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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

Report of the Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals on its seventh session

held in Geneva on 12 December 2014

Addendum

Annex II

Amendments to the 5th revised edition of the United Nations Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.5)

Section 1

1.1.2 Add the following new sentence at the end:

"Examples which may be listed within various test procedures are for illustrative purposes and are provided for guidance only.".

(Reference documents: ST/SG/AC.10/C.3/2014/37 and informal document INF.61/Add.2 of the forty-fifth session)

1.1.3 Add a new section 1.1.3 to read as follows:

"1.1.3 In situations where the proper classification of substances and articles of certain Hazard Classes or Divisions for transport is the responsibility of the Competent Authority, it is normal and accepted practice that due consideration will be given to testing or classification results of other Competent Authorities when provided.".

(Reference document: ST/SG/AC.10/C.3/86/Add.1)

Part I

Section 10

Figures 10.3 and 10.9 Amend as follows:

Figure 10.3: PROCEDURE FOR ASSIGNMENT TO A DIVISION OF CLASS 1

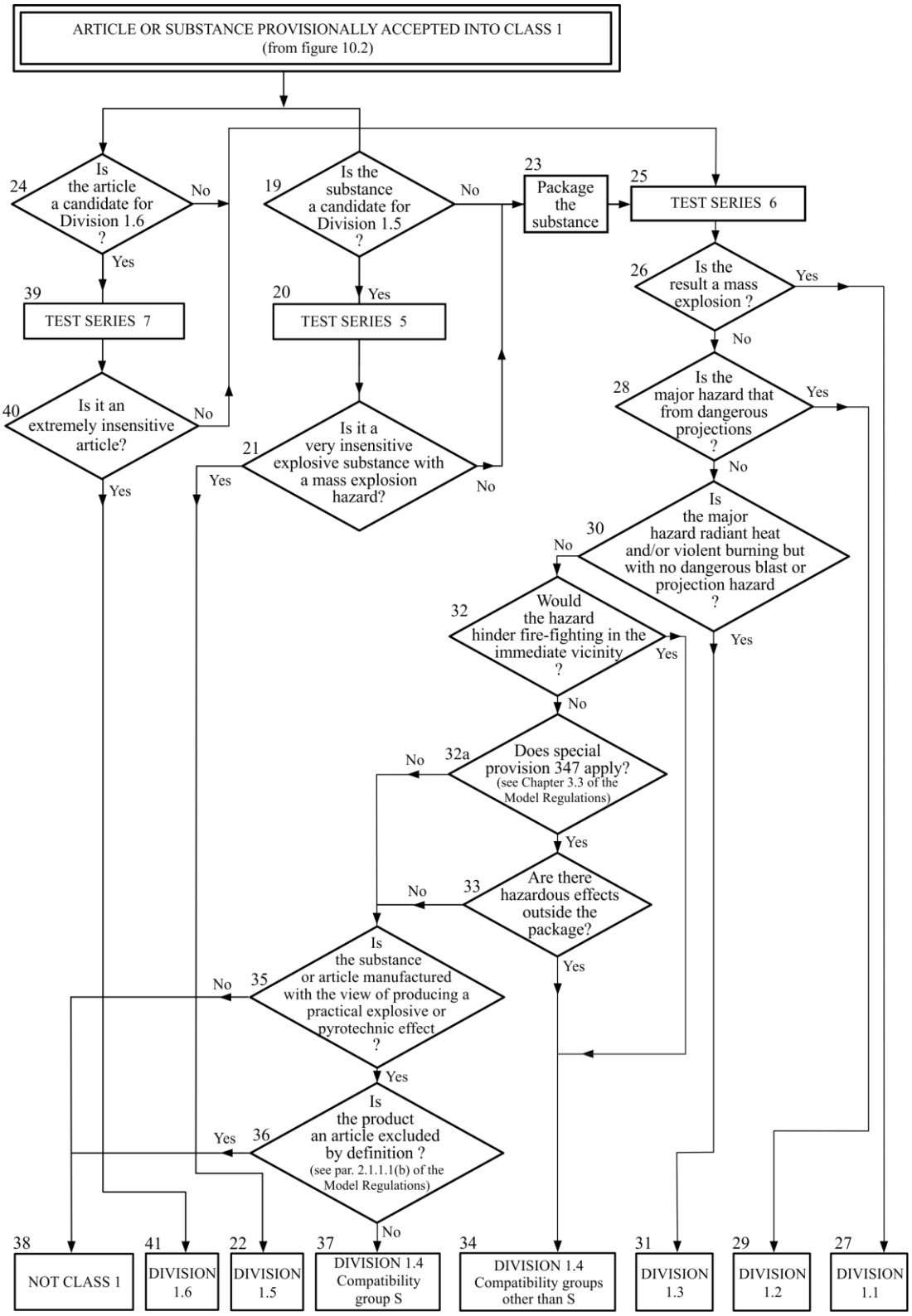
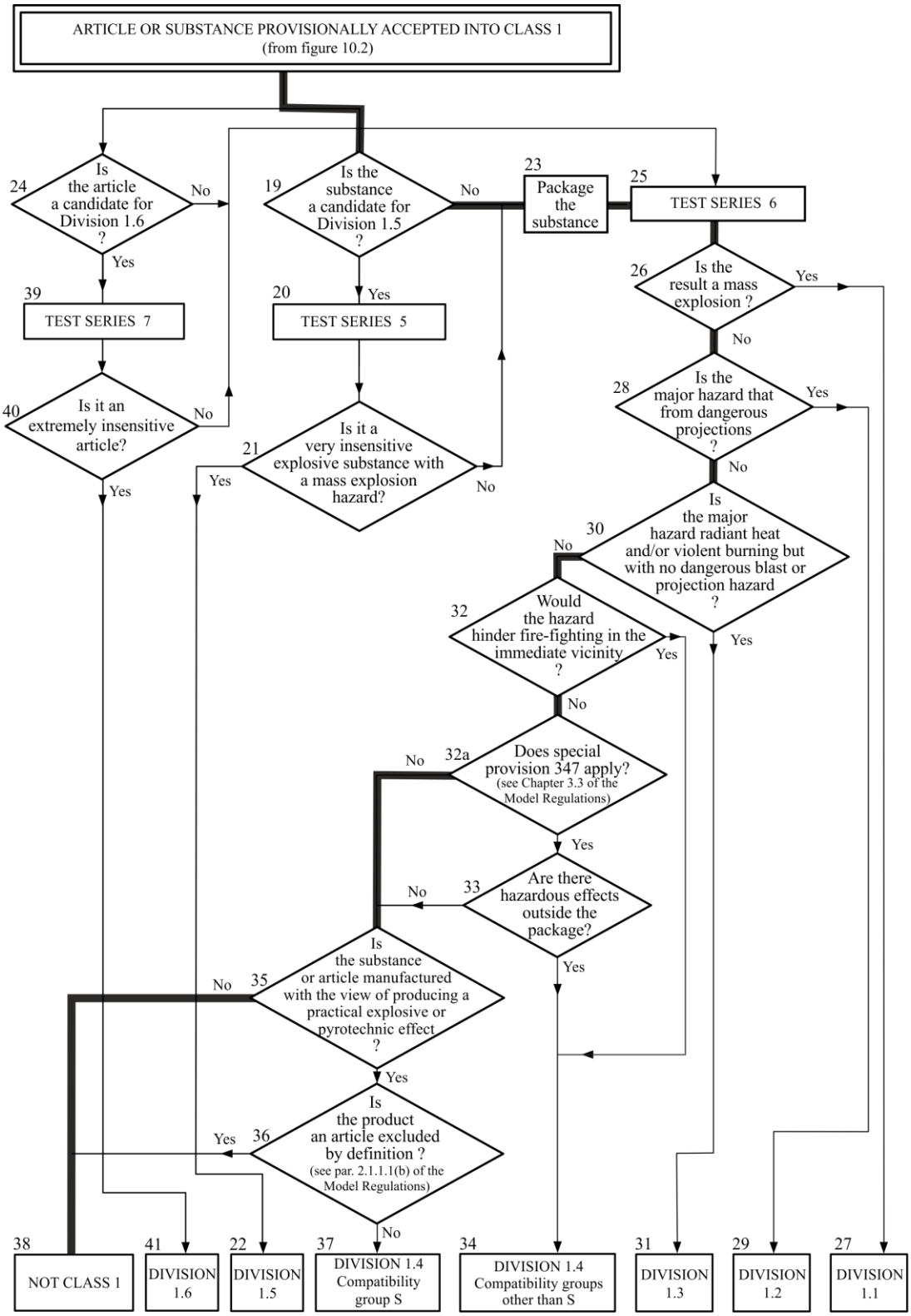


Figure 10.9: PROCEDURE FOR EXEMPTION OF MUSK XYLENE FROM CLASS 1



(Reference documents: ST/SG/AC.10/C.3/2014/4 and informal document INF.61/Add.2 of the forty-fifth session)

Consequential amendments:

Figure 10.8 In 6.2, replace "box 35" by "box 32a". After 6.2, insert new lines to read as follows:

"7. Box 32a : Does special provision 347apply?

7.1. Anwser : No

7.2. Exit : Go to box 35"

Renumber existing lines 7 and 8 accordingly.

10.4.2.5 In the last paragraph, insert "of ANEs" after "the suitability" and "portable" before "tanks".

(Reference documents: ST/SG/AC.10/C.3/2014/11 and informal document INF.61/Add.2 of the forty-fifth session)

10.4.3.4 Amend as follows:

In the first sentence, insert "normally" after "and 6 (d) are". In the second sentence, insert "follow this order or to" after "necessary to".

Third and fourth sentences become new sub-paragraphs (a) and (b) respectively. At the end of both add the following phrase: ", (see also section 10.4.3.4.(d));".

Former sub-paragraphs (a) and (b) become indents (i) and (ii) under new sub-paragraph (b).

Next two sentences after (i) and (ii), former sub-paragraphs (a) and (b), become sub-paragraphs (c) and (d) respectively. At the end of (d) insert a new sentence to read as follows: "When testing articles to which special provision 347 applies, test type 6 (d) may be performed first. If the results of test type 6 (d) indicate that a 1.4S classification is appropriate, then test types 6 (a) and 6 (b) may be waived.".

Delete the last sentence, starting with "The results of test series 6 (c)…".

(Reference documents: ST/SG/AC.10/C.3/2014/4 as amended and informal document INF.61/Add.2 of the forty-fifth session)

Section 11

11.1.1 In the first sentence, delete "national and international definitions of an explosive substance and".

(Reference documents: informal document INF.61/Add.2 of the forty-fifth session)

11.3.2 At the end insert ", if known".

(Reference documents: informal document INF.61/Add.2 of the forty-fifth session)

11.3.5 Insert ""Low" or" after "F.1 or F.2 or F.3 test is".

(Reference documents: informal document INF.61/Add.2 of the forty-fifth session)

11.4.1.2.1 Amend as follows:

In the second sentence, delete "cold drawn" and replace "4.0 ± 0.1" by "4".

In the fourth sentence, replace "two layers of 0.08 mm thick polythene" by "a plastics", insert "tightly" before "in place" and delete the remainder of the sentence after "in place".

Amend the fifth and sixth sentences to read as follows: “The plastics sheet shall be compatible with the substance under test. The booster charge consists of 160 g RDX/wax (95/5) or PETN/TNT that has a minimum of 50% PETN in the mixture, 50 ± 1 mm in diameter with a density of 1 600 ± 50 kg/m^3.”.

In the seventh sentence, replace “RDX/wax charge” by “charges”.

In the eighth sentence, replace “3.2 ± 0.2” by “3” and “is mounted” by “may be mounted”.

(Reference documents: ST/SG/AC.10/C.3/2014/6 and informal document INF.61/Add.2 of the forty-fifth session)

11.4.1.3.1 Delete the last sentence.

(Reference documents: informal document INF.61/Add.2 of the forty-fifth session)

11.4.1.4 In the first sentence, replace “and” by “or”. Amend the end of the sentence after the indents to read as follows: “substance is considered not to be able to propagate a detonation”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

11.6.1.2.2 In the third sentence, after “lead washer” insert “or a washer of a suitable deformable material (for example, polyoxymethylene)”.

(Reference documents: ST/SG/AC.10/C.3/2014/6 and informal document INF.61/Add.2 of the forty-fifth session)

Section 12

12.3.2 At the end insert “, if known”.

(Reference documents: informal document INF.61/Add.2 of the forty-fifth session)

12.3.4 Insert ““Low” or” after “F.1 or F.2 or F.3 test is”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

12.4.1.2 Amend as follows:

In the second sentence, delete “cold drawn” and replace “4.0 ± 0.1” by “4”.

In the fourth sentence, replace “two layers of 0.08 mm thick polythene” by “a plastics”, insert “tightly” before “in place” and delete the remainder of the sentence after “in place”.

Amend the fifth and sixth sentences to read as follows: “The plastics sheet shall be compatible with the substance under test. The booster charge consists of 160 g RDX/wax (95/5) or PETN/TNT that has a minimum of 50% PETN in the mixture, 50 ± 1 mm in diameter with a density of 1 600 ± 50 kg/m^3.”.

In the seventh sentence, replace “RDX/wax charge” by “charges”.

In the eighth sentence, replace “3.2 ± 0.2” by “3” and “is mounted” by “may be mounted”.

(Reference documents: ST/SG/AC.10/C.3/2014/6, informal document INF.61/Add.2 of the forty-fifth session)

12.4.1.3.1 Delete the last sentence.

(Reference documents: informal document INF.61/Add.2 of the forty-fifth session)

12.4.1.4 In the first sentence, replace “and” by “or”. Amend the end of the sentence after the indents to read as follows: “substance is considered to be not sensitive to detonative shock.”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

12.6.1.2.2 In the third sentence, after "lead washer" insert "or a washer of a suitable deformable material (for example, polyoxymethylene)".

(Reference documents: ST/SG/AC.10/C.3/2014/6 and informal document INF.61/Add.2 of the forty-fifth session)

Section 13

13.2, Table 13.1 Renumber existing "3 (c)" as "3 (c) (i)". Add the following new entries in the corresponding order:

Test code	Name of Test	Section
3 (a) (vii)	Modified Bureau of Mines impact machine test	13.4.7
3 (b) (iv)	ABL friction machine test	13.5.4
3 (c) (ii)	SBAT thermal stability test at 75 °C	13.6.2

Consequential corrections:

In the table of contents, for 13.5.3, replace "Test 3 (b) (iv)" by "Test 3 (b) (iii).

13.5.3 In the title, replace "Test 3 (b) (iv)" by "Test 3 (b) (iii).

(Reference documents: ST/SG/AC.10/C.3/2014/48, -2014/51, -2014/52 and informal document INF.61/Add.2 of the forty-fifth session)

13.4 Add a new subsection 13.4.7 to read as follows:

"13.4.7 Test 3 (a) (vii): Modified Bureau of Mines impact machine test

13.4.7.1 *Introduction*

This test is used to measure the sensitiveness of the substance to drop-mass impact and to determine if the substance is too dangerous to transport in the form tested. The test substance is subjected to a vertical impact force through an intermediate hammer via a drop mass. It is applicable to solid, semisolid, liquid, and powder substances.

13.4.7.2 *Apparatus and materials*

13.4.7.2.1 The general design of the MBOM impact test apparatus is given in Figure 13.4.7.1. The following components are required:

A mechanism containing a drop mass of 2.0 kg, two drop mass guide rails, a drop mass holding, lifting, and dropping mechanism, and a 1.0 kg intermediate hammer containing a 1.27 cm diameter steel insert with a surface roughness of 1.3 – 1. 8 µm that is resting on a sample placed on an steel anvil (impact surface 3.8 cm diameter) with a surface roughness of 1.3 – 1. 8 µm. Details of the target area are given in Figure 13.4.7.2.

13.4.7.3 *Procedure*

13.4.7.3.1 Solid sample placement

As a rule substances are tested in the form in which they are received. Wetted substances should be tested with the minimum quantity of wetting agent required for transport. Depending on the physical form, the substances should then be subjected to the following procedures:

(a) Powders are to be tested on the anvil in a monolayer; i.e., the thickness of the granular material. Place enough granules on the anvil to cover an area in excess of the 1.3 cm^2 area of the insert.

(b) Solid propellants are tested in the form of thin, uniform slices. The slices are usually square, having a minimum edge length of 1.6 cm and a thickness of 0.08 ± 0.01 cm. This thickness is easily obtainable with the use of a microtome cutting tool.

The intermediate hammer is raised. The test substance is placed centrally on the anvil. The intermediate hammer is then carefully lowered onto the substance on the anvil.

13.4.7.3.2 Liquids and semisolids sample placement

Depending on the physical form, the substances should then be subjected to the following procedures:

(a) Liquids are tested with a controlled thickness and a fixed gap of 0.05 cm above the liquid level using a spring between the hammer collar and the guide collar (adjustable tension). The thickness of the liquid sample is controlled by putting a piece of 0.015 cm thick tape (compatible with the substance) with a 1.6 cm diameter hole in it on the anvil. The intermediate hammer is raised. The hole in the tape is centrally positioned on the anvil such that the intermediate hammer insert does not touch the tape. A 0.05 cm feeler gauge is used to set the proper gap above the liquid. The tape hole is filled with the liquid substance and levelled-off using a straight-edge ensuring that no air gaps are present in the sample. The intermediate hammer is then carefully lowered to 0.05 cm above the substance on the anvil.

(b) Semisolids (slurries, gels, etc.) are prepared and tested in much the same way as liquid samples; however, the sample thickness is governed by the largest particle size. If the largest particle size is greater than the 0.015 cm thickness then a monolayer sample is spread on the anvil in a monolayer; i.e., the thickness of the granular material. If the cohesive properties of the semisolid are not practical for a 0.015 cm thickness, then the minimum attainable thickness is used. Place enough granules on the anvil to cover an area in excess of the 1.3 cm^2 area of the intermediate hammer insert.

13.4.7.3.3 Machine operation

The drop mass is raised to the desired height (17 cm for solids and semisolids and 11 cm for liquids) and released to drop onto the intermediate hammer. Observations are made on whether a “reaction” occurs as evidenced by audible report or production of smoke, fire, charring or visible light as observed by human senses. The type of reaction that occurs is documented. The surfaces are cleaned with a cloth or light abrasive pad to remove any residual material from the anvil or intermediate hammer insert. The anvil and intermediate hammer insert are inspected for scratches, scoring, divots, or other damage which may affect the surface roughness. If damaged these items should be replaced before use on the next trial. Six trials are performed for each test sample.

13.4.7.4 *Maintenance and calibration*

Moving parts should be inspected to ensure that they are freely moving and that friction between them is minimal. The distance between the drop mass and the intermediate hammer that is resting on the anvil should be verified. The contact area between the intermediate hammer insert and anvil should be uniform. The test machine should be periodically cleaned and calibrated according to a schedule based on the amount of usage. At a minimum, the machine should be calibrated on an annual basis.

13.4.7.5 *Test criteria and method of assessing results*

13.4.7.5.1 Solids

The test result is considered "+" if a reaction (see 13.4.7.3.3) is observed in at least 1 out of 6 trials at a drop height of 17 cm and the substance is considered too dangerous for transport in the form in which it was tested. Otherwise, the result is considered "–". Borderline cases may be resolved using the Bruceton method (see Appendix 2).

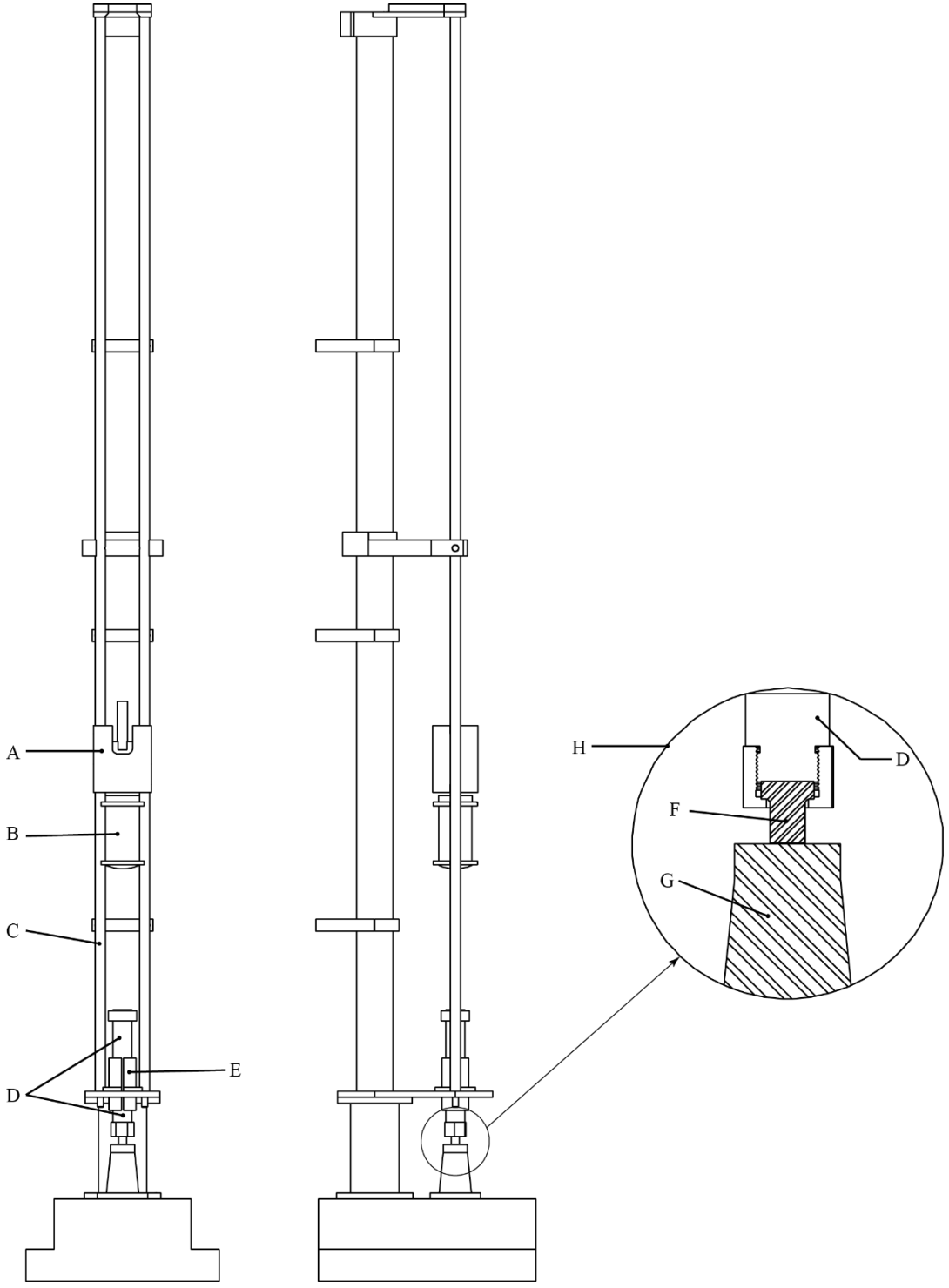
13.4.7.5.2 Liquids

The test result is considered "+" if a reaction (see 13.4.7.3.3) is observed in at least 1 out of 6 trials at a drop height of 11 cm and the substance is considered too dangerous for transport in the form in which it was tested. Otherwise, the result is considered "–". Borderline cases may be resolved using the Bruceton method (see Appendix 2).

13.4.7.6 *Examples of results*

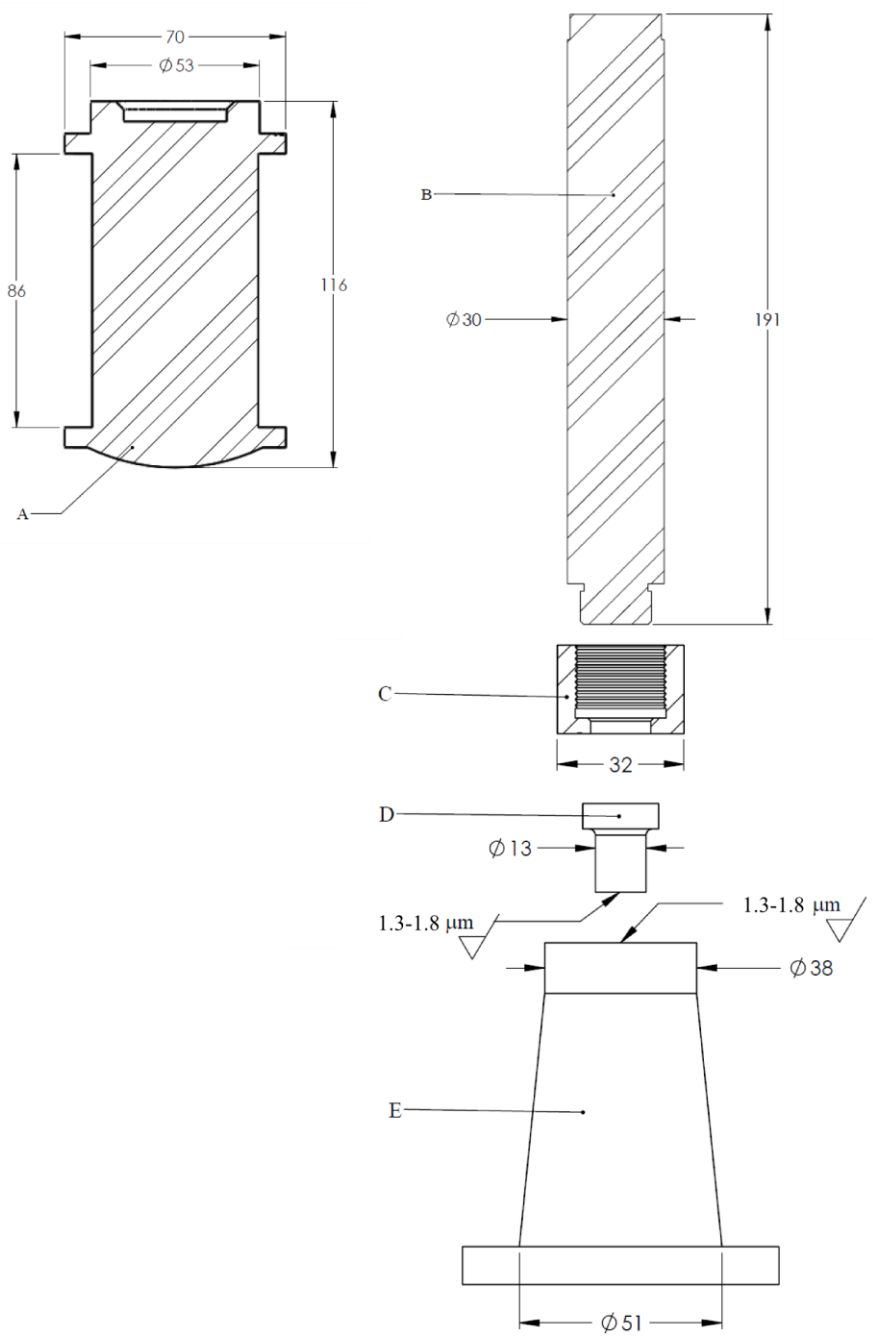
Substances[1]	**Result**
RDX (dry)	+
PBXN-8	–
Nitrocellulose/DNT (90/10)	–
PETN (dry)	+
Nitroglycerin	+

[1] *Data acquired at relative humidity of 10-30% and temperature of 16-24 °C*



(A)	Drop mass lifting, holding, and dropping device	(B)	Drop mass
(C)	Drop mass guild rails	(D)	Intermediate hammer
(E)	Intermediate hammer guide	(F)	Intermediate hammer insert
(G)	Anvil	(H)	Magnified view of target area

Figure 13.4.7.1: MBOM Impact machine



(A)	Drop mass
(B)	Intermediate hammer
(C)	Intermediate hammer insert retaining nut
(D)	Intermediate hammer insert
(E)	Anvil

Figure 13.4.7.2: MBOM Impact machine drop mass and target area detail".

(Reference documents: ST/SG/AC.10/C.3/2014/51 and informal document INF.61/Add.2 of the forty-fifth session)

13.5 Add a new subsection 13.5.4 to read as follows:

"13.5.4 Test 3 (b) (iv): ABL friction machine test

13.5.4.1 *Introduction*

This test is used to measure the sensitiveness of the substance to friction stimuli and to determine if the substance is too dangerous to transport in the form tested. The test substance is subjected to a vertical compression force under a non-rotating wheel, while the substance is moved in a horizontal direction on a sliding anvil. It is applicable to solid, semisolid, and powder substances.

13.5.4.2 *Apparatus and materials*

13.5.4.2.1 The following apparatus and materials are required:

(a) A mechanism capable of applying a force hydraulically through a non-rotating steel wheel to a sample placed on steel anvil. Both the wheel and anvil have a surface roughness of of 1.3 – 1. 8 µm and a Rockwell C hardness of 55 – 62.

(b) A pendulum system that is capable of being positioned and released at an angle that will impart a predetermined velocity to the sliding anvil. A travel distance of approximately 2.5 cm perpendicular to the applied force on the wheel is achieved with this system.

13.5.4.3 *Procedure*

13.5.4.3.1 As a rule, substances are tested in the form in which they are received. Wetted substances should be tested with the minimum quantity of wetting agent required for transport. Depending on the physical form, the substances should then be subjected to the following procedures:

(a) Powders are to be tested on the anvil in a monolayer; i.e., the thickness of the granular material, if possible. Place enough granules on the anvil to approximately cover an area 1.3 cm long by 0.65 cm wide starting about 0.65 cm behind the initial contact point of the wheel with the anvil such that the wheel will be in total contact with the sample when lowered onto it.

(b) Solid propellants are tested in the form of thin, uniform slices with a thickness of 0.08 + 0.01 cm. This thickness is easily obtainable with the use of a microtome cutting tool.

(c) Semisolids will be smoothed with a spatula to a thin layer with uniform thickness approximately 0.015 cm.

With the friction wheel raised, the test substance is placed on the anvil below the wheel such that the wheel will be in total contact with the sample when lowered onto it. The friction wheel is then carefully lowered onto the substance on the anvil and the desired normal force is applied to the wheel 250 N at 2.4 m/s or 445 N at 1.2 m/s. The pendulum is raised to the desired angle to achieve the appropriate test velocity and released. Observations are made on whether a "reaction" occurs as evidenced by audible report or production of smoke, fire, charring or visible light as observed by human senses. The type of reaction that occurs is documented. The force on the wheel is removed and any excess test substance is cleaned from the area. The wheel is indexed and shifted across the anvil in order to ensure that fresh surfaces are used for each trial.

13.5.4.4 *Maintenance and calibration*

The maximum speed of the anvil should be calibrated to 2.4 m/s and 1.2 m/s. The downward force on the wheel should be verified. The test machine should be periodically cleaned and calibrated according to a schedule based on the amount of usage. At a minimum, the machine should be calibrated on an annual basis.

13.5.4.5 *Test criteria and method of assessing results*

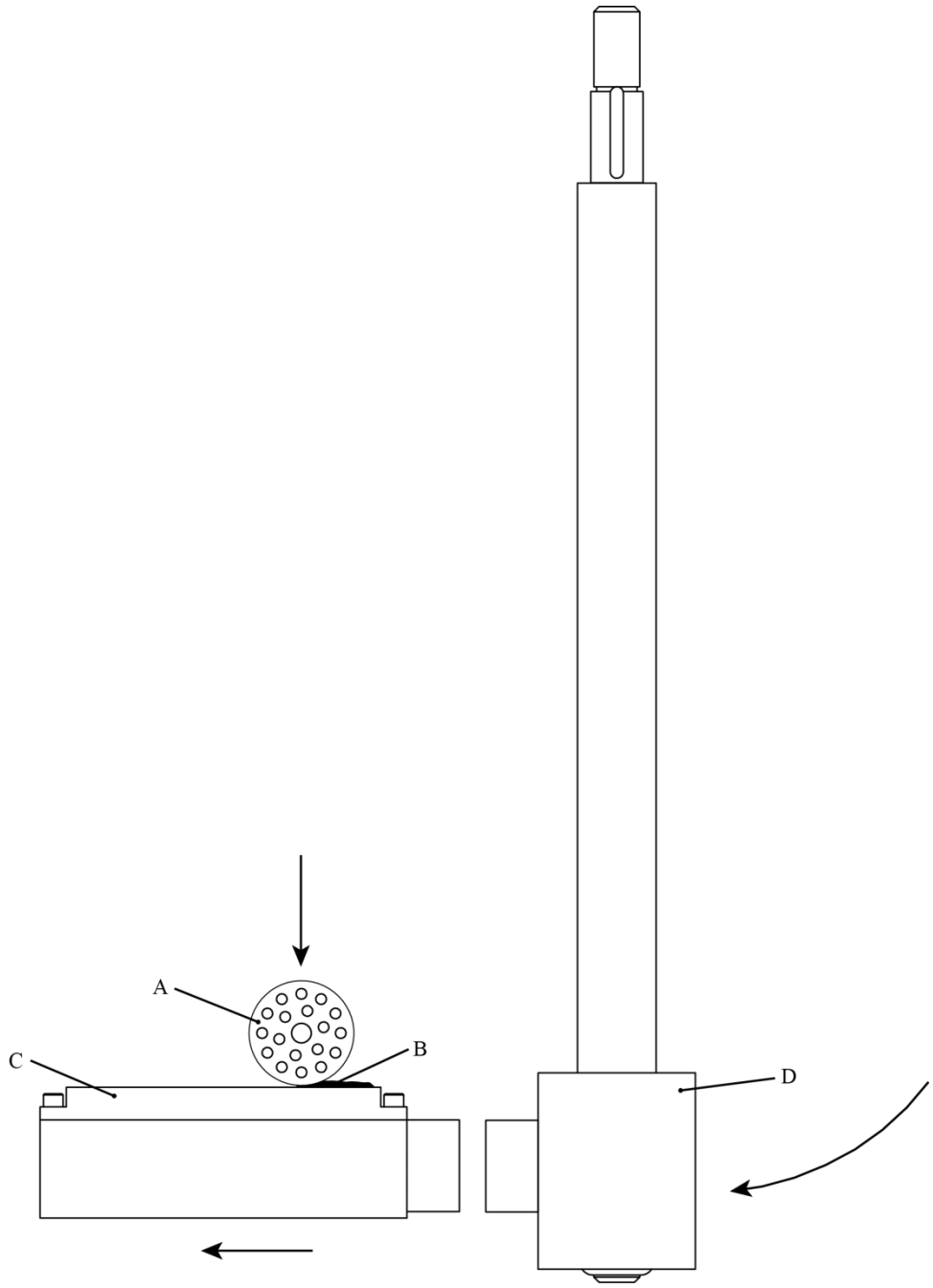
The test result is considered "+" if the lowest friction load at which at least one reaction occurs in six trials is 250 N at 2.4 m/s or 445 N at 1.2 m/s or less and the substance is considered too dangerous for transport in the form in which it was tested. Otherwise, the result is considered "–".

13.5.4.6 *Examples of results*

Substances[1]	**Result**
RDX (class 5)	–
RDX (class 7)	–
PBXN-8	–
PBXN-10	–
Aluminum/TNT (80/20 Mixture)	–
PETN (dry)[2]	+

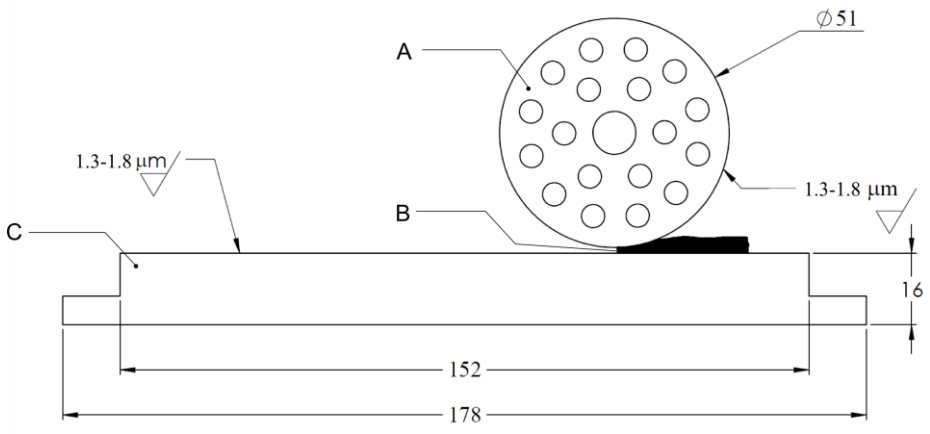
[1] *Data acquired at 2.4 m/s, relative humidity of 10-30%, and temperature of 16-24 °C unless noted otherwise.*

[2] *Data acquired at 2.4 m/s and 1.2 m/s.*



(A)	Non-rotating wheel	(B)	Sample
(C)	Anvil	(D)	Pendulum

Figure 13.5.4.1: ABL Friction machine



(A)	Non-rotating wheel 5.1 cm diameter maximum × 3.18 cm
(B)	Sample under test
(C)	Anvil 18 cm × 5.7 cm × 1.6 cm maximum

Figure 13.5.4.2: ABL Friction machine wheel and anvil detail".

(Reference documents: ST/SG/AC.10/C.3/2014/48 as amended and informal document INF.61/Add.2 of the forty-fifth session)

13.6.1 Amend the title to read: "*Test 3 (c) (i): Thermal stability test at 75 °C*" and amend the table of contents accordingly.

13.6 Add a new subsection 13.6.2 to read as follows:

"13.6.2 Test 3(c) (ii): SBAT thermal stability test at 75 °C

13.6.2.1 *Introduction*

This test is used to measure the stability of the substance when subjected to elevated thermal conditions to determine if the substance is too dangerous for transport.

13.6.2.2 *Apparatus and materials*

13.6.2.2.1 The following apparatus is required:

(a) Glass sample tubes of 13 x 100 mm inside a larger tube of 25 x 100 mm. Each 13 x 100 mm tube is surrounded by insulation and placed into the larger tube. Each larger glass tube has insulation surrounding it further isolating it thermally from the metal oven block. The glass sample tube can be sealed to prevent the escape of gases.

(b) A well-insulated multiport metal block that can be heated with resistance heaters to a temperature of at least 260 °C. The heating of the block must be automated or reliably controlled so that the desired temperature can be maintained within ± 0.5 °C. The heated block should have independent protection against excessively heating the block in the event of a primary control system failure. Each port in the metal block should have a diameter of 5 cm and a depth of 10 cm.

(c) The temperature decay time constant, τ, for the configuration outlined in (a) and (b) should be at least 10 minutes. The decay constant, τ, is found

by heating 5 grams of an inert material (e.g. dried silica, alumina, or silicone) in the sample tube (13 x 100 mm test tube) to a temperature 50 °C or more higher than the constant temperature of the SBAT. The heated sample tube is placed into the SBAT apparatus (into the larger glass tube with internal and external insulation as previously described). The sample will cool to the constant temperature of the oven. While cooling, the sample temperature is recorded. The decaying temperature will be exponential in shape and is fit to the following equation:

$$(T - T_a)/(T_i - T_a) = \exp(-t/\tau)$$

where T is the inert reference temperature that varies with time, T_a is the constant oven temperature, T_i is the initial reference temperature, t is time and τ is the temperature decay time constant.

(d) An inert material (e.g. dried silica, alumina or silicone) to be used as a reference which is also placed into insulated glass tubes (13 x 100 mm inside the larger 25 x 100 mm tube) with the same insulation configuration as the sample.

(e) Thermocouples with a data recording system to record the temperature of the reference and sample(s) as well as thermocouple(s) to measure and control the oven temperature.

13.6.2.3 *Procedure*

13.6.2.3.1 Five grams of the sample or an amount that fills the tube to 75 mm height, whichever is less, is placed inside one of the sample tubes. A second sample tube is filled with the same amount of sample. One of the filled sample tubes is not sealed whereas the second filled sample tube is sealed with a screw cap or other method. For the sample tube that is sealed, the thermocouple is attached to the sidewall of the sample tube. For the open sample tube, the thermocouple can be attached to the side of the tube or inserted into the sample.

13.6.2.3.2 Each sample tube is then surrounded with insulation and placed into the larger 25 x 100 mm tube which is also insulated from the side walls of the SBAT oven ports. The approximately 5 gram reference sample must also be present in one of the SBAT ports with the same insulation configuration as the sample. The samples are heated to 75 – 77 °C and maintained at that temperature for 48 hours. Sample and reference temperatures are recorded throughout the test.

13.6.2.3.3 Once the test has been completed, additional test data may be obtained by linearly increasing the temperature of the apparatus to determine the thermal profile of the sample (measuring endotherms and exotherms, as evidenced by departures of the sample from the temperature of the inert reference).

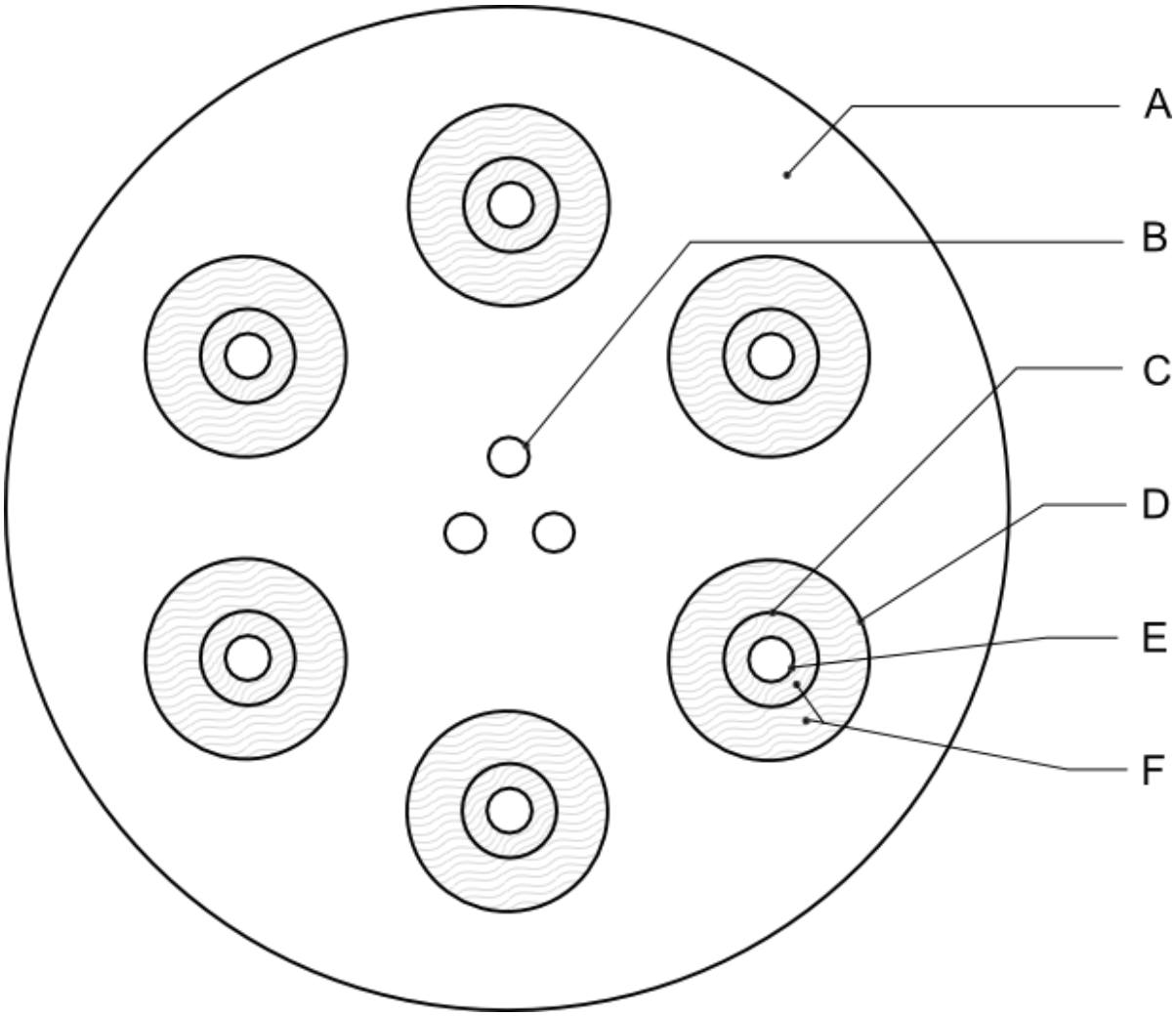
13.6.2.4 *Test criteria and method of assessing results*

13.6.2.4.1 The result from a test is considered "+" if either the sealed or unsealed sample shows more than a 1.5 °C temperature rise during the 48 hour test period indicating self-heating.

13.6.2.4.2 If the test result is "+", the substance should be considered too thermally unstable for transport.

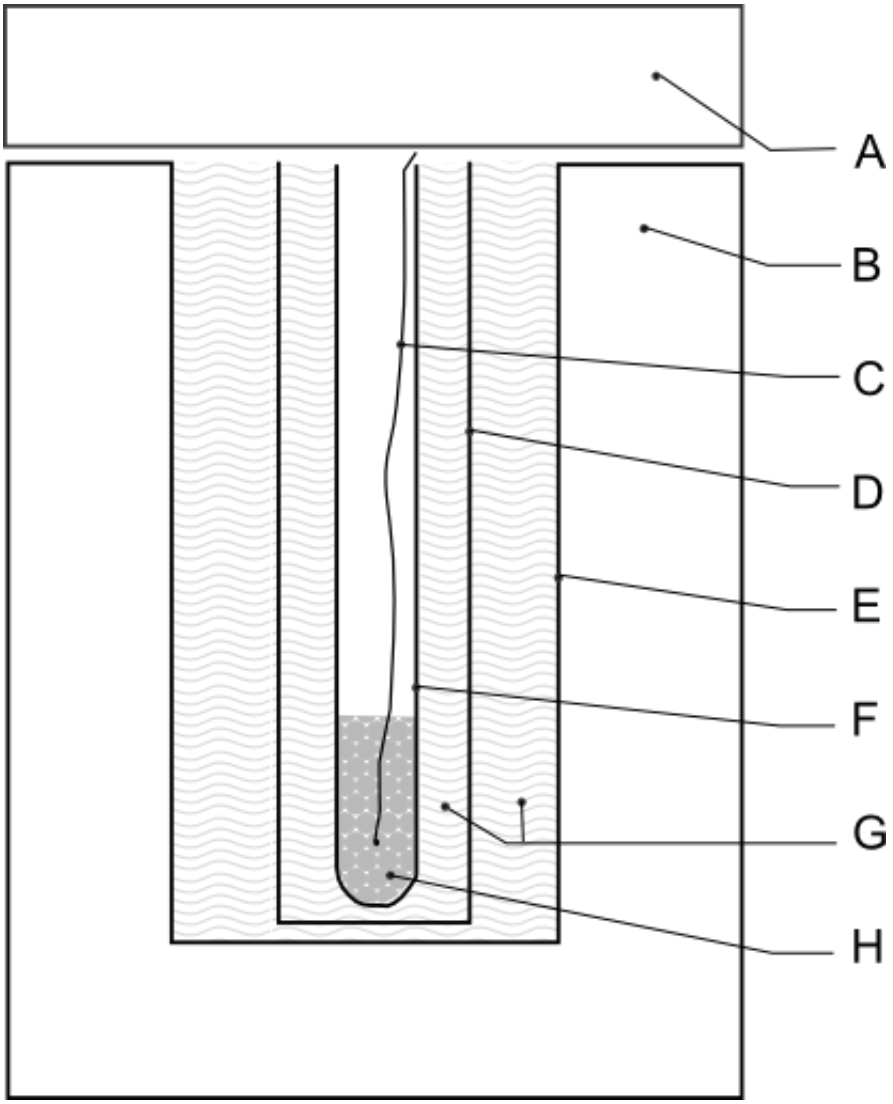
13.6.2.5 *Examples of results*

Substances	**Temperature Rise**	**Result**
PETN	Less than 1.5 °C	–
RDX	Less than 1.5 °C	–
TNT	Less than 1.5 °C	–
Composition B, reclaimed	Less than 1.5 °C	–
Double base smokeless powder, 40% NG	Less than 1.5 °C	–
Black powder	Less than 1.5 °C	–
Barium styphnate	Less than 1.5 °C	–
Rocket motor propellant (60-70% AP, 5-16% Al, 12-30% binder)	Less than 1.5 °C	–
Catalyst containing copper acetylide	Greater than 1.5 °C	+



(A)	Metal block	(B)	Cartridge heaters
(C)	Glassware	(D)	Sample port
(E)	Glass sample container	(F)	Insulation

Figure 13.6.2.1: SBAT Heating Block



(A)	Insulative cap or blanket	(B)	Metal block
(C)	Thermocouple	(D)	Glassware
(E)	Sample port	(F)	Glass sample container
(G)	Insulation	(H)	Sample

Figure 13.6.2.1: SBAT Port"

(Reference documents: ST/SG/AC.10/C.3/2014/52 and informal document INF.61/Add.2 of the forty-fifth session)

Section 16

16.2.2 Amend as follows:

In the first sentence, insert “normally” after “and 6 (d) are”. In the second sentence, insert “follow this order or to” after “necessary to”.

Third and fourth sentences become new sub-paragraphs (a) and (b) respectively. At the end of both add the following phrase: “, (see also section 16.2.2 (d))”.

Former sub-paragraphs (a) and (b) become indents (i) and (ii) under new sub-paragraph (b).

Next two sentences after (i) and (ii), former sub-paragraphs (a) and (b), become sub-paragraphs (c) and (d) respectively. At the end of (d) insert a new sentence to read as follows: “When testing articles to which special provision 347 applies, test type 6(d) may be performed first. If the results of test type 6(d) indicate that a 1.4S classification is appropriate, then test types 6(a) and 6(b) may be waived.”.

Delete the last sentence, starting with “The results of test series 6 (c)…”.

(Reference documents: ST/SG/AC.10/C.3/2014/4 and informal document INF.61/Add.2 of the forty-fifth session)

16.4.1.2 Amend as follows:

Group sub-paragraphs (a) and (b) and amend to read as follows:

(a) “A detonator to initiate the substance or article or an igniter just sufficient to ensure ignition of the substance or article (see 16.4.1.3.2 and 16.4.1.3.3);”.

Renumber sub-paragraphs (c) and (d) as (b) and (c) respectively.

In sub-paragraph (b), former (c), insert “(see 16.4.1.3.4)” after “materials”.

In sub-paragraph (c), former (d), replace “3.0” by “3”.

(Reference documents: ST/SG/AC.10/C.3/2014/4 and informal document INF.61/Add.2 of the forty-fifth session)

16.5.1.2 Amend as follows:

Group sub-paragraphs (a) and (b) and amend to read as follows:

(a) “A detonator to initiate the substance or article or an igniter just sufficient to ensure ignition of the substance or article (see 16.5.1.4 and 16.5.1.5);”.

Renumber sub-paragraphs (c) and (d) as (b) and (c) respectively.

In sub-paragraph (b), former (c), insert “(see 16.5.1.3)” after “materials”.

In sub-paragraph (c), former (d), replace “3.0” by “3”.

(Reference documents: ST/SG/AC.10/C.3/2014/4 as amended and informal document INF.61/Add.2 of the forty-fifth session)

16.6.1.1 At the end of the sentence, delete “or any other dangerous effect”.

(Reference documents: ST/SG/AC.10/C.3/2014/4 and informal document INF.61/Add.2 of the forty-fifth session)

16.6.1.2 (c) Replace “ground” by “fuel surface at the onset of the test”.

(Reference documents: ST/SG/AC.10/C.3/2014/4 and informal document INF.61/Add.2 of the forty-fifth session)

16.6.1.2 (h) Amend to read as follows:

“(h) Video equipment capable of recording the events necessary for classification. The type, number and placement of the camera(s) shall be sufficient to record all events to be assessed.”.

(Reference document: ST/SG/AC.10/C.3/86/Add.1)

16.6.1.2 After sub-paragraph (h), in the last paragraph, add a last sentence to read as follows: “Further equipment may be needed when following the procedure in 16.6.1.3.9.”.

(Reference documents: ST/SG/AC.10/C.3/2014/4 and informal document INF.61/Add.2 of the forty-fifth session)

16.6.1.3.1 Amend to read as follows:

“16.6.1.3.1 The required number of packages or unpackaged articles, in the condition and form in which they are offered for transport, are arranged as close as possible to one another on the metal grid. If directional effects are anticipated, packages or unpackaged articles should be oriented in such a way to maximize probability for projections to hit witness screens and for discrete flame jets to be pointed horizontally. If necessary, the packages or unpackaged articles may be encircled with a steel strip to support them during the test. Fuel is placed beneath the grid so that the fire will engulf the packages or unpackaged articles. Suitable methods of heating include a wood, liquid or gas fuel fire or a combination thereof, which achieves a temperature of 800 °C. Fluctuations of temperature below 800 °C are normal and should not render the test invalid.”.

(Reference document: ST/SG/AC.10/C.3/86/Add.1)

16.6.1.3.2 Amend to read as follows:

“16.6.1.3.2 A wood fire should burn the packages or unpackaged articles with sufficient intensity and duration to completely react the explosives (see 16.6.1.2(e)). Dried pallets, boards, laths, or other wood alone or in combination may be stacked to form a lattice beneath the grid 1 m off the ground, and up to the base of the grid supporting the packages or unpackaged articles. The wood should extend at least 1 m beyond the packages or unpackaged articles to ensure that the fire engulfs the product.”.

(Reference document: ST/SG/AC.10/C.3/86/Add.1)

16.6.1.3.5 Amend the first three sentences to read as follows:

“The witness screens are erected vertically in each of three quadrants at a distance of 4 m from the edge of the packages or unpackaged articles. The sheets should be placed so that the centres are approximately level with the centre of the packages or unpackaged articles or, if this is less than 1.0 m above the ground, in contact with the ground.”.

(Reference document: ST/SG/AC.10/C.3/86/Add.1)

16.6.1.3.6 Amend the last sentence to read as follows:

“A safe waiting period, prescribed by the test agency, should be observed before approaching the test area.”.

(Reference document: ST/SG/AC.10/C.3/86/Add.1)

16.6 Add new paragraph 16.6.1.3.9 to read as follows:

“16.6.1.3.9 For candidates to cartridges, small arms (UN No. 0012), this test can be augmented or replaced by the specialised measurement of the energy of projections as described in Appendix 9. This applies to circumstances where the dominant hazard is a projection hazard, for example as known from previous testing of similar explosive articles.”.

(Reference documents: ST/SG/AC.10/C.3/2014/109)

16.6.1.4.6 Amend to read as follows:

"16.6.1.4.6 If none of the events occur which would require the product to be assigned to Division 1.1, 1.2, 1.3 or 1.4 other than Compatibility Group S (see Box 32 of Figure 10.3), then the product is assigned to Division 1.4 Compatibility Group S, unless special provision 347 of Chapter 3.3 of the Model Regulations applies. For candidates to Cartridges, small arms (UN No. 0012), evidence of projections with a kinetic energy not exceeding 8 J as determined by the test procedure in Appendix 9 may be used to assign the product to Compatibility Group S.".

(Reference documents: ST/SG/AC.10/C.3/2014/109)

16.7.1.2 Amend as follows:

Group sub-paragraphs (a) and (b) and amend to read as follows:

(a) "A detonator to initiate the substance or article or an igniter just sufficient to ensure ignition of the substance or article (see 16.7.1.3.2); and".

Renumber sub-paragraph (c) as (b).

In sub-paragraph (b), former (c), replace "3.0" by "3".

(Reference documents: ST/SG/AC.10/C.3/2014/4 and informal document INF.61/Add.2 of the forty-fifth session)

16.7.1.4 (b) Replace "capable of igniting" by "that ignites".

(Reference documents: ST/SG/AC.10/C.3/2014/4 and informal document INF.61/Add.2 of the forty-fifth session)

Section 18

(Reference documents: ST/SG/AC.10/C.3/2014/11 and informal document INF.61/Add.4 of the forty-fifth session)

18.1 In the last paragraph, insert "of ANEs" after "the suitability" and "portable" before "tanks".

18.2, Table note b Insert "of ANEs" after "the suitability" and "portable" before "tanks".

18.3.1 Amend to read as follows:

"18.3.1 Unless otherwise specified in these tests, the substance should be tested as offered for transport, at the maximum temperature which may occur during transport (see 1.5.4 of this Manual).".

18.4.1 Amend the word "suspension" in sub-title from the singular to the plural "suspensions".

18.4.1.1 and 18.4.1.1.2 Group and amend to read as follows:

"18.4.1.1.1 This test is used to determine whether a candidate for "ammonium nitrate emulsion, suspension or gel, intermediate for blasting explosives" is thermally stable at temperatures encountered during transport. In the way this type of test is normally carried out (see 28.4.4), the 500 ml insulated test vessel is only representative for packagings, IBCs and small tanks. For the transport of ammonium nitrate emulsions, suspensions or gels the test is used to measure their thermal stability during tank transport if the test is carried out on candidate products which are at a temperature 20 °C higher than the maximum

temperature which may occur during transport, or if higher, at the temperature at the time of loading.".

18.4.1.2.1 After "of a suitable" insert "thermostatically controlled" and after "test chamber" insert "(which may be fan assisted)". Replace "Dewar" by "insulated test" and "measuring equipment" by "recording equipment".

18.4.1.2.2 Amend to read as follows (the last sentence is unchanged):

"18.4.1.2.2 The test should be performed following a risk assessment, taking account of the potential for fire and/or explosion in the test chamber, and the application of appropriate control measures for the protection of persons and property. A number of tests may be run concurrently. The recording system should be housed in a separate observation area.".

18.4.1.2.3 Amend as follows:

In the first sentence, replace "A thermostatically controlled drying oven (which may be fan-assisted)" by "The test chamber must be" and "Dewar vessel may be used" by "insulated test vessels.".

In the second sentence, replace "oven" by "test chamber", "Dewar" by "insulated test" and "± 1 °C" by "± 2 °C".

In the third sentence, replace "oven" by "test chamber".

Delete the 2 last sentences.

18.4.1.2.4 In the first sentence, replace "Dewar" by "Insulated test" and insert "approximately" before "500 ml". In the second sentence, replace "Dewar" by "test". Delete the last sentence.

18.4.1.2.5 Replace "Dewar" by "insulated test" and "should" by "must". In the third sentence, replace "can be" by "are" and amend the end to read as follows: "filled with a known inert liquid substance e.g. distilled water." In the last sentence, replace "can be" by "is".

18.4.1.2.6 Replace "Dewar" by "Insulated test".

18.4.1.2.7 Delete.

18.4.1.3.1 Insert "at" before "the temperature". Amend the second and third sentences to read as follows: "Fill the test vessel with the substance under test to about 80% of the capacity of the test vessel, or approximately 400 ml.". Amend the beginning of the last sentence to read as follows: "Seal the lid of the test vessel and place it in the test chamber,…", remainder unchanged.

18.4.1.3.2 Amend the first sentence to read as follows: "The temperature of the sample and of the test chamber are continuously monitored.". Delete the last sentence.

18.4.1.3.3 Amend to read as follows:

"18.4.1.3.3 At the end of the test, allow the sample to cool, remove it from the test chamber and carefully dispose of it as soon as possible.".

18.4.1.4.1 Insert "within the seven day period" after "6 °C or more".

Figure 18.4.1.1 Delete.

18.5.1.1 Replace "donor" by "booster".

18.5.1.2.1 Replace "(donor)" by "(booster charge)", "test charge" by "sample substance" and insert "charge" after "acceptor".

18.5.1.2.1 (a) Amend to read as follows:

"(a) Detonators of sufficient strength to effectively initiate the booster charge;".

18.5.1.2.1 (b) Amend to read as follows:

"(b) Booster charges consisting of 95 mm diameter by 95 mm long pellet with a density of 1 600 kg/m^3 ± 50 kg/m^3 of either Pentolite (PETN/TNT with a minimum 50% PETN), Composition B (RDX/TNT with a minimum 50% RDX) or RDX/WAX (with a minimum 95% RDX);".

18.5.1.2.1 (c) Delete "seamless,"

18.5.1.2.1 (d) Amend to read as follows:

"(d) Sample substances (acceptor charges);".

18.5.1.2.1 (e) Delete the last sentence.

18.5.1.2.1 (f) Insert "approximately" before "200 mm".

18.5.1.2.1 (g) Insert "approximately" before "25 mm", at the end add: "in place against the booster charge;".

18.5.1.2.1 Add a new sub-paragraph (h) to read as follows:

"(h) Wood blocks or similar to stand the assembly at least 100 mm off the ground.".

18.5.1.3.1 Amend to read as follows:

"18.5.1.3.1 As shown in Figure 18.5.1.1, the detonator, booster charge, PMMA gap and acceptor charge are coaxially aligned above the centre of the witness plate. The bottom end of the tube is sealed with a single layer of cloth adhesive tape, or equivalent, to contain the sample substance which is carefully loaded so as to avoid the formation of voids within the sample or between the sample and the tube walls. The surface of the sample should be level with the rim of the tube. Care should be taken to ensure good contact between the detonator, the booster charge, the PMMA cylinder and the acceptor charge. The sample substance should be at ambient temperature. The wood block holding the detonator, the booster charge, the PMMA cylinder and the steel tube should be held firmly in alignment (e.g. by using a band of adhesive tape at each intersection).".

18.5.1.3.2 Amend to read as follows:

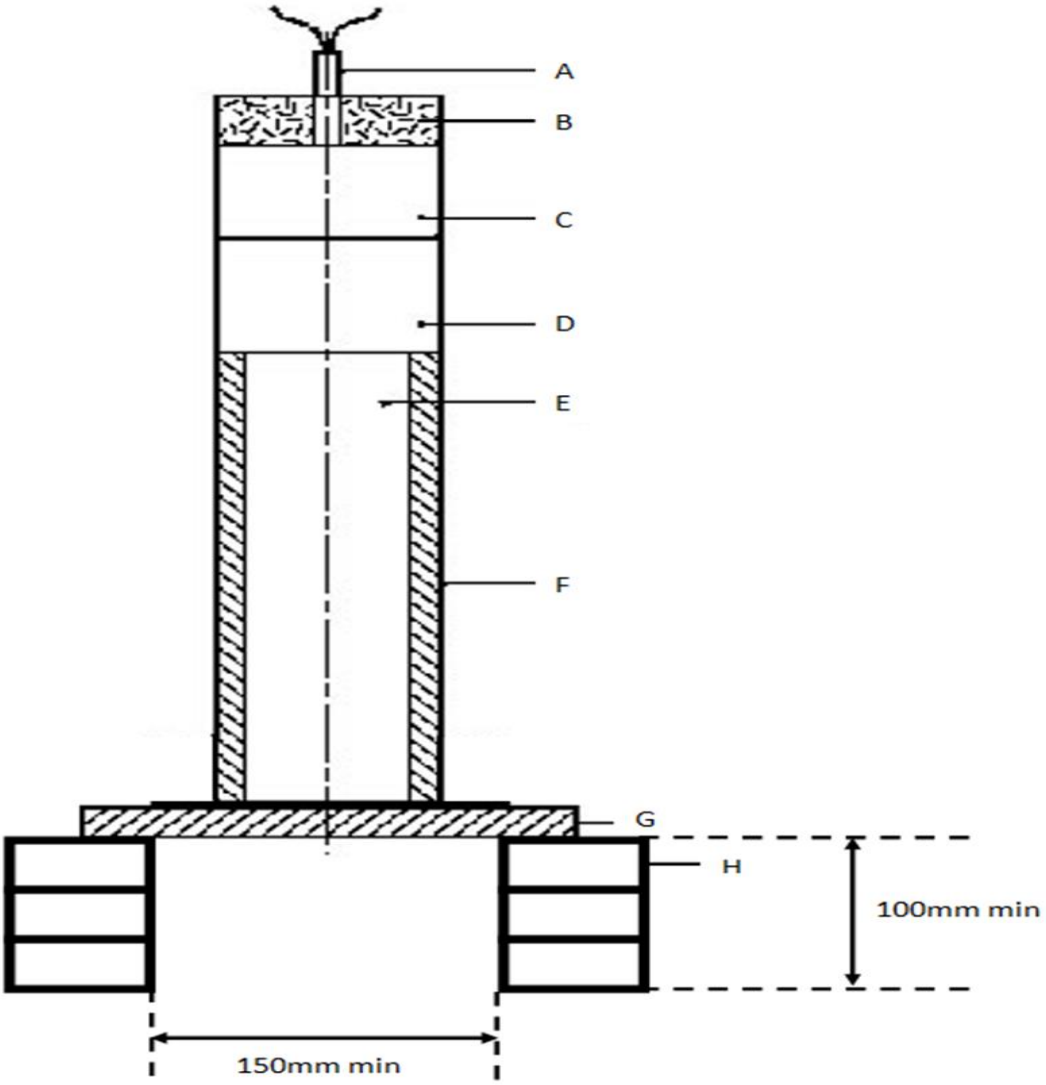
"18.5.1.3.2 The whole assembly, including the witness plate, is raised above the ground, with at least a 100 mm air gap between the ground and the bottom surface of the witness plate which is supported along two edges only with wooden blocks, or similar, as shown in Figure 18.5.1.1. The location of the blocks must ensure there is a clear space under where the tube is standing on the witness plate. To assist in collecting the remains of the witness plate, the whole assembly should be vertical (e.g. checked with a spirit level).".

18.5.1.3.3 Delete the first sentence.

18.5.1.4 Insert "and propagated" after "a detonation was initiated". Amend the middle of the second sentence to read: "…which detonates and punches a hole in the witness plate in any trial is not to be classified…".

18.5, Figure 18.5.1.1 Replace Figure 18.5.1.1 and caption by the following ones *(the heading of the figure remains unchanged)*:

“



(A) Detonator	(B) Wooden detonator holder	(C) Booster charge
(D) PMMA gap	(E) Substance under test	(F) Steel Tube
(G) Witness plate	(H) Wooden blocks	

”.

Table 18.5.1.1 and Figure 18.5.1.2 Delete.

18.6.1.2.1 Amend the end of the first paragraph to read as follows:

“…and is available with numerous sized orifices. For this test the following diameter holes are used:

- 1.5 mm for the closing plate used in the heating calibration procedure; and
- 2.0 mm for the closing plate used in the test.

The dimensions of the threaded collar and the nut (closing device) are given in Figure 18.6.1.1.”.

18.6.1.2.1 (a) Delete the remainder of the sentence after “26.5 ± 1.5 g”.

18.6.1.2.2 Replace “propane” by “a gaseous fuel (e.g. propane)”. Delete the second sentence. Insert “or equivalent” after “dibutyl phthalate” and insert “and inserted through the orifice plate” after “rim of the tube”.

18.6.1.2.3 In the first sentence, insert a full stop after “welded box” and replace the remainder of the sentence by “A suitable arrangement of the construction and dimensions of the box is given in Figure 18.6.1.2.”. In the fourth sentence, replace “The arrangement” by “A suitable arrangement”.

18.6 Insert a new paragraph 18.6.1.2.4 to read as follows:

“18.6.1.2.4 A video camera should be provided to record the test and to ensure all burners are functional during the test. The camera may also provide evidence of blockages of the orifice by solids within the sample.”.

18.6.1.3.1 Replace “appropriate” by “2 mm” and “molybdenum disulphide based lubricant” by “high temperature anti-seize compound (e.g. molybdenum disulphide based lubricant)”.

18.6.1.3.2 Delete the first sentence.

18.6.1.3.3 At the end, add “to ensure all pieces have been recovered”.

18.6.1.3.4 Replace ““no explosion”” by ““no explosion (negative (-))”” and ““explosion”” by ““explosion (positive (+))””.

18.6.1.3.5 Amend to read as follows:

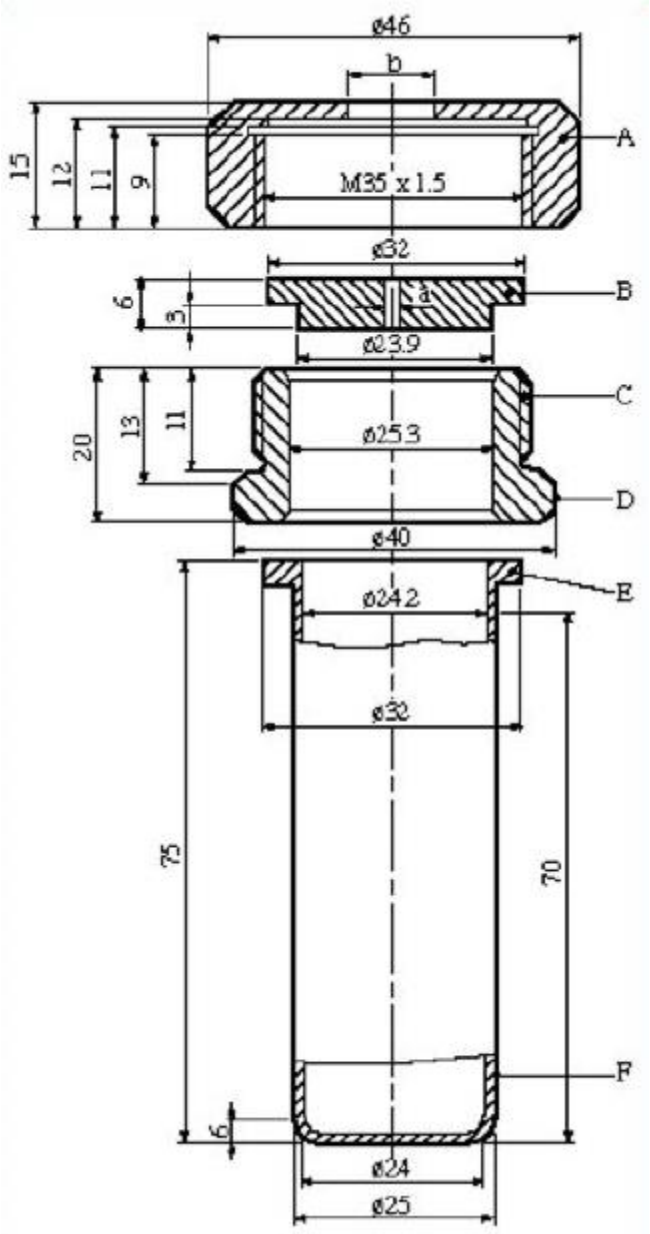
“18.6.1.3.5 The test is performed to achieve negative (-) results in three tests.

Given the nature of ammonium nitrate emulsions, suspensions or gels and the possibility of varying percentages of solids present, blockages of the orifices may occur during testing potentially leading to a false “+” result. Where this is observed the test may be repeated (maximum twice).”.

18.6.1.4 Amend the end of the paragraph to read as follows: “…Division 5.1 if three negative (-) results cannot be achieved within a maximum of five tests.”.

Figures 18.6.1.1 and 18.6.1.2 Replace by the following figures:

“



(A) Nut (b = 10 mm) with flats for size 41 spanner
(B) Orifice plate (a = 1.5 or 2.0 mm)
(C) Threaded collar
(D) Flats for size 36 spanner
(E) Flange
(F) Tube

Figure 18.6.1.1: TEST TUBE ASSEMBLY

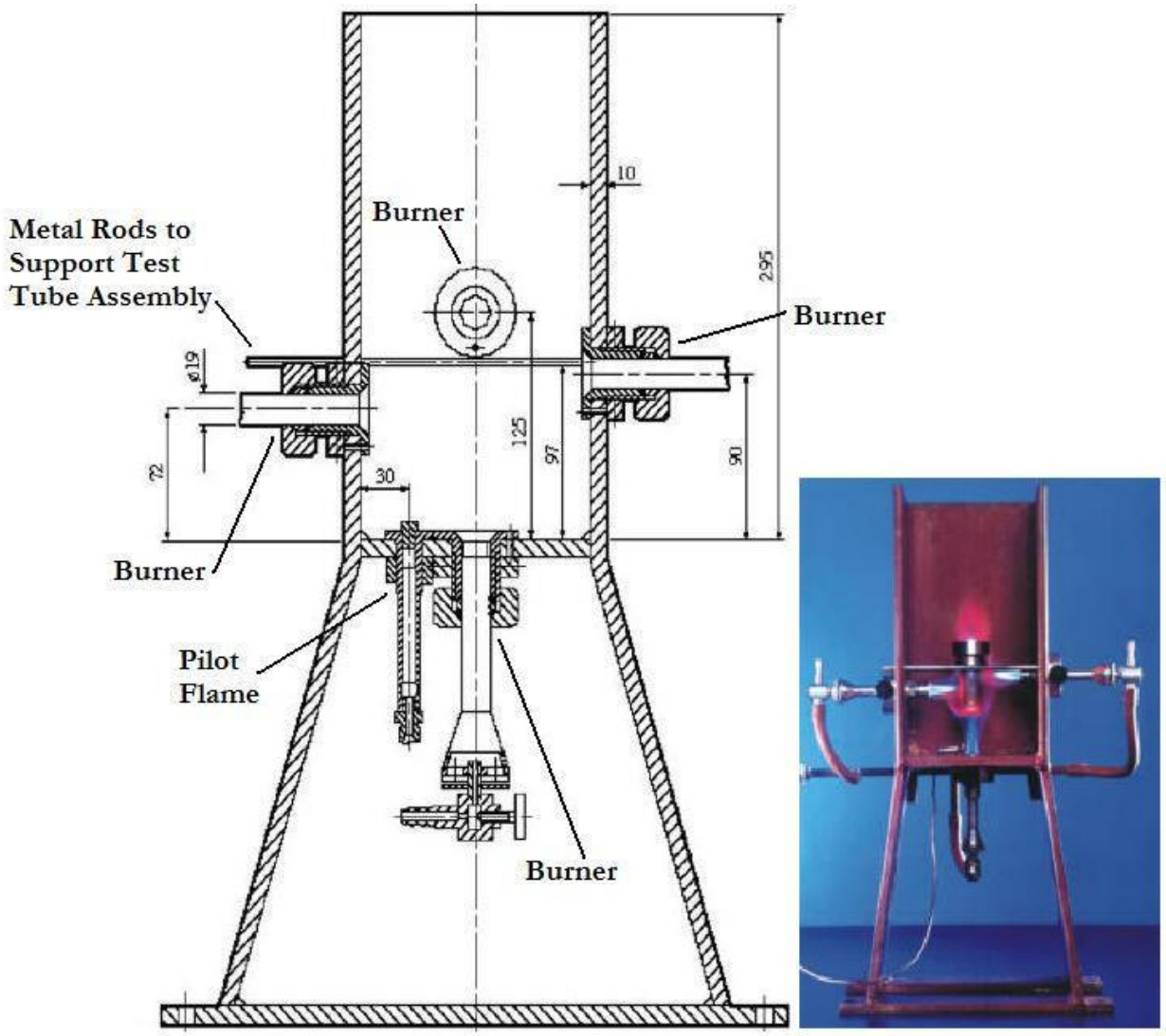


Figure 18.6.1.2 HEATING DEVICE

Figure 18.6.1.3 After the existing figure, add the following pictures:

"**Examples of Koenen test results**

"O": Tube unchanged

"A": Bottom of the tube bulged out

"B": Bottom and wall of the tube bulged out

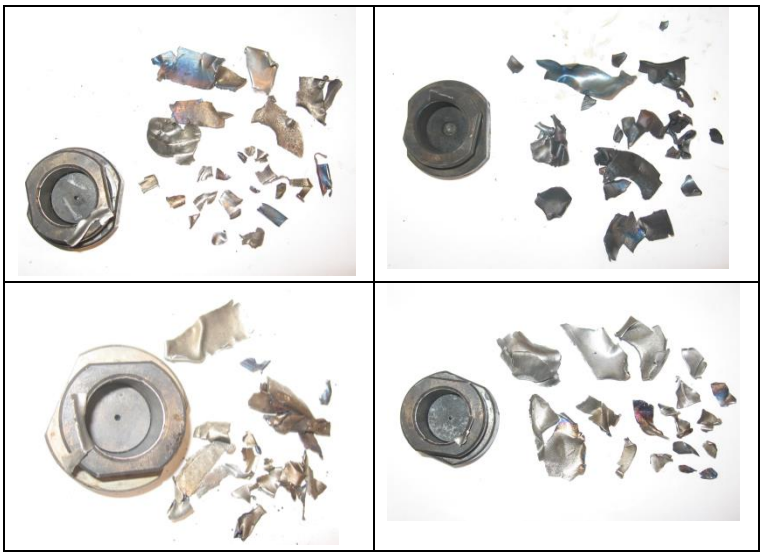
"C": ***Reserved***

"D": Wall of tube split

"E": Tube split into two fragments

“F”: Tube fragmented into three or more mainly large pieces which in some cases may be connected with each other by a narrow strip;

“G”: Tube fragmented into many mainly smaller pieces, closing device undamaged



18.7.1.2 (a) Add the following sentences at the end to read as follows: “All welding should be to a relevant ISO standard or equivalent. All steel components are to be Schedule 40 carbon steel (A53 Grade B) or equivalent;”.

18.7.1.2 (b) Replace “fuel” by “fire”. Insert “approximately” before “1.0 m”. Amend the end of the paragraph to read as follows: “…the grid should be approximately 0.5 m above the fuel surface at the onset of the test”.

18.7.1.2 (c) Amend the beginning to read as follows: “Enough fuel to produce a fire reaching 800 °C (measured at the external base of the pipe) and to keep burning …”. At the end, add: “, evidenced by ejection of material, smoke, fumes, flames, etc., from the top of the pipe. Temporary variation of temperature below 800 °C is normal and should not render the test invalid”.

18.7.1.2 (d) Amend the end of the paragraph to read as follows: “…soak the wood and igniters;”.

18.7.1.2 (e) Amend to read as follows:

“(e) Video cameras to record events in colour;”.

18.7.1.2 (f) Amend to read as follows:

“(f) Means of measuring and recording temperature, up to and above 800 °C, with a thermocouple located at the external base of the pipe;”.

18.7.1.2 Add a new sub-paragraph (g) to read as follows:

“(g) A means of measuring wind speed, such as an anemometer.”.

18.7.1.3.1 In the fourth sentence, insert “, extending in every direction beyond the pipe” after “beneath the grid” and “fully” before “engulf”. In the last sentence, delete “using a lattice of wooden laths”.

18.7.1.3.2 and 18.7.1.3.3 Amend to read as follows:

“18.7.1.3.2 The test should not be performed under conditions where the wind speed consistently exceeds 6 m/s.

18.7.1.3.3 Observations are made on the following:

(a) Wind speed at commencement of the test as per Section 18.7.1.3.2;

(b) Fire duration of at least 30 minutes or until the substance has clearly had enough time to react to the fire, with 800 °C reached at the external base of the pipe;

(c) Temperature at the external base of pipe;

(d) Substance reacting to the fire as described in 18.7.1.2(c);

(e) Evidence of explosion (e.g. fragmentation of the pipe into two or more pieces);

(f) Projection of fragments of the pipe section from the fire area;

(g) Evidence of a rupture (e.g. a split of the pipe or separation of the pipe from the base plate at the weld).”.

18.7.1.3.4 to 18.7.1.3.6 Delete.

18.7.1.4 Amend to read as follows:

“18.7.1.4 *Test criteria and method of assessing results*

A test is considered valid if observation criteria outlined in Section 18.7.1.3.3 (a) to (d) have been met.

The test result is considered "+" and the substance should not be transported in portable tanks as a dangerous good of Division 5.1 if an explosion and/or fragmentation of the pipe, as specified in Section 18.7.1.3.3 (e) and (f) is observed.

The test result is considered "-" if no explosion and/or fragmentation of the pipe is observed. Splitting of the pipe or its separation from the end plates, as specified in Section 18.7.1.3.3 (g) is evidence of a "-" result.".

18.7.2.1 Amend the end of the first paragraph to read as follows: "…the suitability of a candidate for "ammonium nitrate emulsion or suspension or gel, intermediate for blasting explosives", to be transported in portable tanks as a dangerous substance of Division 5.1.".

18.7.2.2 (a) Insert a new fourth sentence to read as follows: "All welding should be to a relevant ISO standard or equivalent.". In the last sentence, move "neatly" to before "accommodate".

18.7.2.2 (b) Insert ", or similar solid base," before "about 400 mm".

18.7.2.2 (c) Insert "approximately" before "150 mm". At the end add: "or similar solid base".

18.7.2.2 (d) In the first sentence, replace "propane" by "fuel gas (e.g. propane)". In the second sentence, insert ", or similar solid base," after "concrete block".

18.7.2.2 Add a new sub-paragraph (e) to read as follows:

"(e) Enough fuel to produce a fire reaching 800 °C (measured at the external base of the pipe) and to keep burning for at least 60 minutes or, if necessary, until the substance has clearly had enough time to react to the fire, evidenced by ejection of material, smoke, fumes, flames, etc., from the top of the pipe. Temporary variation of temperature below 800 °C is normal and should not render the test invalid;".

Renumber sub-paragraphs (e) to (k) accordingly.

18.7.2.2 (f) former (e) In the first sentence, replace "propane" by "fuel gas". In the third sentence, insert "about" before "600 mm" and replace "the height is" by "the height should be about". In the fourth sentence insert "approximately" before "150 mm".

18.7.2.2 (g) former (f) In the first sentence, replace "Propane" by "Fuel gas". Delete the second sentence and replace "propane" by "fuel gas" everywhere else in the paragraph (three times). Replace "measuring up to 60 g/min of propane" by "measuring up to 60 g/min".

18.7.2.2 (h) former (i) Insert "approximately" before "500 (2)".

18.7.2.2 (l) former (k) Amend to read as follows:

"(l) The candidate ammonium nitrate emulsion or suspension or gel, intermediate for blasting explosives to be tested;".

18.7.2.2 Add a new sub-paragraph (m) to read as follows:

"(m) A means of measuring wind speed at the commencement of the test, such as an anemometer;".

18.7.2.2 Number the last sentence as sub-paragraph (n).

18.7.2.3.1 In the first sentence, insert "about" before "435 mm)".

18.7.2.3.3 In the first sentence, replace "ANE" by "test".

18.7.2.4.1 In the first sentence, insert ", or similar solid base," after "concrete block". In the second sentence, replace "propane" by "fuel gas" and "concrete block" by "solid base".

18.7.2.4.2 In the second sentence, insert "approximately" before "435 mm" and replace "ANE" by "substance" twice. In the last sentence, replace "propane" by "gas".

18.7.2.4.3 (c) Insert "about" before "20 mm".

18.7.2.4.3 The amendment to the last paragraph does not apply to the English text.

18.7.2.4.4 In the first sentence, replace "Propane" by "Fuel gas". Amend the end of the paragraph to read as follows: "…exceeds 6 m/s, unless additional precautions against side winds are taken to avoid dissipation of the heat.".

18.7.2.4.5 In the first sentence, replace "propane" by "fuel gas".

18.7.2.4.7 Amend to read as follows:

"18.7.2.4.7 Observations are made on the following:

(a) Wind speed at commencement of the test as per Section 18.7.2.4.4;

(b) Fire duration of at least 60 minutes or until the substance has clearly had enough time to react to the fire, with 800 °C reached at the external base of the pipe;

(c) Temperature at the external base of pipe;

(d) Substance reacting to the fire as described in 18.7.2.2(e);

(e) Evidence of explosion (e.g. fragmentation of the pipe into two or more pieces);

(f) Projection of fragments of the pipe section from the fire area;

(g) Evidence of a rupture (e.g. a split of the pipe or separation of the pipe from the base plate at the weld).".

18.7.2.4.8 Amend to read as follows:

"18.7.2.4.8 *Test criteria and method of assessing results*

A test is considered valid if observation criteria outlined in Section 18.7.2.4.7 (a) to (d) have been met.

The test result is considered "+" and the substance should not be transported in portable tanks as a dangerous good of Division 5.1 if an explosion and/or fragmentation of the pipe, as specified in Section 18.7.2.4.7 (e) and (f) is observed

The test result is considered "-" if no explosion and/or fragmentation of the pipe is observed. Splitting of the pipe or its separation from the end plates, as specified in Section 18.7.2.4.7 (g) is evidence of a "-" result.".

18.7.2.5 Delete.

18.7.2.6 Renumber as 18.7.2.5.

Part II

Section 21

21.1.2 At the end, replace “Series A test may be used” by “Series A test should be performed”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

21.1, Table 21.1 Delete the entry for “A2”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

21.3.2 At the end insert “, if known”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

21.4.3.2 Amend as follows:

In the second sentence, replace “cold-drawn” by “an annealed” and “4.0 ± 0.1” by “4”.

In the fourth sentence, replace “two layers of 0.08 mm thick polythene” by “a plastics”, insert “tightly” before “in place” and delete the remainder of the sentence after “in place”.

Amend the fifth and sixth sentences to read as follows: “The plastics sheet shall be compatible with the substance under test. The booster charge consists of 160 g RDX/wax (95/5) or PETN/TNT that has a minimum of 50% PETN in the mixture, 50 ± 1 mm in diameter with a density of 1 600 ± 50 kg/m^3.”.

In the seventh sentence, replace “RDX/wax charge” by “charges”.

In the eighth sentence, replace “3.2 ± 0.2” by “3” and “is mounted” by “may be mounted”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

21.4.3.3.1 Delete the last sentence.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

21.4.4.2 Amend as follows:

In the second sentence, replace “cold-drawn” by “an annealed”.

In the fourth sentence, replace “two layers of 0.08 mm thick polythene” by “a plastics”, insert “tightly” before “in place” and delete the remainder of the sentence after “in place”.

Amend the fifth and sixth sentences to read as follows: “The plastics sheet shall be compatible with the substance under test. The booster charge is a 200 g RDX/wax (95/5) or PETN/TNT that has a minimum of 50% PETN in the mixture, 60 ± 1 mm in diameter with a density of 1 600 ± 50 kg/m^3.”.

In the seventh sentence, replace “RDX/wax charge” by “charges”.

In the last sentence, replace “3.2” by “3” and “is mounted” by “may be mounted”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

21.4.4.3 Delete the fourth sentence.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

Section 23

23.2.1 Replace “Does it propagate” by “Can it propagate”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.1, Table 23.1 In the entry for “C.2”, under “Section”, replace “23.4.3” by “23.4.2”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.1.2.1 In the seventh sentence, replace “55 mm” by “59 mm”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.1.2.2 Amend the beginning of the third sentence to read as follows: “A suitable deformable washer or rubber ring is used…”, remainder unchanged.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.1.2.6 Amend the beginning of the fourth sentence to read as follows: “An approximately 13 mm…”, remainder unchanged.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.1.2.7 Amend to read as follows:

“23.4.1.2.7 For liquids samples, a single piece of thin PVC sheathing, or equivalent, is used to cover the primed cambric in such a way that the primed cambric is not in contact with the liquid sample. The leads of the resistance wire are then fixed onto the terminals of the firing plug such that the tip of the primed cambric is above the surface of the firing plug.”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.1.3.1 Amend as follows:

In the sixth sentence, replace “lead washer” by “washer or rubber ring”.

In the eighth sentence, replace “An exploder dynamo” by “A power source”.

In the last sentence, insert “data acquisition” after “suitable” and delete the last phrase in brackets.

In footnote 3, delete the square brackets around “burning”.

The consequential amendment does not apply to the English text.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4, Figure 23.4.1.1 In the caption, amend the entry for “(L)” to read “Insulation” and the entry for “(D)” to read “Deformable washer”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.2.2.1 Add a new second sentence to read as follows: “The windows are not necessary when using thermocouples to measure the deflagration rate.”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.2.2.2 Amend the end of the second sentence to read as follows: “…cooling with water or other suitable material filled to a height of 20 mm below the rim (i.e. 265 cm^3) of Dewar vessel, closed by a tight fitting cork, should be longer than 5 hours.”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.2.3.2 Amend the end of the third sentence to read as follows: "…is filled to a height of 20 mm below the rim with the substance.".

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.2.3.3 In the second sentence, replace "should" by "shall".

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

23.4.2.5 In the entry for "Dicetyl peroxydicarbonate", under "Result", amend to read "No".

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

Section 25

25.4.1.2.1 In the fifth sentence, insert a full stop after "chrome steel". Amend the rest of the text before the last sentence to read as follows: "For classification the following diameter holes shall be used: 1.0 - 1.5 - 2.0 - 2.5 - 3.0 - 5.0 - 8.0 - 12.0 - 20.0 mm. In addition, other diameters can be used for hazard assessment.". Remainder unchanged.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.1.2.2 In the penultimate sentence, at the end insert "or equivalent".

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.1.3.1 Amend to read as follows:

"25.4.1.3.1 The tube is filled to a height of 60 mm from the bottom of the tube. Cast solids should be cast to the internal dimensions of the steel tube with a height of 60 mm and then placed inside the tube. Powders are filled in approximately three equal increments with tamping[1] to 80 N force between each increment. Liquids and gels are loaded into the tube to a height of 60 mm taking particular care with gels to prevent the formation of voids. Determine the total mass used to fill the tube to this level and use this amount of solid for each trial filling being performed. The threaded collar is slipped onto the tube from below, the appropriate orifice plate is inserted and the nut tightened by hand after applying some molybdenum disulphide based lubricant. It is essential to check that none of the substance is trapped between the flange and the plate, or in the threads.".

Footnote 1 unchanged.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.1.3.5 Amend as follows:

In the first sentence, replace "trails" by "trials" and "of 20.0 mm" by "with a certain diameter".

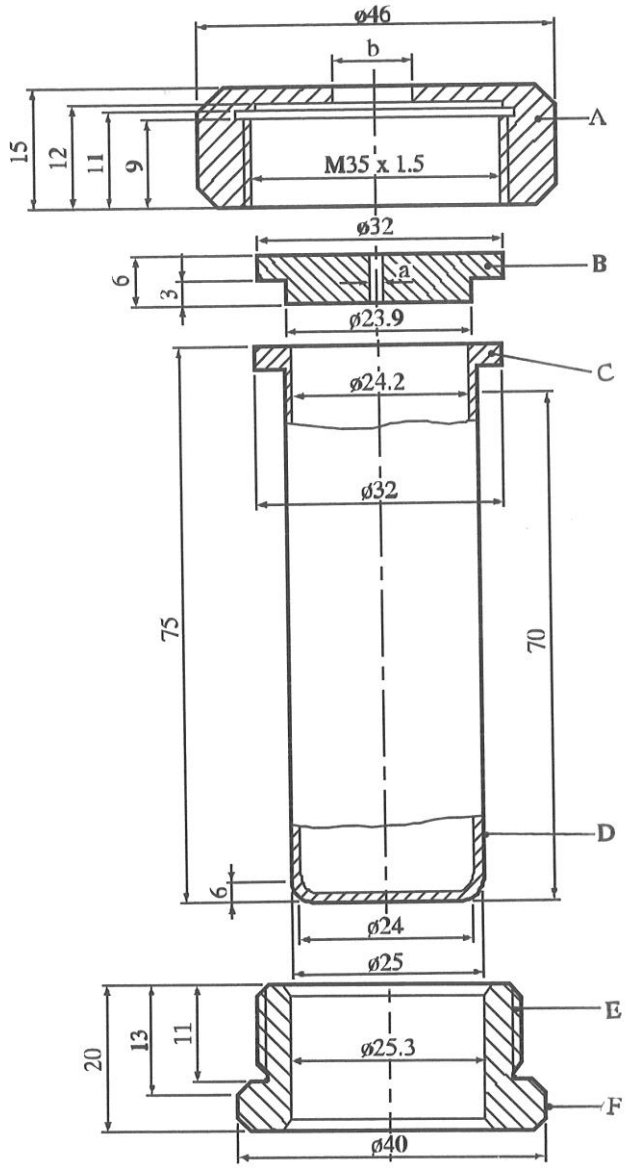
Amend the end of the second sentence to read as follows: "…series is continued with single trials at increasing diameters until only negative results in three tests are obtained at the same level.".

In the third sentence, replace "at 20.0 mm" by "in the first trial" and "following orifices 12.0 - 8.0 - 5.0 - 3.0 - 2.0 - 1.5" by "decreasing diameters".

In the fourth sentence, delete "according to the sequence given in 25.4.1.2.1," and replace "level" by "diameter".

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.1.1 Replace Figure 25.4.1.1 and caption with the following ones:



(A) Nut (b = 10.0 or 20.0 mm) with flats for size 41 spanner
(B) Orifice plate (a = 1.0 to 20.0 mm diameter)
(C) Flange
(D) Tube
(E) Threaded collar
(F) Flats for size 36 spanner

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.2.2.1 Insert a new third sentence to read as follows: “In addition other diameters may be used for hazard assessment.”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.2.2.2 In the fourth sentence, insert “or equivalent” after “dibutyl phthalate”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.2.3.1 Delete the third sentence that reads “The 16.0 mm orifice plate is used first.” In the fourth sentence, replace “central” with “the selected”. At the end of the seventh sentence, replace “which is inside” with “which may be placed inside”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.2.3.3 Amend the first sentence to read as follows: “The series of trials is started with a single trial using an orifice plate with a certain diameter. If there is no rupture of the disc with this orifice, experiments are performed with single trial using plates with decreasing diameters until rupture of the disc occurs.”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

25.4.2.4.2 In the description of “Medium”, replace “6.0 mm” by “larger but smaller than 9.0 mm”. In the description of “Low”, replace “2.0 mm” by “larger but smaller than 3.5 mm”.

(Reference document: informal document INF.61/Add.2 of the forty-fifth session)

Part 3

Section 32

32.3.2 Insert a new sub-section 32.3.2.4 to read as follows:

“32.3.2.4 The classification scheme of liquid desensitized explosives for supply and use (including storage) according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) is referred to section 51.”.

(Reference document: ST/SG/AC.10/C.3/2014/2)

Section 33

33.2.3 Insert a new sub-section 33.2.3.4 to read as follows:

“33.2.3.4 The classification scheme of solid desensitized explosives for supply and use (including storage) according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) is referred to section 51.”.

(Reference document: ST/SG/AC.10/C.3/2014/2)

Section 38

38.3.2.1 Amend the last sentence to read as follows:

“A component cell that is transported separately from the battery shall be subjected to tests T.1 to T.6 and T.8.”.

(Reference document: ST/SG/AC.10/C.3/90/Add.1)

38.3.2.2 In the Note, add a new subparagraph (f) to read as follows:

“(f) For batteries which are to be tested according to T.4 with a peak acceleration less than 150 g_n, a change in the mass which could adversely impact the result of the T.4 test and lead to a failure.”.

(Reference document: informal document INF.11 of the forty-fifth session, proposition 1)

38.3.2.3 Amend the definitions hereafter to read as follows:

"Cell means a single encased electrochemical unit (one positive and one negative electrode) which exhibits a voltage differential across its two terminals, and may contain protective devices. See definitions for battery and single cell battery.".

"Component cell means a cell contained in a battery. A component cell is not to be considered a single cell battery.".

"*Battery* means two or more cells or batteries which are electrically connected together and fitted with devices necessary for use, for example, case, terminals, marking or protective devices. Units which have two or more cells that are commonly referred to as "battery packs", "modules" or "battery assemblies" having the primary function of providing a source of power to another piece of equipment are for the purposes of the Model Regulations and this Manual treated as batteries. See definitions for cell and single cell battery.".

"*Single cell battery* means a cell [externally] fitted with devices necessary for use in equipment or another battery which it is designed to power, for example protective devices. See definitions for cell and battery.

***NOTE**: A single cell battery is considered a "cell" and shall be tested according to the testing requirements for "cells" for the purposes of the Model Regulations and this Manual.".*

(Reference document: ST/SG/AC.10/C.3/90/Add.1)

38.3.3 (d) Amend the last paragraph to read as follows:

"Batteries or single cell batteries not equipped with battery overcharge protection that are designed for use only as a component in another battery or in equipment, which affords such protection, are not subject to the requirements of this test.".

(Reference document: ST/SG/AC.10/C.3/90/Add.1)

38.3.3 (f) Amend to read as follows:

"(f) When testing a battery in which the aggregate lithium content of all anodes, when fully charged, is not more than 500 g, or in the case of a lithium ion battery, with a Watt-hour rating of not more than 6 200 Wh, that is assembled from batteries that have passed all applicable tests, one assembled battery in a fully charged state shall be tested under tests T.3, T.4 and T.5, and, in addition, test T.7 in the case of a rechargeable battery.".

(Reference documents: ST/SG/AC.10/C.3/90/Add.1 and informal document INF.11 of the forty-fifth session, proposition 2)

38.3.3 Last paragraph, after sub-paragraph (f), becomes new sub-paragraph (g) and is amended to read as follows:

"(g) When batteries that have passed all applicable tests are electrically connected to form a battery in which the aggregate lithium content of all anodes, when fully charged, is more than 500 g, or in the case of a lithium ion battery, with a Watt-hour rating of more than 6 200 Wh, the assembled battery does not need to be tested if the assembled battery is of a type that has been verified as preventing:

(i) Overcharge;

(ii) Short circuits; and

(iii) Over discharge between the batteries.".

(Reference documents: ST/SG/AC.10/C.3/90/Add.1 and informal document INF.11 of the forty-fifth session, proposition 3)

38.3.4.4.1 Amend to read as follow:

"38.3.4.4.1 Purpose

This test assesses the robustness of cells and batteries against cumulative shocks.".

(Reference document: informal document INF.11 of the forty-fifth session, proposition 4 option 1)

38.3.4.4.2 Amend to read as follows:

"38.3.4.4.2 Test procedure

Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery.

Each cell shall be subjected to a half-sine shock of peak acceleration of 150 g_n and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 g_n and pulse duration of 11 milliseconds.

Each battery shall be subjected to a half-sine shock of peak acceleration depending on the mass of the battery. The pulse duration shall be 6 milliseconds for small batteries and 11 milliseconds for large batteries. The formulas below are provided to calculate the appropriate minimum peak accelerations.

Battery	Minimum peak acceleration	Pulse duration
Small batteries	150 g_n or result of formula $Acceleration(g_n) = \sqrt{\left(\frac{100850}{mass^*}\right)}$ whichever is smaller	6 ms
Large batteries	50 g_n or result of formula $Acceleration(g_n) = \sqrt{\left(\frac{30000}{mass^*}\right)}$ whichever is smaller	11 ms

* Mass is expressed in kilograms.

***NOTE**: IEC Standard 60068-2-27 (Fourth Edition 2008-02): Environmental testing-Part 2-27: Tests – Test Ea and guidance: Shock provides guidance on tolerance for acceleration and pulse duration.*

The relationship between minimum peak acceleration and mass is illustrated in Figure 1 for small batteries and Figure 2 for large batteries.

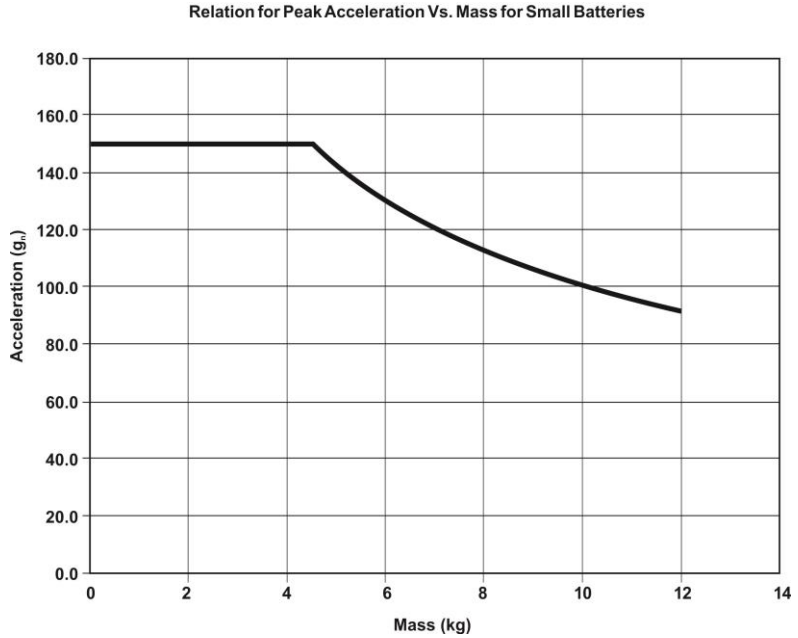


FIGURE 38.3.4.1: Relation between the Peak Acceleration and the Mass for small batteries (below 12.0 kg).

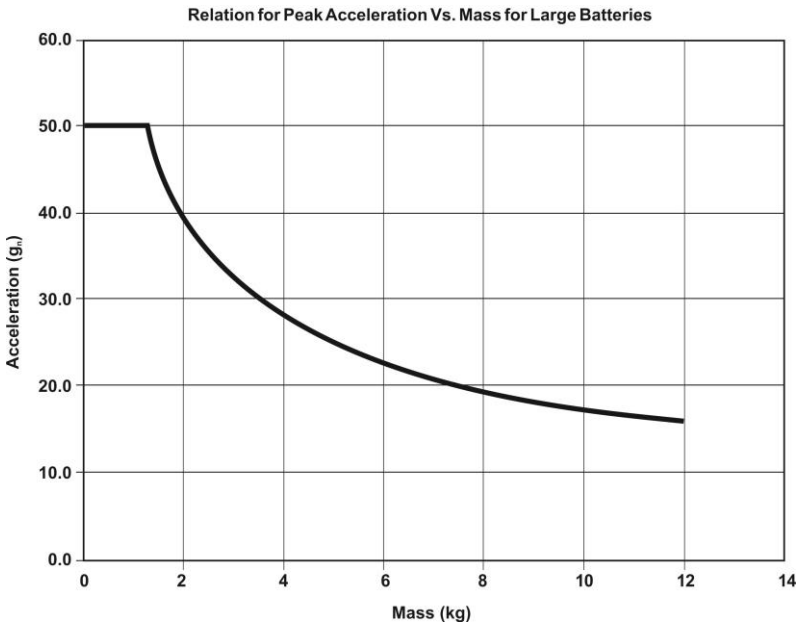


FIGURE 38.3.4.2: Relation between the Peak Acceleration and the Mass for large batteries (equal or above 12.0 kg).

Each cell or battery shall be subjected to three shocks in the positive direction and to three shocks in the negative direction in each of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

(Reference document: informal document INF.11 of the forty-fifth session, proposition 4 option 1)

38.3.4.5.2 Amend to read as follows:

"38.3.4.5.2 – Test Procedure

The cell or battery to be tested shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of 57 ± 4 °C, measured on the external case. This period of time depends on the size and design of the cell or battery and should be assessed and documented. If this assessment is not feasible, the exposure time shall be at least 6 hours for small cells and small batteries, and 12 hours for large cells and large batteries. Then the cell or battery at 57 ± 4 °C shall be subjected to one short circuit condition with a total external resistance of less than 0.1 ohm.

This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 57 ± 4 °C, or in the case of the large batteries, has decreased by half of the maximum temperature increase observed during the test and remains below that value.

The short circuit and cooling down phases shall be conducted at least at ambient temperature.".

(Reference document: informal document INF.11 of the forty-fifth session, proposition 5)

38.3.4.7.1 Amend to read as follows:

"This test evaluates the ability of a rechargeable battery or a single cell rechargeable battery to withstand an overcharge condition.".

(Reference document: ST/SG/AC.10/C.3/90/Add.1)

Add a new sub-section 38.4 to read as follows:

"38.4 Substances evolving flammable vapour

38.4.1 Purpose

This section of the Manual presents the test procedure to determine whether during handling, transport and storage substances of Class 9 evolving flammable vapours (see UN No. 2211), are able to evolve a dangerous concentration of flammable vapours in closed containers resulting in the formation of a flammable atmosphere and, as a consequence, have to be classified or not.

38.4.2 Scope

The scope of the test method is to determine whether polymeric beads with encapsulated blowing agent, fulfilling the description of UN No. 2211, need not to be classified under these UN numbers.

38.4.3 Classification procedure for substances liable to evolve flammable vapours

Polymeric beads with encapsulated blowing agent shall be tested according to the procedures below to determine whether classification under UN No. 2211 is needed.

38.4.4 Test U 1: Test method for substances liable to evolve flammable vapours

38.4.4.1 Introduction

The ability to evolve flammable vapours is determined by placing the substance in a hermetically closed glass bottle, at a specified temperature for a prescribed period of time, and then, determine the identity and concentration of flammable vapours.

38.4.4.2 Apparatus and materials

A serum flask equipped with polytetrafluoroethylene septa with a volume of 50 ml to allow for enough samples to be analysed. A heating cabinet for storage of samples at prescribed time and temperature. A gas chromatographic (GC) apparatus and accompanying equipment, for analysis of flammable vapour concentration in the gas-phase.

38.4.4.3 Procedure

The substance as offered for transport should be put in a serum flask of 50 ml, with a degree of filling of 50 % volume ratio and sealed with polytetrafluoroethylene septa. The sealed flask is put into a heating cabinet at a minimum of 50 °C for 14 days. Under these conditions analyse the gas twice by gas chromatography and calculate the average concentration of the flammable vapour. The test shall be performed on three samples of the same substance.

38.4.4.4 Test criteria and method of assessing results

Substances need not be classified as Polymeric beads, expandable if the concentration of the flammable vapours is less than or equal to 20% of the Lower Explosive Limit (LEL) of the flammable vapour in all of the three samples.".

(Reference document: ST/SG/AC.10/C.3/2014/77)

Insert a new Part 5 to read as follows:

"Part V

Classification procedures, test methods and criteria relating to sectors other than transport

Section 50

Introduction to Part V

50.1 Purpose

Part V of the Manual presents the United Nations schemes for the classification of desensitized explosives for supply and use (including storage) according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

50.2 Scope

The test methods of this Part should be applied when required by the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Section 51

Classification procedures, test methods and criteria relating to the hazard class desensitized explosives

51.1 Purpose

51.1.1 This section presents the United Nations scheme of the classification of liquid and solid desensitized explosives see Chapter 2.17 of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS)). The text should be used in conjunction with the classification principles of Chapter 2.17 of the GHS and the test series given in sub-sections 16.4 and 16.5 of this Manual.

For testing of liquid desensitized explosives for transport purposes, refer to section 32, sub-section 32.3.2 of this Manual. Testing of solid desensitized explosives for transport purposes is addressed in section 33, sub-section 33.2.3 of this Manual, Chapter 2.4, sub-section 2.4.2.4 of the United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations (for solid desensitized explosives) and in Chapter 2.3, sub-section 2.3.1.4 of the Model Regulations (for liquid desensitized explosives).

51.2 Scope

51.2.1 Desensitized explosives are solid or liquid explosive substances or mixtures which are phlegmatized to suppress their explosive properties in such a manner that they may be excluded from the hazard class "Explosives" (Chapter 2.1 of GHS). Desensitized explosives, should be first tested according to the tests series 1 (type 1(a)), 2 and 6 (type (a) and (b), respectively) of this Manual[1] .

51.2.2 The appropriate classification procedures for desensitized explosives should be undertaken before they are offered for supply and use unless:

(a) They are manufactured with the view to producing a practical, explosive or pyrotechnic effect;

(b) They have a mass explosion hazard according to Test Series 6(a) or 6(b) or their corrected burning rate according to the burning rate test 51.4 is more than 1 200 kg/min;

(c) Their exothermic decomposition energy is less than 300 J/g[2].

[1] Unstable explosives as defined in Chapter 2.1 of GHS can also be stabilized by desensitization and consequently may be classified as desensitized explosive, provided all criteria of Chapter 2.17 of GHS are met. In this case the desensitized explosive should be tested according to test series 3 (Part I of this Manual) because information about its sensitiveness to mechanical stimuli is likely to be important for determining conditions for safe handling and use. The results should be communicated in the safety data sheet.

[2] The exothermic decomposition energy should be determined using the explosive already desensitized (i.e.: the homogenous solid or liquids mixture formed by the explosive and the substance(s) used to suppress its explosive properties). The exothermic decomposition energy may be estimated using a suitable calorimetric technique (see Section 20, sub-section 20.3.3.3 in Part II of this Manual)

51.3 Classification procedure

51.3.1 Before packaged substances or mixtures are subjected to the burning rate test, the test series 6 types 6 (a) and 6 (b) shall be performed in alphabetical order. The substances or mixtures should be tested first with a standard detonator (Appendix 1 of the Manual) and, if no explosion occurs, with an igniter just sufficient (but not more than 30 g of black powder) to ensure ignition of the substance or mixture in the packaging. The initiation system giving a positive result in the 6 (a) test should be used for the 6 (b) test.

51.3.2 However, it is not always necessary to conduct tests of all types. Test type 6 (b) may be waived if in each type 6 (a) test:

(a) The exterior of the package is undamaged by internal detonation and/or ignition; or

(b) The contents of the package fail to explode, or explode so feebly as would exclude propagation of the explosive effect from one package to another in test type 6(b).

51.3.3 If a substance or mixture gives a negative result (no propagation of detonation) in the Series 1 type 1(a) test, the 6(a) test with a detonator may be waived[3]). If a substance or mixture gives a negative result (no or slow deflagration) in a Series 2 type 2(c) test, the 6 (a) test with an igniter may be waived.

51.3.4 The test for determination of the burning rate by large-scale test need not be performed if, in a test type 6 (b), there is practically instantaneous explosion of virtually the total contents of the stack. In such cases the product is assigned to Division 1.1.

51.4 Burning rate test (external fire)

51.4.1 *Introduction*

51.4.1.1 The test method for determination of the burning rate (10 000 kg scale burning rate) is to be used to determine the behaviour of substances or mixtures as packaged for storage and use if involved in an external fire. This test is performed with several packages of the substances or mixtures to determine

(a) Whether there is a mass explosion hazard, a hazard from dangerous projection or a too violent burning,

(b) A burning rate (10 000 kg scaled), which depends on the total mass.

51.4.1.2 The burning rate is defined as the extrapolated burning rate for a mass of 10 000 kg packaged material. In practice, this burning rate is determined using both a single package and stacks of packages, following by an extrapolation procedure. The tests are performed with the substances or mixtures in the packages as provided for storage and use. All types of packages are subjected to the tests unless:

(a) A substance or mixture, as packed for supply and use, may be unambiguously assigned to a burning rate and category by a competent authority on the basis of results from other tests or of available information; or

(b) The substance or mixture, as packed for supply and use, is assigned to the hazard class “Explosives”, Division 1.1.

[3] If the type 1 (a) test is not carried out the Series 6 type 6(a) test cannot be waived.

51.4.1.3 The corrected burning rate (10 000 kg scaled) is to be used for classification into four different categories.

51.4.2 ***Apparatus and materials***

51.4.2.1 The test should be applied to packages of substances or mixtures in the condition and form in which they are offered for supply and use (including storage). The following elements are needed:

(a) A number of 1, 6 and 10 packages, with a net mass of desensitized explosive of 25 kg in each package;

(b) A number of 1, 3 and 6 packages, with a net mass of desensitized explosive between 25 kg and 50 kg in each package;

(c) A number of 1 and up to six packages, with a net mass of desensitized explosive of more than 50 kg, the total net mass should not be greater than 500 kg;

(d) One or two trays with an adequate size and height to contain the wooden pallets and the packages and to protect the ground;

(e) Wooden pallets (e.g. according to DIN 15146), with wood-wool distributed between, under and above the packages;

(f) A suitable ignition source guaranteeing the ignition of the wooden pallets/wood-wool and consequently the tested packages (a mixture of gasoline and light fuel oil 10/90 evenly distributed over the packages and the wood-wool is recommended);

(g) Cine and/or video cameras and suitable equipment to measure the heat of radiation, e.g. infrared sensors and/or thermo cameras.

51.4.2.2 The number of tests and/or the total mass (whereas necessary) should be increased if the test results are ambiguous and the corresponding hazards cannot be clearly defined.

51.4.3 ***Procedure***

51.4.3.1 The tests start with a single package and then the number of packages are successively increased as mentioned under 51.4.2.1 (a), (b) or (c). Normally the burning rate test should be performed once for each number of packages. The required numbers of packages, in the condition and way in which they are offered for supply and use (including storage), are arranged in such way, that the most severe results are anticipated, on wooden and leveled pallets. The pallets are placed in one (or two, if necessary) trays. A tray must comprise at least one complete pallet including 10 cm open space all around the pallet. Flammable material (wood-wool, paper, etc.) is placed under and around the packages in such a way that an optimum ignition is guaranteed (see 51.4.2.1 (f)).

NOTE*: A quantity of about 10 kg dry wood-wool is usually sufficient. The wooden pallets and the dry wood-wool shall be soaked with a liquid mixture of fuel (about 10 liter, see 51.4.2.1 (f)).*

51.4.3.2 The heat of radiation is measured during the test by suitable equipment, at least at three locations with three different distances from the seat of fire (the distances depend on the sensitivity of the equipment (sensors, thermo camera, etc.) and should be calculated before the test.

51.4.3 The signals are continuously recorded. The starting-point of the fire outbreak is defined as the moment when a reaction of the substance is detected. The end of the fire is determined from registered radiation curves.

51.4.3.4 If a mass explosion or individual explosions or metallic projections (fragments) are observed this should be noted in the test report.

51.4.4 ***Test criteria and method of assessing results***

51.4.4.1 The burning rates A and A_{10t} are determined as follows:

(a) The starting point of the fire is defined as the moment at which the substance or mixture reacts detectably. The end of the fire is characterized by a decrease in radiation level I (as caused by the fire) to less than 5 % of the maximum level (I_{max}) (see Figure 51.4.1);

(b) The effect of either remainder or burning materials, if present, shall be taken into account in the evaluation;

(c) The burning time *t* is the time span between the starting point and the end of the fire;

(d) The burning rate *A* [kg/min] can be calculated for each tested quantity *m* [kg] and its corresponding burning time *t* [min] from the equation:

$$A = \frac{m}{t}$$

(e) log *A* is plotted against log *m*, where *A* is the determined burning rate, and *m* is the mass of substance or mixture used for the test. The observed test results are extrapolated by means of this graph to an uncorrected burning rate A_{10t} for a mass of 10 000 kg corresponding to the following function:

$$A_{10t} = \left(\frac{10000\ kg}{m}\right)^{\frac{2}{3}} \cdot A$$

51.4.4.2 The corrected burning rate A_C is determined as follows:

(a) The internal amount of energy of the substance is partially converted into radiation. The percent average radiation efficiency η at a distance from the fire is determined from the measured radiation level ($dose_{measured}$) and the theoretical maximum energy ($dose_{calculated}$);

$$\eta = \frac{dose_{measured}}{dose_{caculated}}$$

(b) The theoretical maximum energy is calculated by multiplying the individual mass of tested substance *m* [kg] with the heat of combustion H_v [kJ/kg][4]

$$dose_{calculated} = H_v \cdot m$$

(c) The amount of energy that in practice appears to be transferred by radiation is determined by integrating the area below the measured radiation curve;

$$dose_{measured} = f(t) = \left[\sum_{t=start}^{end} \frac{(I_{(t+\Delta t)} + I_t}{2} \cdot \Delta t\right] \cdot 4\,\pi \cdot r^2$$

[4] Should be determined by a suitable technique e.g. combustion calorimeter.

The numerical integration of the radiation intensities I_t [W/m^2] over the total burning time delivers $dose_{measured}$ [kJ] at the distance r [m].

(d) To this end a graph is made showing the radiation level I [kW/m^2] as a function of time. The complete radiation dose is calculated by integration of the smoothed and corrected curve down to 1 % to 5 % of I_{max};

(e) $I_{relevant}$ is obtained from the maximum of the curve of heat radiation calculated as average value of the radiation by converting the integrated area in a rectangle of equal size during the same time span;

(f) The form factor f that must be taken into account during the maximum fire intensity can be averaged from the formula:

$$f = \frac{I_{relevant}}{I_{calculated}}$$

(g) The corrected burning rate A_c is calculated as follows:

$$A_c = A_{10t} \cdot \frac{H_v}{33500} \cdot \frac{\eta}{0.25} \cdot \frac{f}{2.78}$$

Where H_v is the heat of combustion of the substance [kJ/kg] (i.e. reaction enthalpy of the burning reaction); ŋ is the radiation efficiency and f the form factor. A_C is the corrected burning rate [kg/min] for a quantity of 10 000 kg.

51.4.4.3 If a mass explosion or individual explosions or metallic projections (fragments) occur the substance or mixture is classified in the hazard class “explosives”.

51.4.4.4 The test results are assessed on the basis of the corrected burning rate A_C for a quantity of 10 000 kg of the packaged substance or mixture.

51.4.4.5 The test criteria for determining the burning behavior of substances or mixtures are:

Category 1: Any substance or mixture with a corrected burning rate A_C equal to or greater than 300 kg/min but not more than 1200 kg/min;

Category 2: Any substance or mixture with a corrected burning rate A_C equal to or greater than 140 kg/min but less than 300 kg/min;

Category 3: Any substance or mixture with a corrected burning rate A_C equal to or greater than 60 kg/min but less than 140 kg/min;

Category 4: Any substance or mixture with a corrected burning rate AC less than 60 kg/min.

Any substance or mixture with a corrected burning rate greater than 1200 kg/min is classified as an explosive (See Chapter 2.1 of the GHS).

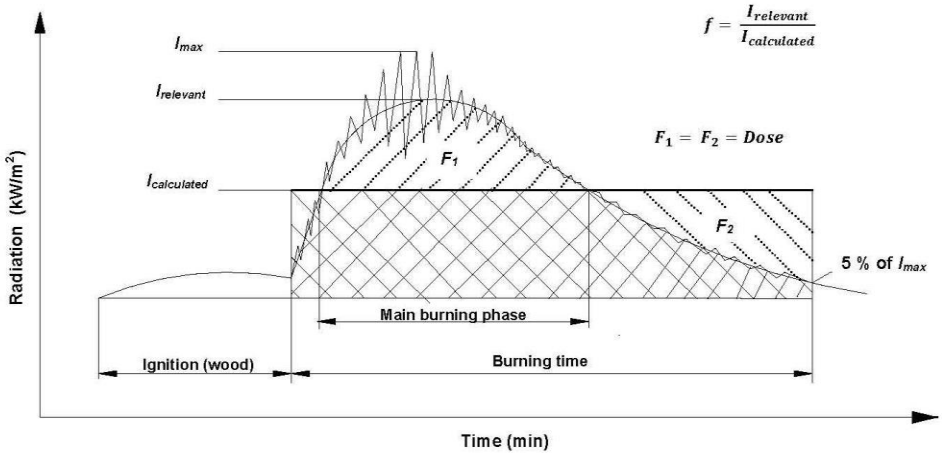


Figure 51.4.1: Measurement of radiation as a function of time

51.4.5 *Examples of results*

51.4.5.1 The nitrocellulose formulations are packed in fiber drums (1G) with a maximum mass of 140 kg and fiber board boxes (4G) with a maximum mass of 25 kg, assigned to categories as follows:

(a) Ester soluble (E-grades) nitrocellulose formulations with different phlegmatizers and a nitrogen content of 11.8 % to 12.3 %

NC-type	IPA 35%	IPA 30%	ETH 35%	ETH 30%	BUT 35%	BUT 30%	Water	Chips[a)]
12E	3	2	4	3	2	1 (330 kg/min)	4	1 (1115 kg/min)
22E	3	3	4	3	3	3	4	1 (1115 kg/min)
25E	3	3	4	3	3	3	3	1 (1115 kg/min)

IPA (Isopropanol), ETH (Ethanol), BUT (Butanol),
[a)] NC-Chips with 20 % plasticizer

(b) Medium soluble (M-grades) nitrocellulose formulations with different phlegmatizers and a nitrogen content of 11.3 % to 11.8 %

NC-type	IPA 35%	IPA 30%	ETH 35%	ETH 30%	BUT 35%	BUT 30%	Water	Chips[a)]
15M	-	-	-	-	3	2	-	
27M	3	3	4	4	3	3	4	1 (1115 kg/min)
34M	3	3	4	4	4	-	-	1 (1115 kg/min)

IPA (Isopropanol), ETH (Ethanol), BUT (Butanol),
[a)] NC-Chips with 20 % plasticizer

(c) Alcohol soluble (A-grades) nitrocellulose formulations with different phlegmatizers and a nitrogen content of 10.7 % to 11.3 %

NC-type	IPA 35%	IPA 30%	ETH 35%	ETH 30%	BUT 35%	BUT 30%	Water	Chips[a)]
15A	4	3	4	3	3	2	-	1 (1115 kg/min)
30A	4	3	4	4	3	3	4	1 (1115 kg/min)
32 A	4	3	4	4	4	3	-	-

IPA (Isopropanol), ETH (Ethanol), BUT (Butanol),
[a)] NC-Chips with 20 % plasticizer

51.4.6 ***Example of a calculation***

NC-formulation (nitrogen content 10.7 % to 11.2 %) wetted with 30 % isopropanol:

Mass of the tested NC formulation: m = 285 kg
Burning time: t = 9.7 min
Form factor: f = 3.73
Radiation efficiency: η = 0.24
Enthalpy of combustion: H_v = 15626 kJ/kg

Calculation of the burning rate A:

$$A = \frac{m}{t} = \frac{285\ kg}{9.7\ min} = 29.4\ \frac{kg}{min}$$

Calculation of the burning rate A_{10t}:

$$A_{10t} = \left(\frac{10000\ kg}{m}\right)^{\frac{2}{3}} \cdot A = \left(\frac{10000\ kg}{285\ kg}\right)^{\frac{2}{3}} \cdot 29.4\ \frac{kg}{min} = 315\ \frac{kg}{min}$$

Calculation of the corrected burning rate A_c:

$$A_c = A_{10t} \cdot \frac{H_v}{33500} \cdot \frac{\eta}{0.25} \cdot \frac{f}{2.78} = 315\ \frac{kg}{min} \cdot \frac{15626\ \frac{kJ}{kg}}{33500\ \frac{kJ}{kg}} \cdot \frac{0.24}{0.25} \cdot \frac{3.73}{2.78} = 189\ \frac{kg}{min}$$

The desensitized explosive is classified in category 2.".

(Reference document: ST/SG/AC.10/C.3/2014/2)

Appendix 6

3.3 (c) Amend to read as follows:

"(c) For the organic substance or a homogenous mixture of organic substances containing chemical group (or groups) associated with explosive properties:

- when the exothermic decomposition energy is less than 500 J/g, or

- when the onset of exothermic decomposition is 500 ºC or above

as indicated by Table A6.2.

Table A6.2 DECISION TO APPLY THE ACCEPTANCE PROCEDURE FOR CLASS 1 FOR AN ORGANIC SUBSTANCE OR A HOMOGENOUS MIXTURE OF ORGANIC SUBSTANCES

Decomposition energy (J/g)	Decomposition onset temperature (°C)	Apply acceptance procedure for Class

		1? (Yes/No)
< 500	< 500	No
< 500	≥ 500	No
≥ 500	< 500	Yes
≥ 500	≥ 500	No

The exothermic decomposition energy may be determined using a suitable calorimetric technique (see 20.3.3.3); or".

5.1 (a) Amend the reference to Table A6.2 to read "Table A6.3".

5.1, Table A6.2 Renumber as A6.3.

(Reference document: ST/SG/AC.10/C.3/86/Add.1)

Appendix 7

In section 4, second sentence:

Amend the beginning to read as follows:

"The result is considered positive "+" and the pyrotechnic substances in powder form or as pyrotechnic units as presented in the fireworks, that are used in waterfalls, or…."

Replace "8 ms" by "6 ms".

Remainder unchanged.

(Reference document: ST/SG/AC.10/C.3/2014/84 as amended)

Add a new Appendix 9 to read as follows:

"**Appendix 9**

Ballistic projection energy test for cartridges, small arms (UN No. 0012)

1. Introduction

This test is conducted with candidates for Cartridges, small arms (UN No. 0012) with individual cartridges and is used to determine the maximum possible energy of a projection that could be generated upon functioning in transport. The test takes worst-case conditions into account, since no packaging attenuates the energy of the projectile and the cartridge is supported by a fixed anvil block. It is not necessary to reverse the test set-up to a situation where the cartridge is propelled, because experimentation shows that energy transfer from the propellant to the bullet is equal or more than that to the case.

2. Apparatus and materials

The following items are required:

(a) A suitable actuator to initiate ammunition; and

(b) A ballistic pendulum with an interception device for the projectile for determining the energy, or a high-speed camera and a background with a scale to determine the velocity of the projectile.

3. Procedure

The test is performed on single cartridges. The cartridge is actuated as designed by means of the primer cap and a firing pin. The cartridge, actuator and measuring device are arranged along the flight path in such a way that angle errors are minimized. The test is performed three times.

4. Test criteria and method of assessing the results

The energy of the projectile is calculated either from the maximum displacement of the ballistic pendulum or from the velocity (v) determined by the high-speed camera taking the mass (m) of the projectile into account. The value of energy (E) can be calculated from the equation:

$$E = ½mv^2$$

If the energy of the projectile does not exceed 8 J in any of the test runs, the article, in the appropriate packaging in accordance with Chapter 3.2 of the Model Regulations, may be assigned to Cartridges, small arms (UN No. 0012).".

(Reference documents: ST/SG/AC.10/C.3/2014/109)