of an explosive substance or explosive articles, or non-packaged explosive articles, to determine whether an explosion is propagated from one package to another or from a non-packaged article to another;

Type 6 (c): A test on packages of an explosive substance or explosives articles, or non-packaged explosive articles, to determine whether there is a mass explosion or a hazard from dangerous projections, radiant heat and/or violent burning or any other dangerous effect when involved in a fire; and

Type 6 (d): A test on an unconfined package of an explosive substance or explosive articles, to determine if there are severe effects outside the package following accidental ignition or initiation of the contents.”

8. Replace Section 16.2 with the following:

“16.2 Test methods

16.2.1 The tests methods currently in use are listed in Table 16.1.

Table 16.1: TEST METHODS FOR TEST SERIES 6

Test code	Name of Test	Section
6 (a)	Single package test ^a	16.4.1
6 (b)	Stack test ^a	16.5.1
6 (c)	External fire (bonfire) test ^a	16.5.1
6 (d)	Unconfined package test ^a	16.7.1

^a *Recommended test.*

16.2.2 Test types 6 (a), 6 (b), 6 (c) and 6 (d) are performed in alphabetical order. However, it is not always necessary to conduct tests of all types. Test 6 (a) may be waived if explosive articles are carried without packaging or when the package contains only one article. Test type 6 (b) may be waived if in each type 6 (a) test:

- (a) The exterior of the package is undamaged by internal detonation and/or ignition; or
- (b) The contents of the package fail to explode, or explode so feebly as would exclude propagation of the explosive effect from one package to another in test type 6 (b).

Test type 6 (c) may be waived if, in a type 6 (b) test, there is practically instantaneous explosion of virtually the total contents of the stack. In such cases the product is assigned to Division 1.1. Test type 6 (d) is a test used to determine whether a 1.4S classification is appropriate and is only used if:

- (a) The results of test series 6 (a), 6 (b) or 6 (c) indicate that a 1.4S classification may be applicable; and
- (b) The functioning of the product as intended would be expected to produce effects more severe than those obtained in the 6 (c) test (e.g., where detonating explosives are present).

The results of test 6 (d) indicate if 1.4S is appropriate, otherwise the classification is 1.4 other than S.

16.2.3 If a substance gives a “—” result (no propagation of detonation) in the Series 1 type (a) test, the 6 (a) test with a detonator may be waived. If a substance gives a “—” result (no or slow deflagration) in a Series 2 type (c) test, the 6 (a) test with an igniter may be waived.

16.2.4 Explanations of certain terms used in the assignment of divisions and compatibility groups are given in the Glossary in Appendix B of the Model Regulations (e.g. mass explosion, pyrotechnic substance, entire load, total contents, explode, explosion of the total contents).”

9. Replace 16.6.1.4.6 with the following:

If none of the events occur which would require the product to be assigned to Division 1.1, 1.2, 1.3 or 1.4 other than Compatibility Group S, the thermal, blast, or projection effects would not significantly hinder fire-fighting or other emergency response efforts in the immediate vicinity, then subject to a 6 (d) unconfined test the product is assigned to Division 1.4 Compatibility Group S.

10. Insert a new Section 16.7 after Section 16.6 as follows:

“16.7 Series 6 type (d) test prescription

16.7.1 Test 6 (d): Unconfined package test

16.7.1.1 Introduction

This is a test on a single package to determine if there are severe effects outside the package following accidental ignition or initiation of the contents.

16.7.1.2 Apparatus and materials

The following items are required:

- (a) A detonator to initiate the substance or article;
- (b) An igniter just sufficient to ensure ignition of the substance or article; and
- (c) A sheet of 3.0 mm thick mild steel to act as a witness plate.

Video equipment may be used.

16.7.1.2 Procedure

16.7.1.3.1 The test is applied to packages of explosive substances and articles in the condition and form in which they are offered for transport. Where explosive articles are to be carried without packaging, the tests should be applied to the non-packaged articles. The decision to use either an initiating stimulus or an igniting stimulus is based on the following considerations.

16.7.1.3.2 For packaged substances:

- (a) If the substance is intended to function by detonation, it should be tested with a standard detonator (Appendix 1);
- (b) If the substance is intended to function by deflagration, it should be tested with an igniter just sufficient (but not more than 30 g of black powder) to ensure ignition of the substance within the package. The igniter should be located in the centre of the substance in the package;

16.7.1.3.3 For packaged articles:

- (a) Articles provided with their own means of initiation or ignition:

The functioning of an article near the centre of the package is stimulated by the article's own means of initiation or ignition. Where this is impracticable, the article's own means of initiation or ignition is replaced by another form of stimulus having the required effect;

- (b) Articles not provided with their own means of initiation or ignition:

- (i) An article near the centre of the package is caused to function in the designed mode; or
- (ii) An article near the centre of the package is replaced by another article which can be caused to function with the same effect.

16.7.1.3.4 The package is placed on a steel witness plate on the ground without confinement.

16.7.1.3.5 The substance or article should be initiated and observations made on the following: evidence of thermal effects, projection effects, detonation, deflagration, explosion, fire or disruption of the package. ***A safe waiting period, prescribed by the test agency, should be observed after initiation.*** The test should be performed three times unless a decisive result is observed earlier (e.g. visible flames outside the package). If the results of the recommended number of tests do not enable unambiguous interpretation of the results, the number of tests should be increased.

16.7.1.4 *Test criteria and method of assessing the results*

Inclusion in Compatibility Group S requires that any hazardous effects arising from functioning of the substances or articles in this test are confined within the package. Evidence of a hazardous effect outside the package includes:

- (a) Damage to the witness plate beneath the package;
- (b) A fireball or jet of flame which extends more than 1 m from the package;
- (c) Severe disruption and scattering of the package and its contents; and
- (d) A metallic projection with a kinetic energy exceeding 8 J as assessed by the distance-mass relation given in Figure 16.6.1.1;

The competent authority may wish to take into account the expected effect of the initiator when assessing the results of the test, if these are expected to be significant when compared to the substance or articles being tested. If there are hazardous effects outside the package, then the product is excluded from Compatibility Group S.

16.7.1.5 *Examples of results*

Article	Packaging	Initiation system	Events	Result
Cartridges, power device	Fibreboard box containing 20 articles (300 g of propellant each) each in a plastic bag.	One of the articles.	Articles ignited one by one, producing flames up to 2 m high outside package.	Not consistent with Compatibility Group S.
Detonator assemblies, non-electric	Fibreboard box containing 60 assemblies each in a plastic bag with its shock tube coiled in a figure 8, with attenuators on the detonators.	One of the articles.	One out of sixty detonators fired and no visible effects outside the box.	Consistent with Compatibility Group S.
Detonators, electric	Fibreboard box containing 84 assemblies, each bundled with its wire so that the blast from a firing detonator would be attenuated.	One of the articles.	One out of eighty-four detonators fired. The reaction caused the box to break open and released some of the assemblies but it was judged that there were no hazardous effects outside the package.	Consistent with Compatibility Group S.
Igniters	Fibreboard box containing 10 igniters each packaged in a steel tube with screw-thread end-caps.	One of the articles.	One out of ten igniters functioned with no effects outside the box.	Consistent with Compatibility Group S.
Charges, shaped (open-face 19 g perforators)	Fibreboard box containing 50 charges in two layers so that pairs of charges were focused toward each other.	Detonator with approximately 60 mm of detonating cord.	Three trials were conducted. In each of the trials, the witness plate was perforated with 3 to 4 charges reacting. The packages were blown apart scattering the remaining charges over a wide area.	Not consistent with Compatibility Group S.
Detonators, electric	Fibreboard box containing 50 detonators each with a 450-mm lead wire. Each assembly was contained in its own fibreboard inner box. The boxes were separated by fibreboard panels.	One of the articles.	One out of fifty detonators fired causing one of the box flaps to open. There were no hazardous effects outside of the package.	Consistent with Compatibility Group S.