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COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS

Sub-Committee of Experts on the Transport of Dangerous Goods
(Thirteenth session,
Geneva, 7-17 July 1997,
agenda item (4 (a))

DRAFT AMENDMENTS TO PART 1 OF THE MANUAL OF TESTS AND CRITERIA

Test 6(c) - Coordination report

Transmitted by the Expert from Canada

INTRODUCTION

1. At the meeting of the Committee of Experts on the Transport of Dangerous Goods held in Geneva in December 1996 Canada agreed to coordinate the work proposed at a working group session in Orlando Florida, USA on the 6(c) Test.

2. To do so Canada requested that any country who committed to some aspect of the work prepare a short document describing: their understanding of the specific item; defining a scope of work for the item; providing a tentative time table required to achieve the item; reporting any progress to date and giving any comments.

3. Countries have provided this information and it is presented below as the points that were proposed by the Orlando Working Group.

4. Countries or organizations who committed to carry out certain aspects of the work have their names appear in parentheses after each point. Each point is followed the comments or description of the work to be carried out, made by a particular country.

5. The Expert from the United States of America has elected to submit a formal paper to the Sub-Committee and an outline of that work is given at the end of the points.

6. Other countries have elected to submit information papers on differing aspects of the work which could be the basis for a working group discussion on the issues uncovered to date, progress to date or recommendations made to the Sub-Committee for further action.

RECOMMENDATIONS

7. Canada recommends that a Working Group should be convened to review each countries' proposal of work or the comments included in this paper. A suggested approach is to develop three areas of agreement: issues which are not contentions; issues where countries disagree; and issues requiring more work or information. The first will be recommended to the Sub-Committee; the disagreement should be voted on and the last will determine the work of the future.

8. In preparation for this, countries which indicated that they could prepare a paper should do so.

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OUTLINE OF WORK AND COMMENTS

9. The following comments are listed according to the order in which they appeared in document ST/SG/AC.10/R.556. The comments are specific to the point being addressed.

15.1 Definition of a Fireball (USA)

Netherlands

The Netherlands is awaiting the American definition. A decision should be taken to see if the definition is acceptable to all.

USA

See the outline of work for the USA at the end.

15.2 Verification of using time measurements to assess thermal flux (USA, Netherlands, Sweden)

France

France would be interested in a better definition of thermal flux and in methods of evaluating this. France has much documentation on thermal flux and measurement and could prepare an informal paper on this topic for the Sub-Committee.

Netherlands

The Netherlands proposes to record the 6(c) Test on video and measure the thermal flux. From the video the burning time can be measured and this compared to the actual thermal flux. This can be completed by the end of April. The results will be presented to the Sub-Committee at the July meeting by means of an information paper.

Sweden

Sweden proposes to develop a theoretical model which will be confirmed by practical tests.

Scope is:

a) produce the theoretical model, which will be used to calculate heat radiation as a function of the energy content of the explosive and the burning rate of that explosive,
b) the model to be tested against some typical cases.

The model will be finished this spring and a report will be ready for the July meeting; depending on the discussions in Geneva, the model will then be either re-modeled or practical test can start during the autumn of 1997.

When it comes to practical tests Sweden feels that these should be correlated and made together with other delegates due to the costs.

This work is dependent on the results from 15.9

15.3 Need to consider quantities for unique and/or expensive substances and / or articles (All, not immediate)

Germany

If the number of packages or articles or the mass of a substance to be tested can be reduced for technical reasons, it should be possible to do this. A reduction for only economic reasons must not be done. This is also relevant for the 6(a) and 6(b) tests. If the effect to be assessed for a given result in a test is the same with a reduced quantity, it should be taken into account. A justification for the reduction should be included in the report.

If some substance or articles are unique or expensive and the test cannot be performed because of that reason, then the substance or articles should be classified as 1.1 or the most dangerous division which can be imagined for it.

Japan

If we adopt a test method using a smaller scale samples, we should confirm that the test method could predict the test results obtained by using the original test method.

Netherlands

The Netherlands confirms the need to obtain guidelines; for the case when only one article is transported there is no need to assess sympathetic explosion and only one item needs to be tested. For storage differing rules may apply. We would require objective guidelines when deviation from the quantity requirements is acceptable. A discussion in a Working Group meeting is necessary for this purpose.

15.4 Need to assess projection criteria against current practice (live, fiery, inert) (All)

The question is whether live projections or inert projections, other than metal, present similar dangers to fire-fighting or emergency response as do metallic and fiery projections.

Canada

Canada believes that it is necessary to review the (differing) hazards of live, fiery, and inert projections and to develop a data base to decide which should or should not be included in the testing.

France

The criteria to differentiate a 1.4 from a 1.4 S is the presence or not of an important hindrance caused by the explosion to emergency response personnel.

We propose to take this point to our emergency response personnel in order to determine, in a more objective manner, this risk with regards to their equipment to what may constitute such a hindrance.

Germany

If there is a hazard from inert projectiles, it is shown by penetration or indentation of the witness screens.

The hazard from fiery projections might be less if it is possible to extinguish the fire of the projections or the fire caused by the projections. A problem to be discussed is that of fireworks or signal devices being thrown or even flying by their own propellant charges.

In the case of live projections there are three different things:

a) if the live article is lying on the ground and it will not be set off by stepping on it, it is not hazardous;
b) if the live article is lying on the ground and will be set off by stepping on it, it is hazardous;
c) if the live article functions while being thrown or when it hits the ground, it is hazardous.

Japan

Although we do not have enough experience, we think that live or non-live projections may have smaller dangerous properties than metallic and fiery projections. However, it might be better for us to determine the criteria after examining it sufficiently.

Netherlands

The Netherlands confirms the need to do an assessment but we do not have a complete idea on how to perform such an assessment.

15.5 Excluding of Articles and Substances from Class 1 (Canada, HMAC)

Canada

Articles and substances can be excluded from Class 1 by a number of mechanisms as defined by the Flow Chart. The mechanism of interest to this work involves those articles which can be excluded from Class 1 by virtue of the 6(c) test. If a packaged product is determined to be 1.4 S, then it is possible to remove the articles from Class 1 if there is no effect external to the unpackaged article when functioned. The method of assessment nor the criteria are clearly defined.

A second issue is the approach taken in assigning a substance or article to a hazards division. The current approach "top down" from the highest hazard division to the lowest risk (1.4S) and the lack of encompassing criteria may lead to substances or articles being excluded from Class 1.

A "bottom up" approach was proposed in the OECD-IGUS document (R.529). This could form the basis for a re-written 6(c) Test.

A clear methodology and assessment scheme for removal of items from Class 1 needs to be defined. Canada is prepared to put a proposal, in the form of an Information Paper, on the table for the July 1997 UN Meeting in Geneva concerning this point. The gathering of information has begun.

Germany

Germany only accepts to exclude articles according to paragraph 1.11 (b) of the recommendations as is currently possible and for substances only if they are not manufactured with the view to producing a practical explosive or pyrotechnic effect and having no hazard in the event of ignition or initiation.

Netherlands

The Netherlands have not given much consideration to this issue; we believe that the description like the one given in paragraph 1.11 (b) of the Recommendations " .....of such a character that their inadvertent or accidental ignition or initiation during transport shall not cause any effect external to the device wither by projection, fire, smoke, heat or loud noise;" needs to be covered by a suitable test. Such a test is not available at this moment.

15.6 Need to clarify dividing line between 1.4 and 1.4S including the possible use of an unconfined type 6(a) test (All)

The issue is one of what defines a 1.4 S; one criterion for a 1.4 S article is that, in case of accidental function, the hazardous effects are confined within the packaging. The 6c test degrades the package by fire and does not address accidental function when the package is not degraded. A functioning test is required in conjunction with the 6c Test. The 6a test could be so used if conducted unconfined so that effects outside the packaging are evident.

Germany

A dividing line between 1.4 and 1.4S depends on the effects of projections produced and therefore connected to the question of energy and material of the screen.

To decide whether an accidental function could cause hazardous effects the performance of an unconfined 6(a) test seems necessary. It shows whether there are effects in a distance of 5 m which produce minor injuries to persons protected or unprotected. It could be necessary to have a kind of screen at a distance of 5 m.

This is not a 6(c) question but we should not leave it aside.

Japan

We think that we may evaluate the dangerous properties of packed articles from the effects of projections by using the present test methods (69C0 Test method).

Netherlands

No comments so far.

15.7 Review current standards for level of protection given by firefighter's clothing and protection gear. (Norway, UK)

Netherlands

The opinion of the Netherlands is that the level of protection of fire-fighter's clothing (both against projections and thermal effects) should be the basis for the 1.2/1.3/1.4 dividing line.

Norway:

Norway has been able to verify existence of European Standard on Protective Clothes for Fire-fighters - EN496; it contains requirements for tensile strength and tear strength as well as heat exposure. The Standard also makes reference to other protective clothing standards against heat and flame but do not address the concept of "flying objects"

Norway has contacted National Textiles Institute and they are looking at this question. If they are not able to come up with a test, criteria or empirical values regarding Fire-fighters Protective Clothing as its level of protection against projectiles, a work program will be established with them to do some research on this specific topic; possibly in cooperation with the UK. Immediate time scale is 2 months. If the research program is required the time scale moves into 1998 and funding will be required,

United Kingdom

The United Kingdom will review the existing standards for fire-fighting personal protective equipment, particularly helmets, suits and visors. To review the products currently on the market. The reviews will concentrate on heat penetration and against injury by projectile.

The protection of clothing worn by the public will also be considered..

In order to review dermal injury criteria for exposure to heat, the European Standard for fire-fighters clothing which classifies materials in terms of time to second degree burn could possibly be used to obtain similar data for first degree burn.

To review the likely irradiance levels in the category described in the 6(c) test will be a desk top exercise not involving experimental tests.

The aim is to have the information submitted as an Information Paper to the UN Working Group shortly before the July meeting in Geneva.

Discussion have been held and laboratories are about to commence to work.

15.8 Need to clarify test duration - is it for a specific time or to reaction (All)

France

15.8 (duration) and 15.9 (energy level) are in the opinion of France linked together. France has much documentation on this , especially for military needs. France will make a synthesis of this work for articles that could be transported and subject to the 6(c) test. This to could be the object of an informal paper to be presented to the Sub-Committee.

Germany

If there is a reaction and it is seen that there is nothing left to react then the test can be stopped.

If the fire has burned for a certain time, with or without a reaction, and there is no significant quantity of explosives remaining, then the test can be stopped.

“Can be stopped” means that if wood is used, it can be extinguished; if gas is used it, can be closed.

If there is a significant quantity of explosives after the lattice of wood has burned down, it cannot be prolonged and therefore the test must be repeated until no significant quantity of explosive remains.

The 30 minutes is only a duration time that is thought to be long enough for most of the substances or articles under test; it cannot be a fixed duration for all cases.

Japan

If the 30 minutes is thought to be long enough to burn out most of the substance and articles under the test conditions, we should stop the test after burning 30 minutes to make the test results negative if there are no detectable reactions.

However, if we could have experience to observe any remarkable reactions after burning for 30 minutes, we might have to extend the test duration.

Netherlands

Would prefer a testing time corresponding to the worst possible practical situation. An interesting point of discussion might be to include the determination of the sensitivity of the unreacted energetic materials after the exposure to the high temperature.

When absence of a reaction after the specified maximum time is obtained, it might be considered to determine the structural strength of the packaging at the high temperatures occurring in the 6(c) test. It that way it is not relevant to test until reaction; when the packaging is capable of containing the explosion effects at high temperature, the proper classification is 1.4S.

15.9 Need to consider fuels used and energy of fire (USA, UK)

Germany

The advantage of wood is that it is readily available and does not produce soot; you can do the test whenever you want. The disadvantage is that you cannot stop the fire to see whether the package or articles continue burning with no heat input; nor can you prolong the fire if there has not been any reaction up to when the wood is consumed but you still expect a reaction. The heat output is not the same throughout the test but increases in the beginning and decreases at the end and you do not know beforehand when the reaction will occur.

The advantages of a liquid fuel is that it is readily available and the test can be done when you want. The disadvantage is that it produces soot and if you do not have a large receptacle, the flames can be blown to one side by the wind. It is difficult to stop or prolong the fire.

The advantages of a gas fire is that you can stop it or prolong it. The fire is not blown by the wind, it produces no soot and the heat output is the same for the duration of the test. That makes it easier to recognize the additional heat of the substance or articles. The disadvantage is that it is not readily available but that an installation is required. A detonation could conceivably destroy the burners. However, having done 6(a) and 6(b) you should be aware if detonation will be a problem.

Germany has experience with gas for burn tanks and it is planned to use this for explosives.

Netherlands

Alternative to the wood fire should be allowed, a figure specifying the energy of the fire would prevent possible differences.

United Kingdom

This is a two fold issue: firstly, to provide a description of methods for using alternative fuel to wood as allowed by UN. E.g. LPG and liquid fuels; secondly, from the results of practical tests to compare and contrast the temperature environments produced by alternative fuels used as the source for the bonfire.

The UK will provide information from studies of LPG fuels sources already undertaken. This will also be a desk top exercise. We believe we have sufficient data from experiments previously carried out to obviate the need for further experimentation on that source of fuel.

The United Kingdom has experience in the use of liquid fuels for classification testing of military explosives. It will make proposals based on this experience and the use of NATO test methods

We shall provide comments on the advantages and disadvantages of using different fuels and the possible effects on the resulting classification.

We hope to produce our comments and proposals in an Information Paper before the UN meeting in July.

Our laboratories have a method for the use of LPG fuels. The study so far and the extrapolation of key parameters to explosives will begin shortly.

15.10 Need to specify packaging orientation within test description (All)

Germany

There are two cases:

Orientation relative to the second and third package: it can be done according to the text in 16.1.3 procedure of 6(b) test.

Orientation relative to the screen: if it is known that there is a preferred direction for projections to leave the package, then the test has to be performed in a way that this side of the package has to point at one of the screens

Japan

If the direction of projections is predicted, the packing orientation should be decided for projections not to fly to the open space from the experimental and safety point of view.

Netherlands

Packages should be oriented in such a way that a maximum probability of hitting the witness screens is obtained. Perhaps, needless to say, there is a relation with what is stated under item 15.8.

15.11 Develop a suitable witness screen and mounting for assessing the two energy levels associated with a 1.4/1.4S and 1.2/1.4 (Canada)

Canada

The current witness screen and mounting are not well defined. Tests have shown that the type of aluminum used and the rigidity of the mounting affect the outcome. Several proposals have suggested that the depth of indention be measured and used as one criterion for assignment to a Hazard Division. Materials for the witness screens must be commonly available.

The scope for this area is dependent on the information gathered and decisions made in several areas in including 15.4 and 15.7. CERL has developed reliable techniques to evaluate witness panels response to a variety of projections and has accumulated much data in this area. Once decisions have been made on projection energies that form the dividing lines between various hazard division, then the data will be reviewed to determine if more testing is required to select a witness panel or whether one can be easily selected from our current information.

The timetable for this work will be determined after the July UN Meeting assuming that decisions have been taken on projections energies.

15.12 One objective of 6(c) test is to assess propagation between packages in a fire. Need to establish guidelines for determining sample requirements if less than 0.15m^3 of packaging is used (Germany)

Germany

The 6 series are performed in alphabetical order. The 6(c) Test is to determine whether there is propagation of explosion from one package to another. For it is necessary to have enough substance or articles to get a mass explosion if it can occur.

Our recommendations is to use package of a total volume of 0.15 m^3. If one package is smaller than 0.15m^3, than more packages are used up to that volume. This is for substances or packaged or unpackaged articles.

In connection with this it is necessary to look at the question of unique or expensive articles (15.3)

Netherlands

No comments; waiting for the German input.

15.13 Need to assess if witness screens alone are adequate to assess projection effects (All)

Germany

The arrangement of the screens should be in such a manner that the bottom edge of the screens should be as high as the bottom edge of the lowest package.

The normal way of assessing the results should be the inspection of the screens (penetration, indentation). If there are projection to be seen during the test they should be looked for after the test and before a new test is started. These projection (fragments or articles) should be used for the decision. The experience of the people performing the test should influence the assignment.

Japan

It may be difficult to gather all projections. Therefore, we think that it may be practical to assess the energy levels of the projections mainly from the witness screens.

Netherlands

The opinion of the Netherlands is that we can not rely on witness screens alone. Often the projected articles describe a ballistic trajectory, most of the times missing the witness screens. We agree that it is not always simple to trace the projections but careful study of the video recordings will help a lot, perhaps is combinations with IR video.

15.14 Need to determine if other methods can be used to provide classification data, e.g. trough test to assess thermal flux (All, USA)

Germany

Germany does not think measuring flux is difficult.

The use of duration of a fireball is applicable only to substances which behave like smokeless powders.

For pyrotechnic substances and articles the measurement of thermal flux is necessary. There are pyrotechnic substance that burn slowly but very hot and the duration of a fire ball (even if it occurs) would lead to the wrong result. For pyrotechnic articles the measurements of thermal flux shows clearly whether there is heat flux of all the articles together or if it is differentiated, i.e. it does not coincide.

Japan

Japan has no experience and therefore no good ideas on determining heat flux.

Netherlands

No comment yet; waiting USA input.

15.15 Implication of specifying a blast overpressure for 1.4 may have an impact on current definitions and classification. This must be reviewed. (All)

Germany

The following should be used to distinguish 1.2, 1.3, 1.4 and 1.4 S.

1.2	more than 10 kPa (100 mbar) at 15 m
1.3/1.4	less than or equal to 10 kPa (9100 mbar) at 15 m
1.4 S	less than 5 kPa (950 mbar) at 5 m

The figure for 1.3/1.4 means the effect of a detonation of about 300 g of TNT. The values are given as reflected peak over pressure

Japan

We can determine the accurate blast over pressure due to the explosion of articles by using a piezo pressure sensor, although we have to examine the classification method from the blast over pressure.

We should revise the division from the scientific point of view, even if the division might be changed depending on the kinds of articles.

Netherlands

This should be part of the criteria, especially with report composition and report shell classification. Division 1.4S is sometimes not allowed because of loud noise, leading to damage of the eardrums. The Netherlands always measured blast overpressure during 6(c) Tests.

15.16 The criteria need to be developed in a bottom up approach starting with the least hazardous. (All)

Canada

See the Comments under 15.5.

Germany

We do not think that there is a difference; one should not forget the performance of 6(a) and 6 (b).

Japan

To do the test safely, it may be better to do the top down approach. However, if we could confirm to do the test safely from pre-experiments, we may do the bottom up approach to from a practical standpoint.

Netherlands

The bottom up approach is sensible.

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GENERAL COMMENTS

10. The following are comments made addressing all the points:

Germany

A number of the items above need to be discussed and decisions need to be taken. Others require that tests be performed.

On 6 series. This test consists of 3 types of tests. For classification the results of all of them should be taken into account. Under special conditions certain tests can be waived. Also, the competent authority has the discretion to dispense with certain tests, to vary the details of the test, and to require addition tests (see 1.1.2 of the General introduction).

The knowledge and experience of the people performing the test is needed and must have influence on the conclusions. The assessing of results cannot be a pure calculation based on numerical tests results.

BAM will perform the following tasks for about one year:

a) All products applied for classification will be tested according to the test procedures 6(a), 6(b) and 6(c) whenever this seems meaningful (about 12 to 20 products per year);

b) Additionally an unconfined 6(a) test will be carried out in all cases under a);

c) All tests will be carried out instrumented; i.e. equipped with devices for the measurement of thermal flux and blast over pressure.

We ask that all competent authorities do likewise.

USA

The USA announced that it would present a formal paper describing the work that will be undertaken by all the US participants in Orlando; the work will be divided into two phases:

First Phase

1. Present a formal proposal by April 15, 1997

1) Thermal hazards:	Fireball	item 15.1
	Burning time	item 15.2
	Fiery projection	item 15.4
2) Projection hazards	Review of current practice	item 15.4
	Current practice vs., Firefighters clothing	item 15.7
	Witness screens and energy levels	item 15.11
	Methods of assessing projection hazards	item 15.13
	Blast overpressure	item 15.15
3) Criteria issues	Exclusion from Class 1	item 15.5
	Dividing line between 1.4 and 1.4S	item 15.6

2. Fine tuning of those parameters identified above, which have reached some sort of consensus at the July meeting and submit a revised proposal for the December meeting.

Second Phase

1. Continue fine tuning work left over from phase one.

2. Work will begin on (in 1998):

1) How to conduct the test	Quantities of test samples	items 15.3 and 15.12
	Duration of test	item 15.8
	Fuels used in test	item 15.9
	Packaging orientation	item 15.10
2) Other issues	Alternative test methods and criteria	item 15.14
	General approach	item 15.16