INTERNATIONAL STANDARD

ISO 25947-4

First edition
2017-04

Fireworks — Categories 1, 2 and 3 —

Part 4: Test methods

Artifices de divertissement — Catégories 1, 2 et 3 —
Partie 4: Méthodes d'essai

Reference number
ISO 25947-4:2017(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 264, *Fireworks*.

A list of all the parts in the ISO 25947 series can be found on the ISO website.

Fireworks — Categories 1, 2 and 3 —

Part 4: Test methods

1 Scope

This document specifies test methods. It is applicable to fireworks in categories 1, 2 and 3 according to ISO 25947-2.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3599, *Vernier callipers reading to 0,1 and 0,05 mm*

ISO 6344-3, *Coated abrasives — Grain size analysis — Part 3: Determination of grain size distribution of microgrits P240 to P2500*

ISO 21948, *Coated abrasives — Plain sheets*

ISO 25947-1, *Fireworks, Categories 1, 2 and 3 — Part 1: Terminology*

ISO 25947-3:2017, *Fireworks, Categories 1, 2 and 3 — Part 3: Minimum labelling requirements*

ISO 25947-5, *Fireworks, Categories 1, 2 and 3 — Part 5: Requirements for construction and performance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 25947-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

4 Test environment

4.1 General

The test area shall be a clean, flat, horizontal, non-flammable and sound reflecting surface (for example concrete). The test sample shall be placed in accordance with the instructions on the label in the centre of the test area.

4.2 Indoor

The test area shall be indoors.

The test area shall be inside a fume cupboard, or similar enclosed space, which is capable of preventing movement of air.

4.3 Outdoor

4.3.1 General

The test area shall be an outdoor site. If applicable, provisions shall be made at the centre of the test area for partially burying into the ground.

If applicable, insert a support pole in the centre of the test area.

A means of measuring the wind speed at a height of 1,5 m above the ground shall be provided. No performance testing shall be carried out if the wind speed exceeds 5,0 m/s.

4.3.2 Category 1

A test area meeting the requirements given in 4.1, with a radius of at least 2,0 m and a circle, radius 1,0 m, shall be marked around the centre of the test area.

4.3.3 Category 2

A test area meeting the requirements given in 4.1, with a radius of at least 9,0 m and a circle, radius 8,0 m, shall be marked around the centre of the test area.

4.3.4 Category 3

A test area meeting the requirements given in 4.1, with a radius of at least 16,0 m and a circle, radius 15,0 m, shall be marked around the centre of the test area.

4.4 Monitoring height

Two positions for monitoring the height of ascent and angle of flight shall be provided, at a measured distance of at least 50 m from and at an angle of 90° to each other in relation to the testing point. If the monitoring positions are not in the same horizontal plane, appropriate corrections shall be made in the calculation of heights.

If necessary, the measuring distance and the number of positions can be adapted to the firework.

5 Apparatus

NOTE The described apparatuses are only examples, any equivalent apparatus with the same accuracy or better can be used.

5.1 Timing device.

5.1.1 Timing device, capable of being read to the nearest 0,1 s.

5.1.2 Timing device, capable of being read to the nearest 1 min.

5.2 Calliper, flat faced vernier calliper reading to 0,1 mm, conforming to ISO 3599.

5.3 Ruler, reading to 1 mm.

5.4 Measuring tape, reading to 10 mm.

5.5 Wind speed meter, capable to measure with accuracy of at least 0,5 m/s.

5.6 Weights with clamping devices.

5.6.1 Weight with clamping device, (50 ± 1,0) g total.

5.6.2 Weight with clamping device, (100 ± 1,0) g total.

5.6.3 Weight with clamping device, (500 ± 1,0) g total.

5.7 Balance.

5.7.1 Balance, reading to 100 mg.

5.7.2 Balance, reading to 10 mg.

5.7.3 Balance, reading to 0,1 mg.

5.8 Abrasive sheet, large enough to permit striking of the ignition head, conforming to ISO 21948, grit P240 measured in accordance with ISO 6344-3.

5.9 Temperature chamber.

5.9.1 Up to (+130 ± 2,5) °C.

5.9.2 Up to (+75 ± 2,5) °C.

5.9.3 Up to (+50 ± 2,5) °C.

5.10 Test paper, 700 mm × 750 mm, (80 ± 3,0) g/m^2.

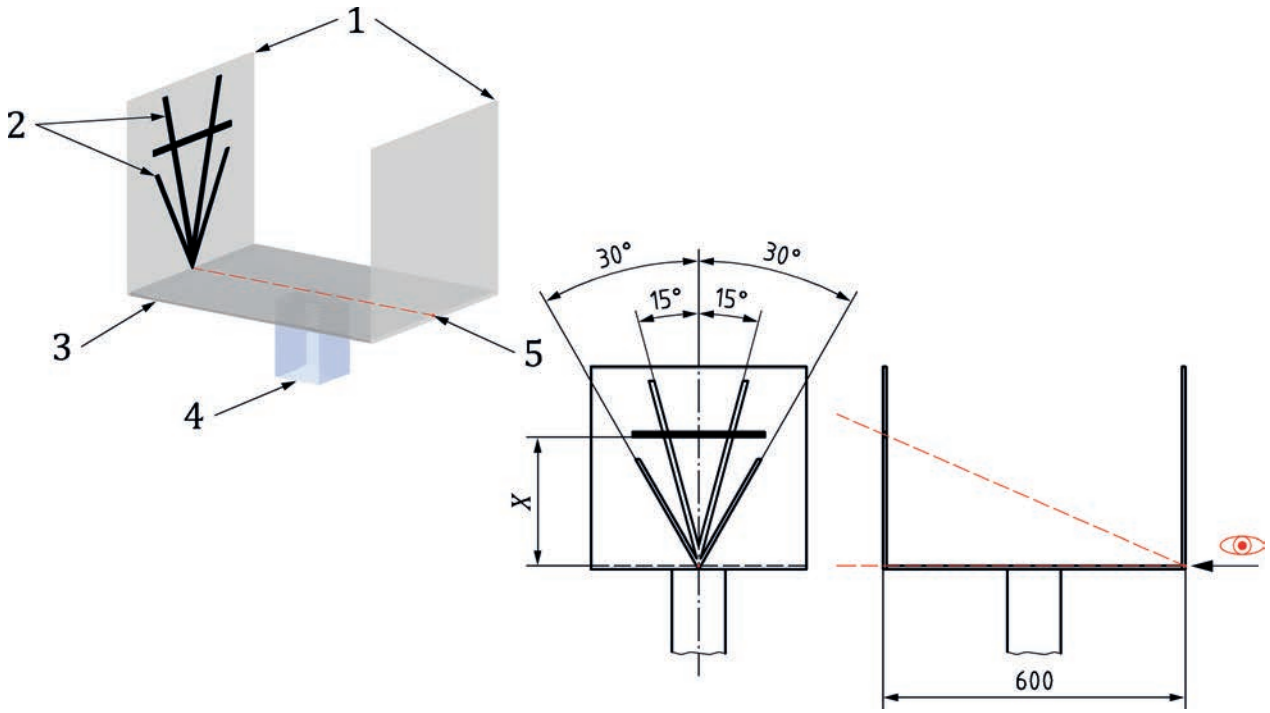
5.11 Clamping device, means of clamping to hold different test sample at different heights and/or angles.

5.12 Plate, non-flammable, with a diameter of (200 ± 5) mm.

5.13 Paper holder, means of clamping to fix the test paper in a horizontal or vertical plane in different heights.

5.14 Viewing screen, suitable viewing screens, as shown in Figure 1, shall be provided for monitoring height and angle of flight criteria.

Dimensions in millimetres



Key

1 acryl glass
2 black tape, 10 mm to 20 mm wide
3 solid base
4 stand
5 position of observer

Figure 1 — Viewing screen

Distance X is given in metres using Formula (1) (with e.g. Y = 50 m):

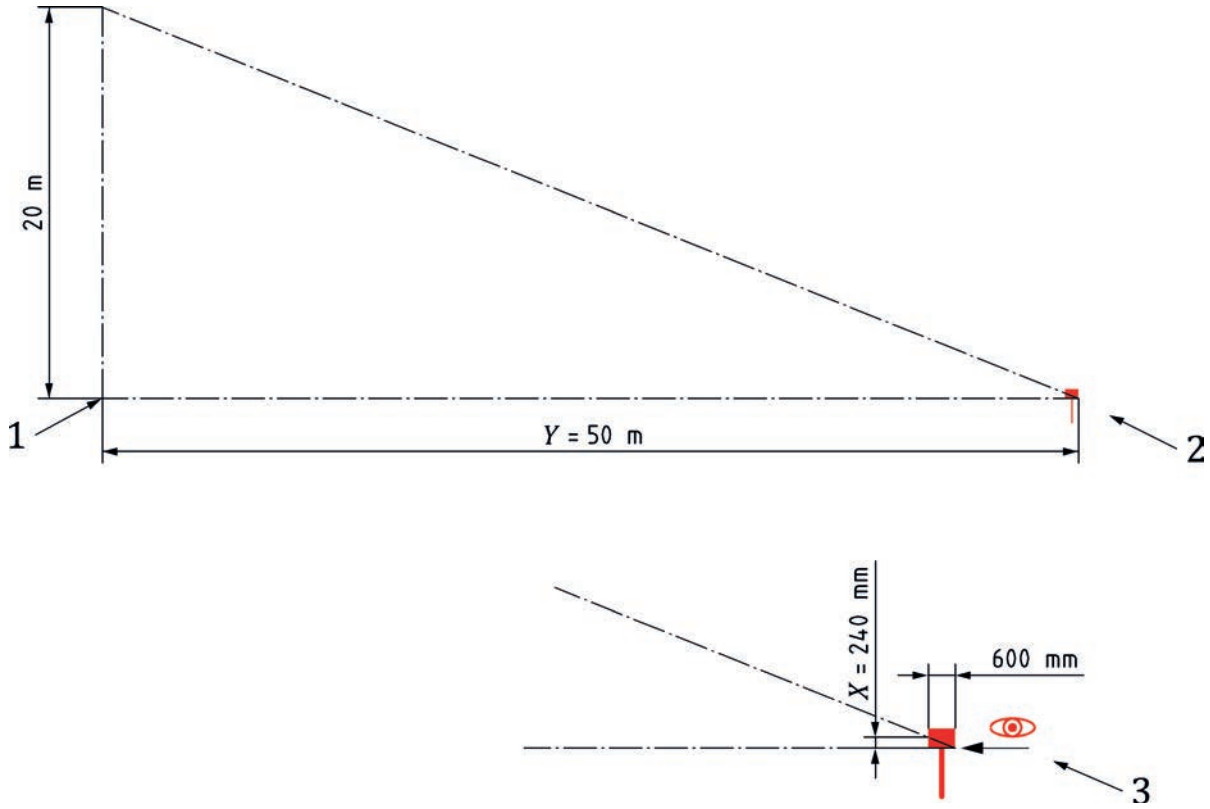
$$\frac{20\,\text{m}}{X} = \frac{Y}{0{,}6\,\text{m}} \tag{1}$$

where

Y is the distance in metres from the viewing point to the testing point.

EXAMPLE Y = 50 m

$$X = \frac{0{,}6\,\text{m} \cdot 20\,\text{m}}{Y} = \frac{0{,}6\,\text{m} \cdot 20\,\text{m}}{50\,\text{m}} = 0{,}24\,\text{m} \tag{2}$$



Key

1 base of firework before firing
2 sighting device
3 position of observer

Figure 2 — Use of a viewing screen to monitor a height of 20 m

5.15 Poles, with 3 m height.

NOTE A vertical height of 3 m can be identified by the poles placed around the perimeter of the test area and the 8 m height can be estimated using the same poles.

5.16 Rack, horizontal plate with a central hole of 800 mm diameter, mounted in a height of 3,0 m above the ground in a mobile rack.

5.17 Sound level meter, to class 1 of IEC 61672-1 with free-field microphone.

5.18 Shock apparatus.

The apparatus shall provide a deceleration of 490 m/s^2 (–50/+100) m/s^2 (when measured at the centre of an unloaded platform) and the mechanical conditioning impulse duration (time elapsed from the starting of the machine's deceleration to the time in which the deceleration reaches its maximum value during each first shock pulse) shall be (2 ± 1) ms working at a frequency of (1 ± 0,1) Hz.

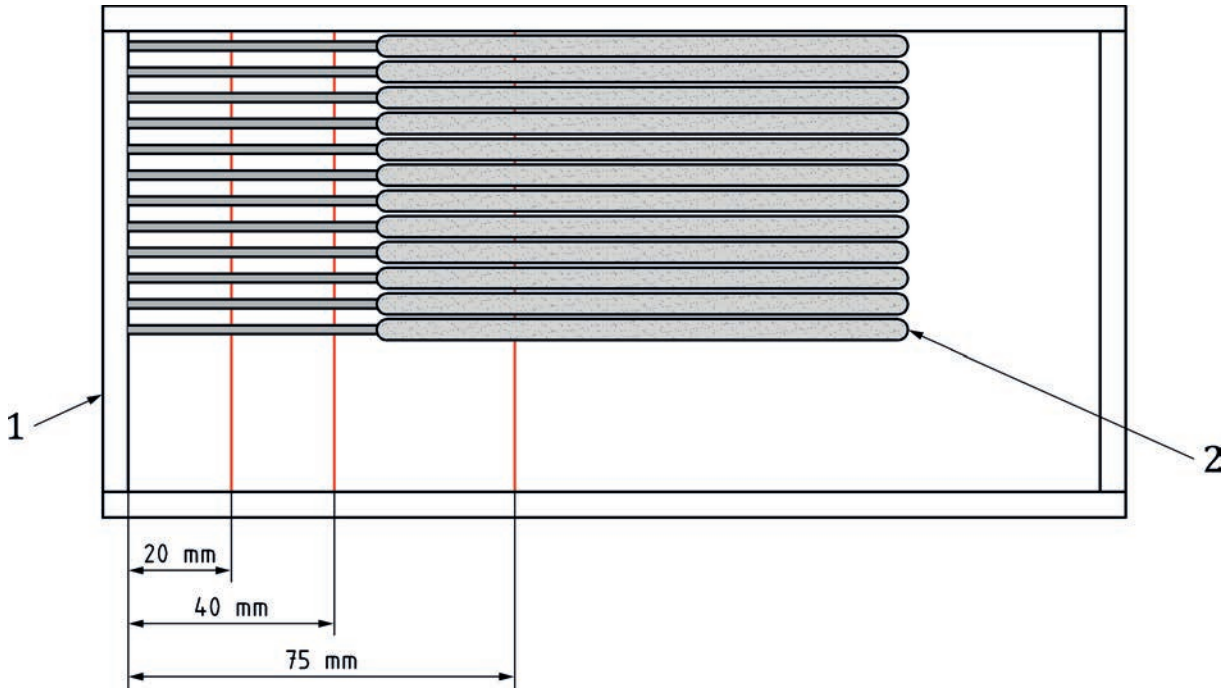
An example of an apparatus is shown in Annex A.

5.19 Goniometer, read to 1°.

5.20 Frame.

The frame shall retain the test sample consistently.

To gauge the length of the handles, clearly marked lines shall be marked at distances of 20 mm, 40 mm and 75 mm from the handle end of the frame.



Key

1 frame

2 sparkler

Figure 3 — Example for determining length of handles (Batch test)

5.21 Ignition source, capable of producing a small flame or of smouldering.

5.22 Transparent type size sheet.

The printing of Latin characters, as required in ISO 25947-3:—, 4.8, shall comply with the sizes shown in Figure 4.

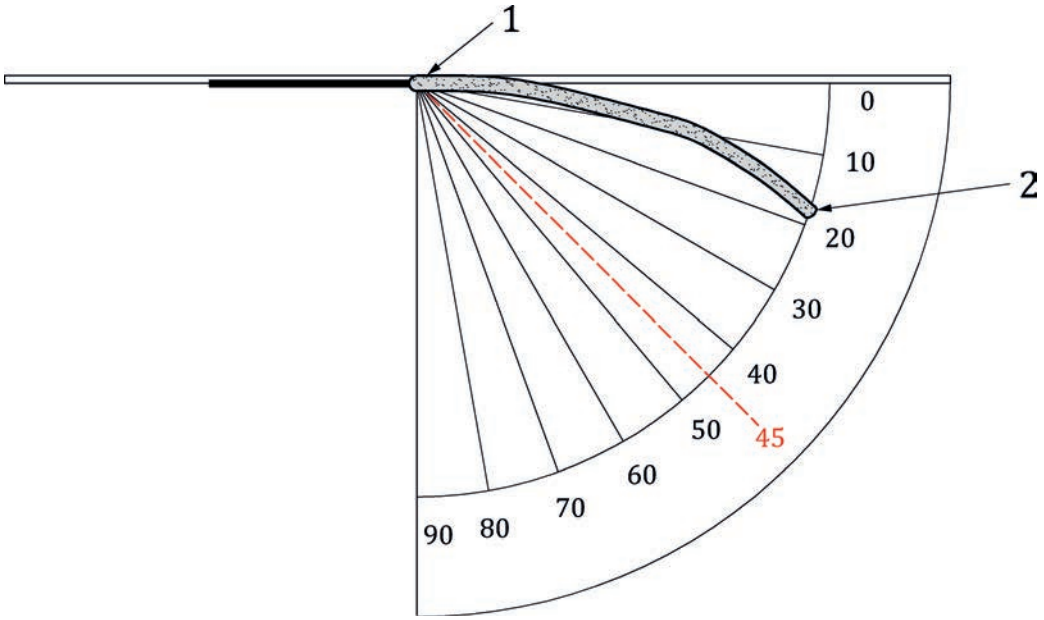
2,8 mm: ABC abc XYZ xyz 123

2,1 mm: ABC abc XYZ xyz 123

Figure 4 — Type sizes of print

For other languages, similar equipment shall be used in compliance with ISO 25947-3.

5.23 Protractor.



Key

1 junction of handle/pyrotechnic composition

2 tip of hand-held sparkler

Figure 5 — Measurement of droop

5.24 Striking surface.

The primary pack is supplied with a striking surface for safety matches.

5.25 Post, with a height of 0,5 m.

Place one or more posts inside the test area (see 4.3.2) with the related radius.

5.26 Cage.

Thin-wire cage with a mesh size of 10 mm to 15 mm.

The wire shall have a diameter of approximately 1,0 mm.

The inner length and width shall be (200 ± 10) mm. The inner height of the cage shall be (100 ± 10) mm.

6 Test methods

6.1 General

NOTE These methods are only examples. Any equivalent method with the same sensitivity and the same accuracy or better can be used.

6.2 Construction and stability

6.2.1 Length of handle

6.2.1.1 Apparatus

— Calliper (5.2)

— Ruler (5.3)

— Frame (5.20)

6.2.1.2 Procedure

6.2.1.2.1 Fireworks with visible handles

For the type test, measure and record the length of the uncoated end using the calliper (5.2) if the length of the handle is smaller than or equal to 100 mm or using the ruler (5.3) if the length exceeds 100 mm.

For the batch test, measure the length of the uncoated end by using the calliper (5.2), the ruler (5.3) or the frame (5.20) to determine the length of the uncoated end and record if the length of uncoated end is within the requirements.

If using the frame (5.20), place the fireworks with the handles in accordance with Figure 3 and record whether and if so, for how many items, the uncoated end is less than the required length.

6.2.1.2.2 Hand-held fountains without a separate handle

Use the fireworks that are sampled for the determination of the net explosive content. Cut open the marked end of the firework case. Using a calliper (5.2), measure and record the length of the firework case which is not filled with pyrotechnic composition to the nearest 1,0 mm.

6.2.2 Attachment of separate handle

6.2.2.1 Apparatus

— Timing device (5.1.1)

— Weight (5.6.3)

6.2.2.2 Procedure

Clamp the sample by means of a clamping device in a position such that the handle of the sample is pointing vertically downwards. Securely attach the 500 g weight (5.6.3) to the handle.

Using the timing device (5.1.1), determine and record the time until the handle of the sample becomes detached. If this time is longer than 10 s, stop the test and record as “longer than 10 s”.

6.2.3 Length of item

6.2.3.1 Apparatus

— Ruler (5.3)

6.2.3.2 Procedure

Use the ruler to measure and record the total length of the test item to the nearest 1 mm.

6.2.4 Length of pull-string or pull-strip

6.2.4.1 Apparatus

— Ruler (5.3)

6.2.4.2 Procedure

Carefully extend the pull-string or pull-strip to its full length without firing the test item. Using the ruler (5.3), measure the total exposed length of the pull-string or pull-strip. Record the length.

6.2.5 Determination of diameter

6.2.5.1 Apparatus

— Calliper (5.2)

6.2.5.2 Procedure

Using the calliper (5.2), measure the inside diameter of the tube at least three times at different positions to the nearest 1,0 mm.

Using the calliper (5.2), measure the outer diameter of the propellant tube of the mini rocket at least three times at different positions to the nearest 0,5 mm.

Record the individual diameters and calculate the mean diameter.

6.2.6 Attachment of initial fuse

6.2.6.1 Apparatus

— 50 g weight with clamping device (5.6.1)

— 100 g weight with clamping device (5.6.2)

— Timing device (5.1.1)

— Clamping device (5.11)

6.2.6.2 Procedure

Clamp the firework by means of a clamping device (5.11) in such a position that the initial fuse is pointing vertically downwards. If testing a category 1 firework or a category 2 mini rocket, securely attach the 50 g weight with clamping device (5.6.1) to the initial fuse. If testing a category 2 firework other than a mini rocket or a category 3 firework, securely attach the 100 g weight with clamping device (5.6.2) to the initial fuse.

Using the timing device (5.1.1), determine and record the time until the initial fuse becomes detached. If this time is longer than 10 s, stop the test and record the time as “longer than 10 s”.

6.2.7 Attachment of sealing paper, ignition head or friction head

See 6.15.

6.2.8 Resistance to ignition by an abrasive surface

6.2.8.1 Apparatus

— Abrasive sheet (5.8).

6.2.8.2 Procedure

Strike the friction head of the test sample in the test area (see 4.2 or 4.3) on the rough surface of the abrasive sheet (5.8). Record whether the friction head ignites.

6.2.9 Height of initial fuse for mounted wheels in category 3

6.2.9.1 Apparatus

— Measuring tape (5.4).

6.2.9.2 Procedure

Mount the wheel in accordance with the instructions on the label. Extend the protruding fuse vertically downwards and measure the height of the initial fuse above the ground to the nearest 10 mm, using a measuring tape (5.4). Record the height.

6.3 Design — Verification

6.3.1 General

These tests shall be done for type testing to verify that the tested item is in accordance with the requirements of ISO 25947-5.

For batteries, batteries requiring external support, combinations and combinations requiring external support, three samples of each different pyrotechnic unit shall be inspected.

6.3.2 Conformity to drawings and part lists

The tested item shall be in accordance with the relevant manufacturing drawing. The drawing shall show any relevant component, e.g. pyrotechnic unit, with its dimensions, the masses of each pyrotechnic charge as well as the detailed pyrotechnic composition of the firework.

Observe and record any nonconformity.

6.3.3 Pyrotechnic composition — Determination of net explosive content or total NEC

6.3.3.1 Apparatus

— Timing device (5.1.2)

— Balance 10 mg (5.7.2)

— Balance 100 mg (5.7.1)

— Temperature chamber (5.9.1)

6.3.3.2 Procedure

6.3.3.2.1 Determination by dismantling

Carefully dismantle the test sample. Separate any pyrotechnic units and count them, except when pyrotechnic units are stars. Record the number of units containing report composition.

Table 1 — Accuracy of weighing

Mass of pyrotechnic composition	Weigh to the nearest	Using the balance
≤3,0 g	10 mg	5.7.2
>3,0 g	100 mg	5.7.1

Weigh the pyrotechnic composition not contained in pyrotechnic unit(s). Record the mass.

If applicable, remove the pyrotechnic composition from each pyrotechnic unit, separate bursting charge, report charge and effect charge and weigh each portion. Record the mass of each portion.

6.3.3.2.2 Determination by separation of pyrotechnic composition by water/solvent

Weigh at least five test samples to the nearest 100 mg using the balance (5.7.1). Note the mass. Subsequently place the test samples in water or an appropriate solvent until all pyrotechnic compositions are soaked and easy to remove. Wash the inert material with water until there is no adherent composition and dry them for 1 h (5.1.2) at 120 °C (5.9.1). Weigh the inert material after a cooling period of 2 h (5.1.2) at room temperature to the nearest 100 mg using the balance (5.7.1). Note the mass.

Calculate the mean net explosive content (NEC) or total NEC of the pyrotechnic composition as the difference between the initial mass and the mass of the sample without any composition divided by the number of samples. Record the mean NEC of the pyrotechnic composition.

6.3.3.2.3 Determination of silver fulminate

A description of a method to determine silver fulminate is given in Annex B.

6.4 Paper tests

6.4.1 Test for burning or incandescent matter

6.4.1.1 Apparatus

— Ruler (5.3)

— Test paper (5.10)

— Clamping device (5.11)

— Plate (5.12)

— Goniometer (5.19)

6.4.1.2 Procedure

6.4.1.2.1 General

Place the sheet of paper (5.10) on a horizontal area (see 4.2). Place the plate (5.12) in the middle of the test paper, only if testing table bombs, serpents, flash pellets, indoor non-hand-held sparklers or

indoor fountains, and place the sample on the plate. If the sample is not fitted with a base, then use the clamping device (5.11) to fix the sample at the required angle and height to the test paper.

6.4.1.2.2 Test configuration

The test configuration shall comply with Tables 2 and 3.

Table 2 — Test configuration

	Angle of test sample (5.19)	Height of test sample above test paper (5.10)
Fountains (for indoor use)	vertical	direct on the plate
Hand-held fountains (for indoor use)	45° upwards	(500 ± 10) mm
Hand-held sparklers (for indoor use)	horizontal	(200 ± 10) mm
Non hand-held sparklers (for indoor use)	vertical in supplied stand	direct on the plate
Bengal matches	horizontal	(200 ± 10) mm
Novelty matches	horizontal	(200 ± 10) mm
Serpents	vertical	direct on the plate
Flash pellets	vertical	direct on the plate

Table 3 — Additional test configuration

	Angle of test sample (5.19)	Height of test paper (5.10) above test samples (additionally to the test paper (5.10) below the test sample)
Fountains (hand-held, for indoor use)	vertical	(500 ± 10) mm

Ignite test sample in accordance with the label instruction with an appropriate ignition source.

After functioning, remove the sample, the plate and the clamping device, if any.

Record whether the test paper caught fire and/or has holes burnt in it.

6.4.2 Test for horizontal projected debris

6.4.2.1 Apparatus

— Ruler (5.3)

— Test paper (5.10)

— Clamping device (5.11)

— Paper holder (5.13)

— Goniometer (5.19)

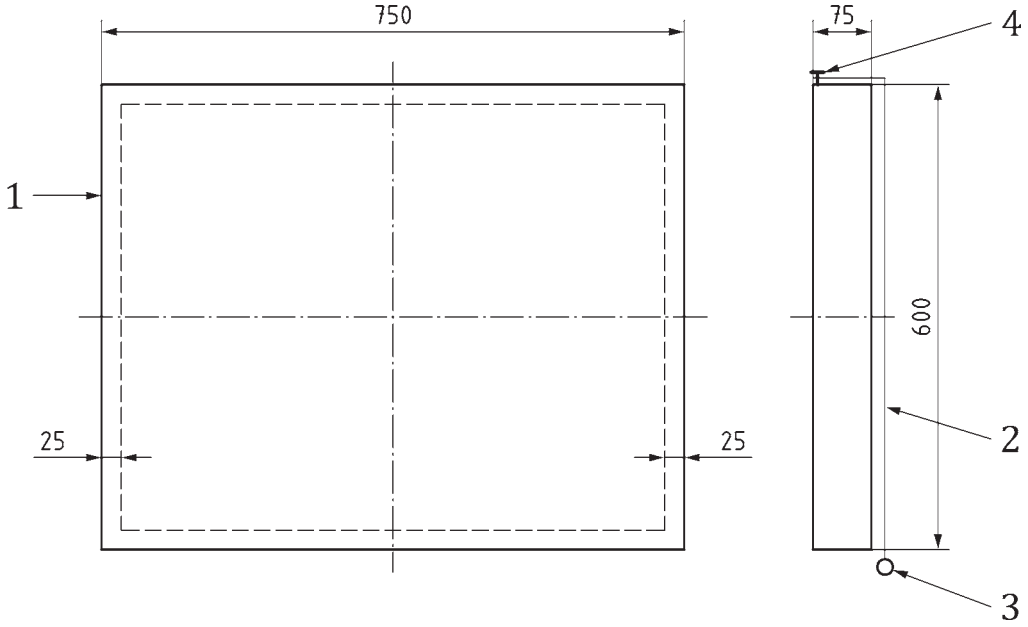
6.4.2.2 Procedure

If applicable, use the clamping device (5.11) to fix the test sample at the specified height, measured with the ruler (5.3), and angle, measured with the goniometer (5.19), above the centre of the test paper (5.10).

Use a paper holder (5.13) to fix the test paper (5.10) vertically. Use a ruler (5.3) to adjust the paper holder in the required position and distance.

Function the test sample in accordance with the labelled instructions with an appropriate ignition source (5.21). In case of party poppers, pull the string to fire the party popper.

Record whether any ejected material penetrated the sheet of test paper or whether the ejected material or test paper caught fire.

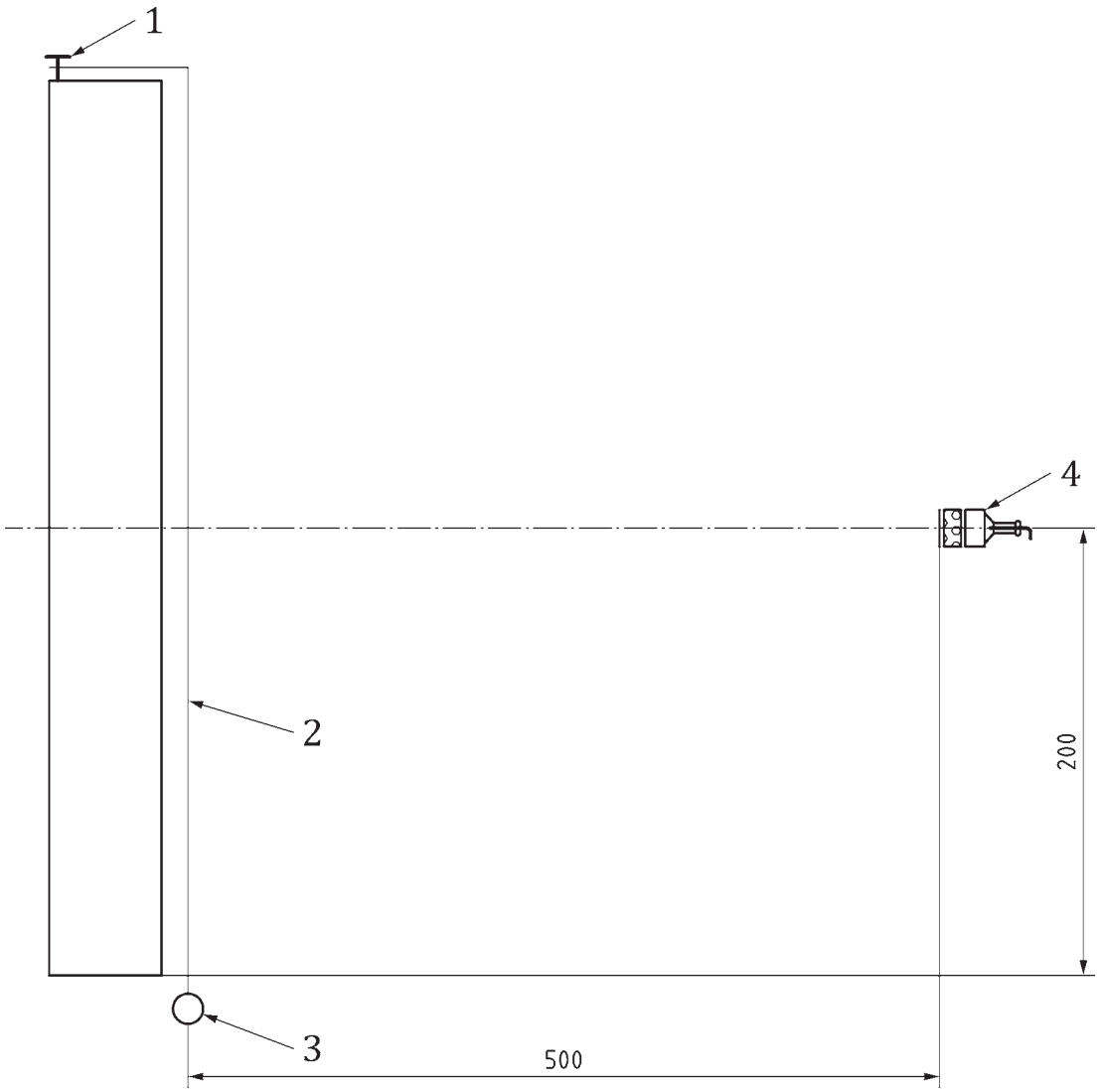


Key

1 paper holder
2 sheet of paper
3 weighted rod
4 paper clamp

Figure 6 — Example of paper holder

Dimensions in millimetres



Key

1 paper clamp
2 sheet of paper
3 weighted rod
4 party popper

Figure 7 — Arrangement for party popper performance test

6.4.3 Test for vertical projected debris

6.4.3.1 Apparatus

— Ruler (5.3)

— Test paper (5.10)

— Clamping device (5.11)

— Paper holder (5.13)

— Goniometer (5.19)

6.4.3.2 Procedure

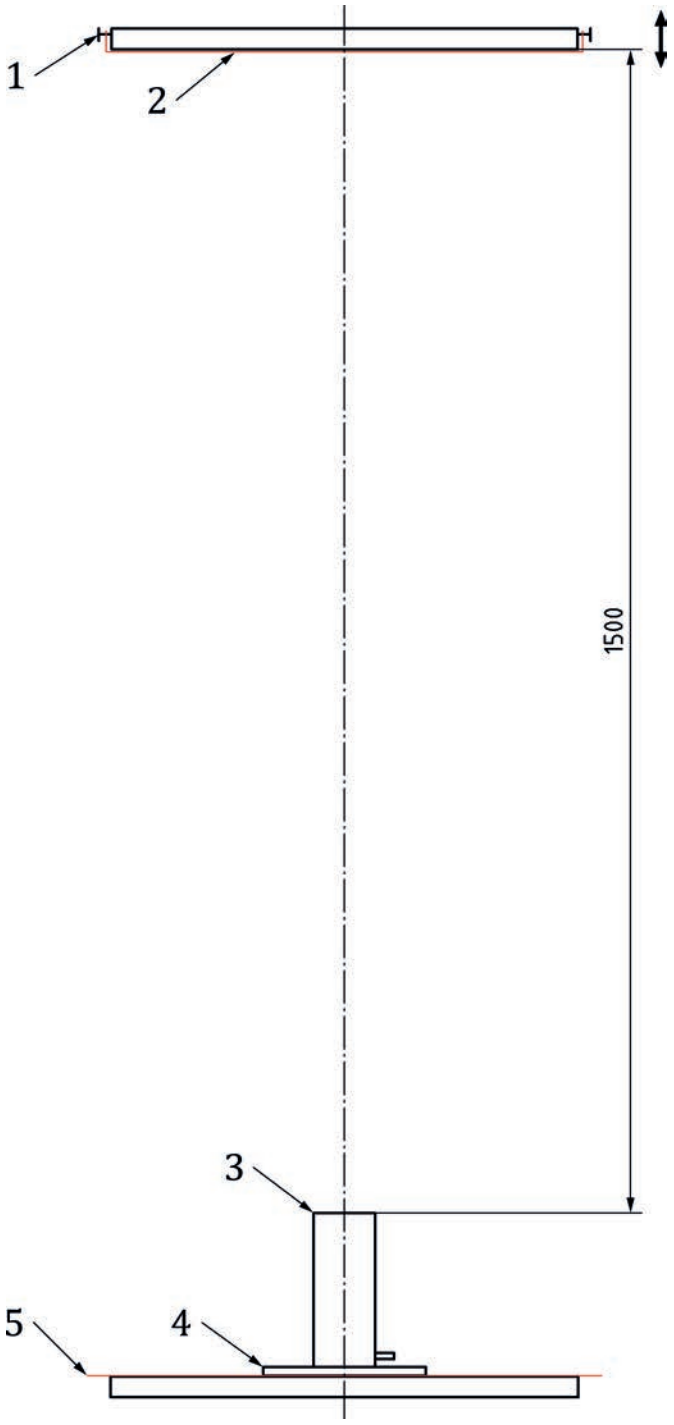
If applicable, use the clamping device (5.11) to fix the test sample at the specified height, measured with the ruler (5.3), and angle, measured with goniometer (5.19), above the centre of the test paper.

Use a paper holder (5.13) to fix the test paper (5.10) horizontally. Use the ruler (5.3) to adjust the paper holder to the required position and distance.

Ignite the test sample in accordance with the labelled instructions.

Record whether any ejected material penetrated the sheet of test paper and whether any ejected material were made of glass or sharp metal or whether the ejected material or either sheet of test paper caught fire.

Dimensions in millimetres



Key

1 paper holder
2 test paper
3 table bomb
4 non-flammable plate
5 test paper

Figure 8 — Arrangement for table bombs performance test

6.5 Angle of ascent and height of effects

6.5.1 Apparatus

— Viewing screen (5.14)

— Poles (5.15)

— Rack (5.16)

— Post (5.25)

6.5.2 Procedure for double bangers and double flash bangers

Position the rack (5.16) so the centre of the 800 mm hole is directly above the centre of the test area. Place the double banger or the double flash banger in accordance with the labelled instructions in the centre of the test area and ignite.

Observe and record whether the double banger or the double flash banger passes through the hole in the horizontal plate. Estimate and record the height where the second report occurs.

For a double flash banger, one observer with viewing screen is positioned at a measured distance of at least 50 m, so that the bottom edge of the triangle on the screen aligns with the base of the test sample, and the bottom edge of the back screen aligns with the bottom edge of the horizontal tape on the front screen.

6.5.3 Procedure for items other than double bangers and double flash bangers

Two observers with viewing screens are positioned in accordance with 4.4 so that the bottom edge of the triangle on the screen aligns with the base of the test sample and the bottom edge of the back screen aligns with the bottom edge of the horizontal tape on the front screen.

Ignite the sample in accordance with the labelled instructions.

Record whether the angle of ascent and the height of the effects of the test sample were within the limits specified.

Record whether any burning matter was extinguished at the specified height by using the poles (5.15).

Record whether any bursts or explosions occurred at a height of less than the specified height by using the poles (5.15).

Ground movers, ground spinners and jumping ground spinners shall not move outside the relevant distance. Observe the height reached by category 1 articles with the aid of the posts (5.25).

6.6 Measurement of sound pressure level

6.6.1 General measurement for outdoors

6.6.1.1 Apparatus

— Sound level meter (5.17)

— Measuring tape (5.4)

6.6.1.2 Procedure

The measurement of the sound pressure level shall be carried out outdoors for all fireworks of category 1, 2 and 3 except for party poppers, Christmas crackers and snaps.

Set up the microphone of the sound level meter in the test area (see 4.2 or 4.3) at the required distance and at a height of 1,0 m.

a) For category 1, the microphone is set up at a horizontal distance of 1,0 m from the testing point.

b) For category 2, the microphone is set up at a horizontal distance of 8,0 m from the testing point.

c) For category 3, the microphone is set up at a horizontal distance of 15,0 m from the testing point.

Record the maximum A-weighted impulse sound pressure levels as measured by the sound level meter (5.17).

For ground spinners, jumping crackers and ground movers, 10 extra measurements of sound pressure level shall be performed with the item fixed to the firing point by a cage (5.26) which ensures no movement of more than 0,1 m to all directions.

6.6.2 Party poppers for indoors

6.6.2.1 Apparatus

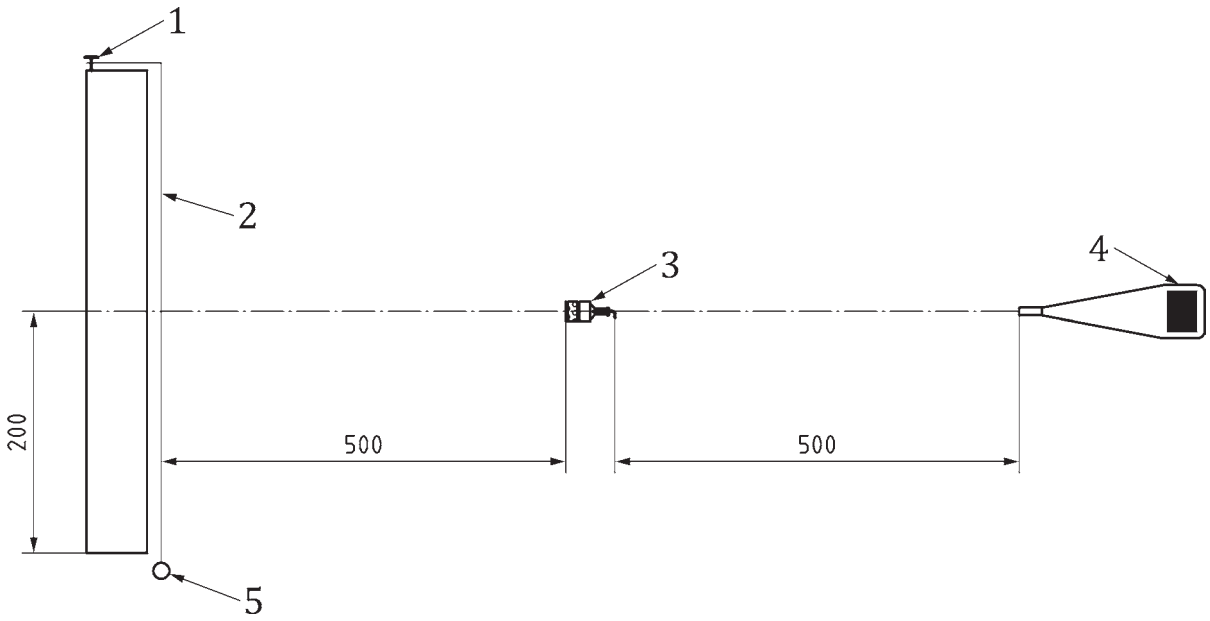
— Sound level meter (5.17)

— Ruler (5.3)

6.6.2.2 Procedure

Set up the microphone of the sound level meter (5.17) in the test area (see 4.1) at a height of (200 ± 10) mm above the surface, determined by the ruler (5.3), and at a horizontal distance of 500 mm behind the sample, determined by the ruler (5.3); see Figure 9.

Dimensions in millimetres



Key

1 paper holder
2 sheet of paper
3 party popper
4 sound level meter
5 weighted rod

Figure 9 — Arrangement of sound level measuring

Unfold the pull-string, if necessary, and extend the pull-string to its full length. Pull the string sharply. If the pull-string breaks, record the fact and do not proceed with further testing of that party popper. Observe and record whether the party popper produces a single report.

Record the maximum A-weighted impulse sound pressure as measured by the sound level meter (5.17).

6.6.3 Christmas crackers and snaps for indoors

6.6.3.1 Apparatus

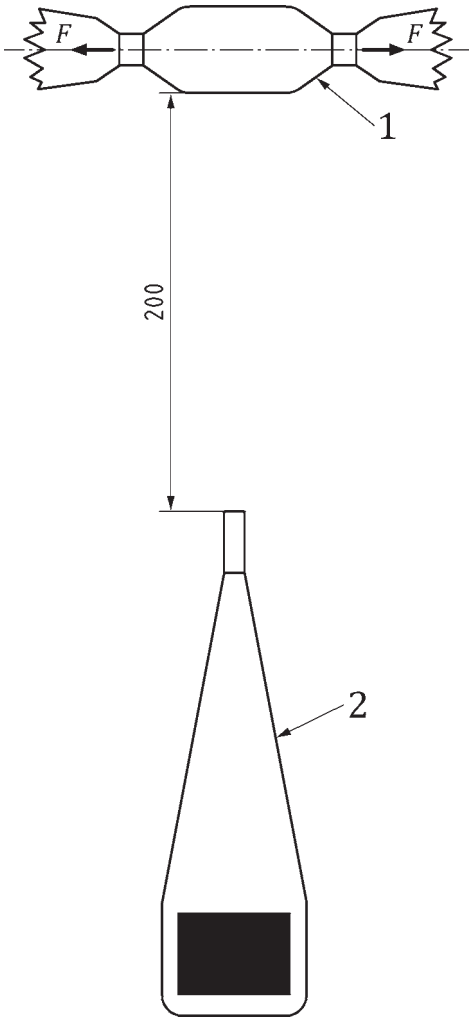
— Sound level meter (5.17)

— Ruler (5.3)

6.6.3.2 Procedure

Set up the microphone of the sound level meter (5.17) in the test area (see 4.1) at a height of (200 ± 10) mm above the surface, determined by the ruler (5.3), and at a horizontal distance of 200 mm from the sample, determined by the ruler (5.3); see Figure 10.

Dimensions in millimetres



Key

1 Christmas cracker/snap

2 sound level meter

Figure 10 — Arrangement of sound level measuring

Pull the Christmas cracker or snap sharply. Observe and record whether the Christmas cracker or snap produces a single report.

If the pull-strip breaks, record the fact and do not proceed with further testing of that Christmas cracker or snap.

Record the maximum A-weighted impulse sound pressure as measured by the sound level meter (5.17).

6.7 Timing measurement

6.7.1 Apparatus

— Timing device (5.1.1)

— Ignition source (5.21)

6.7.2 Procedure

6.7.2.1 Ignition time

Remove any protection of initial fuse and ignite in accordance with the labelled instructions.

Apply the ignition source (5.21) to the initial fuse and at the same instant, start the timing device (5.1.1). Stop the intermediate time at the moment the initial fuse ignites. If the initial fuse fails to ignite within the required time, record the fact and do not proceed with further testing of that firework.

If the firework has a friction head, strike the friction head of the firework on the ignition source, supplied with the firework. If the firework fails to ignite at the first strike, try it twice more. Record if the firework did not ignite.

6.7.2.2 Initial fuse time

Initial fuse time shall be measured by using the timing device (5.1.1) and shall be recorded from the moment the initial fuse ignites to the time the firework starts to produce its preliminary effect.

6.7.2.3 Invisible burning time

If the preliminary effect is different from the first principal effect, measure and record the invisible burning time after the preliminary effect by using the timing device (5.1.1).

Also, for Roman candles, measure and record the invisible burning time after the preliminary effect by using the timing device (5.1.1).

6.7.2.4 Delay time for compound fireworks

Measure the delay time between the single fireworks articles in the compound firework using the timing device (5.1.1) and check if 15 s are exceeded.

6.8 Measuring of labelling

6.8.1 Apparatus

— Calliper (5.2)

— Transparent type size sheet (5.22)

6.8.2 Procedure

Using the calliper (5.2) or the transparent type size sheet (5.22), record whether the type sizes are correct and the printing is legible.

6.9 Extinguishing of flames

6.9.1 Apparatus

— Timing device (5.1.1)

6.9.2 Procedure

After the firework has ceased to function, start the timing device (5.1.1) immediately and record the time until any flames caused by the functioning of the fireworks are extinguished.

6.10 Burning rate of composition

6.10.1 Apparatus

— Timing device (5.1.1)

6.10.2 Procedure

Immediately after starting the principal effect of the fireworks, start the timing device (5.1.1). Stop it after the end of the principal effect and record the time.

Estimate the burning rate by using the net explosive content in accordance with 6.3.3 in grams divided by the measured time in seconds. Record the burning rate in grams per second.

6.11 Droop test

6.11.1 Apparatus

— Protractor (5.23)

— Goniometer (5.19)

6.11.2 Procedure

After functioning, remove the hand-held sparkler from the clamping device (5.11) and use it for the measurement of the droop.

Measure the deflection of the unsupported tip from the horizontal, as shown in Figure 5, using the protractor (5.23) or the goniometer (5.19). Record the droop angle from the horizontal.

6.12 Projected debris (outdoor)

6.12.1 Apparatus

— Balance (5.7.1)

6.12.2 Procedure

Record whether any debris is projected laterally more than the relevant safety distance during functioning.

Record whether there is any metallic debris projected.

For rockets and aerial wheels, collect any debris which might have a mass exceeding the specified limits. Measure with the balance (5.7.1) and record any particle of debris which exceeds the specified mass.

6.13 Incandescent matter

Observe and record whether any burning or incandescent matter falls to the ground outside the relevant safety distance.

6.14 Visual and audible examinations

The visual examination shall be done by the naked eye and shall verify the requirements for this inspection.

The audible inspection shall be done by suitably protected ears at the relevant safety distance and shall verify the requirements for this inspection.

Record any anomalies.

6.15 Mechanical conditioning

6.15.1 Apparatus

— Shock apparatus (5.18)

— Balance capable of weighing to an accuracy 10 mg (5.7.2) or

— Balance capable of weighing to an accuracy 0,1 mg (5.7.3)

— Timing device (5.1.2)

6.15.2 Procedure

Place a sheet of paper on the platform of the mechanical shock apparatus (5.18) and place the test samples on the top of the sheet of paper. For test samples supplied in primary packs, in order to protect the initial fuse of the test sample, use the appropriate number of complete, unopened packs. Cover the test samples or packs with the cellular rubber sheet and secure it to the platform around its edges. Run the shock apparatus (5.18) for 1 h.

At the end of the 1 h (5.1.2) period, stop the machine and remove the test samples or primary packs. For samples which have been conditioned in primary packs, carefully open the packs, remove the samples and empty any loose material on to the sheet of paper. Separate any pyrotechnic composition from the loose material and weight this pyrotechnic composition with the balance (5.7.2). For novelty matches, party poppers, throwdowns, Christmas crackers and snaps, use a balance with an accuracy of 0,1 mg (5.7.3).

Record the mass of the pyrotechnic composition and whether any articles are damaged to an extent that might affect their functioning.

If applicable, record whether there was any damaged or loose sealing paper, ignition head or friction head.

For throwdowns, record whether any of the samples have exploded. Observe visually and record whether there is any damage to the primary pack and whether it has opened and whether any material has fallen out.

6.16 Thermal conditioning

6.16.1 Apparatus

— Temperature chamber (5.9.2) or

— Temperature chamber (5.9.3)

— Timing device (5.1.2).

6.16.2 Procedure (option 1)

Store the fireworks for 48 h (5.1.2) at a temperature of (75,0 ± 2,5) °C in the temperature chamber (5.9.2) and then for at least 2 d at ambient temperature before testing. For fireworks which were supplied in primary packs, condition the fireworks by storing the appropriate number of complete, unopened packs.

Record whether any article presents signs of ignition or chemical reaction. If any signs are visible, the test has failed and no re-test in accordance with 6.16.3 is possible.

Record whether any articles are damaged to an extent that might affect their functioning.

6.16.3 Procedure (option 2)

Store the fireworks for 28 d at a temperature of (50,0 ± 2,5) °C in the temperature chamber (5.9.3) and then for at least 2 d at ambient temperature before testing. For fireworks which were supplied in primary packs, condition the fireworks by storing the appropriate number of complete, unopened packs.

Record whether any article presents signs of ignition or chemical reaction. If any signs are visible, the test is failed and no re-test in accordance with 6.16.2 is possible.

Record whether any articles are damaged to an extent that might affect their functioning.

6.17 Striking surface test

6.17.1 Apparatus

— Striking surface (5.24)

6.17.2 Procedure

All samples from the primary pack, if any, shall be ignited with the striking surface using the striking surface as shown on the labelled firework.

6.18 Function test

6.18.1 Apparatus

— Test area (see 4.2), if applicable.

— Test area (see 4.3), if applicable.

6.18.2 Procedure

Place and ignite test sample in accordance to the labelled instruction.

The visual and audible examination while functioning shall confirm conformity to, including but not limited to:

— the related principal effect;

— that all pyrotechnic units functioned completely;

— the article remains upright while functioning;

— no explosion or rupture occurs during function (except in case the explosion is the principal effect);

— that there is no splintering of plastics body (for bangers, crackling granules and flash bangers);

— that there is no splintering of aluminium body (for rocket motors);

— the elements of the batteries and combinations are attached securely;

— that category 1 articles lift less or equal than 0,5 m from the ground;

— the elements of the batteries, batteries requiring external support, combinations and combinations requiring external support are attached securely;

— for compound fireworks, the articles included in compound fireworks are securely attached to the base plate.

For further specific requirements, see ISO 25947-5.

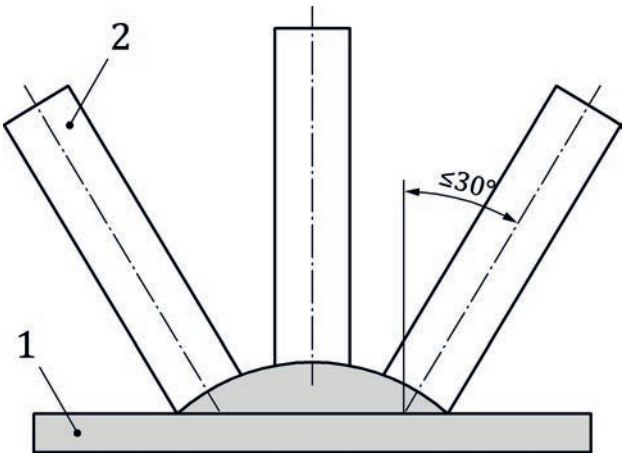
6.19 Determination of tube angle

6.19.1 Apparatus

— Goniometer (5.19)

6.19.2 Procedure

For determination of the tube angle, use the function tested sample and dismantle the sample in such a way that the angle of the tube could be measured (see Figure 11) with the goniometer (5.19). Record the angle between the vertical and the centre line of the tube.



Key

1 base of firework

2 tube of mine, Roman candle or shot tube

Figure 11 — Determination of tube angle

Annex A
(informative)

Mechanical conditioning (shock apparatus)

The mechanical shock apparatus is illustrated in Figures A.1 to A.4 and is comprised of the following components:

a) **flat horizontal platform made of steel**, 800 mm × 600 mm, 2 mm to 3 mm thick, with a 3 mm thick rim having a height of 15 mm; the platform is reinforced with eight steel ribs, 5 mm thick with a height of 30 mm, which are welded to the underside and run from the centre to each of the four corners and to the middle of each edge;

b) **20 mm thick plate of fibreboard**, firmly attached to the platform by screws;

c) **cylindrical steel boss**, diameter 125 mm and height 35 mm, located under the centre of the platform;

d) **284 mm long shaft**, with diameter of 20 mm, fixed to the centre of the boss;

e) **restraining peg**, to prevent the platform from rotating; the mass of the platform assembly [items a) to e)] shall be (23 ± 1) kg;

f) **annular**, elastomeric pressure spring, with a Shore A hardness of 68, when determined in accordance with ISO 868, outside diameter 125 mm, inside diameter 27 mm and height 32 mm, on which the cylindrical boss will rest;

g) **shallow steel cylinder**, inside diameter 126 mm, wall thickness 5 mm, outside height 30 mm, with a base 8 mm thick which has a 25 mm diameter hole drilled through the centre, to contain the elastomeric spring;

h) **supporting steel cylinder**, outside diameter 80 mm, inside diameter 60,1 mm and height 92,4 mm, to which the shallow cylinder is screwed;

i) **PVC liner**, outside diameter 60 mm, inside diameter 20,2 mm and height 92,4 mm, located inside the supporting cylinder and attached by a screw;

j) **steel mounting plate**, thickness 12 mm with a 25 mm hole drills through the centre, to which the supporting steel cylinder is screwed;

k) **steel base plate**, thickness 12 mm;

l) **four supporting pillars**, height 260 mm and diameter 32 mm, screwed to the mounting plate and to the base plate;

m) **framework** to support the based plate so that the complete assembly is at a convenient height;

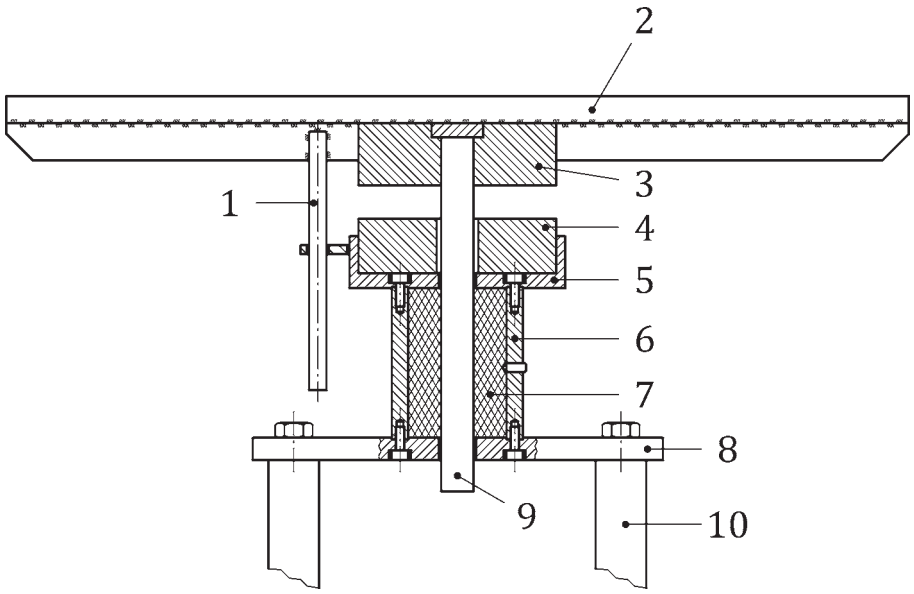
n) **attachment to the shaft**, allowing adjustment to the overall length, fitted with a cam wheel, outside diameter 30,0 mm, with a contact surface 8,0 mm wide;

o) **cylindrical cam**, outside diameter 120 mm, inside diameter 100 mm, wall thickness 10 mm, with a "vertical drop" of 50,0 mm between the high point and the low point;

p) **collar**, outside diameter 50 mm, height 4,0 mm;

q) **electric motor and suitable gearing**, to rotate the cam at a rotational frequency of 1 Hz;

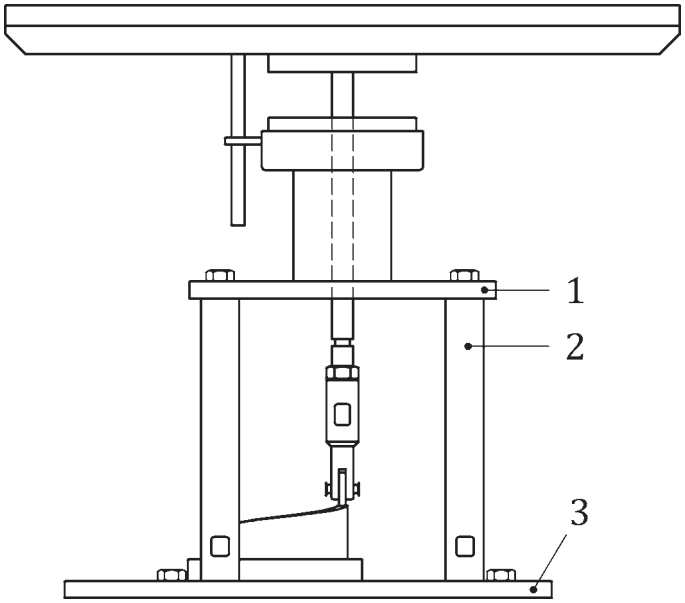
r) **cellular rubber sheet**, 100 mm thick. The material used shall have an apparent density, when determined in accordance with ISO 845, of 35 kg/m^3 and an indention hardness check, when determined in accordance with ISO 2439, of 215 N.



Key

1	restraining peg	6	supporting cylinder
2	platform	7	PVC liner
3	boss	8	mounting plate
4	pressure spring	9	shaft
5	cup	10	supporting pillar

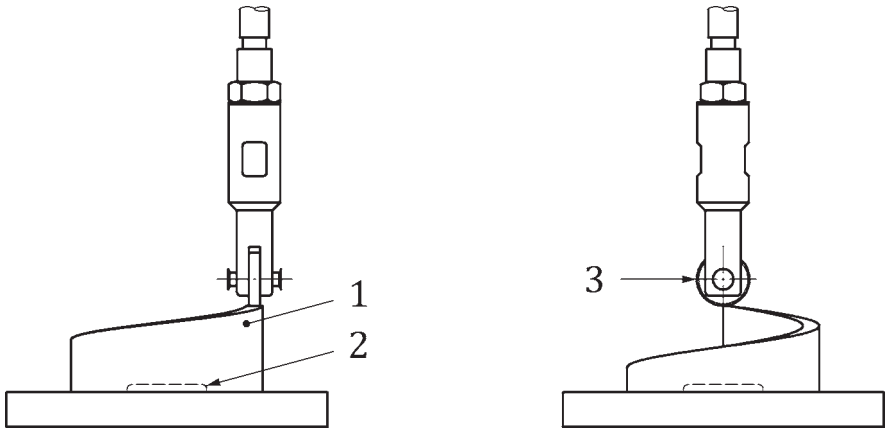
Figure A.1 — Detail of top section of mechanical shock apparatus



Key

1 mounting plate
2 supporting pillar
3 base plate

Figure A.2 — General assembly of mechanical shock apparatus



Key

1 cam
2 collar
3 cam wheel

Figure A.3 — Detail of shaft attachment and cam assembly of mechanical shock apparatus

a)

b)

Figure A.4 — Examples of mechanical shock apparatus

Annex B
(informative)

Determination of silver fulminate

B.1 Reagents

B.1.1 Purified water, conforming to grade 3 of ISO 3696.

B.1.2 Concentrated ammonia solution.

B.1.3 Nitric acid solution, 10 g/100 ml.

B.1.4 Hydrochloric acid solution, 5 g/100 ml.

B.2 Apparatus

B.2.1 Laboratory balance, capable of weighing to the nearest 0,1 mg (5.7.3).

B.2.2 Beaker, 100 ml.

B.2.3 Beaker, 200 ml.

B.2.4 Filter funnel.

B.2.5 Filter paper.

B.2.6 Glass filter crucible with a porous glass filter grade P16 conforming to ISO 4793.

B.2.7 Scalpel.

B.2.8 Timing device (5.1.2).

B.2.9 Temperature chamber up to (130 ± 2,5) °C (5.9.1).

B.3 Procedure

Select a random of:

a) 50 novelty matches from the primary pack. Carefully cut out the segment of the sticks which is covered with report composition using the scalpel (B.2.7);

b) 50 snaps or throwdowns from the primary pack. Remove them carefully from the paper.

Put the parts from a) or b) in a 100 ml beaker (B.2.2) and wet it with 30 ml of purified water (B.1.1) and 20 ml of the ammonia solution (B.1.2). Warm the solution while stirring continuously and transfer the hot solution quantitatively to the filter funnel (B.2.4) containing the filter paper (B.2.5) into the 200 ml beaker (B.2.3) and wash the residue with purified water (B.1.1).

Dilute the filtrate with 100 ml of purified water (B.1.1). Acidify the diluted filtrate by carefully adding the nitric acid solution (B.1.3) and heat it until boiling. While stirring contentiously, add the hydrochloric acid solution (B.1.4) drop by drop until no further precipitate is formed.

Store the solution with the precipitate in the dark for 3 h (5.1.2). Weigh the glass filter crucible (B.2.6) to the nearest 0,1 mg using the balance (5.7.3) and record the mass (m_0). Filter the precipitate through the glass filter crucible (B.2.6) and wash it with purified water (B.1.1) until the washings are neutral. Dry the filter crucible for 1 h (5.1.2) at 130 °C (5.9.1). Allow the crucible with the residue to cool down to room temperature, weigh it to the nearest 0,1 mg using the balance (5.7.3) and record the mass (m_1).

Calculate the mean mass, in milligrams, of silver fulminate per sample using Formula (B.1):

$$\bar{m} = 1{,}045\,6\left(\frac{m_1 - m_0}{50}\right) \tag{B.1}$$

Record the mean mass of silver fulminate.

Bibliography

[1] ISO 536, *Paper and board — Determination of grammage*

[2] ISO 845, *Cellular plastics and rubbers — Determination of apparent density*

[3] ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)*

[4] ISO 2439, *Flexible cellular polymeric materials — Determination of hardness (indentation technique)*

[5] ISO 3696, *Water for analytical laboratory use — Specification and test methods*

[6] ISO 4793, *Laboratory sintered (fritted) filters — Porosity grading, classification and designation*

[7] ISO 25947-2, *Fireworks — Categories 1, 2 and 3 — Part 2: Categories and types*

[8] EN 1783, *Matches — Performance requirements, safety and classification*

[9] IEC 61672-1:2002, *Electroacoustics — Sound level meters — Part 1: Specifications*

ICS 71.100.30

Price based on 32 pages