ST/SG/AC.10/11/Rev.6/Amend.1

Recommendations on the

TRANSPORT OF DANGEROUS GOODS

Manual of Tests and Criteria

Sixth revised edition

Amendment 1

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UNITED NATIONS
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NOTE

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INTRODUCTION

The Manual of Tests and Criteria contains criteria, test methods and procedures to be used for classification of dangerous goods according to the provisions of Parts 2 and 3 of the United Nations *Recommendations on the Transport of Dangerous Goods, Model Regulations*[1], as well as of chemicals presenting physical hazards according to the *Globally Harmonized System of Classification and Labelling of Chemicals (GHS)*[2].

As a consequence, it supplements also national or international regulations which are derived from the United Nations Recommendations on the Transport of Dangerous Goods or the GHS.

Originally developed by the Economic and Social Council's Committee of Experts on the Transport of Dangerous Goods which adopted a first version in 1984, it has been regularly updated and amended every two years. Presently, the updating is done under the auspices of the Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals, which replaces the original committee since 2001.

The sixth revised edition published in 2015, includes all the amendments to the fifth revised edition adopted by the Committee at its fifth and sixth sessions in 2010 and 2012 (published under the symbols ST/SG/AC.10/11/Rev.5/Amend.1 and ST/SG/AC.10/11/Rev.5/Amend.2) and those adopted at its seventh session in 2014 (ST/SG/AC.10/42/Add.2).

The amendments listed in this publication were adopted by the Committee at its eighth session (9 December 2016)[3]. This publication also takes into account the corrections to section 38.3 adopted by the Sub-Committee of the Experts on the Transport of Dangerous Goods at its fiftieth session (28 November – 6 December 2016)[4].

This publication includes:

- Amendments to the procedures to be followed for the classification of lithium metal and lithium ion cells and batteries;
- Amendment to the classification procedure for ammonium nitrate based fertilizers;
- A new sub-section on lithium cell and battery test summary;
- A new section on Classification procedure and criteria relating to solid ammonium nitrate based fertilizers;
- Amendment to appendix 7 on Flash composition Tests;
- Amendments to facilitate the use of the Manual in the context of the GHS.

1 *ST/SG/AC.10/1/Rev.20. United Nations publication, sales No. 17.VIII.1.*
2 *ST/SG/AC.10/30/Rev.7. United Nations publication, sales No. 17.II.E.10.*
3 *ST/SG/AC.10/44/Add.2.*
4 *ST/SG/AC.10/C.3/100/Add.1, Annex II*

TABLE OF CONTENTS

AMENDMENTS TO THE SIXTH REVISED EDITION OF THE RECOMMENDATIONS ON THE TRANSPORT OF DANGEROUS GOODS, MANUAL OF TESTS AND CRITERIA

GENERAL INTRODUCTION

Section 1

1.1.2 Amend the second sentence to read as follows: “It therefore assumes technical competence on the part of the testing body.”.

1.3.1 In the first sentence, replace “risk” by “hazard”. In the second sentence, replace “risks” by “hazards”.

PART I

Section 10

10.3.3.2 Amend to read as follows:

“10.3.3.2 The acceptance procedure for substances designed to have a practical explosive or pyrotechnic effect starts with the application of test series 3 to determine if the substance is too sensitive for transport in the form in which it is tested. If the substance passes all tests, the procedure for the assignment to the appropriate division is applied. If the substance fails any of the tests, it is forbidden for transport in the form tested. A substance which fails test type 3 (c) may be altered and resubmitted to test type 3 (c). A substance which fails test types 3 (a), 3 (b) or 3 (d) may be encapsulated or packaged to reduce sensitiveness to external stimuli and submitted to test type 4 (b).”.

10.3.3.4 Delete.

10.3.3.3 Renumber as 10.3.3.4.

Add the new paragraph 10.3.3.3 to read as follows:

“10.3.3.3 All articles as presented for transport (packaged or unpackaged) should be subjected to test series 4. However, if there is sufficient information to indicate that the article would not be too dangerous for transport, the competent authority may decide to waive all or part of these tests for the article. If the product passes all the required tests in test series 4, the procedure for assignment to the appropriate division is applied. If the product fails any of the required tests, it is forbidden for transport in the form tested, but it may be modified or repackaged and resubmitted to test series 4. If the competent authority suspects that the product may be subject to stimuli other than those specified in test series 4 resulting in potentially dangerous effects, additional information or tests may be required (see note under paragraph 2.1.3.3.1 of the Model Regulations).”.

Section 11

11.3.2 Delete “during transport”.

11.3.3 Replace “should be performed” by “are performed”. Replace “is to be transported under conditions” by “is likely to encounter conditions”.

11.3.4 Replace “considered for transport” by “considered for packing”.

11.5.1.2.1 (d) Replace “30 ± 3 MPa” by “29 MPa ± 4 MPa”.

11.5.1.3.1 In footnote 1, replace “transport conditions” by “operating conditions”.

Section 12

12.1.1 Replace “Class 1” by “the class of explosives”.

12.3.2 Delete “during transport”.

12.3.3 Replace “should be performed” by “are performed”. Replace “is to be transported under conditions” by “is likely to encounter conditions”.

12.5.1.2.1 (d) Replace “30 ± 3 MPa” by “29 MPa ± 4 MPa”.

12.5.1.3.1 In footnote 1, replace “transport conditions” by “operating conditions”.

Section 13

13.1 Amend to read as follows:

“13.1 This test series is used to answer the questions in boxes 10 and 11 of Figure 10.2 by determining the sensitiveness of the substance to mechanical stimuli (impact and friction), to heat and to flame. The question in box 10 is answered "no" if a "+" is obtained in test type 3 (c) and the substance shall be categorised as an unstable explosive; consequentially the substance is not permitted for transport. The question in box 11 is answered "yes" if a "+" is obtained in any of the test types 3 (a), 3 (b) or 3 (d). If a "+" is obtained, the substance shall be categorised as an unstable explosive in the form in which it was tested but may be encapsulated or otherwise desensitized or packaged to reduce its sensitiveness to external stimuli.

NOTE: *Although explosives categorised as unstable explosives are forbidden for transport they are not prohibited in other sectors where special precautions may be applied.*”.

13.3.2 Replace “wetting agent provided for transport” by “wetting agent specified”.

13.3.3 Amend the middle of the sentence as follows: “… at ambient temperature unless the substance is likely to encounter conditions …”.

13.4 Throughout the whole sub-section replace “too dangerous to transport” and “too dangerous for transport” by “an unstable explosive”.

(Applies to the following paragraphs: 13.4.1.1; 13.4.1.4.1; 13.4.1.4.2; 13.4.2.1; 13.4.2.4; 13.4.3.1; 13.4.3.4.1 (twice); 13.4.3.4.2 (twice); 13.4.4.1; 13.4.4.4; 13.4.5.1; 13.4.5.4.2; 13.4.5.4.3; 13.4.6.1; 13.4.6.4.1; 13.4.6.4.2; 13.4.7.1; 13.4.7.5.1 and 13.4.7.5.2)

13.4.2.3.1 (c) Replace “are transported” by “are manufactured”.

13.4.6.3.1.1 At the end of the second sentence replace “wetting agent required for transport” by “wetting agent specified”.

13.4.7.3.1 At the end of the second sentence replace “wetting agent required for transport” by “wetting agent specified”.

13.5 Throughout the whole sub-section replace “too dangerous to transport” and “too dangerous for transport” by “an unstable explosive”.

(Applies to the following paragraphs: 13.5.1.1; 13.5.1.3.4; 13.5.2.1; 13.5.2.4 (twice); 13.5.3.1; 13.5.3.4; 13.5.4.1 and 13.5.4.5)

13.5.1.3.1 At the end of the second sentence replace “wetting agent provided for transport” by “wetting agent specified” and in sub-paragraph (c) replace “are transported” by “are manufactured”.

13.5.3.3.1 Replace “wetting agent provided for transport” by “wetting agent specified”.

13.5.4.3.1 Replace “wetting agent provided for transport” by “wetting agent specified”.

13.6.1.1 Replace “stability” by “thermal stability” and delete “to determine if the substance is too dangerous to transport” at the end on the sentence.

13.6.1.3.1 Amend the last sentence to read as follows: “If explosion or ignition occurs then the substance is too thermally unstable for transport and shall be categorized as an unstable explosive”.

13.6.1.4.2 Amend the end of the sentence to read as follows: “…considered thermally unstable, shall be categorised as an unstable explosive and is not permitted for transport.”.

13.6.2.1 Replace “stability” by “thermal stability” and delete “to determine if the substance is too dangerous to transport” at the end on the sentence.

13.6.2.4.2 Amend the end of the sentence to read as follows: “…considered thermally unstable, shall be categorised as an unstable explosive and is not permitted for transport.”.

13.7.1.3 In the last paragraph, replace “too dangerous for transport” by “an unstable explosive”.

Section 15

15.3.2 Replace “to be transported under conditions” by “likely to encounter conditions”.

15.4.1.3 Delete the fourth sentence (“In all cases,… shipping density.)”. In the fourth sentence counting from the end, replace “which have to be transported in regions of high ambient temperatures” by “which could be subjected to high ambient temperatures”.

Figure 15.4.1.1 Amend the description for (B) to read as follows: “Cardboard tube”.

Figure 15.4.1.2 Amend the description for (B) to read as follows: “Cardboard tube”. Delete the dimensions from the description of (E) and (F).

15.6.1.1 Replace “packaged as for transport” by “as packaged for transport”.

15.6.1.2 (a) Replace “transport” by “classification”.

Section 16

16.1.1 At the end of the second sentence delete “a load is”. In the last sentence replace “Class 1” by “the class of explosives”.

16.2.2 In sub-paragraph (a), replace “carried” by “classified”. In sub-paragraph (b) (i), replace “detonation and/or ignition” by “initiation”.

16.3.1 In the second sentence replace “most disadvantageous” by “most severe”. In the third sentence replace “carried” by “classified”.

16.4.1.3.1 In the second sentence replace “carried” by “classified”.

16.4.1.3.2 (c) Replace “Class 1” by “the class of explosives”.

16.4.1.3.5 Delete the last sentence.

16.4.1.4 Delete the text between parentheses.

16.5.1.3 In the second sentence and in the last but one sentence, replace “carried” by “classified”.

16.5.1.4 (c) Replace “Class 1” by “the class of explosives”.

16.5.1.6 In the second sentence replace “carried” by “classified”.

16.6.1.3.9 In the first sentence, insert “Division 1.4, Compatibility Group S in transport” before “UN No.0012”.

16.6.1.4.6 In the last sentence, insert “Division 1.4, Compatibility Group S in transport” before “UN No. 0012”.

16.7.1.3.1 “In the second sentence replace “are to be carried” by “are classified”

Section 17

17.11.1.2.1 In the last but one sentence, replace “to surround articles transported bare” by “to surround bare articles”.

Section 18

18.1 Amend the end of the last paragraph to read: “… of ANEs for containment in portable tanks as an oxidizing substance.”.

Table 18.1 Amend the end of note [b] to the table to read: “… of ANEs for containment in portable tanks as an oxidizing substance.”.

18.6.1.2.1 (d) Replace “30 ± 3 MPa” by “29 MPa ± 4 MPa”.

18.7.1.1 Amend the end of the first sentence to read: “… suitability for containment in portable tanks as an oxidizing substance.”.

18.7.1.4 Amend the middle of the second paragraph to read: “…should not be contained in portable tanks as an oxidizing substance…”.

18.7.2.1 Amend the end of the first paragraph to read: “…to be contained in portable tanks as an oxidizing substance”.

18.7.2.4.8 Amend the middle of the second paragraph to read: “…should not be contained in portable tanks as an oxidizing substance…”.

PART II

Section 20

Figure 20.1 (a), Exit B, replace “subsidiary risk” by “subsidiary hazard”.

20.4.2 (b) and (c) Replace “subsidiary risk” by “subsidiary hazard”.

20.4.3 (b) and (c) Replace “subsidiary risk” by “subsidiary hazard”.

Figure 20.2 Item 9.7, replace “risks” by “hazards”.

Figure 20.3 Exit B, replace “subsidiary risk” by “subsidiary hazard”.

Section 25

25.4.1.2.1 (d) Replace “30 ± 3 MPa” by “29 MPa ± 4 MPa”.

Section 28

28.1 In sub-paragraph (b) and in the second reference, replace “Frank-Kamentskii” by “Frank-Kamenetskii”.

PART III

Section 30

30.1.1 (h) Replace “Ammonium nitrate fertilizers” by “Ammonium nitrate based fertilizers”.

30.2 (c) Replace “risk” by “hazard”.

Section 32

32.3.1.1 Replace “risk” by “hazard”.

32.3.1.2 Replace “risk” by “hazard”.

32.3.1.3 Replace “risk(s)” by “hazard(s)” twice. At the end, replace “risks” by “hazards”.

Section 33

33.2.1.4.4.1 Amend the last sentence to read as follows: “Powders of metals or metal alloys should be classified when they can be ignited and the reaction spreads over the whole length (100 mm) of the sample in 10 minutes or less.”.

33.2.1.4.4.2 Amend the last sentence to read as follows: “Packing group II should be assigned to powders of metals or metal alloys if the zone of reaction spreads over the whole length (100 mm) of the sample in five minutes or less.”.

33.2.1.4.4.3 Amend the last sentence to read as follows: “Packing group III should be assigned to metal powders if the reaction spreads over the whole length (100 mm) of the sample in more than five minutes but not more than ten minutes.”.

Section 34

34.3.1 Add the following new last sentence: “By exception, solid ammonium nitrate based fertilizers are not classified as oxidizing solids on the basis of results from tests O.1 or O.3, since the hazardous properties are not sufficiently described by the outcome of tests for oxidizing properties. Instead, such fertilizers are classified on the basis of acquired experience and knowledge of their hazardous behaviour. They shall be classified in accordance with the procedure as set out in Section 39.”.

34.4.1.1 Replace "fibrous cellulose" by "cellulose".

34.4.1.2.2 Replace the first sentence by “Dried white cellulose [1], with a fibre mean diameter of approximately 25 µm, grain size less than 100 µm, apparent density of approximately 170 kg/m^3 and pH-value between 5 and 7, is used as the combustible material.”. Footnote 1 remains unchanged.

34.4.1.4.2 At the end, replace “risks” by “hazards”.

34.4.2.1 Replace "fibrous cellulose" by "cellulose".

34.4.2.2.5 Replace the first sentence by “Dried white cellulose[3], with a fibre mean diameter of approximately 25 µm, grain size approximately 100 µm, apparent density 150 to 200 kg/m^3 and pH-value between 5 and 7.5, is used as the combustible material.”. The text of footnote 3 is replaced by: “[3] Source reference available from the national contact for test details in France (see Appendix 4)”.

34.4.2.4.2 At the end, replace “risks” by “hazards”.

34.4.3.1 Replace "fibrous cellulose" by "cellulose".

34.4.3.2.2 Replace the first sentence by “Dried white cellulose [5], with a fibre mean diameter of approximately 25 µm, grain size less than 100 µm, apparent density of approximately 170 kg/m^3 and pH-value between 5 and 7, is used as the combustible material.”. Footnote 5 reads: “[5] Source reference available from the national contact for test details in France (see Appendix 4)”. In 34.4.3.3, renumber footnote 5 as footnote 6.

34.4.3.5.4 In the paragraph after “Not Division 5.1”, replace “risks” by “hazards”.

Section 38

38.2 In the heading, replace “ammonium nitrate fertilizers” by “ammonium nitrate based fertilizers”.

38.2.1.1 Replace “ammonium nitrate” by “ammonium nitrate based” (twice).

38.2.3.1 Replace “ammonium nitrate fertilizer” by “ammonium nitrate based fertilizer”.

38.2.3.2 Replace “ammonium nitrate fertilisers” by “ammonium nitrate based fertilizers”.

38.2.3.3 At the beginning, replace “Ammonium nitrate fertilizers” by “Ammonium nitrate based fertilizers”.

Insert the following new 38.2.3.4:

“38.2.3.4 The overall classification procedure for ammonium nitrate based fertilizers is set out in Section 39.”.

38.3 Amend to read as follows:

“38.3 Lithium metal and lithium ion batteries

38.3.1 *Purpose*

This section presents the procedures to be followed for the classification of lithium metal and lithium ion cells and batteries (see UN Nos. 3090, 3091, 3480 and 3481, and the applicable special provisions of Chapter 3.3 of the Model Regulations).

38.3.2 *Scope*

38.3.2.1 All cell types shall be subjected to tests T.1 to T.6 and T.8. All non-rechargeable battery types, including those composed of previously tested cells, shall be subjected to tests T.1 to T.5. All rechargeable battery types, including those composed of previously tested cells, shall be subjected to tests T.1 to T.5 and T.7. In addition, rechargeable single cell batteries with overcharge protection shall be subjected to test T.7. A component cell that is not transported separately from the battery it is part of needs only to be tested according to tests T.6 and T.8. A component cell that is transported separately from the battery shall be subjected to tests T.1 to T.6 and T.8. A cell or battery that is an integral part of the equipment

it is intended to power that is transported only when installed in the equipment, may be tested in accordance with the applicable tests when installed in the equipment.

38.3.2.2 Lithium metal and lithium ion cells and batteries shall be subjected to the tests, as required by special provisions 188 and 230 of Chapter 3.3 of the Model Regulations prior to the transport of a particular cell or battery type. Cells or batteries which differ from a tested type by:

(a) For primary cells and batteries, a change of more than 0.1 g or 20% by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte;

(b) For rechargeable cells and batteries, a change in nominal energy in Watt-hours of more than 20% or an increase in nominal voltage of more than 20%; or

(c) A change that would lead to failure of any of the tests,

shall be considered a new type and shall be subjected to the required tests.

NOTE: *The type of change that might be considered to differ from a tested type, such that it might lead to failure of any of the test results, may include, but is not limited to:*

(a) A change in the material of the anode, the cathode, the separator or the electrolyte;

(b) A change of protective devices, including hardware and software;

(c) A change of safety design in cells or batteries, such as a venting valve;

(d) A change in the number of component cells;

(e) A change in connecting mode of component cells; and

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

In the event that a cell or battery type does not meet one or more of the test requirements, steps shall be taken to correct the deficiency or deficiencies that caused the failure before such cell or battery type is retested.

38.3.2.3 For the purposes of classification, the following definitions apply:

Aggregate lithium content means the sum of the grams of lithium content contained by the cells comprising a 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".

Button cell or battery means a round small cell or battery when the overall height is less than the diameter.

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.

Cycle means one sequence of fully charging and fully discharging a rechargeable cell or battery.

Disassembly means a rupture of the cell or battery case where solid components are ejected.

NOTE: *During cell or component cell testing, ejection of internal components is acceptable. Energy of ejected components shall be limited and can be measured as follows:*

(a) *It will not penetrate a wire mesh screen (annealed aluminium wire with a diameter of 0.25 mm and grid density of 6 to 7 wires per cm) placed 25 cm away from the cell; or*

(b) *It can be measured by a method demonstrated to be equivalent to the one described in sub-paragraph (a) above.*

Effluent means a liquid or gas released when a cell or battery vents or leaks.

Fire means that flames are emitted from the test cell or battery.

First cycle means the initial cycle following completion of all manufacturing processes.

Fully charged means a rechargeable cell or battery which has been electrically charged to its design rated capacity.

Fully discharged means either:

a primary cell or battery which has been electrically discharged to remove 100% of its rated capacity; or

a rechargeable cell or battery which has been electrically discharged to its endpoint voltage as specified by the manufacturer.

Large battery means a lithium metal battery or lithium ion battery with a gross mass of more than 12 kg.

Large cell means a cell with a gross mass of more than 500 g.

Leakage means the visible escape of electrolyte or other material from a cell or battery or the loss of material (except battery casing, handling devices or labels) from a cell or battery such that the loss of mass exceeds the values in Table 38.3.1.

Lithium content is applied to lithium metal and lithium alloy cells and batteries, and for a cell means the mass of lithium in the anode of a lithium metal or lithium alloy cell, which for a primary cell is measured when the cell is in an undischarged state and for a rechargeable cell is measured when the cell is fully charged. The lithium content of a battery equals the sum of the grams of lithium content contained in the component cells of the battery.

Lithium ion cell or battery means a rechargeable electrochemical cell or battery in which the positive and negative electrodes are both intercalation compounds (intercalated lithium exists in an ionic or quasi-atomic form with the lattice of the electrode material) constructed with no metallic lithium in either electrode. A lithium polymer cell or battery that uses lithium ion chemistries, as described herein, is regulated as a lithium ion cell or battery.

Mass loss means a loss of mass that exceeds the values in Table 38.3.1 below.

Table 38.3.1: Mass loss limit

Mass M of cell or battery	Mass loss limit
$M < 1$ g	0.5%
$1 \text{ g} \leq M \leq 75$ g	0.2%
$M > 75$ g	0.1%

NOTE: *In order to quantify the mass loss, the following procedure is provided:*

$$\text{Mass loss}\,(\%) = \frac{(M_1 - M_2)}{M_1} \times 100$$

where M_1 is the mass before the test and M_2 is the mass after the test. When mass loss does not exceed the values in Table 38.3.1, it shall be considered as "no mass loss".

Nominal energy or Watt-hour rating, expressed in watt-hours, means the energy value of a cell or battery determined under specified conditions and declared by the manufacturer. The nominal energy is calculated by multiplying nominal voltage by rated capacity expressed in ampere-hours.

Nominal voltage means the approximate value of the voltage used to designate or identify a cell or battery.

Open circuit voltage means the voltage across the terminals of a cell or battery when no external current is flowing.

Primary cell or battery means a cell or battery which is not designed to be electrically charged or recharged.

Prismatic cell or battery means a cell or battery whose ends are similar, equal and parallel rectilinear figures, and whose sides are parallelograms.

Protective devices means devices such as fuses, diodes and current limiters which interrupt the current flow, block the current flow in one direction or limit the current flow in an electrical circuit.

Rated capacity means the capacity, in ampere-hours or milliampere-hours, of a cell or battery as measured by subjecting it to a load, temperature and voltage cut-off point specified by the manufacturer.

NOTE*: The following IEC standards provide guidance and methodology for determining the rated capacity:*

(1) IEC 61960 (First Edition 2003-12) : Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications;

(2) IEC 62133 (First Edition 2002-10): Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications;

(3) IEC 62660-1 (First Edition 2011-01): Secondary lithium-ion cells for the propulsion of electric road vehicles – Part 1: Performance testing.

Rechargeable cell or battery means a cell or battery which is designed to be electrically recharged.

Rupture means the mechanical failure of a cell container or battery case induced by an internal or external cause, resulting in exposure or spillage but not ejection of solid materials.

Short circuit means a direct connection between positive and negative terminals of a cell or battery that provides a virtual zero resistance path for current flow.

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.*

Small battery means a lithium metal battery or lithium ion battery with a gross mass of not more than 12 kg.

Small cell means a cell with a gross mass of not more than 500 g.

Type means a particular electrochemical system and physical design of cells or batteries.

Undischarged means a primary cell or battery that has not been wholly or partly discharged.

Venting means the release of excessive internal pressure from a cell or battery in a manner intended by design to preclude rupture or disassembly.

Watt-hour rating, see *Nominal energy*.

38.3.3 When a cell or battery type is to be tested under this sub-section, the number and condition of cells and batteries of each type to be tested are as follows:

(a) When testing primary cells and batteries under tests T.1 to T.5 the following shall be tested in the quantity indicated:

(i) ten cells in undischarged states;

(ii) ten cells in fully discharged states;

(iii) four small batteries in undischarged states;

(iv) four small batteries in fully discharged states;

(v) four large batteries in undischarged states; and

(vi) four large batteries in fully discharged states.

(b) When testing rechargeable cells and batteries under tests T.1 to T.5 the following shall be tested in the quantity indicated:

(i) five cells at first cycle, in fully charged states;

(ii) five cells after 25 cycles ending in fully charged states;

(iii) four small batteries at first cycle, in fully charged states;

(iv) four small batteries after 25 cycles ending in fully charged states;

(v) two large batteries at first cycle, in fully charged states; and

(vi) two large batteries after 25 cycles ending in fully charged states.

(c) When testing primary and rechargeable cells under test T.6, the following shall be tested in the quantity indicated:

(i) for primary cells, five cells in undischarged states and five cells in fully discharged states;

(ii) for component cells of primary batteries, five cells in undischarged states and five cells in fully discharged states;

(iii) for rechargeable cells, five cells at first cycle at 50% of the design rated capacity and five cells after 25 cycles ending at 50% of the design rated capacity; and

(iv) for component cells of rechargeable batteries, five cells at first cycle at 50% of the design rated capacity and five cells after 25 cycles ending at 50% of the design rated capacity.

(d) When testing rechargeable batteries or rechargeable single cell batteries under test T.7, the following shall be tested in the quantity indicated:

(i) four small batteries at first cycle, in fully charged states;

(ii) four small batteries after 25 cycles ending in fully charged states;

(iii) two large batteries at first cycle, in fully charged states; and

(iv) two large batteries after 25 cycles ending in fully charged states.

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.

(e) When testing primary and rechargeable cells and components cells under test T.8, the following shall be tested in the quantity indicated:

(i) ten primary cells in fully discharged states;

(ii) ten primary component cells in fully discharged states;

(iii) ten rechargeable cells, at first cycle in fully discharged states;

(iv) ten rechargeable component cells, at first cycle in fully discharged states;

(v) ten rechargeable cells after 25 cycles ending in fully discharged states; and

(vi) ten rechargeable component cells after 25 cycles ending in fully discharged states.

(f) When testing a battery assembly 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.

(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.

38.3.3.1 Provisions 38.3.2.1 and 38.3.3 are summarized in the following table.

Table 38.3.2: Summary table of required tests for primary cells and batteries

Primary cells and batteries										
		T.1	T.2	T.3	T.4	T.5	T.6	T.7	T.8	Sum[c]
Cells not transported separately	undischarged state						5			20
	fully discharged state						5		10	
Cells	undischarged state	10					5			40
	fully discharged state	10					5		10	
Single cell batteries[a]	undischarged state	10					5			40
	fully discharged state	10					5		10	
Small batteries	undischarged state	4								8
	fully discharged state	4								
Large Batteries	undischarged state	4								8
	fully discharged state	4								
Batteries assembled with tested batteries ≤ 500 g Li	undischarged state			1						1
Batteries assembled with tested batteries > 500 g[b] Li										0

[a] *A single cell battery containing one tested cell does not require testing unless a change in cell design could result in the failure of any test.*

[b] *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.

[c] *The sum represents the number of tests required, not the number of cells or batteries tested.*

Table 38.3.3: Summary table of required tests for rechargeable cells and batteries

Rechargeable cells and batteries										
		T.1	T.2	T.3	T.4	T.5	T.6	T.7[a]	T.8	Sum[d]
Cells not transported separately from a battery	first cycle, 50% charged state						5			30
	25th cycle, 50% charged state						5			
	first cycle, fully discharged state								10	
	25th cycle, fully discharged state								10	
Cells	first cycle, fully charged state	5								40
	25th cycle, fully charged state	5								
	first cycle, 50% charged state						5			
	25th cycle, 50% charged state						5			
	first cycle, fully discharged state								10	
	25th cycle, fully discharged state								10	
Single cell batteries[b]	first cycle, fully charged state	5						4		48
	25th cycle, fully charged state	5								
	first cycle, 50% charged state						5			
	25th cycle, 50% charged state						5			
	25th cycle, fully charged state							4		
	first cycle, fully discharged state								10	
	25th cycle, fully discharged state								10	
Small batteries	first cycle, fully charged state	4						4		16
	25th cycle, fully charged state	4						4		
Large batteries	first cycle, fully charged state	2						2		8
	25th cycle, fully charged state	2						2		
Batteries assembled with tested batteries ≤ 6 200 Wh or ≤500 g Li	fully charged state			1				1		2
Batteries assembled with tested batteries > 6 200 Wh or or >500 g Li[c]										0

[a] *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;*

[b] *Except for the T.7 Overcharge test, a single cell battery containing one tested cell does not require testing unless a change in cell design could result in the failure of any test;*

[c] *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.

[d] *The sum represents the number of tests required, not the number of cells or batteries tested.*

38.3.4 ***Procedure***

Tests T.1 to T.5 shall be conducted in sequence on the same cell or battery. Tests T.6 and T.8 shall be conducted using not otherwise tested cells or batteries. Test T.7 may be conducted using undamaged batteries previously used in Tests T.1 to T.5 for purposes of testing on cycled batteries.

38.3.4.1 *Test T.1: Altitude simulation*

38.3.4.1.1 Purpose

This test simulates air transport under low-pressure conditions.

38.3.4.1.2 Test procedure

Test cells and batteries shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature (20 ± 5 °C).

38.3.4.1.3 Requirement

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

38.3.4.2 *Test T.2: Thermal test*

38.3.4.2.1 Purpose

This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.

38.3.4.2.2 Test procedure

Test cells and batteries are to be stored for at least six hours at a test temperature equal to 72 ± 2 °C, followed by storage for at least six hours at a test temperature equal to - 40 ± 2 °C. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated until 10 total cycles are complete, after which all test cells and batteries are to be stored for 24 hours at ambient temperature (20 ± 5 °C). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

38.3.4.2.3 Requirement

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

38.3.4.3 *Test T.3: Vibration*

38.3.4.3.1 Purpose

This test simulates vibration during transport.

38.3.4.3.2 Test procedure

Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes.

This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.

The logarithmic frequency sweep shall differ for cells and batteries with a gross mass of not more than 12 kg (cells and small batteries), and for batteries with a gross mass of more than 12 kg (large batteries).

For cells and small batteries: from 7 Hz a peak acceleration of 1 g_n is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 8 g_n occurs (approximately 50 Hz). A peak acceleration of 8 g_n is then maintained until the frequency is increased to 200 Hz.

For large batteries: from 7 Hz to a peak acceleration of 1 g_n is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 2 g_n occurs (approximately 25 Hz). A peak acceleration of 2 g_n is then maintained until the frequency is increased to 200 Hz.

38.3.4.3.3 Requirement

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery directly after testing in its third perpendicular mounting position is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

38.3.4.4 *Test T.4: Shock*

38.3.4.4.1 Purpose

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

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 $Acceleration(g_n) = \sqrt{\left(\frac{100850}{mass^a}\right)}$ whichever is smaller	6 ms
Large batteries	50 g_n or result of formula $Acceleration(g_n) = \sqrt{\left(\frac{30000}{mass^a}\right)}$ whichever is smaller	11 ms

[a] 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 38.3.4.1 for small batteries and Figure 38.3.4.2 for large batteries.

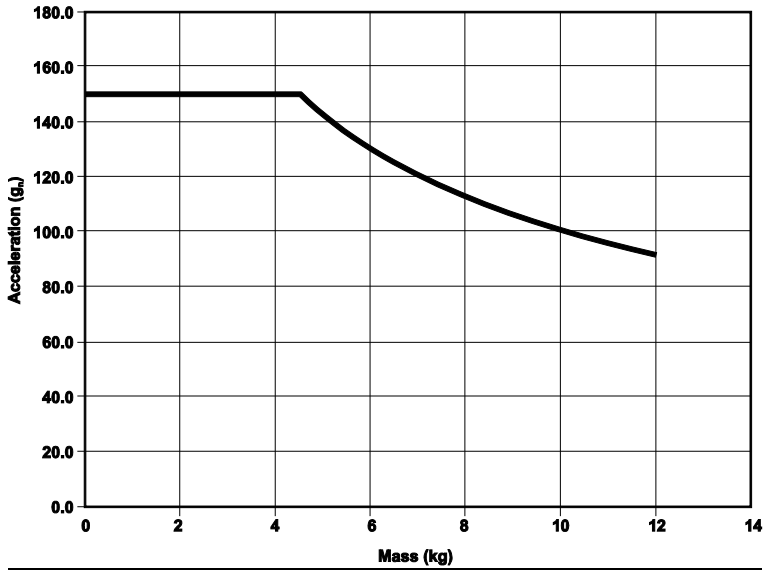


Figure 38.3.4.1: RELATION BETWEEN THE PEAK ACCELERATION AND THE MASS FOR SMALL BATTERIES (below 12.0 kg)

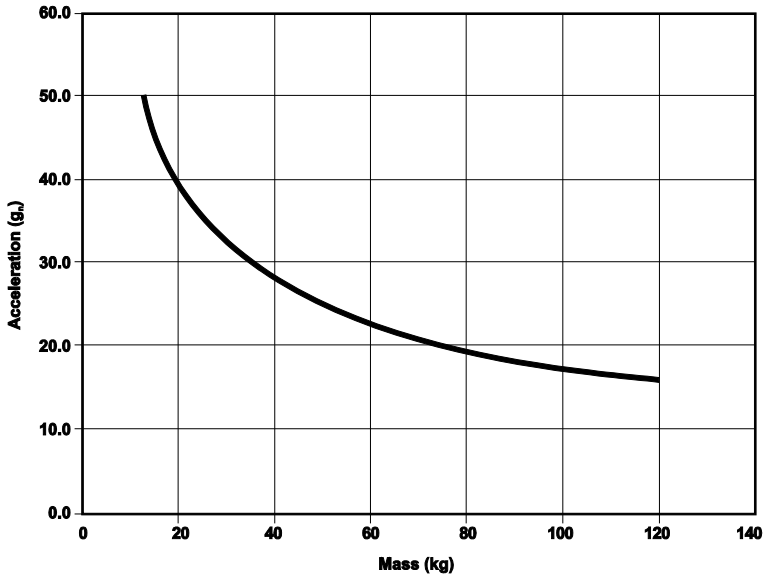


Figure 38.3.4.2: RELATION BETWEEN THE PEAK ACCELERATION AND THE MASS FOR LARGE BATTERIES (equal or above 12.0 kg)

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.

38.3.4.4.3 Requirement

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

38.3.4.5 *Test T.5: External short circuit*

38.3.4.5.1 Purpose

This test simulates an external short circuit.

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.

38.3.4.5.3 Requirement

Cells and batteries meet this requirement if their external temperature does not exceed 170 °C and there is no disassembly, no rupture and no fire during the test and within six hours after the test.

38.3.4.6 *Test T.6: Impact/Crush*

38.3.4.6.1 Purpose

These tests simulate mechanical abuse from an impact or crush that may result in an internal short circuit.

38.3.4.6.2 Test procedure – Impact (applicable to cylindrical cells not less than 18.0 mm in diameter)

***NOTE**: Diameter here refers to the design parameter (for example the diameter of 18 650 cells is 18.0 mm).*

The test sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm ± 0.1 mm diameter, at least 6 cm long, or the longest dimension of the cell, whichever is greater, Type 316 stainless steel bar is to be placed across the centre of the sample. A 9.1 kg ± 0.1kg mass is to be dropped from a height of 61 ± 2.5 cm at the intersection of the bar and sample in a controlled manner using a near frictionless, vertical sliding track or channel with minimal drag on the falling mass. The vertical track or channel used to guide the falling mass shall be oriented 90 degrees from the horizontal supporting surface.

The test sample is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8 mm ± 0.1 mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.

38.3.4.6.3 Test Procedure – Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter)

***NOTE**: Diameter here refers to the design parameter (for example the diameter of 18 650 cells is 18.0 mm).*

A cell or component cell is to be crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1.5 cm/s at the first point of contact. The crushing is to be continued until the first of the three options below is reached.

(a) The applied force reaches 13 kN ± 0.78 kN;

Example: The force shall be applied by a hydraulic ram with a 32 mm diameter piston until a pressure of 17 MPa is reached on the hydraulic ram.

(b) The voltage of the cell drops by at least 100 mV; or

(c) The cell is deformed by 50% or more of its original thickness.

Once the maximum pressure has been obtained, the voltage drops by 100 mV or more, or the cell is deformed by at least 50% of its original thickness, the pressure shall be released.

A prismatic or pouch cell shall be crushed by applying the force to the widest side. A button/coin cell shall be crushed by applying the force on its flat surfaces. For cylindrical cells, the crush force shall be applied perpendicular to the longitudinal axis.

Each test cell or component cell is to be subjected to one crush only. The test sample shall be observed for a further 6 h. The test shall be conducted using test cells or component cells that have not previously been subjected to other tests.

38.3.4.6.4 Requirement

Cells and component cells meet this requirement if their external temperature does not exceed 170 °C and there is no disassembly and no fire during the test and within six hours after this test.

38.3.4.7 *Test T.7: Overcharge*

38.3.4.7.1 Purpose

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

38.3.4.7.2 Test procedure

The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The minimum voltage of the test shall be as follows:

(a) when the manufacturer's recommended charge voltage is not more than 18 V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22 V.

(b) when the manufacturer's recommended charge voltage is more than 18 V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.

Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.

38.3.4.7.3 Requirement

Rechargeable batteries meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

38.3.4.8 *Test T.8: Forced discharge*

38.3.4.8.1 Purpose

This test evaluates the ability of a primary or a rechargeable cell to withstand a forced discharge condition.

38.3.4.8.2 Test procedure

Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

The specified discharge current is to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere).

38.3.4.8.3 Requirement

Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

38.3.5 ***Lithium cell and battery test summary***

The following test summary shall be made available:

Lithium cell or battery test summary in accordance with sub-section 38.3 of Manual of Tests and Criteria
The following information shall be provided in this test summary: (a) Name of cell, battery, or product manufacturer, as applicable; (b) Cell, battery, or product manufacturer's contact information to include address, phone number, email address and website for more information; (c) Name of the test laboratory to include address, phone number, email address and website for more information; (d) A unique test report identification number; (e) Date of test report; (f) Description of cell or battery to include at a minimum: (i) Lithium ion or lithium metal cell or battery; (ii) Mass; (iii) Watt-hour rating, or lithium content; (iv) Physical description of the cell/battery; and (v) Model numbers. (g) List of tests conducted and results (i.e., pass/fail); (h) Reference to assembled battery testing requirements, if applicable (i.e. 38.3.3 (f) and 38.3.3 (g)); (i) Reference to the revised edition of the Manual of Tests and Criteria used and to amendments thereto, if any; and (j) Signature with name and title of signatory as an indication of the validity of information provided.

".

Add the following new section 39:

"SECTION 39

CLASSIFICATION PROCEDURE AND CRITERIA RELATING TO SOLID AMMONIUM NITRATE BASED FERTILIZERS

39.1 Purpose

This section presents the United Nations scheme for the classification of solid ammonium nitrate based fertilizers as referred to in the Model Regulations, Chapter 3.3, special provisions 307 and 193.

39.2 Scope

Any new solid fertilizer composition containing ammonium nitrate shall be subjected to the classification procedure as set out in 39.4.

39.3 Definitions

39.3.1 An ammonium nitrate based fertilizer is a uniform mixture containing ammonium (NH_4^+) and nitrate (NO_3^-) ions. See also 39.3.3.

39.3.2 A compound fertilizer is a uniform mixture that contains at least two of the three primary nutrients nitrogen (N), phosphorus (P) and potassium (K).

39.3.3 In determining the ammonium nitrate content, all nitrate ions for which a molecular equivalent of ammonium ions is present in the fertilizer shall be calculated as ammonium nitrate.

39.3.4 Combustible substances as referred to in paragraph 39.4 include also inorganic substances that can be oxidized, e.g. elemental sulphur. For organic substances the content of combustibles is calculated as carbon.

39.3.5 Materials that may be incompatible with ammonium nitrate include urea, acids, superphosphates with free acid, elemental sulphur, sulphides and most transition metals, including heavy metals (e.g. copper), and chlorides. Note however that this listing is not exhaustive.

39.4 Classification procedure

39.4.1 Solid ammonium nitrate based fertilizers are classified on the basis of their composition and experience and knowledge of their hazardous behaviour. Occasionally, the classification is complemented by testing for the ability to undergo self-sustaining decomposition or for explosive properties. These principles are condensed in the flowchart in 39.5.

39.4.2 UN No. 2067 may only be used for ammonium nitrate based fertilizers that do not show explosive properties when tested in accordance with Test Series 2 of this Manual.

39.4.3 Ammonium nitrate based fertilizers that do not fulfil the requirements for classification as UN No. 2067, can be assigned another suitable UN number in Class 1 or Class 5, Division 5.1, provided that the suitability for transport is demonstrated and this is approved by the competent authority. This may for instance be when contamination has occurred in e.g. an accident, so that the fertilizer can be transported under a suitable UN number e.g. in Class 1 as approved by the competent authority.

39.4.4 Ammonium nitrate based fertilizers that meet composition limits relevant for inclusion in the class of Explosives as set out in 39.5 shall be classified in that class regardless of the results when tested in accordance with Test Series 2 of this Manual.

39.4.5 Ammonium nitrate based fertilizers that meet composition limits relevant for classification as oxidizing solids as set out in 39.5, or are otherwise classified as oxidizing solids, shall not be exempted

from that classification on the basis of the results from tests O.1 and/or O.3 in Section 34 of this Manual. See also paragraph 34.3.1 in Section 34 of this Manual.

39.4.6 Fertilizers that contain 70 % or more ammonium nitrate shall not contain ammonium sulphate as nutrient, unless they are compound fertilizers with less than 90% ammonium nitrate and with at least 10% inorganic materials excluding ammonium nitrate and ammonium sulphate.

39.4.7 Compound fertilizers that meet the composition limits relevant for potential inclusion for transport in Class 9 shall be tested for their capability to undergo self-sustaining decomposition according to the method given in paragraph 38.2.4 of this Manual (test S.1, trough test) and classified according to criteria given there and in 39.5.

39.5 Classification criteria

39.5.1 Ammonium nitrate based fertilizers shall be classified in accordance with the flowchart below.

Figure 39.1 (a)

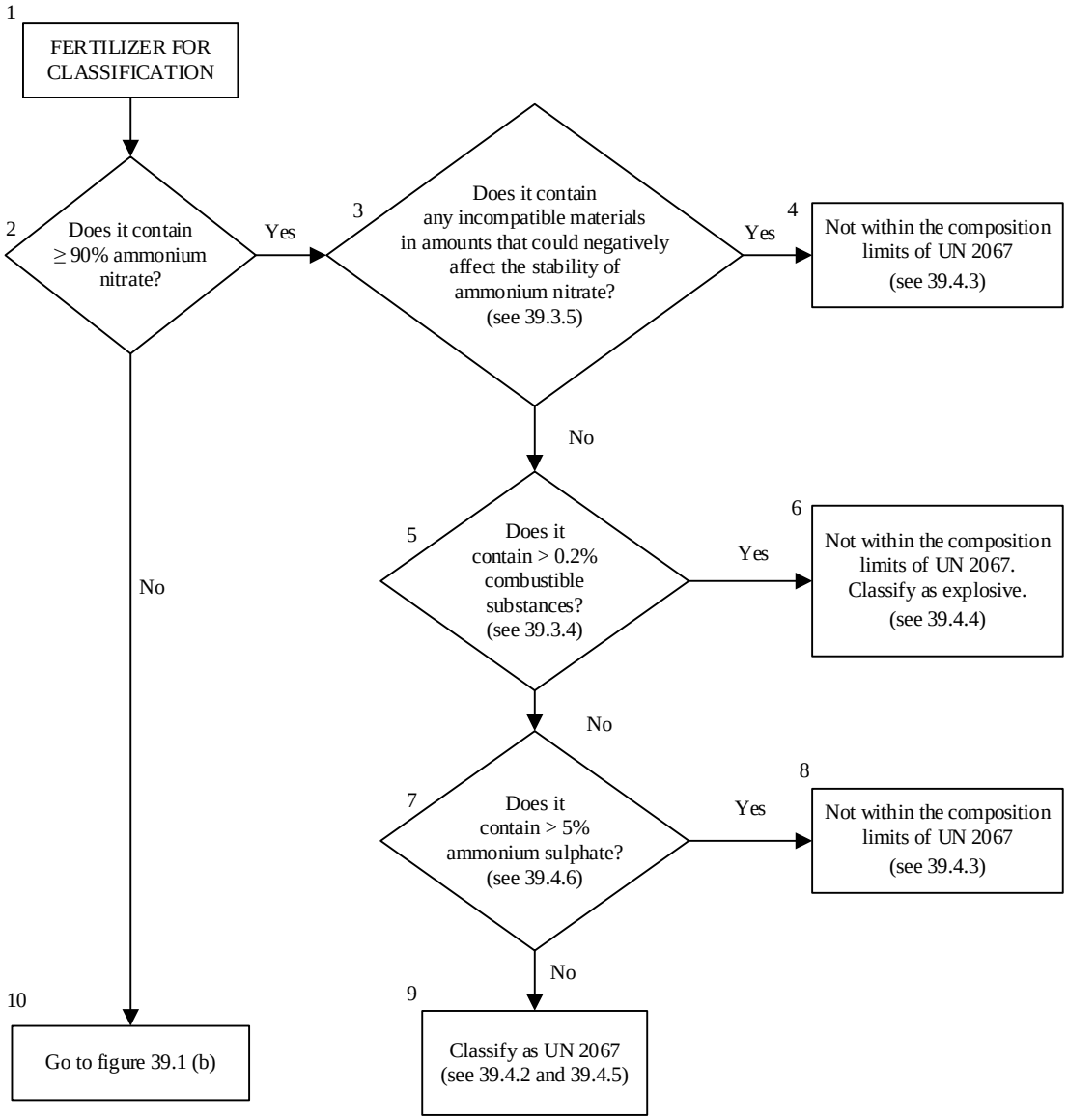


Figure 39.1 (b)

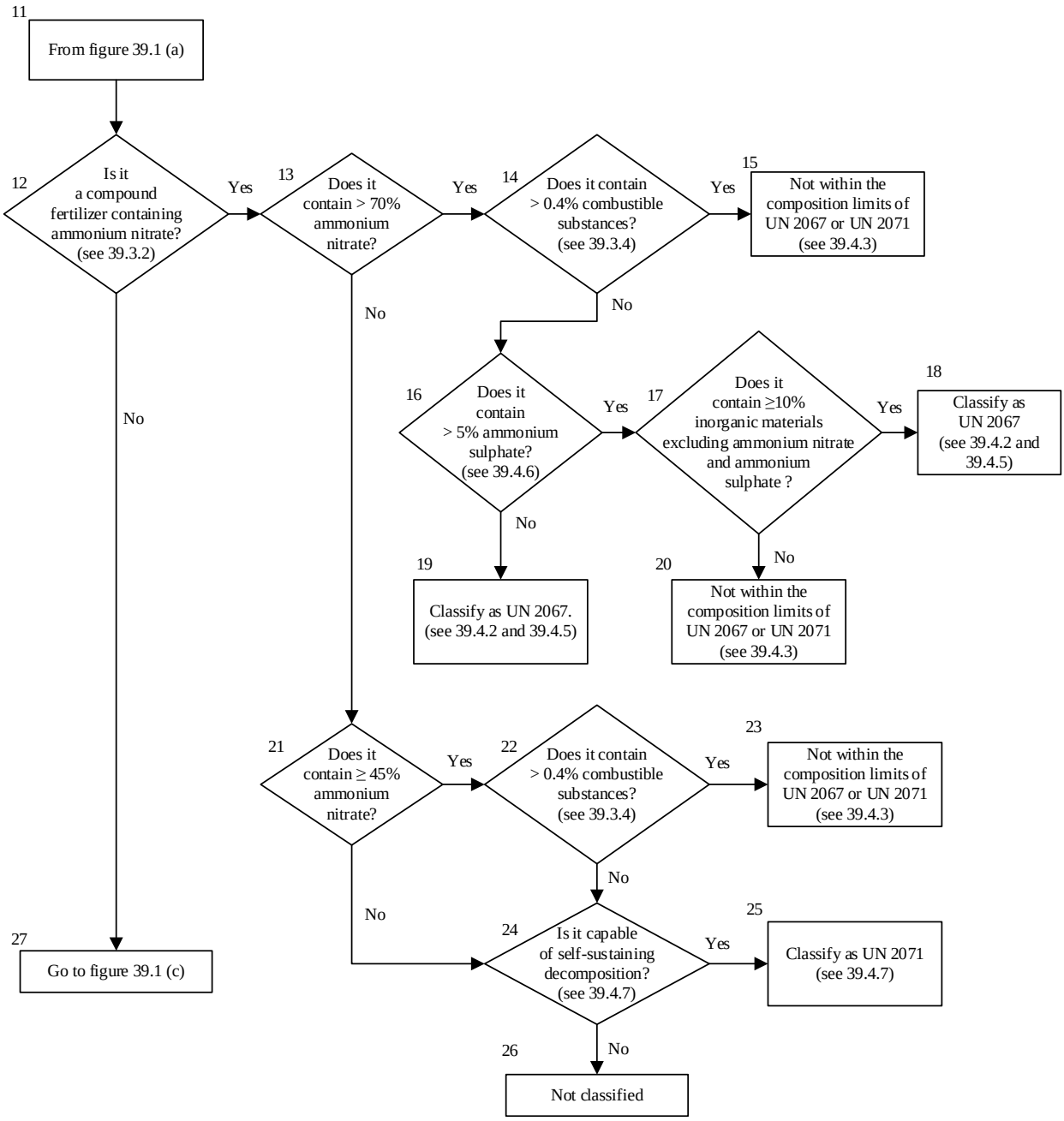
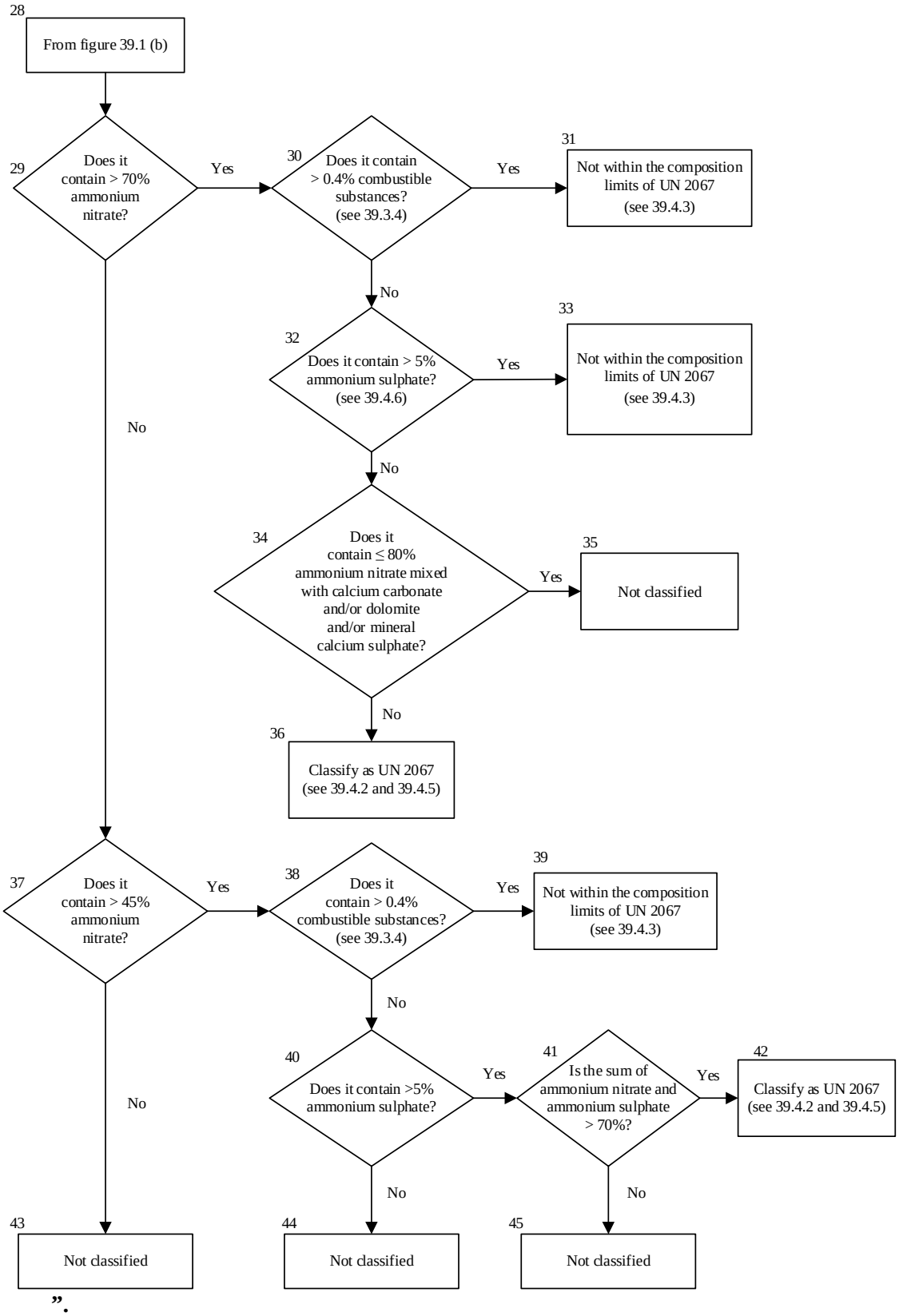

11
From figure 39.1 (a)
12
Is it a compound fertilizer containing ammonium nitrate? (see 39.3.2)
Yes
13
Does it contain > 70% ammonium nitrate?
Yes
14
Does it contain > 0.4% combustible substances? (see 39.3.4)
Yes
15
Not within the composition limits of UN 2067 or UN 2071 (see 39.4.3)
No
No
16
Does it contain > 5% ammonium sulphate? (see 39.4.6)
Yes
17
Does it contain ≥10% inorganic materials excluding ammonium nitrate and ammonium sulphate ?
Yes
18
Classify as UN 2067 (see 39.4.2 and 39.4.5)
No
19
Classify as UN 2067. (see 39.4.2 and 39.4.5)
No
20
Not within the composition limits of UN 2067 or UN 2071 (see 39.4.3)
No
21
Does it contain ≥ 45% ammonium nitrate?
Yes
22
Does it contain > 0.4% combustible substances? (see 39.3.4)
Yes
23
Not within the composition limits of UN 2067 or UN 2071 (see 39.4.3)
No
No
24
Is it capable of self-sustaining decomposition? (see 39.4.7)
Yes
25
Classify as UN 2071 (see 39.4.7)
No
26
Not classified
27
Go to figure 39.1 (c)

Figure 39.1 (c)


28
From figure 39.1 (b)
29
Does it contain > 70% ammonium nitrate?
Yes
30
Does it contain > 0.4% combustible substances? (see 39.3.4)
Yes
31
Not within the composition limits of UN 2067 (see 39.4.3)
No
32
Does it contain > 5% ammonium sulphate? (see 39.4.6)
Yes
33
Not within the composition limits of UN 2067 (see 39.4.3)
No
34
Does it contain ≤ 80% ammonium nitrate mixed with calcium carbonate and/or dolomite and/or mineral calcium sulphate?
Yes
35
Not classified
No
36
Classify as UN 2067 (see 39.4.2 and 39.4.5)
No
37
Does it contain > 45% ammonium nitrate?
Yes
38
Does it contain > 0.4% combustible substances? (see 39.3.4)
Yes
39
Not within the composition limits of UN 2067 (see 39.4.3)
No
40
Does it contain >5% ammonium sulphate?
Yes
41
Is the sum of ammonium nitrate and ammonium sulphate > 70%?
Yes
42
Classify as UN 2067 (see 39.4.2 and 39.4.5)
No
No
No
43
Not classified
44
Not classified
45
Not classified

”.

PART V

Section 51

51.2.2 Amend the introductory sentence to read as follows: “Any explosive while in a desensitized state shall be considered in this class unless, in that state:”.

51.2.2 (a) Amend to read as follows:

“(a) It is intended to produce a practical explosive or pyrotechnic effect;”.

51.2.2 (b) In sub-paragraph (b), replace “They have a mass explosion hazard” by “It has a mass explosion hazard” and “their corrected burning rate” by “the corrected burning rate”.

51.2.2 (c) Replace “Their exothermic” by “The exothermic”.

APPENDICES

Appendix 4

In the column “Address”:

- For France, replace “INERIS/LSE” with “INERIS/CERT”

- For Germany, delete “Abteilung II” and insert “Abteilung 2” under “Bundesanstalt …”

- For the Netherlands, delete “Prins Maurits Laboratory”

- For Japan, replace the address with the following:

“Physical & Chemical Analysis Center
Nippon Kaiji Kentei Kyokai (NKKK)
1-14-2 Sachiura, Kanazawa-ku
Yokohama 236-0003, Japan”

- For Spain, replace the address with the following:

“Laboratorio Oficial J.M. Madariaga (LOM)
Erik Kandel, 1 (Tecnogetafe)
E-28906 Getafe (Madrid)
Spain”

- For Sweden, replace the address with the following:

“Swedish Civil Contingencies Agency
Section for the Safe Handling of Hazardous Substances
S-651 81 Karlstad
Sweden”

- For the United States of America, replace the address with the following:

“Associate Administrator for Hazardous Materials Safety
Pipeline and Hazardous Materials Safety Administration
US Department of Transportation
1200 New Jersey Avenue, SE
Washington, D.C. 20590
USA”.

Appendix 5

Section 2 At the end of the 7th sentence ("Usually, the bursting pressure...") replace "transport" by "operating". At the end of the 8th sentence ("The 10 l vessel…") delete "as to be used in transport".

Appendix 6

2.1 In the first sentence, replace "a new substance" with "new substances" and offered for transport" with "offered for classification".

2.2 At the end of the first sentence insert: "taking into account their physical state, e.g. for solid nanomaterials". In the second sentence delete "during transport". Add a new sentence at the end to read as follows: "Some potentially corrosive materials may not be corrosive when solid but may liquefy during normal operating conditions. Judgement needs to be applied in such cases to determine the need or otherwise for testing and classification.".

2.3 Amend to read as follows:

"2.3 The remarks 1.1.2 from section 1 «General introduction» are emphasized that technical competence on the part of the testing body is assumed.".

3.1 Delete "of Division 4.1" and "of Division 5.2".

3.2 Replace "Class 1 Acceptance Procedure" with "acceptance procedure".

3.3 At the introductory sentence, delete "Class 1". In sub-paragraph (d):

Delete "of Division 5.1" in the introductory sentence.

In the first indent, insert "/category I" after "packing group I" and "/2" after "II".

In the second indent, insert "/category III" after "packing group III".

3.4 Delete "class 1" and replace "should be applied" with "has to be performed".

4 In the title, delete "(Class 3)".

5 In the title, delete "(Class 4)".

5.1 In the title, delete "(Division 4.1)".

Insert a section 5.2 to read as follows:

"**5.2** ***Substances which may be polymerizing substances***

Provided that the substance is not intended for polymerization, the classification procedure for polymerizing substances need not be applied if:

(a) The chemical structure of the substance contains no double or triple bonds or strained rings; or

(b) The compound contains double or triple bonds or strained rings, and the molecular mass M(CHON) counting only the elements C, H, O and N is more than 150; or

(c) The compound is solid with a melting point above 50 °C.".

Renumber existing sections 5.2 and 5.3 as 5.3 and 5.4.

5.2 (renumbered 5.3) In the title, delete “(Division 4.2)”.

5.3 (renumbered 5.4) Amend the title to read as follows: “Substances which, in contact with water, may react to emit flammable gases”.

6 In the title, delete “(Class 5)”.

6.1 In the title, delete “(Division 5.1)”.

6.1.1 In the first sentence, delete “of Division 5.1”.

6.2 In the title, delete “(Division 5.2)”.

Appendix 7

Amend the title of the appendix to read as follows: “FLASH COMPOSITION TESTS”. Insert a new subtitle to read: “1. HSL Flash Composition Test”. Renumber existing paragraphs accordingly.

In 1.1 (former 1), after “fireworks, that are used” insert “in waterfalls, or”. In the second sentence, replace “lifting” by “propellant”.

In 1.2.2 (former 2.2), replace “vessel is closed by an aluminium bursting” by “vessel is closed by a brass or aluminium bursting”. In the last sentence, after “lead washer” insert “or a washer of a suitable deformable material (for example, polyoxymethylene)”.

In 1.4 (former 4), after “used in waterfalls,” insert “or to produce an aural effect,”. Replace “lifting” by “propellant”. Amend the table to read as follows:

Composition (mass %)	**Use or effect**	**Minimum time for a pressure rise from 690 to 2 070 kPa (ms)**	**Result**
Potassium perchlorate/Aluminium (77/23)	Aural (report)	0.48	Flash composition
Potassium perchlorate/Barium nitrate/Aluminium/Magnalium (20/20/45/15)	Aural (report)	2.15	Flash composition
Potassium perchlorate/Potassium benzoate (71/29)	Aural (whistle)	0.89	Flash composition
Potassium perchlorate/Potassium hydrogen terephthalate/Titanium (62/25/13)	Aural (whistle)	1.67	Flash composition
Potassium perchlorate/Aluminium (P2000)/Aluminium (P50) (53/16/31)	Waterfall	2.73	Flash composition
Potassium perchlorate/Aluminium (P2000)/Aluminium (P50)/Antimony sulphide (50/15/30/5)	Waterfall	1.19	Flash composition
Potassium perchlorate/Charcoal (80/20)	Bursting	0.85	Flash composition
Potassium perchlorate/Charcoal (60/40)	Bursting	2.80	Flash composition
Potassium perchlorate/Charcoal (50/50)	Bursting	9.26	Not flash composition
Potassium perchlorate/Potassium nitrate/Charcoal (53/26/21)	Bursting	1.09	Flash composition
Potassium perchlorate/Potassium nitrate/Charcoal (53/26/21) (Cottonseed core)	Bursting	7.39	Not flash composition
Potassium perchlorate/Charcoal/Aluminium (59/23/18)	Bursting	1.14	Flash composition

Insert a new section 2 to read as follows:

"2. US Flash Composition Test

2.1 *Introduction*

This test may be used to determine if pyrotechnic substances in powder form or as pyrotechnic units as presented in fireworks that are used in waterfalls, or to produce an aural effect or used as a bursting charge or propellant charge, may be considered a "flash composition" for the purposes of the default fireworks classification table in 2.1.3.5.5 of the Model Regulations.

2.2 *Apparatus and materials*

The experimental set up consists of:

A cardboard or fibreboard sample tube with a minimum inside diameter of 25 mm and a maximum height of 154 mm with a maximum wall thickness of 3.8 mm, closed at the base with a thin cardboard or paperboard disk, plug or cap just sufficient to retain the sample;

A 1.0 mm thick 160 × 160 mm witness plate consisting of steel conforming to specification S235JR (EN10025) or ST37-2 (DIN17100) or SPCC (JIS G 3141) or equivalent having a stretch limit (or rupture strength) of 185-355 N/mm^2, an ultimate tensile strength of 336 - 379 N/mm^2 and a percentage elongation after fracture of 26-46% ;

An electric igniter, e.g. a fuse head, with lead wires of at least 30 cm in length;

A mild steel confinement sleeve (weighing approximately 3 kg) having an outside diameter of 63 mm and a minimum length of 165 mm with a flat-bottomed round bore whose interior dimensions for diameter and depth are 38 mm and 155 mm, respectively, and a notch or groove cut into one radius of the open end sufficient to allow the igniter lead wires to pass through (the steel sleeve might be provided with a rugged steel handle for easier handling);

A steel ring of approximately 50 mm height with an inner diameter of 95 mm; and

A solid metal base, e.g. a plate of approximately 25 mm in thickness and 150 mm square.

2.3 *Procedure*

2.3.1 Prior to testing, the pyrotechnic substance is stored for at least 24 hours in a desiccator at a temperature of 20-30 °C. Twenty-five (25) g net mass of the pyrotechnic substance to be tested as a loose powder or granulated or coated onto any substrate, is pre-weighed and then poured carefully into a fibreboard sample tube with the bottom end closed with a cardboard or paperboard disk, cap or plug. After filling, the top cardboard or paperboard disk, cap or plug might be inserted lightly to protect the sample from spillage during transport to the test stand. The height of the sample substance in the tube will vary depending on its density. The sample should be first consolidated by lightly tapping the tube on a non-sparking surface. The final density of the pyrotechnic substance in the tube should be as close as possible to the density achieved when contained in a fireworks device.

2.3.2 The witness plate is placed on the supporting ring. If present, the paperboard or cardboard top disk, cap or plug of the fibreboard sample tube is removed and the electric igniter is inserted into the top of the pyrotechnic substance to be tested and visually positioned to an approximate depth of 10 mm. The paperboard or cardboard top disk, cap or plug is then inserted or re-inserted, fixing the igniter's position in the fibreboard sample tube and the depth of its match head. The lead wires are bent over and down along the sidewall and bent away at the bottom. The sample tube is placed vertically and centred on the witness plate. The steel sleeve is placed over the fibreboard sample tube. The igniter lead wires are positioned to pass through the slotted groove in the bottom edge of the steel confining sleeve and will be ready to attach to the firing circuit apparatus. Finally, the alignment of the steel sleeve and the witness plate is corrected so that their centres are aligned with the centre of the steel ring. See Figure A7.10 as an example of the test set-up.

The cardboard or paperboard disk, cap or plug at the bottom end of the sample tube should be placed properly to avoid air gap between the witness plate and the bottom end of the substance to be tested.

2.3.3 The electric igniter is then initiated from a safe position. After initiation and a suitable interval the witness plate is recovered and examined. The test should be performed 3 times unless a positive result is obtained earlier.

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

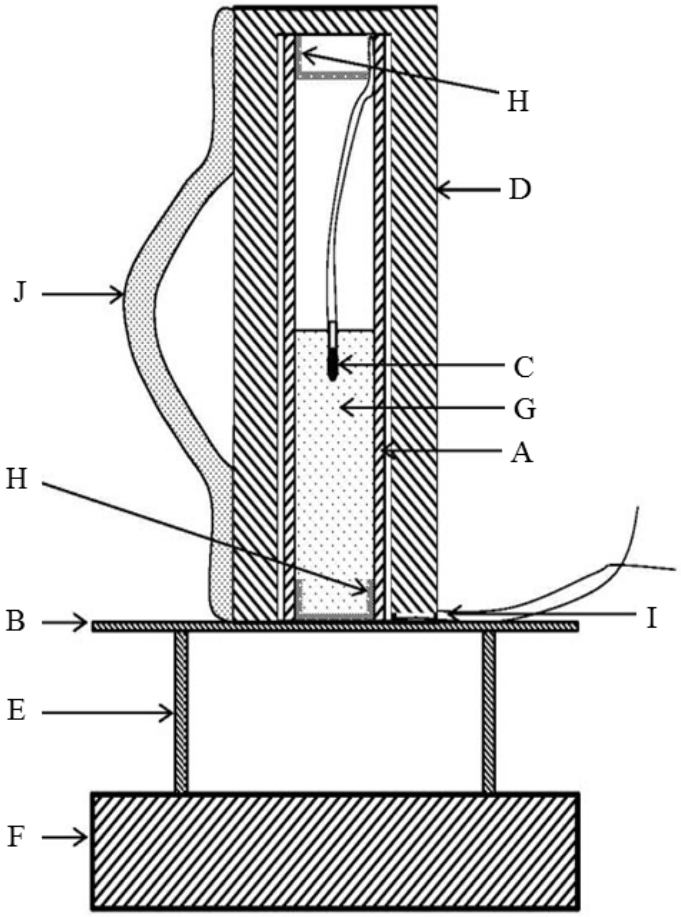
The result is considered positive "+" and the pyrotechnic substances in powder form or as pyrotechnic units as presented in the fireworks, that are used in waterfalls, or to produce an aural effect, or used as a bursting charge or propellant charge, are to be considered as flash composition if:

(a) In any trial the witness plate is torn, perforated, pierced or penetrated; or;

(b) The average of the maximum depths of indented witness plates from all three trials exceeds 15 mm.

Examples of results

Composition (mass %)	**Use or effect**	**Observation of witness plate or averaged depth of indentation (mm)**	**Result**
Potassium perchlorate/Aluminium (77/23)	Aural (report)	Pierced	Flash composition
Potassium perchlorate/Barium nitrate/Aluminium/Magnalium (20/20/45/15)	Aural (report)	11.3	Not flash composition
Potassium perchlorate/Potassium benzoate (71/29)	Aural (whistle)	Pierced	Flash composition
Potassium perchlorate/Potassium hydrogen terephthalate/Titanium (62/25/13)	Aural (whistle)	Pierced	Flash composition
Potassium perchlorate/Aluminium (P2000)/Aluminium (P50) (53/16/31)	Waterfall	Pierced	Flash composition
Potassium perchlorate/Aluminium (P2000)/Aluminium (P50)/Antimony sulphide (50/15/30/5)	Waterfall	Pierced	Flash composition
Potassium perchlorate/Charcoal (80/20)	Bursting	Pierced	Flash composition
Potassium perchlorate/Charcoal (60/40)	Bursting	17.7	Flash composition
Potassium perchlorate/Charcoal (50/50)	Bursting	6.7	Not flash composition
Potassium perchlorate/Potassium nitrate/Charcoal (53/26/21)	Bursting	Torn	Flash composition
Potassium perchlorate/Potassium nitrate /Charcoal (53/26/21) (Cottonseed core)	Bursting	12.7	Not flash composition
Potassium perchlorate/Charcoal/Aluminium (59/23/18)	Bursting	Pierced	Flash composition



(A) Cardboard or fibreboard sample tube	(B) Steel witness plate
(C) Electric igniter	(D) Mild steel confinement sleeve
(E) Steel ring	(F) Solid metal base
(G) Substance to be tested	(H) Cardboard or paperboard disk, cap or plug
(I) Groove in sleeve for igniter wires	(J) Handle welded on (optional)

Figure A7.10".