UNITED
NATIONS

ST

Secretariat

Distr.
GENERAL

ST/SG/AC.10/1998/14
18 September 1998

Original: ENGLISH

COMMITTEE OF EXPERTS ON THE
TRANSPORT OF DANGEROUS GOODS

(Twentieth session,
Geneva, 7-16 December l998,
agenda item 2 (c))

WORK OF THE SUB-COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS

Draft amendments to the Recommendations on the Transport of Dangerous Goods

Consolidated Text of Draft Amendement to the Manual of Tests and Criteria supplemented to the Model Regulations annexed to the tenth revised edition of the United Nations Recommendations on the transport of dangerous goods (ST/SG/AC.10/11/Rev.2)

Note by the secretariat

This consolidated text contains all draft amendments to the Manual of Tests and Criteria supplemented to the Model Regulations annexed to the tenth revised edition of the UN Recommendations on the Transport of Dangerous Goods, adopted by the Sub-Committee on its thirteenth, fourteenth and fifteenth sessions in 1997 and 1998 (ST/SG/AC.10/C.3/26/Add.2, Annex 2, ST/SG/AC.10/C.3/28/Add.1, Annex 2 and ST/SG/AC.10/C.3/30/Add.2).

CONSOLIDATED TEXT OF DRAFT AMENDEMENT TO THE MANUAL OF TESTS AND CRITERIA SUPPLEMENTED TO THE MODEL REGULATIONS ANNEXED TO THE TENTH REVISED EDITION OF THE UNITED NATIONS RECOMMENDATIONS ON THE TRANSPORT OF DANGEROUS GOODS (Refer to ST/SG/AC.10/11/REV.2)

GENERAL TABLE OF CONTENTS

APPENDICES Insert a new entry to read:

"Appendix 6 SCREENING PROCEDURES"

GENERAL INTRODUCTION

1.1.2 At the end, add the following new sentences:

"In some cases, a small scale screening procedure may be used to decide whether or not it is necessary to perform larger scale classification tests. Suitable examples of procedures are given in the introductions to some test series and in Appendix 6."

1.2.1 Amend the last sentence to read:

"... Test details, on an example method for emergency relief vent sizing of portable tanks for the transport of organic peroxides and on screening procedures."

PART I

Section 11

11.5.1.2.2 Amend to read as follows:

"11.5.1.2.2 Heating is provided by propane, from an industrial cylinder fitted with pressure regulator, via a flow meter and distributed by a manifold to the four burners. Other fuel gases may be used provided the specified heating rate is obtained. The gas pressure is regulated to give a heating rate of 3.3 ± 0.3 K/s when measured by the calibration procedure. Calibration involves heating a tube (fitted with a 1.5 mm orifice plate) filled with 27 cm^3 of dibutyl phthalate. The time taken for the temperature of the liquid (measured with a 1 mm diameter thermocouple centrally placed 43 mm below the rim of the tube) to rise from 135 °C to 285 °C is recorded and the heating rate calculated."

Section 12

12.5.1.2.2 Amend to read as follows:

> "12.5.1.2.2 Heating is provided by propane, from an industrial cylinder fitted with pressure regulator, via a flow meter and distributed by a manifold to the four burners. Other fuel gases may be used provided the specified heating rate is obtained. The gas pressure is regulated to give a heating rate of 3.3 ± 0.3 K/s when measured by the calibration procedure. Calibration involves heating a tube (fitted with a 1.5 mm orifice plate) filled with 27 cm^3 of dibutyl phthalate. The time taken for the temperature of the liquid (measured with a 1 mm diameter thermocouple centrally placed 43 mm below the rim of the tube) to rise from 135 °C to 285 °C is recorded and the heating rate calculated."

Section 16

16.6 Replace with the following:

" 16.6 Series 6 type (c) test prescription

16.1.1 *Test 6 (c): External fire (bonfire) test*

16.6.1.1 *Introduction*

This is a test performed on packages of an explosive substance or explosive articles, or unpackaged explosive articles, to determine whether there is a mass explosion or a hazard from dangerous projections, radiant heat and/or violent burning or any other dangerous effect when involved in a fire.

16.6.1.2 *Apparatus and materials*

The following items are needed:

(a) If the volume of the package of substance or articles, or unpackaged article, is less than 0.05 m^3, sufficient packages or unpackaged articles to give a total volume of not less than 0.15 m^3;

(b) If the volume of the package of substance or articles, or unpackaged article, is equal to or greater than 0.05 m^3, three packages or unpackaged articles. If the volume of one package or unpackaged article is greater than 0.15 m^3, the competent authority may waive the requirement for three packages or unpackaged articles to be tested;

(c) A metal grid to support the products above the fuel and allow adequate heating. If a wooden crib fire is used, the grid should be 1.0 m above the ground and if a liquid hydrocarbon pool fire is used then the grid should be 0.5 m above the ground;

(d) Strapping or wire, if necessary, to hold the packages or unpackaged articles together on the support grid;

(e) Enough fuel to keep a fire burning for at least 30 minutes or, if necessary, until the substance or article has clearly had sufficient time to react to the fire (see 16.6.1.3.8);

(f) Suitable means of ignition to ignite the fuel on at least two sides e.g. for a wood fire, kerosene to soak the wood and pyrotechnic igniters with wood wool;

(g) Three 2000 mm × 2000 mm × 2 mm 1100-0 aluminium sheets (Brinell Hardness 23, tensile strength 90 megapascals), or equivalent, to act as witness screens together with suitable supports to hold them vertically. The witness screens shall be mounted rigidly to their frames. When more than one panel is used to make a witness screen, each panel shall be supported at all joints;

(h) Cine or video cameras, preferably high speed and normal speed, to record events in colour.

Blast gauges, radiometers and associated recording equipment may also be used.

16.6.1.3 *Procedure*

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. Packages should be oriented in such a way that a maximum probability for projections hitting the witness screens is obtained. 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. Precautions against side winds may be required to avoid dissipation of the heat. Suitable methods of heating include a wood fire using a lattice of wooden laths, a liquid or gas fuel fire, that produces a flame temperature of at least 800°C.

16.6.1.3.2 One method is to use a wood fire which has a balanced air/fuel ratio, thereby avoiding too much smoke which would obscure the events, and which burns with sufficient intensity and duration to bring many kinds of packaged explosives to reaction in 10 to 30 minutes. A suitable method involves using air-dried pieces of wood (approximately 50 mm square section), 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 beyond the packages or unpackaged articles to a distance of at least 1.0 m in every direction and the lateral distance between the laths should be about 100 mm.

16.6.1.3.3 A receptacle filled with suitable liquid fuel, a combination of both wood and liquid fuel fire may be used as an alternative to the wood fire providing it is as severe. If a liquid pool fire is used, the receptacle should extend beyond the packages or unpackaged articles to a distance of at least 1.0 m in every direction. The distance between the grid platform and the receptacle should be approximately 0.5 m. Before using this method, consideration should be given to whether any quenching action or adverse interaction between explosives and liquid fuel can occur such as might bring the results into question.

16.6.1.3.4 If gas is to be used as a fuel, the burning area must extend beyond the packages or unpackaged articles to a distance of at least 1.0 m in every direction. The gas must be supplied in such a manner to ensure that the fire is evenly distributed around the packages. The gas reservoir should be large enough to keep the fire burning for at least 30 minutes. Ignition of the gas may be accomplished either by remotely ignited pyrotechnics or by remote release of the gas adjacent to a pre-existing source of ignition.

16.6.1.3.5 The vertical witness screens are erected in each of three quadrants at a distance of 4 m from the edge of the packages or unpackaged articles. The downwind quadrant is not used for screens because prolonged exposure to flames may change the resistance of the aluminium sheets to projections. The sheets should be placed so that the centres are 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. If there are any perforations or indentations in the witness screens before the test, they should be marked so that they can be clearly distinguished from those created during the test.

16.6.1.3.6 The ignition system should be put into place and the fuel ignited on two sides, one the upwind side, simultaneously. The test should not be performed under conditions where the wind speed exceeds 6 m/s. ***A safe waiting period, prescribed by the test agency, should be observed after the fire has extinguished.***

16.6.1.3.7 Observations are made on the following:

(a) Evidence of explosion;

(b) Potentially hazardous projections; and

(c) Thermal effects.

16.6.1.3.8 The test is normally performed once only but if the wood or other fuel used for the fire is all consumed leaving a significant quantity of unconsumed explosive substance in the remains or in the vicinity of the fire, then the test should be performed again using more fuel, or a different method, to increase the intensity and/or duration of the fire. If the result of the test does not enable the hazard division to be determined, a further test should be performed.

16.6.1.4 *Test criteria and method of assessing results*

16.6.1.4.1 The following criteria are used to answer the questions in figure 10.3 (boxes 26, 28, 30, 32, 33, 35 and 36) in order to assess the results and classify the product.

16.6.1.4.2 If mass explosion occurs then the product is assigned to Division 1.1. A mass explosion is considered to occur if a substantial proportion explodes so that the practical hazard should be assessed by assuming simultaneous explosion of the whole of the explosive content of the packages or unpackaged articles.

16.6.1.4.3 If a mass explosion does not occur but any one of the following occurs:

(a) A perforation of any of the witness screens (see 16.6.1.3.5);

(b) A metallic projection with a kinetic energy exceeding 20 J as assessed by the distance - mass relation given in Figure 16.6.1.1;

then the product is assigned to Division 1.2.

16.6.1.4.4 If none of the events occur which would require the product to be assigned to Division 1.1 or 1.2 but any one of the following events occurs:

(a) A fireball or jet of flame which extends beyond any of the witness screens;

(b) A fiery projection emanating from the product is thrown more than 15 m from the edge of the packages or unpackaged articles;

(c) A burning time of the product measured to be less than 35 seconds for 100 kg net explosive mass (see 16.6.1.4.8 Notes for scaling time measurements in evaluating thermal flux effects). Alternatively, in the case of articles and low energy substances, the irradiance of the burning product exceeds that of the fire by more than 4 kW/m^2 at a distance of 15 m from the edge of the packages or unpackaged articles. The irradiance is measured over 5 seconds, during the period of maximum output;

then the product is assigned to Division 1.3.

16.6.1.4.5 If none of the events occur which would require the product to be assigned to Division 1.1, 1.2 or 1.3, but any one of the following events occurs:

(a) A fireball or jet of flame which extends more than 1 m from the flames of the fire;

(b) A fiery projection emanating from the product is thrown more than 5 m from the edge of the packages or unpackaged articles;

(c) An indentation in any of the witness screens of more than 4 mm;

(d) A metallic projection with a kinetic energy exceeding 8 J as assessed by the distance - mass relation given in Figure 16.6.1.1;

(e) A burning time of the product measured to be less than 330 seconds for 100 kg net explosive mass (see 16.6.1.4.8: Notes for scaling time measurements in evaluating thermal flux effects);

then the product is assigned to Division 1.4 and to a compatibility group other than Compatibility Group S.

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, the thermal, blast, or projection effects would not significantly hinder fire-fighting or other emergency response efforts in the immediate vicinity, then the product is assigned to Division 1.4 Compatibility Group S.

16.6.1.4.7 If there are no hazardous effects at all, the product is considered for exclusion from Class 1.

The possibilities, as shown by boxes 35 and 36 in figure 10.3, are:

(a) If the product is an article manufactured with a view to producing a practical explosive or pyrotechnic effect, then:

  (i) if there is some effect (projection, fire, smoke, heat or loud noise) external to the device itself, the device is not excluded from Class 1 and the product, as packaged, is assigned to Division 1.4 and to Compatibility Group S. Paragraph 2.1.1.1 (b) of the Model Regulations refers explicitly to the device, rather than the package, so it is usually necessary to make this assessment on the basis of a test involving functioning of the device without packaging or confinement. Sometimes the stated effects are observed in test 6 (c), in which case the product is classified 1.4 S without further tests;

  (ii) if there is no effect (projection, fire, smoke, heat or loud noise) external to the device itself, the unpackaged device is excluded from Class 1 in accordance with paragraph 2.1.1.1 (b) of the Model Regulations. Paragraph 2.1.1.1 (b) of the Model Regulations refers explicitly to the device, rather than the package, so it is usually necessary to make this assessment on the basis of a test involving functioning of the device without packaging or confinement;

(b) If the product is not manufactured with a view to producing a practical explosive or pyrotechnic effect, it is excluded from Class 1 in accordance with paragraph 2.1.1.1 of the Model Regulations.

16.6.1.4.8 Notes for scaling time measurements in evaluating thermal flux effects

Notes:

(1) The value of 35 seconds/100 kg (see 16.6.1.4.4(c)) correlates to an average thermal flux of 4 kW/m^2 at 15 m and is based on an assumed heat of combustion of 12500 J/g. If the true heat of combustion is significantly different, the burning time of 35 sec may be corrected; for example, a true heat of combustion of 8372 J/g burning for (8372/12500) × 35 s = 23.4 s would produce the same flux level. Corrections for masses other than 100 kg are made according to the scaling relations and examples in Table 16.2.

(2) The value of 330 seconds/100 kg (see 16.6.1.4.5(e)) correlates to an average thermal flux of 4 kW/m^2 at 5 m and is based on an assumed heat of combustion of 12500 J/g. If the true heat of combustion is significantly different, the burning time of 330 sec may be corrected; for example, a true heat of combustion of 8372 J/g burning for (8372/12500) × 330 s = 221 s would produce the same flux level. Corrections for masses other than 100 kg are made according to the scaling relations and examples in Table 16.2.

(3) In some burn time trials, individual packages or articles will be observed to burn in separate, identifiable events; in such cases, the burning times and masses of each separate event should be used.

	1.3/1.4		1.4/1.4S	
Mass (kg)	Flux (15 m)	Burn time (s)	Flux (5 m)	Burn time (s)
20	1.36 kW/m^2	21.7	1.36 kW/m^2	195
50	2.5	29.6	2.5	266
100	4	35	4	330
200	6.3	46.3	6.3	419
500	11.7	63.3	11.7	569

Table 16.2
Comparative Thermal Flux Values for Varying Masses

Note: Thermal flux is scaled on basis of $(m/m_0)^{2/3}$.
Times are scaled on basis of $(m/m_0)^{1/3}$.

The values of thermal flux can be calculated from the equation:

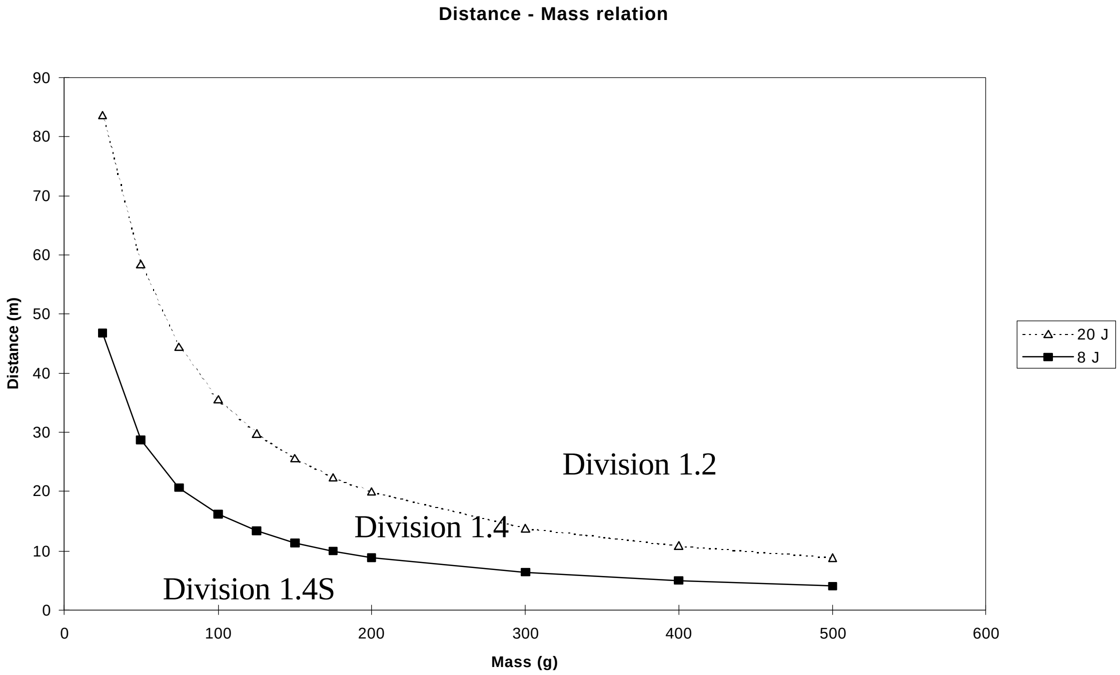
$$F = \frac{C \cdot E}{4\pi R^2 t}$$

where:

F = thermal flux in kW/m²,
C = constant = 0.33,
E = total energy content in joules,
R = distance from fire to exposed position in meters,
t = observed burn time in seconds.

16.6.1.5 *Examples of results*

Substance	**Packaging**	**Events**	**Result**
Musk xylene	3 × 50 kg fibreboard drums	Slow burning only	Not Class 1



Mass	**Projection distance (m)**	
(g)	**20 J**	**8 J**
25	83.6	46.8
50	58.4	28.7
75	44.4	20.6
100	35.6	16.2
125	29.8	13.3
150	25.6	11.4
175	22.43	10
200	20	8.8
300	13.9	6.3
400	10.9	4.9
500	8.9	4.1

Example data for metallic projections with a kinetic energy of 20 J and 8 J

FIGURE 16.6.1.1: Distance-mass Relation for Metallic Projections with a kinetic energy of 20 J and 8J 1/

1/ *The data presented in Figure 16.6.1.1 is based upon metallic projections. Non-metallic projections will produce different results and may be hazardous. Hazards from non-metallic projections should also be considered.*

PART II

Section 20

Fig. 20.1 (b) Delete the asterisk and the footnote.

20.3.3.3 Amend the last indent to read as follows:

> "using rapid heating rates (when differential scanning calorimetry is used, the heating rates should normally be in the range 2 to 5 K/min)."
>
> At the end, add the following new sentence:
>
> "If differential scanning calorimetry is used, the extrapolated onset temperature is defined as being the point of intersection of the tangent drawn at the point of greatest slope on the leading edge of the peak with the extrapolated baseline."

20.4.2 (f) Insert "or tanks" after "IBCs".

20.4.4.8 Delete "(organic peroxides only)" after "tanks".

Section 25

25.4.1.2.2 Amend to read as follows:

> "25.4.1.2.2 Heating is provided by propane, from an industrial cylinder fitted with pressure regulator, via a flow meter and distributed by a manifold to the four burners. Other fuel gases may be used provided the specified heating rate is obtained. The gas pressure is regulated to give a heating rate of 3.3 ± 0.3 K/s when measured by the calibration procedure. Calibration involves heating a tube (fitted with a 1.5 mm orifice plate) filled with 27 cm^3 of dibutyl phthalate. The time taken for the temperature of the liquid (measured with a 1 mm diameter thermocouple centrally placed 43 mm below the rim of the tube) to rise from 135 °C to 285 °C is recorded and the heating rate calculated."

Section 26

26.1.1 Delete "(organic peroxides only)" after "or tank-containers".

Section 28

28.2.3/Table 28.2 Amend to read as follows:

"**Table 28.2: DERIVATION OF CONTROL AND EMERGENCY TEMPERATURES**

Type of receptacle	**SADT 1/**	**Control temperature**	**Emergency temperature**
Single packagings and IBCs	20 °C or less over 20 °C to 35 °C over 35 °C	20 °C below SADT 15 °C below SADT 10 °C below SADT	10 °C below SADT 10 °C below SADT 5 °C below SADT
Portable tanks	< 50 °C	10 °C below SADT	5 °C below SADT

1/ i.e. the SADT of the substance as packaged for transport"

PART III

Section 38

38.3.3.2 Add the following new definitions in appropriate alphabetical order:

"*Large battery* means a battery in which the aggregate lithium content of all anodes, when fully charged, is more than 500 g."

"*Large cell* means a cell in which the lithium content of the anode, when fully charged, is more than 12 g."

"*Small battery* means a battery composed of small cells, and in which the aggregate lithium content of all cell anodes, when fully charged, is not more than 500 g."

"Small cell means a cell in which the lithium content of the anode, when fully charged, is not more than 12 g."

38.3.4.1.2.2 Amend the first sentence to read as follows:

"For small cells and small batteries, the number and condition of cells and batteries to be tested are as follows:" [(a) to (f) unchanged].

38.3.4.1.2.3 Add the following new paragraph:

"38.3.4.1.2.3 For large cells and large batteries, the number and condition of cells and batteries to be tested are as follows:

(a) Only when cells are to be transported individually:

(i) ten cells which should be tested, at first cycle, in both fully charged and fully discharged states; and

(ii) ten cells which should be tested after deep cycling a minimum of 50 times, in both fully charged and fully discharged states;

(b) Four batteries, which should be tested, at first cycle, in both fully charged and fully discharged states;

(c) Four batteries, which should be tested after deep cycling a minimum of 50 times, in both fully charged state and fully discharged states."

38.3.4.1.3.2 Replace "5 minutes" by "10 minutes" in the second sentence.

38.3.4.2.2.1 Amend the second sentence to read as follows:

"The shock test apparatus should be constructed to give the minimum accelerations required by 38.2.3.2.3.2 for the size of cell or battery being tested, e.g., apparatus to IEC 68-2-27."

38.3.4.2.2.2 Amend the first sentence to read as follows:

"For small cells and small batteries, the number and condition of cells and batteries to be tested are as follows:" [(a) to (f) unchanged].

38.3.4.2.2.3 Add a new paragraph to read as follows:

"38.3.4.2.2.3 For large cells and large batteries, the number and condition of cells and batteries to be tested are as follows:

(a) Only when cells are to be transported individually:

(i) ten cells which should be tested, at first cycle, in both fully charged and fully discharged states; and

(ii) ten cells which should be tested after deep cycling a minimum of 50 times, in both fully charged and fully discharged states;

(b) Four batteries, which should be tested, at first cycle, in both fully charged and fully discharged states;

(c) Four batteries, which should be tested after deep cycling a minimum of 50 times, in both fully charged state and fully discharged states."

38.3.4.2.3.2 Replace the last two sentences with the following:

"In each case, the cell or battery is accelerated in such a manner that:

(a) For small cells and small batteries, during the first three milliseconds the minimum average acceleration is 75 times the local acceleration due to gravity, and the peak acceleration is between 125 and 175 times the local acceleration of gravity; or

(b) For large cells and large batteries, a peak acceleration of not less than 50 times the local acceleration of gravity is achieved over a maximum duration of 11 milliseconds."

38.3.4.3.2.1 Amend the second sentence to read as follows:

"The shock test apparatus should be constructed to give the minimum accelerations required by 38.2.3.2.3.2 for the size of cell or battery being tested, e.g., apparatus to IEC 68-2-27."

38.3.4.3.2.2 Amend to read as follows:

"38.3.4.3.2.2 For small cells and small batteries, the number and condition of cells and batteries to be tested are as follows:"

38.3.4.3.2.3 Add the following new paragraph:

"38.3.4.3.2.3 For large cells and large batteries, tests need not be performed on batteries, and the number and condition of cells to be tested are as follows:

(a) Ten cells which should be tested, at first cycle, in the fully charged state; and

(b) Ten cells which should be tested after deep cycling a minimum of 50 times, in the fully charged state."

38.3.4.3.3.2 Replace the last two sentences with the following:

"In each case, the cell or battery is accelerated in such a manner that:

(a) For small cells and small batteries, during the first three milliseconds the minimum average acceleration is 75 times the local acceleration due to gravity, and the peak acceleration is between 125 and 175 times the local acceleration of gravity; or

(b) For large cells, a peak acceleration of not less than 50 times the local acceleration of gravity is achieved over a maximum duration of 11 milliseconds."

38.3.4.3.3.3 In the fifth sentence, add "continuous" after "maximum" and insert the following new sixth sentence:

"When for large cells this average current draw cannot be achieved employing this test procedure, the current draw required is the maximum current attainable according to this test procedure at the ambient temperature at which the test is performed."

38.3.4.4.2.1 Replace "a 6 mm (diameter) rod" with "a rod with a diameter of at least 50% of the smallest cell overall dimension, or 6 mm, whichever is greater ".

38.3.4.4.2.2 Transfer the first two sentences to the end of 38.3.4.4.1 and amend the third sentence to read as follows:

"For small cells, the number and condition of cells to be tested are as follows:" [(a) to (d) unchanged].

38.3.4.4.2.3 Add the following new paragraph:

"38.3.4.4.2.3 For large cells, ten cells should be tested, at first cycle, in the fully charged state."

38.3.4.4.3 Amend to read as follows:

"38.3.4.4.3 Each cell is deformed until the open circuit voltage drops abruptly or is reduced to at least one third [, or until a maximum force of 10 kN is applied]. The deformation is effected by placing the rod between one jaw of the clamping device and the cell and applying force. In the case of prismatic cells, the force is to be applied to each face that is perpendicular to the terminal face. The applied force is removed at the point at which the cell voltage drops [, or when the maximum 10 kN force is achieved, whichever occurs first]."

38.3.4.5.2.1 Amend the second sentence to read as follows:

"The shock test apparatus should be constructed to give the minimum accelerations required by 38.2.3.5.3.2 for the size of cell or battery being tested, e.g., apparatus to IEC 68-2-27."

38.3.4.5.2.2 Amend the first sentence to read as follows:

"For small cells and small batteries, the number and condition of cells and batteries to be tested are as follows:" [(a) and (b) unchanged].

38.3.4.5.2.3 Add the following new paragraph:

"38.3.4.5.2.3 For large cells and large batteries, batteries should be constructed with uncycled cells except for one in each series string which is deep cycled a minimum of 50 times, and then brought to a 60 % state of charge. Four batteries are tested at first cycle in the fully charged state."

38.3.4.5.3.2 Replace the last two sentences with the following:

"In each case, the cell or battery is accelerated in such a manner that:

(a) For small cells and small batteries, during the first three milliseconds the minimum average acceleration is 75 times the local acceleration due to gravity, and the peak acceleration is between 125 and 175 times the local acceleration of gravity; or

(b) For large cells and large batteries, a peak acceleration of not less than 50 times the local acceleration of gravity is achieved over a maximum duration of 11 milliseconds."

38.3.4.5.3.3 Insert before the last sentence the following new sentence:

"When for large batteries this average current draw cannot be achieved employing this test procedure, the current draw required is the maximum current attainable according to this test procedure at the ambient temperature at which the test is performed."

38.3.4.6.2.2 Amend the first sentence to read as follows:

"For small cells and small batteries, the number and condition of cells and batteries to be tested are as follows:"

38.3.4.6.2.3 Add the following new paragraph to read as follows:

> "38.3.4.6.2.3 For large cells and large batteries, tests need not be performed on batteries, and need only be performed on component cells when the battery voltage does not exceed 12 volts. When required to be tested, the number and condition of cells to be tested are as follows:
>
> (a) Ten cells which should be tested, at first cycle, in the fully discharged state;
>
> (b) Ten cells which should be tested, after deep cycling a minimum of 50 times, in the fully discharged state."

38.3.4.6.3 Insert after the sixth sentence, the following new sentence:

> "When for large cells this average current draw cannot be achieved employing this test procedure, the current draw required is the maximum current attainable according to this test procedure at the ambient temperature at which the test is performed."

38.3.4.7.2 Replace "subject to the mass requirements in Special Provision 230," with "not excepted from the Model Regulations according to 38.3.4.7.1,".

CONTENTS OF APPENDICES

Insert a new entry to read as follows:

"6 SCREENING PROCEDURES"

NEW APPENDIX 6

Insert a new Appendix 6 to read as follows:

"APPENDIX 6
SCREENING PROCEDURES

1. Purpose

1.1 Industry uses screening procedures to identify the hazard potential of raw materials, reactive mixtures and intermediates, products and by-products. The use of such procedures is essential to ensure safety during research and development and to ensure that new products and processes are as safe as possible. These procedures usually consist of a combination of a theoretical appraisal and small-scale tests and, in many cases, enable an adequate hazard evaluation to be carried out without the need for larger scale classification tests. This reduces the quantity of material required, lessens any detrimental effect on the environment and minimizes the amount of unnecessary testing.

1.2 The purpose of this appendix is to present example screening procedures. It should be used in conjunction with any screening procedures given in the introductions to the relevant test series. With the specified safety margin, the results from the screening procedures adequately predict when it is not necessary to perform the classification test as a negative result would be obtained. They are presented for guidance and their use is not compulsory. Other screening procedures may be used provided that adequate correlation has been obtained with the classification tests on a representative range of substances and there is a suitable safety margin.

2. Scope

2.1 A hazard evaluation for a new substance should be undertaken before it is offered for transport. Initially this evaluation can use the screening procedures given in this Appendix. If the screening procedure indicates that there is a hazard, the full classification procedure should be applied.

2.2 The screening procedures are only applicable to substances and stable, homogeneous mixtures of substances. If a mixture can separate out during transport, the screening procedure should also be performed on each reactive component of the mixture in addition to the mixture.

2.3 The remarks 1.1.2 from section 1 "general introduction" are emphasized that competence on the part of the testing authority is assumed and responsibility for classification is left with them.

3. Screening procedures for substances which may have explosive properties

3.1 The screening procedure may be used for new substances which are suspected of having explosive properties. When considering the explosive properties of self-reactive substances of Division 4.1 or organic peroxides of Division 5.2, refer to Part II of this manual and section 5.1 of this appendix. It should not be used for substances manufactured with the intention of producing a practical explosive or pyrotechnic effect.

3.2 Explosive properties are associated with the presence of certain chemical groups in a molecule which can react to produce very rapid increases in temperature or pressure. The screening procedure is aimed at identifying the presence of such reactive groups and the potential for rapid energy release. If the screening procedure identifies the material to be a potential explosive, the Class 1 Acceptance Procedure (see 10.3) should be applied.

***NOTE**: Neither a Series 1 type (a) propagation of detonation test nor a Series 2 type (a) test of sensitivity to detonative shock is required if the exothermic decomposition energy of organic materials is less than 800 J/g.*

3.3 The acceptance procedure for Class 1 explosives need not be applied:

(a) When there are no chemical groups associated with explosive properties present in the molecule. Examples of groups which may indicate explosive properties are given in Table A6.1

Table A6.1 EXAMPLES OF CHEMICAL GROUPS INDICATING EXPLOSIVE PROPERTIES IN ORGANIC MATERIALS

Structural feature	**Examples**
C-C unsaturation	Acetylenes, acetylides, 1,2-dienes
C-Metal, N-Metal	Grignard reagents, organo-lithium compounds
Contiguous nitrogen atoms	Azides, aliphatic azo compounds, diazonium salts, hydrazines, sulphonylhydrazides
Contiguous oxygen atoms	Peroxides, ozonides
N-O	Hydroxylamines, nitrates, nitro compounds, nitroso compounds, N-oxides, 1,2-oxazoles
N-halogen	Chloramines, fluoroamines
O-halogen	Chlorates, perchlorates, iodosyl compounds

or

(b) When the substance contains chemical groups associated with explosive properties which include oxygen and the calculated oxygen balance is less than -200.

The oxygen balance is calculated for the chemical reaction:

$$C_xH_yO_z + [x + (y/4)-(z/2)].\ O_2 \rightleftarrows x.\ CO_2 + (y/2).\ H_2O$$

using the formula:

$$\text{oxygen balance} = -1600.[2.x + (y/2) - z]/\text{molecular weight}$$

or

(c) When the organic substance or a homogenous mixture of organic substances contain chemical groups associated with explosive properties but the exothermic decomposition energy is less than 500 J/g and the onset of exothermic decomposition is below 500 ºC. (The temperature limit is to prevent the procedure being applied to a large number of organic materials which are not explosive but which will decompose slowly above 500 ºC to release more than 500 J/g.) The exothermic decomposition energy may be determined using a suitable calorimetric technique (see 20.3.3.3);

or

(d) For mixtures of inorganic oxidizing substances of Division 5.1 with organic material(s), the concentration of the inorganic oxidizing substance is:

less than 15 %, by mass, if assigned to Packing Group I (high hazard) or II (medium hazard);
less than 30 %, by mass, if assigned to Packing Group III (low hazard).

3.4 When the substance is a mixture containing any known explosives, the class 1 acceptance procedure should be applied.

4. Screening procedures for mixtures which may be flammable liquids (Class 3)

4.1 The procedure only applies to possible flammable mixtures containing known flammable liquids in defined concentrations although it may contain non-volatile components e.g. polymers, additives etc. The flash point of these mixtures need not be determined experimentally if the calculated flash point of the mixture, using the method given in 4.2, is at least 5 °C greater than the relevant classification criterion and provided that:

(a) The composition of the mixture is accurately known (if the material has a specified range of composition the composition with the lowest calculated flash point should be selected for assessment);

(b) The flash point (closed cup as given in 2.3.3 of the Model Regulations) of each component is known (an appropriate correlation has to be applied when these data are extrapolated to other temperatures than test conditions);

(c) The activity coefficient is known for each component as present in the mixture including the temperature dependence;

(d) The liquid phase is homogeneous.

4.2 A suitable method is described by Gmehling and Rasmussen (Ind. Eng. Chem. Fundament, **21**, 186, (1982)). For a mixture containing non-volatile components, e.g. polymers or additives, the flash point is calculated from the volatile components. It is considered that a non-volatile component only slightly decreases the partial pressure of the solvents and the calculated flash point is only slightly below the measured value.

5. Screening procedures for substances which may be flammable solids (Class 4)

5.1 *Substances which may be self-reactive substances (Division 4.1)*

The classification procedures (see section 20.4) for self-reactive substances need not be applied if:

(a) There are no chemical groups present in the molecule associated with explosive or self-heating properties; examples of such groups are given in Tables A6.1 and A6.2.

Table A6.2 EXAMPLES OF CHEMICAL GROUPS INDICATING SELF-REACTIVE PROPERTIES IN ORGANIC MATERIALS

Structural feature	Examples
Mutually reactive groups	Aminonitriles, haloanilines, organic salts of oxidizing acids
S=O	Sulphonyl halides, sulphonyl cyanides, sulphonyl hydrazides
P-O	Phosphites
Strained rings	Epoxides, aziridines
Unsaturation	Olefins, cyanates

or

(b) For a single organic substance or a homogeneous mixture of organic substances, the estimated SADT is greater than 75 °C or the exothermic decomposition energy is less than 300 J/g. The onset temperature and decomposition energy may be estimated using a suitable calorimetric technique (see 20.3.3.3).

5.2 *Substances which may be liable to spontaneous combustion (Division 4.2)*

5.2.1 The classification procedure for *pyrophoric solids and liquids* need not be applied when experience, in production or handling, shows that the substance do not ignite spontaneously on coming into contact with air at normal temperatures (i.e. the substance is known to be stable at room temperature for prolonged periods of time (days)).

5.2.2 The classification procedure for *self-heating substances* need not be applied if the results of a screening test can be adequately correlated with the classification test and an appropriate safety margin is applied. Examples of screening tests are:

(a) The Grewer Oven test (VDI guideline 2263, part 1, 1990, *Test methods for the Determination of the Safety Characteristics of Dusts*) with an onset temperature 80 K above the reference temperature for a volume of 1 *l* (33.3.1.6);

(b) The Bulk Powder Screening Test (Gibson, N. Harper, D. J. Rogers, R. *Evaluation of the fire and explosion risks in drying powders,* Plant Operations Progress, **4** (3), 181 - 189, 1985) with an onset temperature 60 K above the reference temperature for a volume of 1.l (33.3.1.6).

5.3 *Substances which in contact with water may react to emit flammable gases (Division 4.3)*

The classification procedure for substances which may react with water to emit flammable gases need not be applied if:

(a) The chemical structure of the substance does not contain metals or metalloids; or

(b) Experience in production or handling shows that the substance does not react with water, e.g. the substance is manufactured in water or washed with water; or

(c) The substance is known to be soluble in water to form a stable mixture.

6. Screening procedures for substances which may be oxidizing substances and those which may be organic peroxides (Class 5)

6.1 *Substances which may be oxidizing substances (Division 5.1)*

6.1.1 For *organic compounds*, the classification procedure for oxidizing substances of Division 5.1 need not be applied if:

(a) The compound does not contain oxygen, fluorine or chlorine; or

(b) The compound contains oxygen, fluorine or chlorine and these elements are chemically bonded only to carbon or hydrogen.

6.1.2 For *inorganic substances*, the test procedure in Section 34 need not be applied if the substance does not contain any oxygen or halogen atoms.

6.2 *Substances which may be organic peroxides (division 5.2)*

6.2.1 Organic peroxides are classified by definition based on their chemical structure and on the available oxygen and hydrogen peroxide content of formulations (see 20.2.2)."