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

Report of the Working Group on Explosives

Transmitted by the chairman of the Working Group

Introduction

1. The working group met from 22 to 24 June 2010 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 33 experts in attendance from Belgium, Canada, China, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, UK, USA, CLEPA, COSTHA, ENA, FEEM, ICCA, ICPP, IME, and SAAMI participating in the working group. A list of participants is provided in Annex 1 to the report. The group was tasked to discuss technical matters related to submitted official and information papers.

2. The following papers were discussed, in the order given below.

ST/SG/AC.10/C.3/2010/8 (Italy) + *UN/SCETDG/37/INF.5 (Italy)*	Packing methods (use of metals other than steel or aluminium)
ST/SG/AC.10/C.3/2010/18 (SAAMI) + *UN/SCETDG/37/INF.50 (SAAMI)*	Division 1.4S limited quantities
ST/SG/AC.10/C.3/2010/29 (USA) + *UN/SCETDG/37/INF.28 (USA)* *UN/SCETDG/37/INF.35 (UK)*	Criteria for excluding articles from Class 1
UN/SCETDG/37/INF.54 (Germany)	*Test results on desensitized explosives*
ST/SG/AC.10/C.3/2010/40 (UK & USA) +	Proposed modifications to Test Series 7
ST/SG/AC.10/C.3/2010/31 (USA) + *UN/SCETDG/37/INF.34 (UK)*	A proposed new DDT Test and Criteria for flash compositions
UN/SCETDG/37/INF.41 (Canada) *UN/SCETDG/37/INF.58 (Spain)*	*On the use of the minimum burning pressure test as an alternative Series 8 Test*

UN/SCETDG/37/INF.42 (Canada)	*On the use of the ARC technique as an alternative to Series 3 Test 3(c) and Series 8 Test 8(a)*
UN/SCETDG/37/INF.47 (Netherlands)	*Large-scale behaviour of fireworks*
UN/SCETDG/37/INF.52 (AEISG)	*Request for consultative status by the Australian Explosives Industry and Safety Group Incorporated*
UN/SCETDG/37/INF.40 (Canada)	*Additional criteria for 1.4 classification*

3. *Packing methods (use of metals other than steel or aluminium).*

Documents …C.3/2010/8 (Italy) and INF5 (Italy)

Italy indicated that the problem originates with transportation of detonators and also with use of packagings for explosives on anti-mine ships, where the metal packagings must be non-magnetic. Some of the packing instructions for specific explosives do not authorize the use of a wide enough selection of metals to solve this issue. The working group observed that packing instructions P001 and P002 already allow use of all metals (1N) for drums and questioned why this allowance should not be expanded to other packing methods.

Conclusion: The working group concluded that it would be acceptable to add an entry for "metal, other than steel or aluminium, (4N)" in the "Outer packagings" column of the following packing instructions: P110(a), P111, P112(a), P112(b), P112(c), P113, P114(a), P114(b), P115, P116, P130, P131, P132(a), P132(b), and P133 – P144 as proposed in …C.3/2010/8.

The group considered whether wood should be added as authorized for use as inner & intermediate packagings (where appropriate) for all explosives packing instructions. Since wood is not listed in some packing methods, the group agreed that an entry for "Wood" should be added under an entry for "Inner packagings", "Intermediate packagings/Receptacles" and/or "Intermediate packagings/Dividing partitions" to certain explosives packing instructions as indicated in the table below (an "X" indicates the entry should be added):

Packing Instruction	Inner packagings	Intermediate packagings	
		Dividers	Receptacles
P110(a)	X		X
P110(b)	See note 1	See note 1	
P111	X		
P112(a)	X		X
P112(b)			
P112(c)	See note 1		X
P113	See note 1		
P114(a)	X	X	
P114(b)	X		
P115	X		X

Packing Instruction	Inner packagings	Intermediate packagings	
		Dividers	Receptacles
P116	See note 1		
P130			
P131	See note 1		
P132(a)			
P132(b)	X		
P133	See note 1		See note 1
P134	See note 1		
P135	See note 1		
P136	See note 1		
P137	X (add under "Boxes)		
P138			
P139	See note 1		
P140	X		
P141	See note 1		
P142	See note 1		
P143	X (see note 2)		
P144	X		

Note 1: Wood is already listed
Note 2: This entry has a listing for "Wood" under "Trays"

4. *Division 1.4S limited quantities*

Documents …C.3/2010/18 (SAAMI) and INF.50 (SAAMI)

The working group was reminded of the comments of the chair of the sub-committee with respect to the implementation of the Model Regulations in 1.1.3 in ADR/RID as they relate to 1.4S.

SAAMI presented their proposals for authorization for UN 0012, UN 0014, and UN 0055 to be shipped using certain provisions authorized for limited quantity shipments. Also, based on comment SAAMI had received from earlier sessions of the sub-committee and the working group on explosives, SAAMI described its proposal to authorize limited quantity shipments of certain other 1.4S entries. SAAMI described the guiding principles it used to determine why UN 0012, UN 0014, and UN 0055 presented a low risk and were appropriate for transport packed in limited quantities:

- The items must not propagate independent of packaging.
- No entries on high consequence list were selected.
- No generic entries or n.o.s. entries were selected.
- The item must present no hazardous effects outside the package in the event of accidental initiation (as determined by use of the 6(d) test).

The working group noted that the guiding principles used by SAAMI were technically appropriate and might be used as a starting point for evaluating whether 1.4S products could be eligible for shipment as limited quantities.

SAAMI also described its concerns about acceptance criteria (as described in INF.50) for 1.4S, specifically questioning the validity of the dent criteria provided in the 6(c) test when evaluating 1.4S entries. These dent criteria seemed to SAAMI to be somewhat arbitrary and could result in classification of certain small arms ammunition in a compatibility group other than S. SAAMI reminded the working group that small arms ammunition was the benchmark originally used for defining 1.4S when that classification was developed by the sub-committee. Later work was done to develop criteria for other articles in 1.4S, but it has historically been accepted that small arms ammunition is 1.4S by default.

The working group considered the question posed in the plenary that the problems of denial and frustration of shipments could be solved in another way than limited quantities. The group saw no other possibility to overcome this problem by changing, for instance, the transport conditions or other measures.

Conclusion: The working group could reach no conclusion as to whether it is advisable to begin allowing these items to use the provisions for limited quantities, although it could identify no technical grounds to do otherwise.

The group agreed to accept SAAMI's proposal A of …C.3/2010/18, as indicated below, in square brackets, excluding the LQ provisions of proposal A, pending consultation of issues other than transport, with a final decision to be taken at the December meeting.

20. Change the wording of the entry for *Cartridges, blank* in the glossary of terms in Annex B to add "tools":

"Articles which consist of a cartridge case with a centre or rim fire primer and a confined charge of smokeless or black powder but no projectile. Used for training, saluting or in starter pistols, [tools,] etc."

21. Make the following changes to the table in Chapter 3.2:

UN No.	Name and description	Class or division	Subsidiary risk	UN packing group	Special provisions	Limited and excepted quantities		Packaging and IBC's	
								Packing Instruction	Special packing provisions
0014	CARTRIDGES FOR WEAPONS, BLANK or CARTRIDGES, SMALL ARMS, BLANK [or CARTRIDGES FOR TOOLS, BLANK] †	1.4S				~~5 kg~~	E0	P130	

Regarding proposal B, SAAMI is retaining the 5kg limit for UN 0014.

Regarding proposal C of …C.3/2010/18, should the plenary decide to allow these three entries into the limited quantity regime then:

a) The working group recommends to accept amended text for the proposal in paragraph 23 as shown below (new text for paragraph 3.4.2 is shown in underlined text):

3.4.2 Dangerous goods shall be packed only in inner packagings placed in suitable outer packagings. Intermediate packagings may be used. However, the use of inner packagings is not necessary for the transport of articles such as aerosols or "receptacles, small, containing gas". Except for goods of Division 1.4S, which shall be packed in UN certified packagings in which they were approved by the competent authority and in accordance with the packing instructions and special packing provisions shown in columns 8 and 9 of the Dangerous Goods List in Chapter 3.2, the packagings shall meet the provisions of 4.1.1.1, 4.1.1.2 and 4.1.1.4 to 4.1.1.8 and be so designed that they meet the construction requirements of 6.1.4. The total gross mass of the package shall not exceed 30 kg.

b) The working group also recommends to accept the proposals contained in paragraphs 24 and 25.

c) SAAMI withdrew the proposal contained in paragraph 26.

5. *Criteria for excluding articles from Class 1*

Documents …C.3/2010/29 (USA), INF.28 (USA), and INF.35 (UK)

USA introduced its proposal by first advising that INF.28 replaces …C.3/2010/29 and proposed that the discussion be confined to INF.28. The intent of INF.28 is to define criteria for exclusion from class 1 as described in paragraph (b) of the definition found in paragraph 2.1.1.1 of the Model Regulations. The working group then considered several factors regarding the process of exclusion from class 1 including:

a) When to do the evaluation. Although the flow chart in Figure 10.3 of the Test Manual shows the evaluation being done at the end (see box 36), the group noted that, in many instances, Competent Authorities might want to consider performing

the evaluation at the beginning so as to avoid performance of costly and unnecessary tests.

b) Behaviour of candidate articles in a fire. The UK and Germany expressed concerns about the behaviour of the test article in a fire. The working group considered this issue and agreed that a note should be added to the proposed text for new paragraph 2.1.3.6.4 to advise Competent Authorities of the possibility of effects by the product if it is involved in a fire.

c) Evaluation of criteria for effects by flame. The working group noted that the proposal in INF.28 did not contain any criteria for effect by flame and, after further discussion, recommended that an evaluation somewhat like that contained in the 6(d) test be used.

d) Several in the group considered that the proposed temperature of 200°C was too high for acceptance of products that are to be allowed to be excluded from class 1. It was pointed out that temperatures achieved upon intentional initiation of the tested device most often dissipate very rapidly and that, in the case of a temperature spike, 200°C might be acceptable. After further discussion, the working group concluded that the temperature must not exceed 65°C, except that a momentary spike up to 200°C is acceptable.

e) Effects of the article when initiated in packaging. Although paragraph 2.1.1.1(b) describes effects from initiating an unpackaged article, several of the group expressed concerns that some articles that might be excluded from class 1 based on tests on unpackaged articles, might, in fact, be quite hazardous if they functioned within their package. The working group agreed that this could be a valid concern and recommended that a note be added to the proposal to caution about this possibility.

Conclusion: The working group accepted an amended version of the proposal in INF.28. The text of this amended proposal is contained in the Annex 2 to this report. To avoid ambiguity the working group noted that the words " (see. 2.1.3.6)" should be added at the end of section 2.1.1.1(b) as follows:

"… or loud noise (see section 2.1.3.6)."

6. *Test results on desensitized explosives*

Document INF.54 (Germany)

Germany presented results of recent tests on desensitized explosives and asked if other members of the working group have test results that they share them. They also proposed another intercessional meeting of the working group on desensitized explosives. The working group agreed that this might be possible, if there are some more papers and data put forward that could be considered at such an intercessional meeting.

ENA made a short presentation of recent testing on industrial nitrocellulose and the successes of safety distances used in conjunction with NC storage. France reported about a very large NC fire in the 1980s, in which there were no injuries, thus confirming their opinion that the safety distances work and confirmed the major hazard is fire. The observer from IPPIC joined the working group momentarily to make a comment from the downstream users of nitrocellulose regarding tremendous difficulties in handling nitrocellulose as a class 1 product, especially with no regard to the decades of safe use without an incident. ENA recommended that nitrocellulose be treated as a fast burning flammable solid rather than as a class 1 substance.

Conclusion: The working group concluded that the proposals underline the need to address the issue in GHS and recommended that as much data as possible be collected and after the collection and organization of that data, that an intercessional meeting be considered, most likely in early 2011, provided that the additional data for other substances is available. The purpose of that intercessional meeting would be to consider ways to reconcile the discrepancy between GHS classification and TDG classification of these types of these substances. The working group also unanimously noted that it is not appropriate to place these types of substances in the group of explosives.

7. *Proposed modifications to Test Series 7*

Document …C.3/2010/40 (UK and USA)

The UK presented a review of the work of an informal working group that had been formed to address the historic lack of articles assigned to Division 1.6, identifying the cause and potential remedies. The working group discussed the proposals in …C.3/2010/40 and made several suggestions for improvement that will be described in a revised proposal from the UK and USA. Additionally, the working group commented that there may be some merit to examine "response descriptors" in the proposal for use in other test series in the future.

Conclusion: Apart from some minor changes proposed by the working group (see Annex 3), it supported the document and the changes it proposes.

8. *A proposed new DDT Test and Criteria for flash compositions*

Documents …C.3/2010/31 (USA) and INF.34 (UK)

The USA described its belief that the HSL flash composition test is somewhat expensive to perform and may lead to mischaracterization of certain compositions. In …C.3/2010/31, USA is proposing a modified DDT test to examine flash compositions to see the explosive effects of the composition and to better characterize those compositions. At present, the USA is only looking for comments to aid them in further developing this proposal.

The UK believes that having a larger scale test as an alternative to the HSL test is desirable. The working group noted that it would be good to have both the HSL test and the proposed test performed on samples so that the results could be evaluated as to

whether the tests provide comparable results. Germany has agreed to perform both tests to provide data for comparison.

The Netherlands pointed out that, when using a DDT test, only detonation is being addressed and the possibility of explosion or fast progressing deflagrations should also be evaluated. It was also suggested that a more scientifically descriptive name might be developed for the proposed test.

France suggested a better description of the ignition source and the identification of the testing density.

Conclusion: The working group supported further development of the test and several members have offered to participate in evaluating the test. The USA took note of the comments offered by the working group and will continue to work on their proposal.

9. *On the use of the minimum burning pressure (MBP) test as an alternative Series 8 Test*

Documents …INF.41 (Canada) and INF.58 (Spain)

The 8(d) test is a large scale heating test to examine the hazards that might be present in the event of an accident involving a tank truck transporting UN 3375, Division 5.1 materials. The test involves large sample amounts that make the practicality of performing the test very limited, mostly to those regions having large test areas available for test performance. Additionally, questions regarding reproducibility and reliability of test results have also arisen. It also appears that the geometry of the test vessel and the method of building the fire may have more effect on the results of the test than does the material tested.

Canada believes its MBP test would serve as a good alternative to the 8(d) VPT and MVPT tests for the purpose of examining potential tank transport of ANEs. Canada stated that one of the desirable aspects of the MBP test is that it is a much smaller scale test. At present, Canada is looking for feedback on whether the MBP test may be a valid alternate 8(d) test.

Spain disagreed that MVPT test results are not reproducible or reliable. However, they also agreed that a smaller scale test would be desirable.

IME pointed out that the result of the MBP test, a dimension, removes the subjectivity from interpreting results that is currently present in evaluating 8(d) test results, and as such is more scientifically desirable. Additionally IME noted that the comparison done in the current 8(d) tests do not realistically represent the transport mode (tank) being evaluated.

Spain would like to see comparison of results from the MBP test with those of the current 8(d) tests. This would be very helpful in determining acceptability of the MBP test. The working group noted that it is a basic principle that when evaluating alternative tests, comparability with existing tests is required.

SAAMI pointed out that the MBP test could also be helpful with the GHS in evaluating workplace hazards, such as, in this case, pumping operations. Spain agreed that the MBP test is acceptable for this purpose and that they currently use the test to evaluate design of pumping installations. At present, they don't see the extrapolation of this test to evaluation of tank transportation hazards and would welcome additional data to help their evaluation of the MBP test for this purpose.

Conclusion: The working group agreed that the MBP test might be a good way forward in evaluating the hazards associated with tank transportation of ANEs. Many members offered to perform some tests to help with the further evaluation of the MBP test.

10. *On the use of the ARC technique as an alternative to Series 3 Test 3(c) and Series 8 Test 8(a)*

Document INF.42 (Canada)

Canada noted certain drawbacks in performing the 3(c) and/or 8(a) tests and suggested that the ARC test might be an acceptable alternative to these tests, especially when evaluating substances with self-heating properties, such as may be present in ANEs.

ICCA noted that the ARC is very old technology and that its energy values tend to be too low. They suggested the use of alternative methods such as long term DSC which is more sensitive and gives more reliable results. Additionally, they pointed out that the current 8(a) (Dewar test) is more sensitive than the ARC.

Conclusion: Canada took note of the comments from the working group and will continue to evaluate its proposal for possible consideration during the next biennium.

11. *Large-scale behaviour of fireworks*

Document INF.47 (Netherlands)

The Netherlands outlined problems getting CHAF II started, and the need for someone to review and advise on the results of testing of large-scale behaviour of fireworks. To resolve this problem, Netherlands is seeking a mandate from the sub-committee for the working group to address this project.

Conclusion: The working group considered and endorsed the proposal and recommends that the sub-committee adopt the following mandate:

In the biennium 2011-2012 the working group will be tasked with discussing and providing guidance on research results regarding large scale behaviour of fireworks in transport and storage conditions and, if necessary, to report the progress to the Sub-Committees with the understanding that the formal and related informal documents regarding explosives submitted to the Sub-Committees take precedence.

12. *Request for consultative status by the Australian Explosives Industry and Safety Group Incorporated*

Document INF.52 (AEISG)

Ken Price described the organization and efforts of AEISG to the working group. These efforts include valuable contribution to the group's efforts in development of Test Series 8 and development of the entry UN3375. IME pointed out that AEISG is analogous to IME and FEEM, both of whom have consultative status with the sub-committee.

Conclusion: The working group acknowledged the past contributions of AEISG and their qualification to provide future valuable contributions to the work of the sub-committee and encourages the sub-committee to favourably consider AEISG's application for consultative status pending further evaluation by the secretariat.

13. *Additional criteria for 1.4 classification*

Document INF.40 (Canada)

Canada reminded the working group that Division 1.4 (other than S) is supposed to present "minor hazard" in transportation. Canada doubts that some things that have been put into 1.4 (other than S) really present only "minor hazards", even though these same articles test favourably in TS 6(a) – 6(c) tests and may, at present, be assigned to Division 1.4 (other than S). Specifically problematic to Canada are articles that contain significant quantities of explosives that, if they were to initiate might present greater than "minor hazards". Canada is seeking the working group's comment on the topic and how it might be resolved.

It was suggested that this might be a good project for IGUS/EPP/CIE.

IME observed that there might be some merit to the proposal by Canada because there certainly could be some deficiencies in the current procedure to assign to Division 1.4. It further stated that it would welcome the opportunity to work with the working group in development of appropriate and realistic test methods to eliminate these deficiencies. IME also reminded the working group that, although it had been stated in earlier sessions that all hazard classes except class 1 are risk based, the working group should consider that an inappropriate test method could potentially exclude from Division 1.4 certain articles that have neglible risk of functioning in transport. SAAMI supported IME's comments, and stated that it also supports in principle the proposal by Canada, provided that the criteria are carefully developed to avoid unintended consequences.

Conclusion: The working group agreed that additional examination criteria for Division 1.4 may be necessary and encouraged Canada to continue to develop its proposal.

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Annex 1
Participants in the meeting of the working group on explosives, 22 – 24 June 2010

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Annex 2
Proposed Amended Proposal for INF.28

Add a new sub-section 2.1.3.6.4 to the Model Regulations to read as follows:

2.1.3.6.4 An article may be excluded from Class 1 when three unpackaged articles, each individually functioned by its own means of initiation or ignition or external means to function in the designed mode, meet the following test criteria:

(a) No external surface shall have a temperature of more than 65º C. A momentary spike in temperature up to 200º C is acceptable;

(b) No rupture or fragmentation of the external casing or movement of the article or detached parts thereof of more than one metre in any direction;

Note 1*: Where the integrity of the article may be affected in the event of an external fire these criteria shall be examined by a fire test, such as described in ISO 12097-3*

(c) No audible report exceeding 135 dB(C) peak at a distance of 1 metre;

(d) No flash or flame capable of igniting a material such as a sheet of 80 ± 10 g/m² paper in contact with the article; and

(e) No production of smoke, fumes or dust in such quantities that the visibility in a one cubic metre chamber equipped with appropriately sized blow out panels is reduced more than 50 percent as measured by a calibrated light (lux) meter or radiometer located one metre from a constant light source located at the midpoint on opposite walls . The general guidance on Optical Density Testing in ISO Standard 5659-1 and the general guidance on the Photometric System described in Section 7.5 in ISO Standard 5659-2 may be used or similar optical density measurement methods designed to accomplish the same purpose may also be employed. A suitable hood cover surrounding the back and sides of the light meter shall be used to minimize effects of scattered or leaking light not emitted directly from the source.

Note 2*: If during the tests addressing criteria (a), (b), (c) and (d) no or very little smoke is observed the test described in (e) may be waived.*

Note 3: *The competent authority may require testing in packaged form if it is determined that, as packaged for transport, the article may pose a greater risk.*

Annex 3
Amended Proposal for …C.3/2010/40

6. It is proposed that the definition of Division 1.6 classification is changed by deleting the word “detonating” from the terms “extremely insensitive detonating articles” and “extremely insensitive detonating substance.” The reason being that it is not a requirement for articles entering Division 1.6 and the substances that they contain to be capable of detonating in the article being assessed.

7. It is recognised that the current position of requiring all ~~energetic~~explosive substances contained in candidate Division 1.6 articles to undergo TS7 type 7 (a) through (f) tests and is not necessary for certain fuze and booster substances where explosive hazard can be controlled through design. The paper proposes a new procedure to govern the requirement to conduct substance testing which maintains appropriate confidence that relative Division 1.6 article insensitivity remains.

8. A number of further changes to article tests of types 7 (g) through to (l), linked to the point above, are proposed to attain confidence in the behaviour of more vulnerable substances upon accidental initiation or propagation of the article, which includes:

(a) Reinforcement of the need for all ~~energetic~~explosive substances to be present in article tests of types 7(g) through (l);

(b) Addition of a Test Type 7 (l): a test to determine the sensitivity of an article to shock directed at vulnerable components;

(c) Specific targeting of vulnerable areas, often associated with fuze or boostering components, in tests of types 7 (j) and 7 (l).

9. This document also includes a proposal on "Response descriptors" used to assign a level of response to TS7 article tests. This addresses the need to improve guidance on assigning response levels and will facilitate international consistency in the analysis of test results. To achieve this ~~a number of definitions are proposed for the Model Regulations, Appendix B, Glossary of the terms. These refer to~~ a new ~~proposed~~ Appendix 8 in the Manuel of Tests and Criteria is proposed which provides the detail needed to achieve this goal.

10. A number of other changes to article tests are proposed in Annex I to help achieve the following aims:

(a) Provide improve guidance on test procedures drawing on best practice;

(b) Develop consistency between article tests;

(c) Introduce the proposed response descriptors.

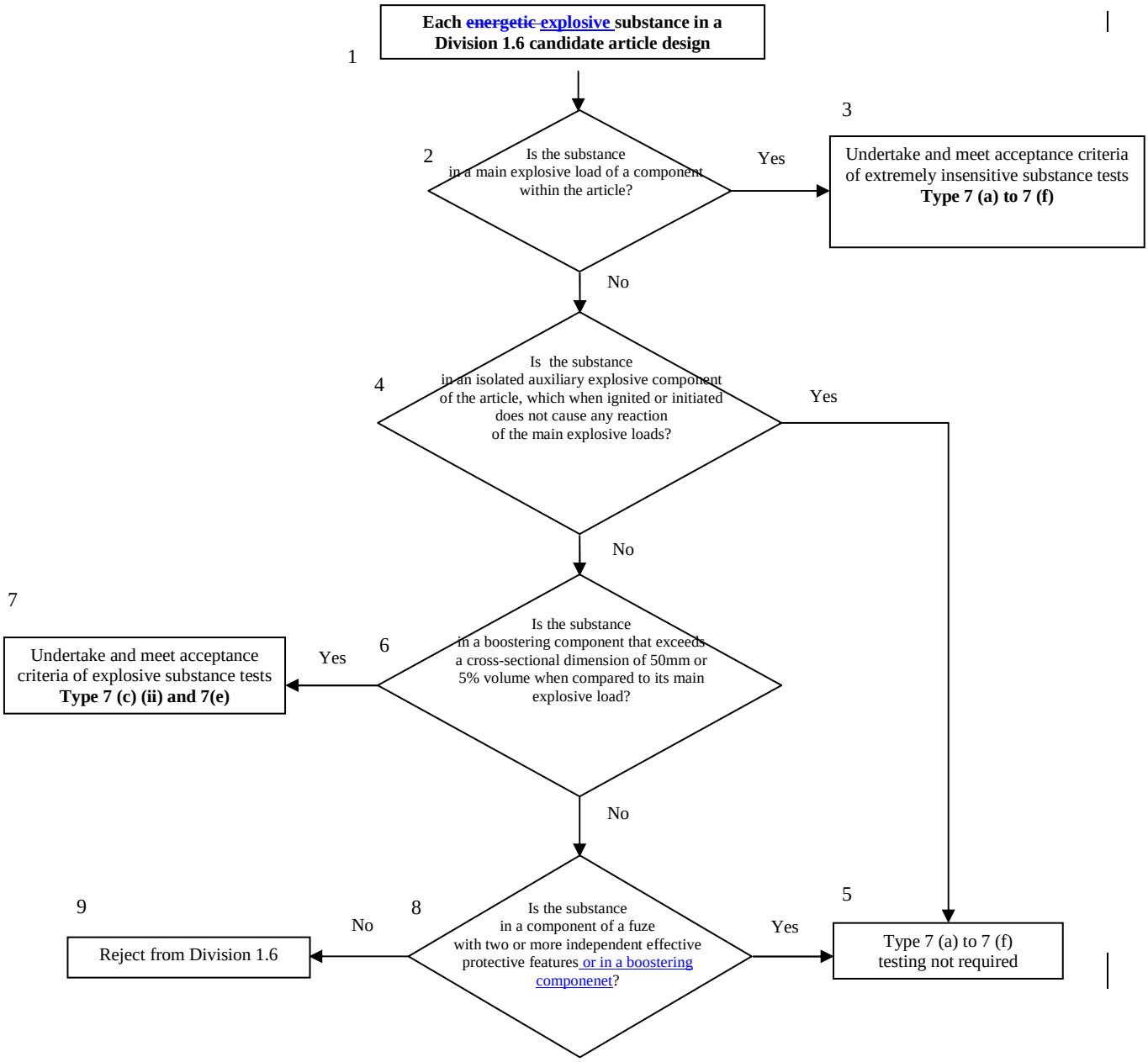
11. The experts from the United Kingdom and United States of America invite the Sub-Committee to consider these proposals for acceptance into the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria and the Model Regulations.

Annex I

Proposed amendments to the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria

Sub-section 10. 4 Procedure for assignment to a division of Class 1

Add Figure 10.5 “Procedure to determine required substance testing for Division 1.6:



10.4.2.4 Amend the beginning to read:

"The question "Is it an extremely insensitive explosive article?" (box 40, Figure 10.3) is answered by series 7 tests and any candidate for Division 1.6 should be assessed against each of the eleven types of test comprising the series. The protocol for determining the test requirements is given in Figure 10.5. The first six types of test (7(a)-7(f)) are used to establish if a substance is an Extremely Insensitive Substance (EIS). The purpose of these tests is to develop an understanding of the sensitivity of substance(s) contained within the article, which informs and provides confidence in the article tests. The remaining five types of test (7(g), 7(h), 7(j), 7(k) and 7 (l)) are used to determine if an article predominantly containing EIS may be assigned to Division 1.6. The eleven test types are:".

Add an additional test to the list at 10.4.2.4:

"Type 7 (l): a test to determine the sensitivity of an article to shock directed at vulnerable components."

10.4.3.6 Amend the sentence to read:

"Tests types 7 (a) to 7 (f) should be used to establish that a substance is an extremely insensitive substance and then test types 7 (g), 7 (h), 7 (j), 7 (k) and 7 (l) used to establish that the articles predominantly containing EIS(s) may be assigned to Division 1.6."

Add a new paragraph to detail the application of test series 7, for which the following is proposed:

"10.4.3.7 Tests of types 7 (g), 7 (h), 7 (j), 7 (k) and 7(l) should be performed to determine if an article with EIS main explosive load(s) and appropriately insensitive boostering components may be assigned to Division 1.6. These tests are applied to articles in the condition and form in which they are offered for transport, except that non-explosive components may be omitted or simulated if the competent authority is satisfied that this does not invalidate the results of the tests. The procedure detailing testing requirements is given in Figure 10.5 and some points of explanation are given below.

(a) Complex articles may contain multiple substances and this procedure should be completed for all substances within the article to be classified.

(b) The question "Is the substance in a main explosive load of a component within the article?" (Box 2 of Figure 10.5) is answered by examining the design of the article. Main explosive load substances are those loaded into components within the article that are not fuze, boostering, or isolated auxiliary explosive components. All substances in main explosive loads must "Undertake and meet acceptance criteria of extremely insensitive substance tests, Type 7 (a) to 7 (f)" (Box 3 of Figure 10.5). If a '+' result is obtained for any main explosive load substance to any Type 7 (a) to 7 (f) test, the substance is not an EIS and the answer to the question in Box 24 of Figure 10.3 is "No." The article is not a candidate for Division 1.6.

(c) Answering the question "Is the substance in an isolated auxiliary explosive component of the article, which when ignited or initiated does not cause any reaction of the main explosive loads?" (Box 4 of Figure 10.5) requires knowledge of the design of the article plus the explosive effects that occur when such components are initiated or ignited, either in their design mode or accidentally. Typically these will be small explosive actuators or pyromechanical devices that produce movement, cutting or opening functions. If the answer is 'yes' to this question, Type 7 (a) to 7 (f) testing is not required for substances in isolated auxiliary explosive components and the article remains a candidate for Division 1.6.

(d) The question “Is the substance in a boostering component that exceeds a cross-sectional dimension of 50 millimetres or 5 percent volume when compared to its main explosive load?” (Box 6 of Figure 10.5) is answered by examining the design of the article. All substances in such larger boostering components, including those contained in explosive components of dual-protected fuzes in an article, must “Undertake and meet acceptance criteria of explosive substance tests, Type 7 (c) (ii) and 7 (e)” (box 7 of Figure 10.5). If a ‘+’ result is obtained for any such larger boostering component substance to either Type 7 (c) (ii) and 7 (e) tests, the answer to the question in Box 24 of Figure 10.3 is “No.” The article is not a candidate for Division 1.6.

(e) The question “Is the substance in a component of a fuze with two or more independent effective protective features or in a boostering component” (Box 8 of Figure 10.5) is answered by an understanding of the design and development of the article. If the answer is ‘no’, the article is not considered to have suitable intrinsic safety characteristics and the answer to the question in Box 24 of Figure 10.3 is ‘No’ the article is not a candidate for Division 1.6.”.

Note: Knowledge of the design and explosive effects can be obtained by modelling or indicative tests etc.

Section 17 Test Series 7

17.1 Introduction

Amend the end of the first sentence to read “… any candidate for Division 1.6 should be assessed against each of the eleven types of test comprising the series.”.

Amend the second sentence to read “The first six types of test (7(a) to 7(f)) are used to establish if a substance is an Extremely Insensitive Substance (EIS) and the remaining five types of test (7 (g), 7 (h), 7 (j), 7 (k) and 7 (l)) are used to determine if an article predominantly containing EIS(s) may be assigned to Division 1.6. The eleven test types are:”.

Add an additional test to the list:

“Type 7 (l): a test to determine the sensitivity of the article to shock directed at vulnerable components.”.

In Table 17.1 Test Methods for test series 7, replace "EIDS" with "EIS"

Add an additional test on articles:

"7 (l) 1.6 article fragment impact test 17.14.1".

Sub-section 17.3 Test conditions

Insert a new paragraph before existing 17.3.1:

“17.3.1 All ~~energetic~~explosive components must always be present in articles during Series 7 testing of types 7 (g) to 7 (l). Smaller explosive components containing substances not subjected to tests of type 7 (a) to 7 (f) shall be specifically targeted in tests 7(j) and 7(l) when it is assessed that they will cause the most severe reaction from the test article, to ensure the probability of accidental initiation or propagation of a Division 1.6 article remains negligible.”.

Amend 17.3.1 to become 17.3.2 and:

Amend the first sentence “… use as the explosive load…”; to read “… use as a main explosive load…”

Insert a new second sentence “A substance intended for use as a larger (dimensionally) boostering component in an article of Division 1.6, where the volumetric size limit

relative to the main explosive load it is boostering is met, should be tested in accordance with Test Series 3 and tests of type 7 (c) (ii) and 7 (e).".

Amend 17.3.2 to become 17.3.3 and:

Amend the end of the first sentence to read "…until after main explosive load and certain boostering component substances have undergone appropriate tests of type 7 (a) to 7 (f) to determine whether they meet the substance requirements for Division 1.6.".

Insert a new second sentence to read: "Guidance on the substance testing determination process is given under section 10.4.3.6.".

Amend 17.3.3 to become 17.3.4 and:

In the first sentence replace "…and 7 (k) should be performed to determine if an article with an EIDS load may be assigned…" ; by "…7 (k) and 7 (l) should be performed to determine if an article with EIS main load(s) and appropriately insensitive boostering components may be assigned…"

Insert a new paragraph 17.3.5:

"17.3.5 Response levels referred to within the following individual Test Series 7 test prescriptions are provided at Appendix 8 (Response descriptors), to aid in the assessment of the results of tests of types 7 (g), 7 (h), 7 (j), 7 (k) and 7 (l) and should be reported to the competent authority to support assignment to Division 1.6.".

Sub-section 17.10 Series 7 type 7 (g) test prescription

Amend 17.10.1 test name to read "Test 7 (g): 1.6 article (or component level) external fire test".

Under 17.10.1.3 Procedure: the existing text is to be numbered 17.10.1.3.1. Add the following new paragraphs.

"17.10.1.3.2 Colour still photographs are taken to document the condition of the test item and the test equipment before and after the test. ~~Energetic materials~~Explosive substance remains, fragmentation, blast, projections, cratering, witness screen damage, and thrust are documented as an indication of the article's response level.

17.10.1.3.3 Colour video for the duration of each trial can be vital to assessment of response. In siting the camera(s), it is important to ensure that the field of view will not be obstructed by any of the test facilities or instrumentation and that the field of view will include all necessary information.

17.10.1.3.4 To classify complex articles containing multiple EIS main explosive loads, external fire testing at the individual main load component level should be conducted to fully characterise the article's response level.".

Amend the beginning of 17.10.1.4 to read "If there is a response level more severe than burning as outlined in Appendix 8, the result is …".

Sub-section 17.11 Series 7 type (h) test prescription

Amend 17.11.1 test name to read "Test 7 (h): 1.6 article or component level slow cook-off test".

17.11.1.3.2 In first sentence replace "the unit" by "the test item".

Amend the second sentence to read "~~Energetic materials~~Explosive substance remains, fragmentation, blast, projections, cratering, witness plate damage, and thrust are documented as an indication of the article's response level.".

Delete the third and fourth sentences.

Add additional sentences; “Colour video for the duration of each trial can be vital to assessment of response. In siting the camera(s), it is important to ensure that the field of view will not be obstructed by any of the test facilities or instrumentation and that the field of view will include all necessary information.”.

17.11.1.3.3 Add an additional sentence after the first to read: “To classify complex articles containing multiple EIS main explosive loads, slow cook-off testing at the individual main load component level should be conducted to fully characterise the article’s response level.”.

17.11.1.4 Amend to read “If there is a response level more severe than burning as outlined in Appendix 8, the result is noted as "+" and the items are not classified as Division 1.6 articles.”.

Sub-section 17.12 Series 7 type (j) test prescription

Amend 17.12.1 test name to read “Test 7 (j~~h~~): 1.6 article or component level bullet impact test”.

17.12.1.2 Amend the first sentence to read “Three 12.7 mm guns are used to fire service 12.7 mm armour-piercing ammunition with a projectile mass of 0.046 kg.”.

Insert a second sentence to read “Standard propellant loads may require adjustment to achieve projectile velocities within tolerance.”.

Amend the existing second sentence to read “The guns are fired by remote control and protected…”

Amend the existing third sentence to read “The firing gun muzzles should be at a minimum range of at least 10 m from the test item to assure bullet stabilization prior to impact, and at a maximum range of 30 m from the test item depending upon the explosive weight of the test item.”.

In the existing fourth sentence replace “… restraining the item against…”; by “…restraining the test item against…”.

Delete the last sentence.

17.12.1.3 The existing text is to be numbered 17.12.1.3.1. Amend the beginning of the first sentence to read “The candidate Division 1.6 article is subjected to a three-round…”.

Amend the remainder of the paragraph to read “The test is repeated in three different orientations, striking the test item in the most vulnerable areas as assessed by the competent authority. These are areas for which an assessment of the explosive sensitivity (explosiveness and sensitiveness) combined with knowledge of the article design indicate the potential producing the most violent response level.”.

Add the following paragraphs:

“17.12.1.3.2 Colour still photographs are taken to document the condition of the test item and the test equipment before and after the test. ~~Energetic materials~~Explosive substance remains, fragmentation, blast, projections, cratering, witness plate damage, and thrust are documented as an indication of the article’s response level.

17.12.1.3.3 Colour video for the duration of each trial can be vital to assessment of response. In siting the camera(s), it is important to ensure that the field of view will not be obstructed by any of the test facilities or instrumentation and that the field of view will include all necessary information.

17.12.1.3.4 To classify complex articles containing multiple EIS main explosive loads, bullet impact testing at the individual main load component level should be conducted to fully characterise the article’s response level.”.

17.12.1.4 Amend to read “If there is a response level more severe than burning as outlined in Appendix 8, the result is noted as "+" and the items are not classified as Division 1.6 articles.”.

Sub-section 17.13 Series 7 type (k) test prescription

17.13.1.2 Amend to read “The experimental set-up is the same as for test 6 (b) (see 16.5.1.2), with one trial conducted confined, and another unconfined. The test should only be conducted on detonable candidate Division 1.6 articles; the test 7 (k) article stack test is waived for non-detonable candidates for Division 1.6 (evidence is available to demonstrate that the article cannot support a detonation). Where the article is designed to provide a detonation output, the article’s own means of initiation or a stimulus of similar power shall be used to initiate the donor. If the ~~detonable~~ article is not designed to detonate but is capable of supporting a detonation, the donor shall be detonated using an initiation system selected to minimise the influence of its explosive effects on the acceptor article(s).”.

17.13.1.3 In the second sentence, replace “…performed three unless…” by “performed twice unless”.

Insert a new third sentence to read “Colour still photographs are taken to document the condition of the test item and the test equipment before and after the test.”.

Amend the existing third sentence to read “~~Energetic materials~~ Explosive substance remains, fragmentation, blast, projections, cratering, witness plate damage, and thrust are documented and used to assess whether or not any acceptor has detonated (including partially).”.

Add the following text at the end of this paragraph “Colour video for the duration of each trial can be vital to assessment of response. In siting the camera(s), it is important to ensure that the field of view will not be obstructed by any of the test facilities or instrumentation and that the field of view will include all necessary information. Comparing data from the two stack test trials to data from a single donor calibration shot, or to a calculated donor detonation pressure, can be useful in assessing the response level of acceptors.”.

17.13.1.4 Amend the second sentence to read “Acceptor article response levels assessed as no reaction, burning, deflagration, or explosion as outlined in Appendix 8 are considered as negative results and noted as "—".”.

Sub-section 17.14 (new)

Add the following new sub-section:

“17.14 Series 7 type (l) test prescription

17.14.1 Test 7 (l): 1.6 article (or component level) fragment impact test

17.14.1.1 Introduction

This test is used to determine the response of an article in its transport configuration to a localised shock input representative of a fragment strike typical of that produced from a nearby detonating article.

17.14.1.2 Apparatus and materials

To reduce variability due to yaw, a gun system is recommended for firing a standard 18.6 gram steel fragment in the shape of a right-circular cylinder with a conical nose, as detailed in Figure 17.14.1, at a candidate Division 1.6 article. The distance between the firing device and the test item should ensure that the fragment is

ballistically stable at impact. Barricades should protect the remote control gun system from the potential damaging effects of the test item's reaction.

17.14.1.3 Procedure

17.14.1.3.1 The test is repeated in two different orientations, striking the test item in the most vulnerable areas as assessed by the competent authority. These are areas for which an assessment of the explosive sensitivity (explosiveness and sensitiveness) combined with knowledge of the article design indicate the potential for producing the most violent response level. Typically, one test would be conducted targeting a non-EIS boostering component and the second test would target the centre of the main explosive load. The orientation of impact should generally be normal to the outer surface of the article. The fragment impact velocity should be 2530 ± 90 m/s.

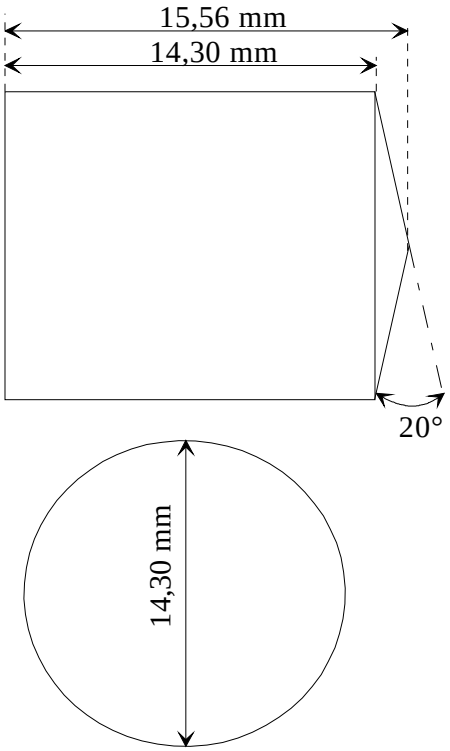
17.14.1.3.2 Colour still photographs are taken to document the condition of the test item and the test equipment before and after the test. ~~Energetic materials~~Explosive substance remains, fragmentation, blast, projections, cratering, witness plate damage, and thrust are documented as an indication of the article's response level.

17.14.1.3.3 Colour video for the duration of each trial can be vital to assessment of response. In siting the camera(s), it is important to ensure that the field of view will not be obstructed by any of the test facilities or instrumentation and that the field of view will include all necessary information.

17.14.1.3.4 To classify complex articles containing multiple EIS main explosive loads, fragment impact testing at the individual main load component level should be conducted to fully characterise the article's response level.

17.14.1.4 Test criteria and method of assessing results

If there is a response level more severe than burning as outlined in Appendix 8, the result is noted as "+" and the items are not classified as Division 1.6 articles.



Notes:

Shape: a conical ended cylinder with the ratio $\frac{\text{L (length)}}{\text{D (diameter)}} > 1$ for stability; Tolerances: ± 0.05 mm and ± 0°30'
Fragment Mass: 18.6 grams
Fragment Material: a mild carbon steel with a Brinell Hardness (HB) less than 270

Figure 17.14.1 Standard fragment for 1.6 article fragment impact test

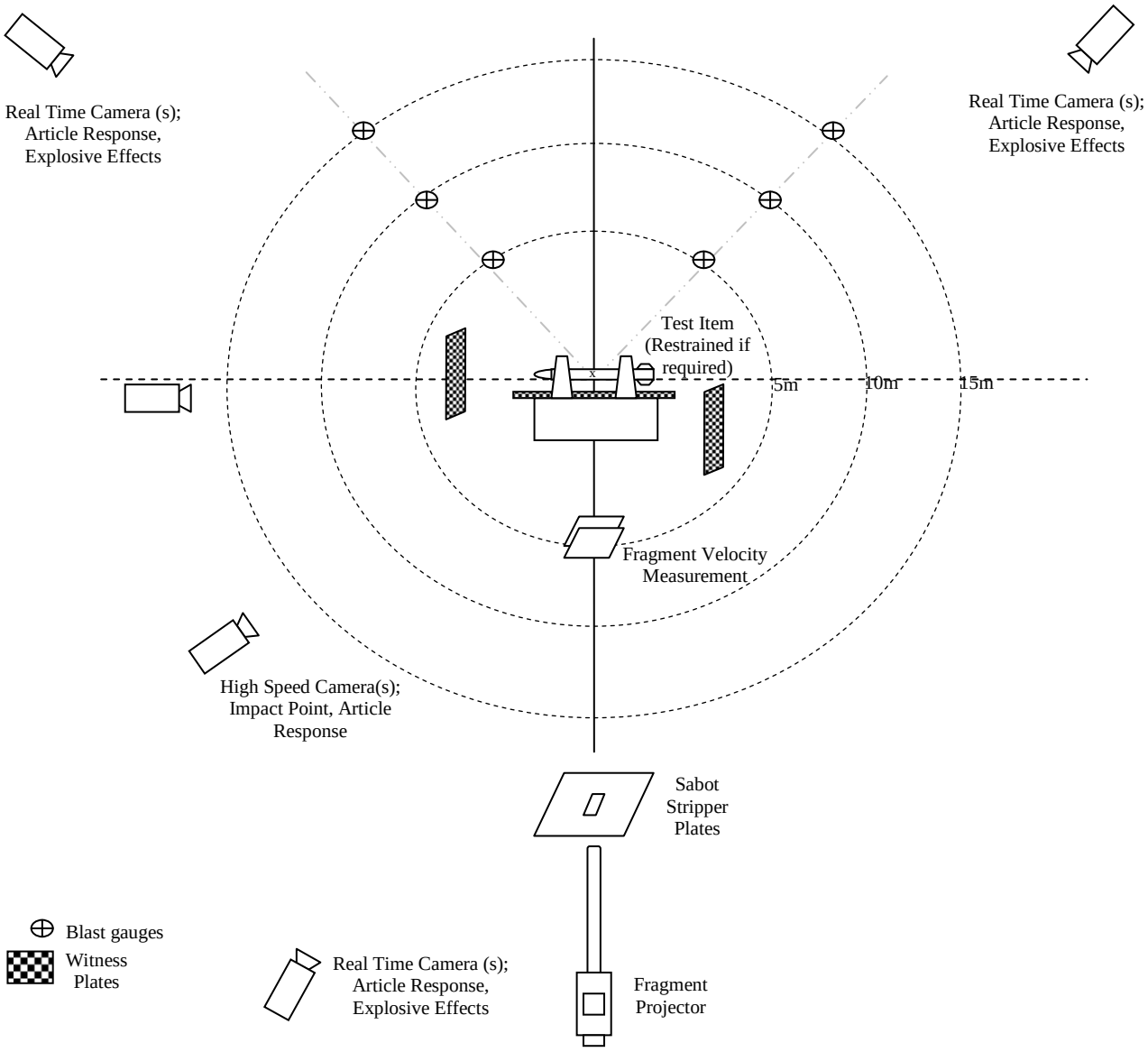


Figure 17.14.2 Typical setup for 1.6 article fragment impact test”

Appendix 8 (new)

Add a new appendix 8 to read as follows:

"APPENDIX 8

RESPONSE DESCRIPTORS

These Response descriptors are to be used for the purposes of TS7 criteria and designed to be used by ~~Subject Matter Experts (SMEs)~~the competent authority to determine the response type of articles. For example, articles vary greatly in size, type, packaging and ~~energetic materials~~explosive substances; these differences need to be taken into account. For a reaction to be judged a particular type, the Primary evidence (denoted P in the table below) for that type would need to be present. The entire (both primary and secondary) body of evidence must be weighed carefully and used in its entirety by ~~experienced SMEs~~the competent authority to assess the reaction. The secondary evidence provides other indicators that may be present.

Response level	Observed or measured effects				
	Explosive Substances~~Energetic materials~~ (~~EM~~ES)	Case	Blast	Fragment or ~~EM~~ES projection	Other
Detonation	Prompt consumption of all ~~EM~~ES once the reaction starts	(P) Rapid plastic deformation of the metal casing contacting the ~~EM~~ES with extensive high shear rate fragmentation	(P) Shock wave with magnitude & timescale = to a calculated value or measured value from a calibration test	Perforation, fragmentation and/or plastic deformation of witness plates	Ground craters of a size corresponding to the amount of ~~EM~~ES in the article
Partial detonation		(P) Rapid plastic deformation of some, but not all, of the metal casing contacting the ~~EM~~ES with extensive high shear rate fragmentation	(P) Shock wave with magnitude & timescale < that of a calculated value or measured value from a calibration test Damage to neighboring structures	Perforation, plastic deformation and/or fragmentation of adjacent witness plates. Scattered burned or unburned ~~EM~~ES.	Ground craters of a size corresponding to the amount of ~~EM~~ES that detonated.
Explosion	(P) Rapid combustion of some or all of the ~~EM~~ES once the article reaction starts	(P) Extensive fracture of metal casings with no evidence of high shear rate fragmentation resulting in larger and fewer fragments than observed from purposely detonated calibration tests ¤	Observation or measurement of a pressure wave throughout the test arena with peak magnitude << and significantly longer duration that of a measured value from a calibration test	Witness plate damage. Significant long distance scattering of burning or unburned ~~EM~~ES.	Ground craters.
Deflagration	(P) Combustion of some or all of the ~~EM~~ES	(P) Rupture of casings resulting in a few large pieces that might include enclosures or attachments. *¤	Some evidence of pressure in the test arena which may vary in time or space.	(P) At least one piece (casing, enclosure or attachment) travels beyond 15m with an energy level > 20J based on the distance/mass relationship of Figure 16.6.1.1. Significant scattered burning or unburned ~~EM~~ES, generally beyond 15 m.	(P) There is no primary evidence of a more severe reaction and there is evidence of thrust capable of propelling the article beyond 15m. Longer reaction time than would be expected in an explosion reaction.

Response level	Observed or measured effects				
	Explosive Substances~~Energetic materials~~ (~~EM~~ES)	Case	Blast	Fragment or ~~EM~~ES projection	Other
Burn	(P) Low pressure burn of some or all of the ~~EM~~ES	(P) The casing may rupture resulting in a few large pieces that might include enclosures or attachments. *~~¤~~	Some evidence of insignificant pressure in the test arena.	(P) No item (casing, enclosure, attachment or ~~EM~~ES) travels beyond 15m with an energy level > 20J based on the distance/mass relationship detailed at Figure 16.6.1.1 . (P) A small amount of burning or unburned ~~EM~~ES relative to the total amount in the article may be scattered, generally within 15m but no farther than 30m.	(P) No evidence of thrust capable of propelling the article beyond 15m. For a rocket motor a significantly longer reaction time than if initiated in its design mode.
No Reaction	(P) No reaction of the ~~EM~~ES without a continued external stimulus. (P) Recovery of all or most of the unreacted ~~EM~~ES with no indication of a sustained combustion.	(P) No fragmentation of the casing or packaging greater than that from a comparable inert test item. *	None	None	None

* Note: Mechanical threats will directly induce damage causing disruption of the article or even a pneumatic response resulting in parts, particularly closures, being projected. This evidence can be misinterpreted as being driven by the reaction of the ~~energetic material~~explosive substance contained in the article, which may result in a more severe response descriptor being assigned. Comparison of observed evidence with that of a corresponding inert article can be useful in helping to determine the article's response."

Consequential amendments

Wherever it appears, replace the acronym "EIDS" by "EIS" in Table 1.2, contents of Part 1, and sub-sections 17.4, 17.5, 17.6, 17.7, 17.8 and 17.9.

In the contents of Part 1:

(a) In the entries for "17.10.1 Test 7 (g), 17.11.1 Test 7 (h) and 17.12.1 Test (j), insert "(or component level)" after "Article".

(b) Add the following:

"17.14 Series 7 type (l) test prescription;

17.14.1 Test 7 (l) * 1.6 Articles (or component level) fragment impact test (UN)".".

In the General Table of Contents, add at the end "Appendix 8 RESPONSE DESCRIPTORS".

Annex II

Proposed amendments to the Recommendations on the Transport of Dangerous Goods; Model Regulations

Chapter 2.1

2.1.1.4 (f) Delete the word "detonating".

2.1.2.1.1 In the description for compatibility group N, delete the word "detonating".

Appendix B Glossary of Terms

Insert the following definitions:

"AUXILIARY EXPLOSIVE COMPONENT, isolated

An "isolated auxiliary explosive component" is a small device that explosively performs an operation related to the article's functioning, other than its main explosive loads' performance. Functioning of the component does not cause any reaction of the main explosive loads contained within the article.".

~~"BURNING~~

~~An explosive effects level which is defined in Appendix 8, Response descriptors, of the Manual of Tests and Criteria.".~~

~~"DEFLAGRATION~~

~~An explosive effects level which is defined in Appendix 8, Response descriptors, of the Manual of Tests and Criteria.".~~

~~"DETONATION~~

~~An explosive effects level which is defined in Appendix 8, Response descriptors, of the Manual of Tests and Criteria.".~~

~~"DETONATION, partial~~

~~An explosive effects level which is defined in Appendix 8, Response descriptors, of the Manual of Tests and Criteria.".~~

~~"EXPLOSION~~

~~An explosive effects level which is defined in Appendix 8, Response descriptors, of the Manual of Tests and Criteria..".~~

~~"FUZING, INDEPENDENT EFFECTIVE PROTECTIVE FEATURES within dual protected fuze arrangements are considered equivalent to the means of initiation or ignition not being present in an article. Mechanical protective features may typically include an interrupter (rotor or slider) that houses an initiator or igniter and keeps the explosive train in an out of line position until unlocked by at least two proper environmental stimuli. Multiple electronically controlled features are also commonly incorporated into fuzing to provide comparable protectiveness in in-line explosive trains. Evidence to demonstrate that such features are effective in not allowing accidental or premature initiation or ignition of their main explosive load, generally obtained during article developmental testing, and documentation explaining the~~

~~features' operational independence from each other, should be made available to competent authorities."~~

In the definition for "ARTICLES, EXPLOSIVE, EXTREMELY INSENSITIVE (ARTICLES, EEI).", delete the word "detonating" before "substance".

Replace the definition for "EXPLOSIVE, EXTREMELY INSENSITIVE DETONATING SUBSTANCE (EIDS)" by a definition for "EXPLOSIVE, EXTREMELY INSENSITIVE SUBSTANCE (EIS)" to read as follows: A substance which has demonstrated through tests that it is so insensitive that there is very little probability of accidental initiation".