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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

Thirty-third session
Geneva, 30 June-9 July (a.m) 2008
Item 2 of the provisional agenda

EXPLOSIVES AND RELATED MATTERS

Additional test for Division 1.4S Shaped Charges

Transmitted by the expert from the United States of America*

Introduction

1. At its thirty-first session, the Sub-Committee considered a revised proposal for an additional test to determine 1.4S classification for all explosive articles (see ST/SG/AC.10/C.3/2007/29). This proposal was made on the basis of several experiments on one specific article, namely a 23 gram shaped charge (see informal document UN/SCETDG/31/INF.43). The expert from the United States has questioned the need for adopting a proposal with such broad implications when no data on other 1.4S articles have been presented (see informal document UN/SCETDG/31/INF.34). There are currently over thirty-four 1.4S articles listed in the Dangerous Goods List. The family of 1.4S articles includes igniters, cartridges, both explosive and shaped charges, cutters, detonators, fireworks, flares, fuse, fuzes, grenades, igniters, primers, release devices and signals of all types. However, no data has been presented to justify applying the proposed new test and criteria to any of these types of articles other than shaped charges. Such a new test would be both unnecessary and burdensome for the majority of these 1.4S articles. Historically, the Sub-Committee has moved carefully and incrementally when adopting new explosive testing methodology and criteria, and

* 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).

only after a number of corroborative experiments on reproducible samples were conducted in several countries. It is viewed as critically important that the same care be exercised in moving this proposal forward.

2. In addition, further tests have been conducted which show that the methodology for the proposed UN 6d test is flawed and its four pass/fail criteria (witness plate damage or jet flame longer than 1 meters or disruption of the packaging contents or metallic projections more than 8 joules) are unnecessarily restrictive, even for shaped charges.

3. Although the expert from the United States of America is not convinced based on the data provided that a new 6d test is justified, he is concerned whether certain 1.4S articles should be authorized for transport on passenger carrying aircraft. Discussions were recently initiated within the US Department of Transportation to evaluate 1.4S articles that are currently authorized on passenger carrying aircraft, and additional test data that may have an impact on the ICAO Technical Instructions (TI) or on future discussions concerning the test regime were produced. The expert from the United States of America expects that any change to the ICAO TI or the test regime should be substantiated by test data conducted at multiple laboratories.

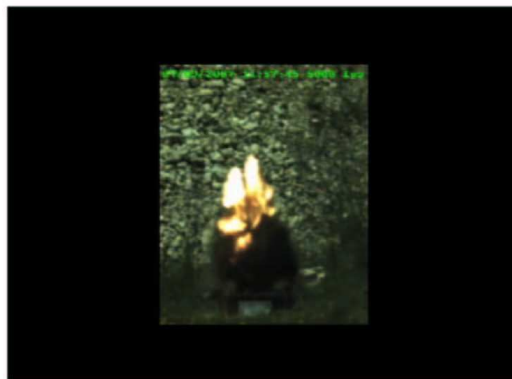
4. A summary of the results of this further testing is presented below.

Additional test information

5. Evaluation of the proposed UN 6d test methodology on packages containing two opposing layers of twenty-five charges each in fibreboard boxes has shown that outcomes can vary widely, depending on which center charge (top or bottom) is chosen to initiate and whether the initiation is done by a standard detonator (as proposed in the test) or by a detonator attached to a 6 cm length of detonating cord (as done in the tests performed by Canada). Typical results for 20 gram RDX charges are shown below:

Experiment A: Top center charge primed with No. 8 detonator only - Produced no evidence of jet flame extending beyond 1 meter from the package.

Experiment B: Bottom center charge primed with No. 8 detonator only – Produced evidence of a jet flame extending beyond 1 meter above the package. (see Photograph below).



Jet flame from the 20-gm RDX Jet perforators.

Experiment C: Top center charge primed with No. 8 detonator and 6 cm of 80 grain detonating cord – Failed to initiate shaped charge in one of two attempts.

6. Multiple tests were conducted on packages containing fifty shaped charges in two opposing layers having net explosive weights of 3.2 grams, 10 grams, 20 grams and 39 grams. The results are summarized in the Annex to this document. The packages were initiated with a standard detonator oriented so that the output end was parallel to and directly against the bottom of the shaped charge. Even the 3.2 gram charges in UN 4G fibreboard outer packaging did not meet all the criteria (see photos below.)



Fig. 1



Fig. 2

Fig. 1 UN 4G Package Containing Fifty 3.2 Gram RDX Shaped Charges Blown Apart
Fig. 2 UN 4G Package Residues from Fifty 3.2 Gram RDX Shaped Charges After Test

Only a package of fifty 3.2 gram charges overpacked in a UN 4D plywood box, was able to successfully meet all four criteria to pass the proposed test as shown in the Annex.

7. Criteria 1 (Evidence of Damage to a 3.0 mm witness plate beneath the package) is difficult to quantify because of the extent of “damage” to the witness plate is undefined. Even a minor deformation could be grounds for failure. Criteria 2 (Evidence of Fireball or Jet of Flame which extends more than 1 meter) is highly dependent on whether the shaped charge initiated first is pointing toward or away from the ground. Criteria 3 (Evidence of Disruption or Scattering of the Package and its contents) in the proposed method is open to wide interpretations and is highly dependent on the packaging construction materials. In addition, Criteria 3 is inconsistent with Criteria 4 (Evidence of Metallic Projections with Kinetic Energy exceeding 8 Joules) since Criteria 4 would allow metallic projections equal to or less than 8 joules beyond the outer packaging but Criteria 3 suggests that they might escape somehow without “disrupting” the outer packaging.

Proposal

8. As suggested in informal document UN/SCETDG/31/INF.34, the expert from the United States believes the proposed UN 6d single unconfined packaging test is unnecessary for 1.4S articles. But if the concerns of the expert of the Working Group on explosives experts are specifically focused upon shaped charges, then, instead of burdening an entire Division of explosives with a new and unproven UN test method, it is proposed that a new test method be applied only to UN 0441, Charges, shaped, 1.4S. For instance the test method could read as a special provision applied to UN 0441 as follows:

SP XXX *A single, unconfined package of shaped charges shall be tested as follows:*

A standard detonator shall be affixed in parallel to the back of the top-center placed shaped charge in the proposed packaging and remotely initiated. If none of the shaped charges in the proposed packaging perforate or puncture a 3 mm thick steel witness plate underneath the package and if no projections from the proposed package are produced with a kinetic energy exceeding 8 joules, those shaped charges when transported in the proposed packaging may be classed as Division 1.4S.

Shaped Charge Proposed Test Results Summary **Annex**

Shaped Charge Size and Type	Outer Packaging (having two layers of 25 charges)	<u>Criteria 1:</u> Evidence of Damage to a 3.0 mm steel witness plate beneath the package	<u>Criteria 2:</u> Evidence of fireball or jet flame which extends more than 1 m from the package	<u>Criteria 3:</u> Evidence of Disruption or Scattering of the package and its contents.	<u>Criteria 4:</u> Evidence of Metallic Projection with Kinetic Energy exceeding 8J.
3.2-gm. RDX (Bottom center charge initiated)	UN 4G fiberboard box	No damage to the witness plate. – <u>Passed the Criteria</u>	No fireball or jet flame – <u>Passed the Criteria</u>	Package ripped apart. – <u>Failed the Criteria</u>	Metallic projection (of a 43-gm mass found @ 5m) with kinetic energy less than 8J. - <u>Passed the criteria.</u>
3.2-gm. RDX (Bottom center charge initiated)	UN 4D plywood box	No damage to the witness plate. – <u>Passed the Criteria</u>	No fireball or jet flame – <u>Passed the Criteria</u>	One charge went through the top of the box lid resulting in a single hole in the box. Two charges went and the rest of the 47 were not damaged. – <u>Passed the Criteria</u>	No metallic projection. – <u>Passed the Criteria</u>
3.2-gm. RDX (Bottom center charge initiated Repeat)	UN 4D plywood box	No damage to the witness plate. – <u>Passed the Criteria</u>	No fireball or jet flame – <u>Passed the Criteria</u>	One charge went through the top of the box lid and made a single hole in the box. Two charges went, 5 damaged and the rest (44) were not damaged. – <u>Passed the Criteria</u>	No metallic projection. – <u>Passed the Criteria</u>
***** *					
10-gm. RDX (Top center charge initiated)	UN 4G fiberboard box	Dented the witness plate but no hole. -- <u>Passed the Criteria</u>	No fireball or jet flame – <u>Passed the Criteria</u>	Package ripped/blew apart. – <u>Failed the Criteria</u>	Metallic projection (of a 76-gm mass found @ 11m) with kinetic energy less than 8J. -- <u>Passed the criteria.</u>
10-gm. RDX (Top center charge primed – initiated)	UN 4G fiberboard box	Dented the witness plate but no hole. -- <u>Passed the Criteria</u>	No fireball or jet flame – <u>Passed the Criteria</u>	Package ripped/blew apart. Two charges went, 25 damaged and the rest (21) were not damaged. – <u>Failed the Criteria</u>	Metallic projection (of a 76-gm mass found @ 9m) with kinetic energy less than 8J. -- <u>Passed the criteria.</u>
***** *					
20-gm. RDX (Bottom center charge initiated)	UN 4G fiberboard box	No damage to the witness plate. – <u>Passed the Criteria</u>	Jet flame extended more than 1-m from the package. <u>Failed the Criteria</u>	Package ripped. Two charges went, 21 damaged, 2 missing and the rest (25) were not damaged. – <u>Failed the Criteria</u>	Metallic projection (18.3-m away for a 200-gm mass) exceeded the kinetic energy of 8J. - <u>Failed the Criteria</u>

Annex
Shaped Charge Proposed Test Results Summary (Continued)

Shaped Charge Size and Type	Outer Packaging	Criteria 1: Evidence of Damage to a 3.0 mm steel witness plate beneath the package	Criteria 2: Evidence of fireball or jet flame which extends more than 1 m from the package	Criteria 3: Evidence of Disruption or Scattering of the package and its contents.	Criteria 4: Evidence of Metallic Projection with Kinetic Energy exceeding 8J.
20-gm. RDX (Bottom center charge initiated – Repeat Test)	UN 4G fiberboard box	No damage to the witness plate. – <u>Passed the Criteria</u>	Jet flame extended more than 1-m from the package. -- <u>Failed the Criteria</u>	Package ripped. Two charges went, 23 damaged, 2 missing and the rest of the 23 were not damaged. – <u>Failed the Criteria</u>	Metallic projection (18.3-m away for a 200-gm mass) exceeded the kinetic energy of 8J. - <u>Failed the Criteria</u>
20-gm. RDX (Bottom center charge initiated – Repeat Test)	UN 4G fiberboard box	No damage to the witness plate. – <u>Passed the Criteria</u>	Jet flame extended more than 1-m from the package. -- <u>Failed the Criteria</u>	Package ripped. Two charges went, 17 damaged, and the rest (23) were not damaged. – <u>Failed the Criteria</u>	Metallic projection (15.8-m away for a 200-gm mass) exceeded the kinetic energy of 8J. - <u>Failed the Criteria</u>
20-gm. RDX (Bottom center charge initiated – Repeat Test)	UN 4G fiberboard box	No damage to the witness plate. – <u>Passed the Criteria</u>	Jet flame extended more than 1-m from the package. -- <u>Failed the Criteria</u>	Package ripped. Two charges went, 22 damaged, and the rest (28) were not damaged. – <u>Failed the Criteria</u>	Metallic projection (18.9-m away for a 200-gm mass) exceeded the kinetic energy of 8J. - <u>Failed the Criteria</u>

39-gm. RDX (Bottom center charge initiated)	UN 4G fiberboard box	No damage to the witness plate. – <u>Passed the Criteria</u>	Jet flame extended more than 1 m from the package – <u>Failed the Criteria</u>	Package ripped/blew apart. Two charges went, 22 damaged, and the rest (28) were not damaged. – <u>Failed the Criteria</u>	Metallic projection (18.9-m away for a 320-gm mass) exceeded the kinetic energy of 8J. - <u>Failed the Criteria</u>
39- gm. RDX (Bottom center charge initiated – Repeat Test)	UN 4G fiberboard	No damage to the witness plate. – <u>Passed the Criteria</u>	Jet flame extended more than 1 m from the package – <u>Failed the Criteria</u>	Package ripped/blew apart. Two charges went, 16 damaged, 4 missing, and the rest (28) were not damaged. – <u>Failed the Criteria</u>	Metallic projection (21.3-m away for a 320-gm mass) exceeded the kinetic energy of 8J. - <u>Failed the Criteria</u>
39-gm. RDX (Bottom center charge initiated – Repeat Test)	UN 4G fiberboard box	No damage to the witness plate. – <u>Passed the Criteria</u>	Jet flame extended more than 1 m from the package – <u>Failed the Criteria</u>	Package ripped/blew apart. Two charges went, 13 damaged, and the rest (28) were not damaged. – <u>Failed the Criteria</u>	Metallic projection (22.3-m away for a 320-gm mass) exceeded the kinetic energy of 8J. - <u>Failed the Criteria</u>