BS EN 16263-4:2015

BSI Standards Publication

Pyrotechnic articles — Other pyrotechnic articles

Part 4: Test methods

bsi.

National foreword

This British Standard is the UK implementation of EN 16263-4:2015.

BSI, as a member of CEN, is obliged to publish EN 16263-4:2015 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard the UK committee voted against its approval as a European standard. The UK committee submitted a negative vote due to the criteria in EN 16263-3:2015 relating to the kinetic energy of projected objects, including fragments, which determine whether an article is categorized as P1 or P2 (see 6.2.3.7), and the corresponding test method in EN 16263-4:2015. The UK committee is of the opinion that these are not sufficiently rigorous to minimize the risk of possible injury to users and bystanders for all articles within the scope of the standard.
The UK committee is actively engaged in seeking amendments to EN 16263-3:2015 and EN 16263-4:2015 in order to address this issue and testing has been carried out in the United Kingdom to support this initiative. In the meantime, the UK committee recommends that people supplying pyrotechnic articles (i.e. placing pyrotechnic articles on the market) that are intended to produce fragments or projected objects ensure that:
- they have assessed the potential for those fragments or projected objects to cause injury to users and bystanders;
- they provide appropriate information to users, including specifying collective measures and suitable personal protective equipment, that will allow users to take appropriate precautions to protect both themselves and bystanders.

The UK participation in its preparation was entrusted to Technical Committee CII/47, Pyrotechnic articles.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2017

ISBN 978 0 580 74546 1

ICS 71.100.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2017.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16263-4

August 2015

ICS 71.100.30

English Version

Pyrotechnic articles - Other pyrotechnic articles - Part 4: Test methods

Articles pyrotechniques - Autres articles pyrotechniques - Partie 4 : Méthodes d'essai

Pyrotechnische Gegenstände - Sonstige pyrotechnische Gegenstände - Teil 4: Prüfverfahren

This European Standard was approved by CEN on 12 May 2015.

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European foreword

This document (EN 16263-4:2015) has been prepared by Technical Committee CEN/TC 212 “Pyrotechnic articles”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2016, and conflicting national standards shall be withdrawn at the latest by February 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA or Annex ZB, which are an integral part of this document.

This European standard is one of the series of standards as listed below:

— EN 16263-1*, Pyrotechnic articles — Other pyrotechnic articles — Part 1: Terminology*;

— EN 16263-2*, Pyrotechnic articles — Other pyrotechnic articles — Part 2: Requirements*;

— EN 16263-3*, Pyrotechnic articles — Other pyrotechnic articles — Part 3: Categories and types*;

— EN 16263-4*, Pyrotechnic articles — Other pyrotechnic articles — Part 4: Test methods*;

— EN 16263-5*, Pyrotechnic articles — Other pyrotechnic articles — Part 5: Minimum labelling requirements and instructions for use*.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies test methods for other pyrotechnic articles (except pyrotechnic articles for vehicles, cartridges for powder actuated tools and ignition devices).

2 Normative references

The following documents, in whole or in part, are referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 16263-1:2015, *Pyrotechnic articles — Other pyrotechnic articles — Part 1: Terminology*

EN 16263-2:2015, *Pyrotechnic articles — Other pyrotechnic articles — Part 2: Requirements*

EN 16263-3:2015, *Pyrotechnic articles — Other pyrotechnic articles — Part 3: Categories and types*

EN 16263-5:2015, *Pyrotechnic articles — Other pyrotechnic articles — Part 5: Minimum labelling requirements and instructions for use*

EN 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications (IEC 61672-1)*

EN ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Callipers; Design and metrological characteristics (ISO 13385-1)*

EN ISO 13385-2, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 2: Calliper depth gauges; Design and metrological characteristics (ISO 13385-2)*

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16263-1:2015 apply.

NOTE Wherever reference is made to a pyrotechnic article only other pyrotechnic articles (not including those for vehicles, cartridges for powder actuated tools and ignition devices) are meant, as it is the scope of this standard.

4 Apparatus

4.1 General

Any equivalent apparatus with the same accuracy or better may be used.

4.2 Test area

4.2.1 General

The test area shall be unobstructed, non-flammable and suitable for the accurate measurement of the required parameters.

The test sample should be placed in the centre of the test area, as shown in the labelled instruction. The manufacturers supplied or recommended equipment shall be used.

4.2.2 Indoor

The test area shall be indoors.

The test area shall be in an enclosed space, which is capable of limiting the movement of air. A means of extracting fumes shall be provided where necessary.

4.2.3 Outdoor

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 support pole in the centre of the test area.

Before starting the function test start the measurement of the wind speed with a wind speed meter (4.7) and continue measuring during the whole function test.

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

4.3 Timing device

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

4.4 Calliper

Calliper, flat faced vernier calliper reading to 0,1 mm (conforming to EN ISO 13385-1 and EN ISO 13385-2).

4.5 Ruler

Ruler, reading to 1,0 mm.

4.6 Measuring tape

Measuring tape, reading to 10 mm.

4.7 Wind speed meter

Wind speed meter capable of measuring to an accuracy of at least 0,5 m/s.

4.8 Balance

4.8.1 **Balance,** read to 0,1 g.

4.8.2 **Balance,** read to 0,01 g.

4.9 Temperature chamber

The temperature chamber(s) shall comply with the following specifications:

— up to 75 °C or 1,25 times the maximum use temperature of the test samples in degrees Celsius (if higher than 60 °C);

— when required, down to 10 °C lower than the minimum use temperature of the test samples;

— when required, capability of developing the highest level of humidity specified by the manufacturer.

The tolerance on each of the above temperature requirements is ± 2,5 °C. The required test conditions may be delivered by means of a single temperature chamber or by means of two or more chambers, each capable of delivering one or more of the specified sets of conditions.

4.10 Sound level meter

Sound level meter of class 1 of EN 61672-1 with free-field microphone.

4.11 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 ms ± 1 ms working at a frequency of 1 Hz ± 0,1 Hz.

An example of an apparatus is shown in Annex A.

4.12 Drop-test apparatus

The drop test apparatus shall comply with the following specifications:

— drop height 1,2 m;

— ground plate with a thickness greater than 10 mm of steel.

An example of an apparatus is shown in Annex B.

4.13 Goniometer

Goniometer, reading to 1°.

4.14 Devices for measuring of effect height

The devices shall be capable of measuring horizontal and/or vertical angles:

— universal surveying instrument (USI);

— theodolite;

— electronic level or clinometers;

— video systems

— measuring grid.

4.15 Devices for measuring thrust

Either of the following apparatus shall be used for the measurement of thrust:

— calibrated strain gauge;

— piezoelectric type load cell.

The accuracy of these gauges shall be determined as a function of levels of thrusts to be measured and the tolerances given by the manufacturer.

4.16 Abrasive sheet

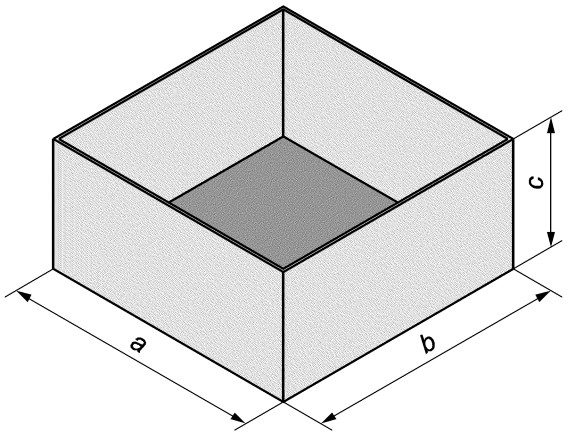
Abrasive sheet, large enough to permit striking of the ignition head, conforming to ISO 21948, grit P240 conforming to ISO 6344-3.

4.17 Witness screen

For the assessment of fragments according to 5.15.2.2, the following equipment shall be used:

— sturdy square based frame: length: 1 m; width: 1 m; height: 0,5 m, or alternatively a sturdy cylindrical frame: radius 0,5 m, height 0,5 m;

— witness screen material: threshold energy of penetration 5 J (e.g. foils of polycarbonate with a thickness of 0,5 mm). The lateral surfaces of the sturdy base shall be totally covered with the witness screen material. The resulting box shall provide an opening at the bottom side, see Figures 1 and 2.



Key

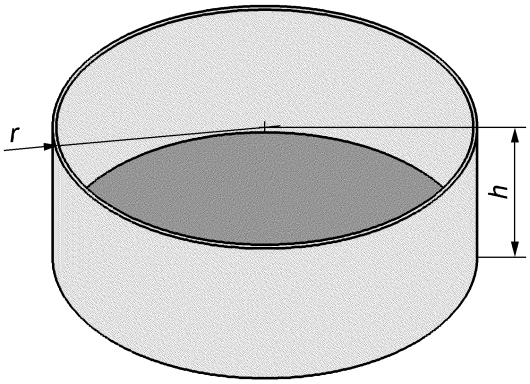
a length: 1 m

b width: 1 m

c height: 0,5 m

Figure 1 — Square based frame covered with witness screen material

An alternative test set-up is given in Figure 2.



Key

r radius: 0,5 m

h height: 0,5 m

Figure 2 — Alternative test set-up: cylindrical frame covered with witness screen material

For the assessment of fragments according to 5.15.2.3, the following equipment shall be used:

— witness screen material: threshold energy of penetration 5 J (e.g. specific foils of polycarbonate with a thickness of 0,5 mm);

— four frames: length: 2 m; width: 2 m.

4.18 Transparent type size sheet

Transparent sheet with the characters shown in Figure 3 printed on it in 2,8 mm and 2,1 mm text. Height of text determined by height of capital X in each case.

2,8 mm : ABC abc XYZ xyz 123

2,1 mm : ABC abc XYZ xyz 123

Figure 3 — Type sizes of print

4.19 High speed video equipment

High speed video camera with suitable speed and resolution adapted to the expected size and speed of the foreseen fragments.

4.20 Further test apparatus

Other test apparatus than those listed in 4.1 to 4.19 are:

— thermal flux measuring apparatus;

— pressure gauge;

— strain gauge or piezoelectric type of load cell (see 5.11.1);

— ESD test apparatus (see 5.13.1.2.1);

— drop hammer for impact sensitivity testing (see 5.13.1.3.1);

— friction test apparatus (see 5.13.1.4.1).

5 Test methods

5.1 General

Any equivalent method with the same sensitivity and the same accuracy or better may be used.

5.2 Construction

5.2.1 Outer dimension of item

Using the ruler (see 4.5), measure and record the outer dimensions of the item(s).

5.2.2 Determination of calibre

Using the calliper (see 4.4), measure and record the calibre of the item(s).

5.2.3 Determination of gross mass

Using the balance (4.8.1), measure and record the gross mass of the item(s).

5.3 Design verification

5.3.1 General

This test shall be done for type testing to verify that the tested item is in accordance with the requirements of EN 16263-2 and EN 16263-3.

5.3.2 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, with its dimensions, the mass and form (e.g. loose powder, granules, pellets, consolidated grains, etc.) of each pyrotechnic composition as well as the proportions of its constituents.

Observe and record any non-conformity.

5.3.3 Pyrotechnic composition — Determination of net explosive content

5.3.3.1 Apparatus

— Balance reading 0,01 g (see 4.8.2).

— Balance reading 0,1 g (see 4.8.1).

5.3.3.2 Procedure – dismantling (if necessary)

Separate any pyrotechnic units and count them.

Table 1 — Accuracy of weighing

Mass of pyrotechnic composition	Weigh to the nearest	Using the balance
≤ 3,0 g	0,01 g	4.8.2
> 3,0 g	0,1 g	4.8.1

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

If applicable, remove the pyrotechnic composition from each pyrotechnic unit, and weigh each portion. Record the mass of each portion.

When safe dismantling is not possible, alternative procedures may be applied.

5.4 Angle of ascent and height of effects

5.4.1 General

The following test method is applicable to articles which are fired vertically or within an angle of ± 15° from the vertical. In other cases, the test method shall be determined according to the performances of the article.

5.4.2 Apparatus

— Universal surveying instrument = USI (for instance theodolite) or comparable instruments (4.14).

— Test area (4.2) for the launching of the article.

— A mounting rack, which can be used to fix hand-held articles, might be needed.

5.4.3 Procedure

When determining effect, rising, or bursting height, firing shall take place only in the vertical direction, i.e. 90° ± 2° from the ground (test area). Measurements shall only take place with a wind velocity of less than 5 m/s (4.7).

Suitable apparatus for height measurement is any kind of regular device for measuring two angles at the same time (4.14), specifically the elevation angle (0° - 90°, 1° steps) and the horizontal angle (0° - 360°, 1° steps). The measurement of heights may be made according to one of the methods described in Annex C as equivalent systems are allowed.

For articles that project pyrotechnic units beyond 30 m or contain pyrotechnic units that are self-propelling two measuring positions are required. For all other cases one measuring point is adequate. If two measuring points are necessary, vertical and horizontal angles shall be recorded. In case of one measuring point, at least the vertical angle shall be recorded.

In order to achieve a reasonable accuracy the distance between firing point and measurement location, referred to as base length here, shall be adjusted to the measurement device. The vertical angle should be within the range of 30° to 60° (optimal 45°). If the monitoring position(s) is / are not in the same horizontal plane as the article, appropriate corrections shall be made in the calculation of heights. Generally the measuring distance should be adapted to the article (height of ascent expected).

When using two positions for monitoring the height of ascent and angle of flight, they shall be positioned at a measured distance and, depending on the method of measurement and calculation of the heights, either at an

angle of 90° to each other in relation to the article (See Method 2 of Annex C) or a sufficient angle to ensure a good validity of the measurement (See Method 1 of Annex C).

5.5 Measurement of sound pressure level

5.5.1 Apparatus

A sound level meter (4.10) and a measuring tape (4.6) are needed.

5.5.2 Procedure

Set up the microphone of the sound level meter (4.10) in the test area (see 4.2) at the safe firing distance or at a known distance from the main effect point and at a height of 1 m.

Record the maximum C-weighted peak or maximum A-weighted impulse sound pressure levels as measured by the sound level meter (4.10).

5.6 Timing measurement

5.6.1 Apparatus

Timing device (4.3).

5.6.2 Procedure

5.6.2.1 Ignition time

Remove any protection of the ignition device and ignite it in accordance with the instructions for use.

Apply the ignition source to the ignition device and at the same instant, start the timing device (4.3). Stop the timing device at the moment the functioning of the article appears. Record the ignition time in seconds.

5.6.2.2 Burning rate of composition

Determine the burning rate by using the timing device (4.3) measuring the burning time of the sample and divide the explosive content in gram by the measured time in seconds. Record the burning rate in g/s.

5.7 Mechanical conditioning

5.7.1 Apparatus

The following apparatus shall be used:

— shock apparatus (4.11);

— balance (4.8);

— timing device (4.3).

5.7.2 Procedure

The number of articles to be submitted to mechanical conditioning is given in EN 16263-2:2015, 8.2.1, Table 1.

Place a sheet of paper on the platform of the mechanical shock apparatus and place the test samples on the sheet of paper. For articles that are supplied in primary packs, condition the appropriate number of complete,

unopened packs. Cover the test samples or packs and secure them to the platform around its edges. Run the machine for 1 h.

At the end of the conditioning 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 weigh this pyrotechnic composition with the balance.

Record the mass of loose pyrotechnic composition.

If applicable, verify and record whether the test samples and primary pack exhibit any visible damage and the safety features are still in the safe position.

For the articles equipped with visible safety features, the safe position shall be verified after the mechanical conditioning by visual examination.

5.8 Mechanical impact test (Drop test)

5.8.1 Apparatus

Drop-test apparatus (see 4.12).

5.8.2 General

The drop test is performed with the number of articles in accordance with EN 16263-2, unless a “positive result” as defined in EN 16263-2:2015, 5.4 is obtained.

If no “positive result” is observed, the articles might still be needed after the test for further testing as described in EN 16263-2:2015, 5.4.

5.8.3 Procedure

The article shall be fixed to a suitable release mechanism (see Annex B for details) and shall be placed at a height of 1,2 m above the metal plate.

The article shall be positioned for the first test in such a way that it can fall along its main geometrical axis of symmetry freely. In a second test, a new article is positioned in a perpendicular orientation. Following test samples are positioned alternating between the two positions described previously.

Record any “positive result” as given in EN 16263-2:2015, 5.4.

For the articles equipped with visible safety features, the safe position shall be verified after the mechanical impact test, by visual examination.

5.9 Thermal conditioning

5.9.1 Apparatus

Temperature chamber(s) (4.9).

5.9.2 Procedure

5.9.2.1 Normal thermal conditioning

Place the items in a temperature chamber at 75 °C ± 2,5°C for 48 h or at 50 °C ± 2,5 °C for 28 days (within the primary pack if any).

At the end of the thermal conditioning, verify and record any ignition, degradation or mass changes (emission of gas, cracks or expansion of compacted compositions, migration of chemicals, etc.).

5.9.2.2 High temperature conditioning

Place the items or primary packs (where applicable) in a temperature chamber at a temperature 1,25 times the maximum use temperature as specified by the manufacturer for 48 h.

At the end of the thermal conditioning, verify and record any ignition, degradation or mass changes (emission of gas, cracks or expansion of compacted compositions, migration of chemicals, etc.).

5.9.2.3 Low temperature conditioning

Place the items or primary packs (where applicable) in a temperature chamber at a temperature 10°C lower than the minimum use temperature as specified by the manufacturer for 48 h.

At the end of the thermal conditioning, verify and record any ignition, degradation or mass changes (emission of gas, cracks or expansion of compacted compositions, migration of chemicals, etc.).

5.9.2.4 Verification of the 'use by' date

When EN 16263-2:2015, 5.1, requires the manufacturer to demonstrate correct functioning of the article at the 'use by' date by extension of the thermal conditioning test, the procedure described in 5.9.2.1 or 5.9.2.2 shall be applied over a period of time that can be calculated by application of accelerated ageing method such as described in Annex D.

5.10 Function test

5.10.1 General

Test area (4.2), if applicable

The test area (4.2.2 or 4.2.3) shall be chosen according to the expected performance of the article. It shall be clean and free from debris etc. from former tests.

5.10.2 Apparatus

Where appropriate, the following apparatus shall be used for the function test:

— video high speed recording equipment (4.19);

— temperature chamber(s) (4.9);

— visual delineation of the hazard zone as defined by the manufacturer in the instructions for use or calculated from performance data according to specialist knowledge;

— witness screen(s) (4.17);

— thermal flux meter (4.20)

— the ancillary device(s) and/or firing equipment which are specified by the manufacturer;

— other measuring equipment which is needed to check the performance of the tested articles and which can be indicated by the manufacturer (e.g. sound level meter (4.10) for sound emitters).

5.10.3 Procedure

5.10.3.1 General

When fragments are to be observed at the firing point (see EN 16263-3:2015, 6.2.3.7), 5.15 shall be applied in combination with the present procedure.

Place and ignite the test sample in accordance with the labelled instructions or the instructions for use given by the manufacturer. For articles that are fired vertically, the main effect height shall (where possible) be measured in accordance with 5.4.

Record the following observations:

— the nature of the principal effect and effect parameters (duration, spatial extension, ignition time (5.6.2.1));

— whether all pyrotechnic units function completely;

— the article's motion from the testing point and the distance of motion from the testing point;

— the generation of fragments from the article; if any

— other performance parameters which are specified by the manufacturer (e.g. sound pressure level (5.5) for sound emitters);

— the burning time and, where appropriate, the thermal flow rate during the maximum exposure time specified by the manufacturer.

5.10.3.2 High temperature

When required the test sample shall be placed in a temperature chamber for 24 h at the maximum use temperature specified by the manufacturer before the function test according to 5.10.3.1.

The articles shall be removed from extreme temperature storage no more than 2 min before the test. This time interval may be increased for large and massive articles according to acquired experience of testing bodies.

5.10.3.3 Low temperature

When required the test sample shall be placed in a temperature chamber for 24 h at the minimum use temperature specified by the manufacturer before the function test according to 5.10.3.1.

The articles shall be removed from extreme temperature storage no more than 2 min before the test. This time interval may be increased for large and massive articles according to acquired experience of testing bodies.

5.10.3.4 Verification of safe position

For the articles equipped with integral safety features, the safe position shall be verified after each of the following tests: mechanical conditioning (5.7), mechanical impact test (5.8) and electrostatic discharge test (5.13.1.2).

When the safety features are not visible, verification of the safe position require the tested items to be initiated by functioning the initiating pyrotechnic train before the safety features. This might require a specific preparation of the tested items depending on their means of ignition. Record any initiation of the main charge or the pyrotechnic train after the safety features.

5.11 Measurement of thrust

5.11.1 Apparatus

A strain gauge or a piezoelectric type of load cell (4.20) and a timing device (4.3) are needed.

5.11.2 Procedure

Testing of the rocket motor shall be performed to confirm that the rocket motor is within the manufacturer's defined tolerances.

The peak thrust, the thrust impulse and burn time shall be measured and recorded.

5.12 Resistance to ignition by an abrasive surface

5.12.1 Apparatus

Abrasive sheet (see 4.16).

5.12.2 Procedure

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

5.13 Further tests

5.13.1 Sensitiveness of pyrotechnic composition

5.13.1.1 General

This test shall be applied when the user might have contact with bare pyrotechnic composition or if composition is likely to become exposed during normal conditions of handling or use.

5.13.1.2 Electrostatic discharge

5.13.1.2.1 Apparatus

The ESD test circuit is illustrated by Figure 4 hereunder.

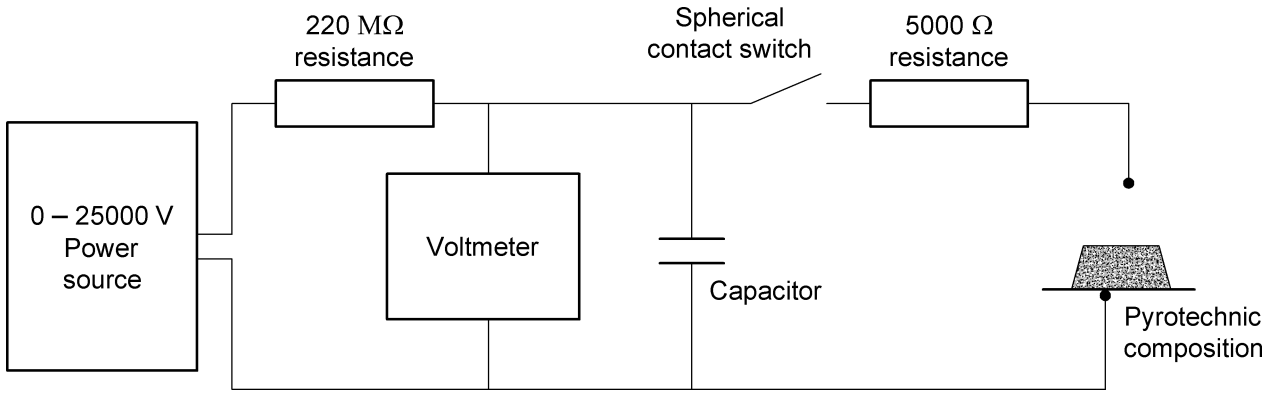


Figure 4 — ESD test circuit

5.13.1.2.2 Procedure

Six tests with a recommended volume of 10 mm^3 of the pyrotechnic composition per test shall be used.

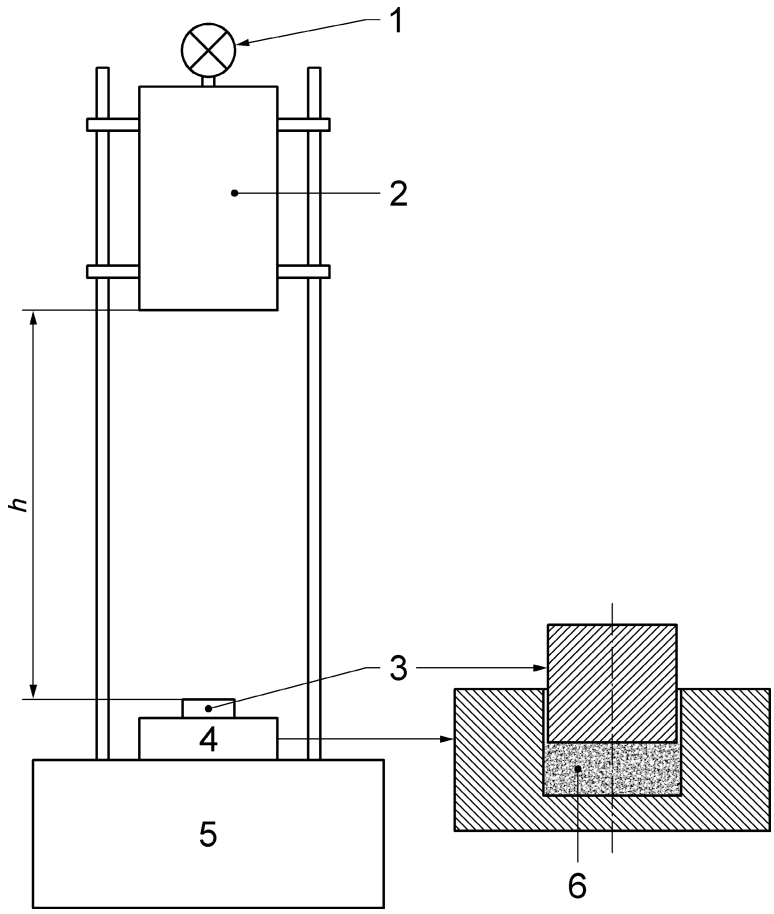
After stabilization at room temperature, discharge 25 000 V from a 660 pF capacitor or 20 000 V from a 1 000 pF capacitor through a 5 000 Ω resistance, “pin-to-case” (conductive electrode in contact with the bare pyrotechnic composition). If during six tests with a discharge of 200 mJ no ignition or explosion occurs the sample is considered to have a sensitivity of more than 200 mJ.

For the articles equipped with visible safety features, the safe position shall be verified after the electrostatic discharge test, by visual examination.

5.13.1.3 Impact

5.13.1.3.1 Apparatus

The general design of the impact test apparatus is illustrated by Figure 5.



Key

1 release device

2 weight M to be dropped

3 piston

4 anvil

5 massive base

6 pyrotechnic composition

Figure 5 — Impact test apparatus

5.13.1.3.2 Procedure

Six tests shall be carried out on samples of the pyrotechnic composition.

These samples shall have a volume of 20 mm^3 of loose pyrotechnic composition per test or have the shape of a pellet of pressed pyrotechnic composition with the following recommended dimensions: diameter 4 mm, height 3 mm.

After stabilization at room temperature:

— place the pyrotechnic composition on the anvil of the test apparatus, then place the weight M (kg) at a distance h (m) above the upper surface of the pyrotechnic article, so that the product M x g x h (with g = 9,81 m/s^2) is equal to 8 J;

— release the weight and record the result.

If during six consecutive tests with impact energy of 8 J no ignition or explosion occurred, the sample is regarded to have a sensitivity of more than 8 J.

NOTE More detailed information can be found in EN 13631–4.

5.13.1.4 Friction

5.13.1.4.1 Apparatus

The general principle to be applied to the friction test apparatus is illustrated by Figure 6.

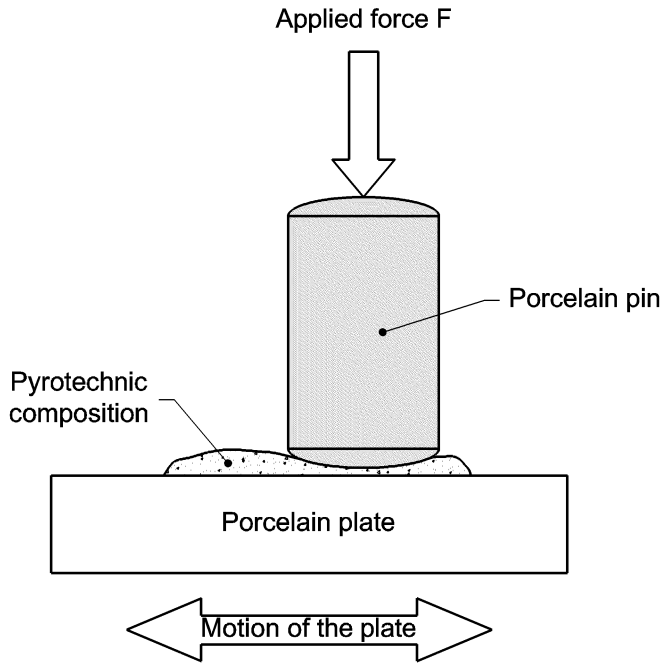


Figure 6 — Friction test apparatus

A sample of pyrotechnic composition is placed on a porcelain plate (25 mm (length) × 25 mm (width) × 5 mm (height), roughness 9 μm – 32 μm) which can be given a linear to-and-fro motion.

A porcelain pin (15 mm (length) × 10 mm (diameter), roughness 9 μm – 32 μm) exerts a force F on the sample of pyrotechnic composition.

5.13.1.4.2 Procedure

Six tests with a volume of 10 mm^3 of the pyrotechnic composition per test shall be carried out.

Each test sample will be spread on the porcelain plate in the shape of a thin strip 15 mm long and 3 mm wide (leading to a thickness of 0,40 mm ± 0,05 mm).

After stabilization at room temperature:

— place the first sample on the porcelain plate, then apply the porcelain pin on it with an applied force of 80 N;

— start the motion of the plate and record the result.

If during six tests with a force of 80 N no ignition or explosion occurred the sample is regarded to have a friction sensitivity of more than 80 N.

NOTE More detailed information can be found in EN 13631–3.

5.13.2 External temperature of hand-held pyrotechnic articles

5.13.2.1 Apparatus

— 3 temperature sensors.

— Data logger.

5.13.2.2 Procedure

After stabilization at room temperature, fix the temperature sensors:

— one at the upper end;

— one in the middle;

— and one at the lower end;

of the hand-held part of the pyrotechnic article.

Record the temperature profile by using the data logger after initiation.

5.14 Measuring of labelling

5.14.1 Apparatus

— Calliper (4.4).

— Transparent type size sheet (4.18).

5.14.2 Procedure

Using the calliper or the transparent type size sheet, record whether the type sizes are correct and the printing is legible (see EN 16263-5).

5.15 Measuring of the energy of fragments

5.15.1 Apparatus

Witness screen (4.17).

5.15.2 Procedure

5.15.2.1 General

If the safe firing distance is less than or equal to 0,5 m, method A shall only be used.

If the safe firing distance is greater than 0,5 m and unless otherwise specified by the manufacturer, method B shall be used or, for small-sized articles, test method A may be used first and shall be followed by method B if a positive result from method A is observed.

5.15.2.2 Test method A

The pyrotechnic article shall be placed on a hard surface (e.g. concrete plate). Centre the witness screen (see 4.17, Figure 1 or 2) - with the opening at the bottom side - above the pyrotechnic article so that the minimum distance from the pyrotechnic article to the lateral surfaces of the witness screen is about 0,5 m.

After ignition and functioning of the pyrotechnic article, the witness screen material shall be checked regarding visible damage caused by fragments. A penetration of the witness screen material (meaning that the fragment has fully passed through the witness screen) constitutes a “positive” result. In this case, the energy of the fragment(s) exceeds 5 J.

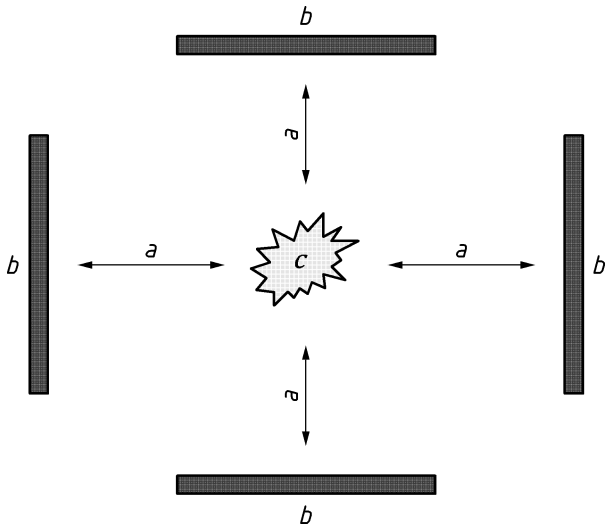
If no penetrations are detected, the energy of the fragments shall be considered less than 5 J.

5.15.2.3 Test method B

The pyrotechnic article shall be placed on a hard surface (e.g. concrete plate). Four separate frames tautly covered with the witness screen material shall be used and placed at the safe firing distance around the centred pyrotechnic article according to Figure 7.

After ignition and functioning of the pyrotechnic article, the witness screen material shall be checked regarding visible damages caused by fragments. A penetration of the witness screen material (meaning that the fragment has fully passed through the witness screen) constitutes a “positive” result. In this case, the energy of the fragment(s) exceeds 5 J at the safe firing distance.

If no penetrations are detected, the energy of the fragments at the safe firing distance shall be considered as less than 5 J.



Key

a safe firing distance

b witness screens: length: 2 m; width: 2 m.

c pyrotechnic article

Figure 7 — Setup for additional tests if the safe firing distance is greater than 0,5 m

5.16 Water immersion test

5.16.1 Apparatus

Means to provide constant water cover above the tested article (e.g. a bucket).

5.16.2 Procedure

The samples shall be visually inspected and any anomaly noted before subjecting them to the test.

The samples shall be immersed horizontally for at least 48 h under 0,5 m of water. After this test, the samples shall be subjected to the function test in accordance with 5.10, within 2 h after removal from the water.

Annex A
(informative)

Mechanical conditioning (Shock apparatus)

The shock apparatus, illustrated in the following Figures A.1, A.2, and A.3, comprises the following components:

a) **a flat horizontal platform** made of steel, 800 mm x 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) **a 20 mm thick plate of fibreboard**, firmly attached to the platform by screws;

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

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

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

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

g) **a shallow steel cylinder (steel cup)**, 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 elastomer spring;

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

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

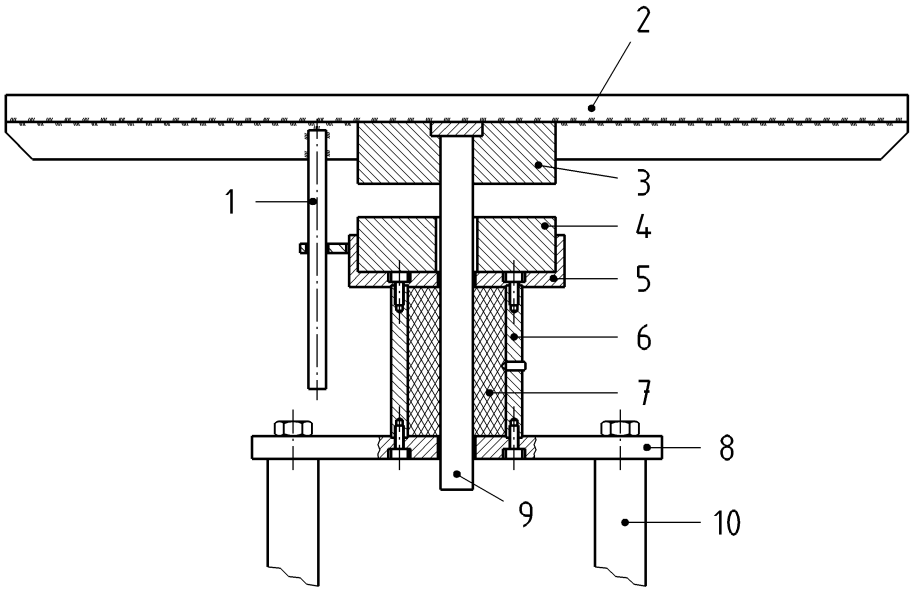
n) **an attachment to the shaft**, allowing adjustment to the overall length, fitted with a cam wheel, outside diameter 30,0 mm, with a contact surface 8,0 mm wide;

o) **a 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 (see Figure A.3); differently shaped cams with the same drop height may be used alternatively;

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

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

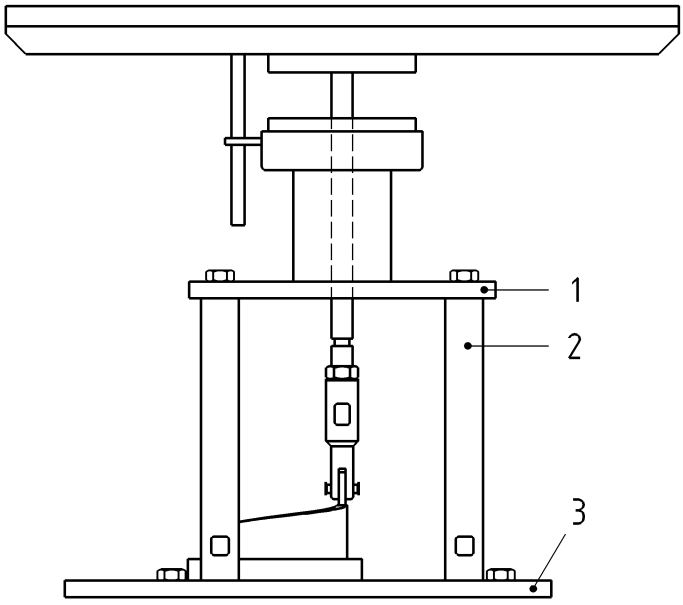
r) **cellular rubber sheet**, 100 mm thick. The material used shall have an apparent density when determined in accordance with EN ISO 845, of 35 kg/m^3 and an indention hardness check, when determined in accordance with EN ISO 2439 of 215 N.



Key

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

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



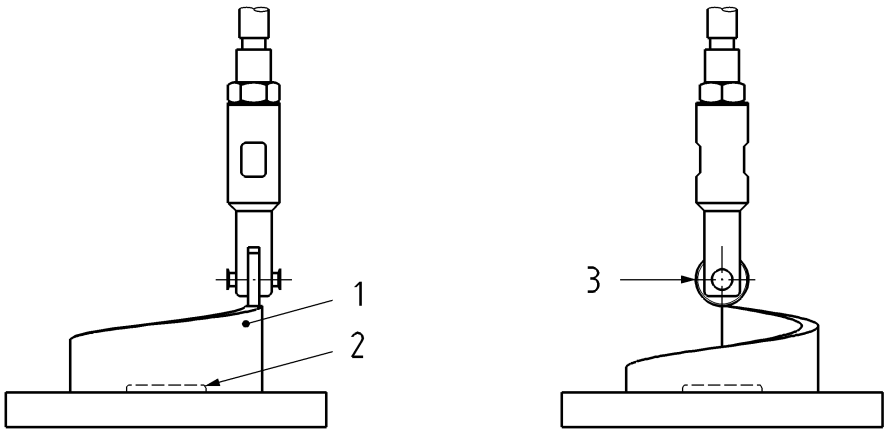
Key

1 mounting plate

2 supporting pillar

3 base plate

Figure A.2 — General assembly of mechanical shock apparatus



Key

1 cam

2 collar

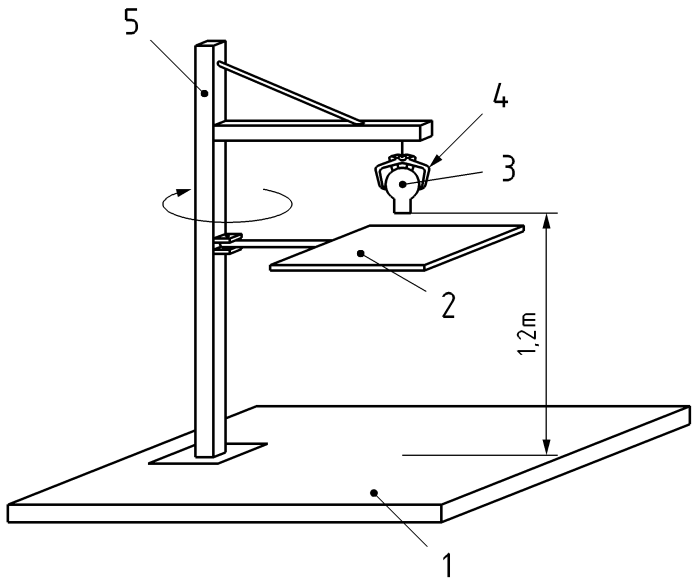
3 cam wheel

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

Annex B
(informative)

Drop test (Mechanical impact test)

An example of typical apparatus which may be used is illustrated in Figure B.1 (other equivalent technical solutions may be used).



Key

1 metal plate
2 movable safety plate
3 article to be tested
4 release device
5 metallic frame

Figure B.1 — Overview of impact test apparatus

The metal plate should be placed on a hard soil, e.g. a concrete slab, and its thickness should be greater than 10 mm of steel.

The release device shall neither deliver an initial linear and/or rotation velocity to the article nor modify its fall from the vertical.

A video recording is useful to check whether the fall of the article is correct and in order to get full knowledge of the behaviour of the article during and after its contact with the metal plate.

Annex C
(informative)

Procedures for calculation of heights

The following methods may be used for the calculation of heights:

a) Method 1

This procedure allows performing measurements with equipment that is not located at the same height as the firing point and at 90° to each other.

Firing takes place only in vertical direction (90° from the horizontal plane at the place of firing) and measurements should only take place with a wind velocity of less than 5 m/s.

Measurement requires two locations – T_1 and T_2 – which should be preferably, but not necessarily, located at 90° to each other with respect to the firing point (see Figure C.1).

Suitable equipment for height measurement is any kind of regular device for measuring two angles at the same time, specifically the elevation angles α_1 and α_2 (0 - 90°, 1° steps) and the azimuth angles β_1 and β_2 (0 - 180°, 1° steps) of the bursting point B (or maximum point of effect) of the pyrotechnic article seen from T_1 and T_2.

Differences in height of the measurement locations T_1 and T_2 shall be taken into account, corresponding to h_1 and h_2 in Figure B.1.

The effect height (or rising height) H is determined from the angles α_1 and α_2, β_1 and β_2, and the horizontal distance $D_{1,2}$ between T_1 and T_2 through the following formulae:

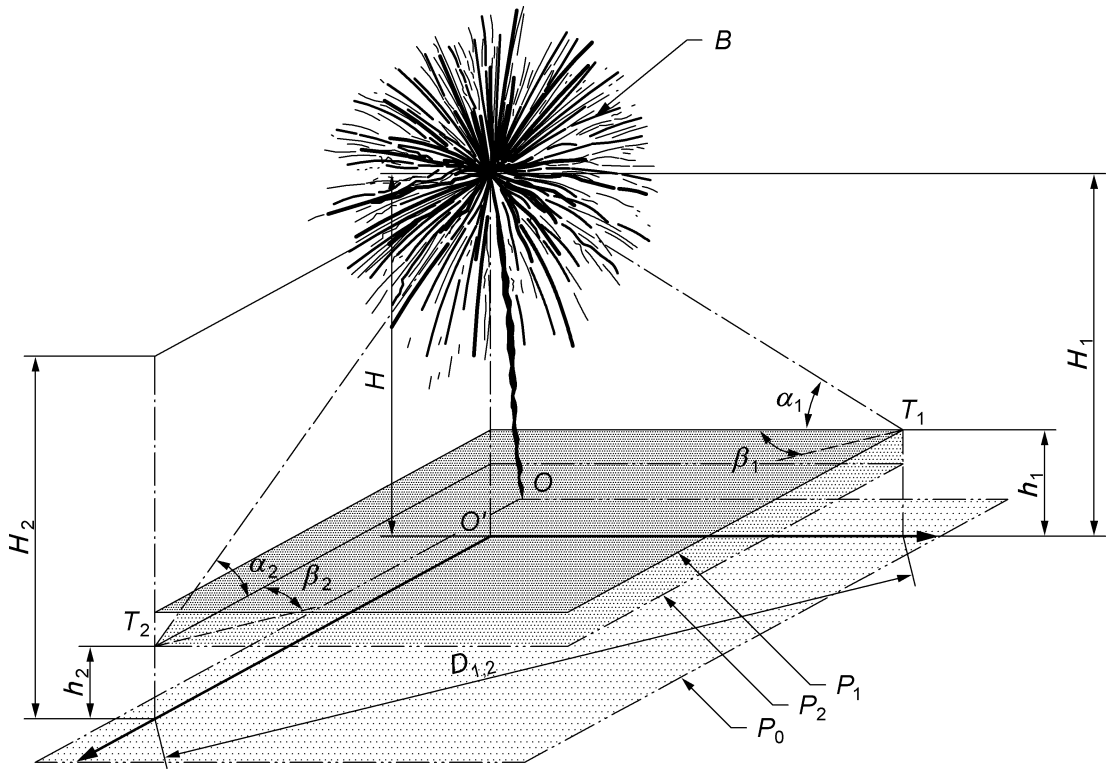
$$H_1 = \frac{D_{1,2} \sin\beta_2}{\sin(\beta_1 + \beta_2)} \tan\alpha_1 + h_1$$

$$H_2 = \frac{D_{1,2} \sin\beta_1}{\sin(\beta_1 + \beta_2)} \tan\alpha_2 + h_2$$

and

$$H = \frac{H_1 + H_2}{2}$$

With these formulae it is not necessary to know the distances of the two measurement locations T_1 and T_2 from the firing point O, or their angle to each other from this point.



Key

P_0 horizontal plane passing through the firing point O

P_1 horizontal plane passing through the measurement location T_1

P_2 horizontal plane passing through the measurement location T_2

h_1, h_2 heights of the measurement locations T_1 and T_2 from plane P_0 respectively, measured and recorded by the suitable equipment located at points T_1 and T_2

O' vertical projection of the bursting point B (or maximum point of effect) of the pyrotechnic article on plane P_0

$D_{1,2}$ horizontal distance between T_1 and T_2

α_1, α_2 elevation angles of the bursting point B (or maximum point of effect) of the pyrotechnic article measured and recorded by the suitable equipment located at T_1 and T_2

β_1, β_2 azimuth angles of the bursting point B (or maximum point of effect) of the pyrotechnic article measured and recorded by the suitable equipment located at T_1 and T_2

H effect height to be calculated from $D_{1,2}$, h_1 and h_2, α_1 and α_2, β_1 and β_2

Figure C.1 — Measurement set-up for aerial effects

The vertical angle should not exceed 60°; optimal would be angles between 40° and 50°.

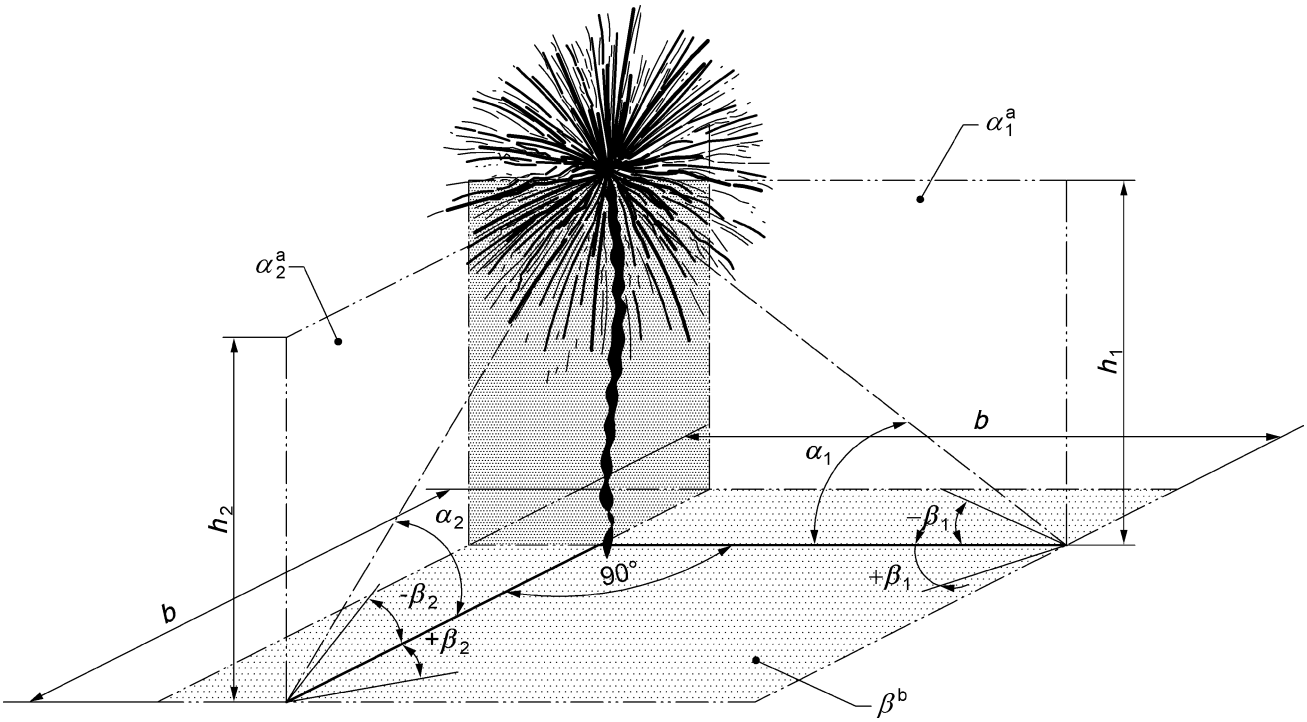
Measurement of the horizontal distance $D_{1,2}$ should take place with an accuracy of at least ± 1 % of the distance.

b) Method 2

Suitable equipment for height measurement is any kind of regular device for measuring two angles at the same time, specifically the vertical angle (0 - 90°, 1° steps) and the horizontal angle (0 - 360°, 1° steps).

Measurement requires two locations which should be preferably located at 90° to each other with respect to the firing point (see Figure C.2).

When using a USI (see 5.10) both angles, the vertical and the horizontal angle, shall be measured. Differences in height of the measurement locations shall be taken into account.



Key

h_1, h_2	calculated heights from vertical planes
b	horizontal distance between the measuring points and the firing point
α_1, α_2	measured elevation angles of the bursting point (or maximum point of effect)
β_1, β_2	measured azimuth angles of the bursting point (or maximum point of effect).
a	vertical plane
b	horizontal plane

Figure C.2 — Measurement set-up for aerial effects

In the case of a vertical trajectory of the article (i.e. the horizontal angles are less than ± 2°) the effect height and rising height, h is determined from the vertical angles α_1 and α_2 and the base length b (distance between firing point and measurement location) through the following formula:

$$h_{1,2} = b \cdot \tan \alpha_{1,2}$$

With this formula it is possible to calculate the heights independently for each measurement location, this making it possible to use different base lengths. Both values are averaged.

For a non-vertical trajectory the actual height is calculated according to the following formulae:

$$h_1 = b \cdot \tan \alpha_1 \cdot \frac{\cos \beta_2 - \sin \beta_2}{\cos\left(\beta_1 + \beta_2\right)}$$

and

$$h_2 = b \cdot \tan\alpha_2 \cdot \frac{\cos\beta_1 - \sin\beta_1}{\cos(\beta_1 + \beta_2)}$$

The angles β_1 and β_2 are the horizontal angles.

The effect height can be calculated as follows:

$$H = \frac{h_1 + h_2}{2}$$

In order to achieve a reasonable accuracy the distance between firing point and measurement location, referred to as base length here, shall be adjusted to the measurement device. The vertical angle should not exceed 60°; optimal would be having angles between 40° and 50°. For an expected rising height of 300 m the base length of at least 175 m is chosen, for example.

Measurement of the base length should take place with an accuracy of at least ± 1 % of the distance.

Annex D
(informative)

Determination of the duration of accelerated ageing test to demonstrate the correct functioning at the 'use by' date

Where thermal conditioning according to 5.9.2 leads to successful functioning test, articles which are intended for use after prolonged storage at a specified temperature T_{LS} ± 5,0 °C or which are kept for more than two days at or above a maximum use temperature T_{UM} shall be subject to additional thermal conditioning as follows:

Store the articles for *N* days at a temperature of 75 °C ± 2,5 °C or 1,25 times the maximum use temperature ± 2,5°C in the climatic chamber and then for at least one day at 20 °C ± 5,0 °C before testing according to 5.10.

When a manufacturer has designed or described an article as being suitable for use in humid conditions, the climatic chamber is maintained at 95 % relative humidity (RH).

N (in days) is calculated by use of the following formula:

$$N = 365{,}25 \cdot H_{\mathrm{LS}} \cdot K_1(T_{\mathrm{LS}}, T_{\mathrm{UM}}) + 30 \cdot H_{\mathrm{LU}} \cdot K_2(T_{\mathrm{UM}})$$

where

H_{LS} = specified life span in storage (in years);

H_{LU} = specified life span at the maximum use temperature (in months);

T_{LS} = long storage temperature (in °C);

T_{UM} = maximum use temperature (in °C); and

$K_1(T_{\mathrm{LS}}, T_{\mathrm{UM}})$, $K_2(T_{\mathrm{UM}})$ are coefficients that can be calculated from the following Figures D.1 and D.2.

NOTE In the case where the above formula gives values greater than 90 d, the temperature of the ageing test would better be increased as much as it is affordable by the design and pyrotechnic compositions of the article.

EXAMPLE 1 For T_{LS} = 20 °C and T_{UM} = 50 °C, the thermal conditioning test is performed à 75 °C and Figures D.1 and D.2 give:

K_1 = 0,007 and K_2 = 0,083.

Then, to demonstrate a life span in storage of 9 years and a life span at the maximum use temperature of 12 months, the thermal conditioning test shall be performed during:

N = 9 × 365,25 × 0,007 + 12 × 30 × 0,083 = 23,01 + 29,88 = 53 d

EXAMPLE 2 For T_{LS} = 20°C and T_{UM} = 90°C, the thermal conditioning test is performed à 112,5°C and Figures D.1 and D.2 give:

K_1 = 0,000 17 and K_2 = 0,107.

Then, to demonstrate a life span in storage of 9 years and a life span at the maximum use temperature of 12 months, the thermal conditioning test shall be performed during:

N = 9 × 365,25 × 0,000 17 + 12 × 30 × 0,107 = 0,55 + 38,52 = 39 d

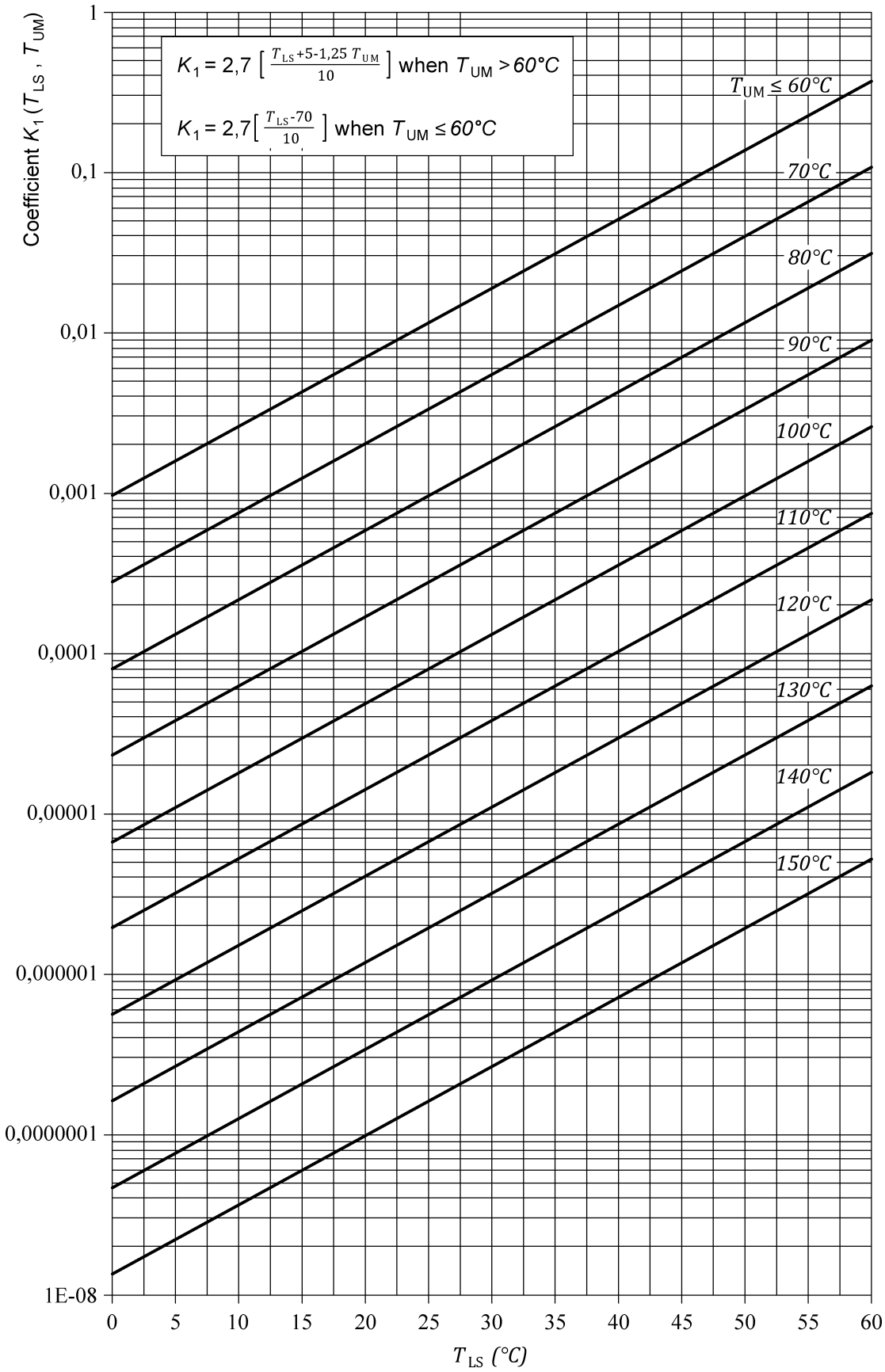


Figure D.1 — Coefficient K_1

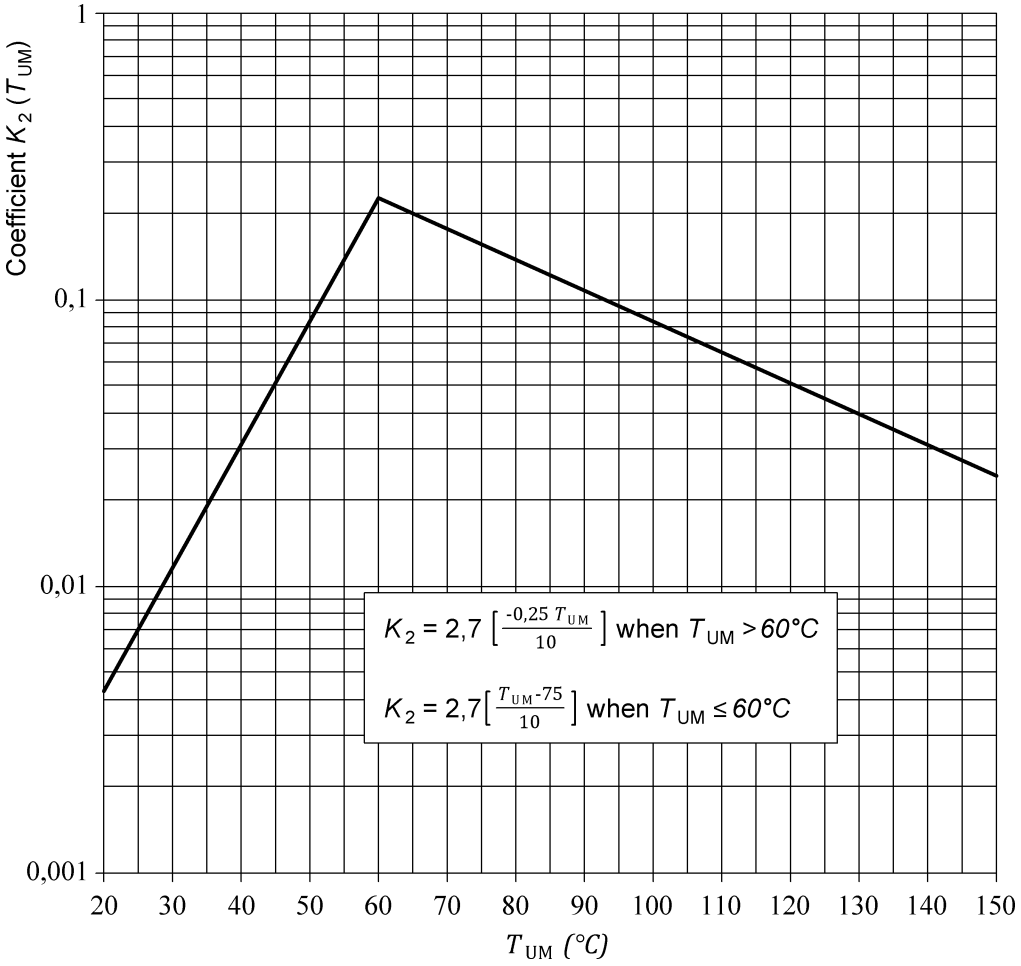


Figure D.2 — Coefficient K_2

Annex E
(informative)

Overview of essential safety requirements and corresponding clauses of all parts of EN 16263

The correspondence between the parts of EN 16263 and Directive 2007/23/EC on the placing on the market of pyrotechnic articles can be found in Annex ZA of each part of EN 16263.

Table E.1 gives an overview about all essential safety requirements and the corresponding clauses and subclauses of all parts of EN 16263.

Table E.1 — Overview of essential safety requirements and corresponding clauses of all parts of EN 16263

Essential Safety Requirements (ESR) of Directive 2007/23/EC	**Clause(s)/sub-clause(s) of**		
	EN 16263–2:2015	EN 16263–4:2015	EN 16263–5:2015
(1)	5.1, 5.7, 5.8, 6.2, 8, 9	5.4, 5.5, 5.6, 5.10, 5.11	
(2)	1, 4.2, 5.2, 8	5.2, 5.3	4.5
(3), 1st paragraph	5.1, 5.7, 5.8, 6.2, 8, 9	5.4, 5.5, 5.6, 5.10, 5.11	4.5
(3), 2nd paragraph	5.1, 5.4, 5.6, 5.7, 5.8, 8, 9	5.7, 5.8, 5.9, 5.10, 5.11, 5.16	
(3) (a)	1, 4.1, 4.4, 5.2, 6.1, 8, 9	5.2, 5.3	
(3) (b)	5.4, 5.5, 5.7, 5.8, 8, 9	5.7, 5.8, 5.9, 5.10	
(3) (c)	5.4, 5.5, 8, 9	5.7, 5.8, 5.9, 5.10, 5.16	
(3) (d)	4.1, 5.7, 5.8, 8	5.9	
(3) (e)	5.6, 7, 8	5.9, 5.16	
(3) (f)	5.8, 8	5.9, 5.10	
(3) (g)	4.3, 4.4, 8, 9	5.7, 5.8, 5.10.3.4, 5.12	4.5, 4.9
(3) (h)	4.2, 4.5, 5.3, 8, 9	5.14	4.5, 4.6, 4.8, 4.9, 4.10, 4.11, 4.12, 4.13
(3) (i)	5.7, 5.8, 7, 8, 9	5.9	
(3) (j)	8, 9	5.7, 5.8	4.5
(3), last paragraph	5.4, 5.5, 8	5.2, 5.3	
(4)	See Annex ZB		
(5) B. (1)	1, 4, 5.2, 8, 9	5.4, 5.5, 5.6, 5.10, 5.11	4.5
(5) B. (2)	4.4, 5.2, 8, 9	5.2, 5.3	4.5, 4.8, 4.9
(5) B. (3)	5.1, 8, 9	5.4, 5.5, 5.6, 5.10, 5.11	
(5) B. (4)	5.1, 5.7, 5.8, 6.2, 8, 9	5.7, 5.8, 5.9, 5.10, 5.11, 5.16	4.11

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2007/23/EC on the placing on the market of pyrotechnic articles

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2007/23/EC on the placing on the market of pyrotechnic articles.

Once EN 16263-4 is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of EN 16263-4 given in Table ZA.1 confers, within the limits of the scope of EN 16263-4, a presumption of conformity with the requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 2007/23/EC on the placing on the market of pyrotechnic articles

Essential Requirements (ESR) of Directive 2007/23/EC	Clause(s)/sub-clause(s) of this EN	Qualifying remarks/Notes
(1)	5.4, 5.5, 5.6, 5.10, 5.11	
(2)	5.2, 5.3	
(3), 1st paragraph	5.4, 5.5, 5.6, 5.10, 5.11	
(3), 2nd paragraph	5.7, 5.8, 5.9, 5.10, 5.11, 5.16	
(3) (a)	5.2, 5.3	
(3) (b)	5.7, 5.8, 5.9, 5.10	
(3) (c)	5.7, 5.8, 5.9, 5.10, 5.16	
(3) (d)	5.9	
(3) (e)	5.9, 5.16	
(3) (f)	5.9, 5.10	
(3) (g)	5.7, 5.8, 5.10.3.4, 5.12	
(3) (h)	5.14	
(3) (i)	5.9	
(3), last paragraph	5.7, 5.8	
(5) B. (1)	5.2, 5.3	
(5) B. (3)	5.15	
(5) B (4)	5.9.2.4, 5.10	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Annex ZB
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2013/29/EU on the placing on the market of pyrotechnic articles

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 2007/23/EC on the placing on the market of pyrotechnic articles, which is repealed by Directive 2013/29/EU.

Once EN 16263-4 is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of EN 16263-4 as given in Table ZB.1 confers, within the limits of the scope of EN 16263-4, a presumption of conformity with the requirements of that Directive and associated EFTA regulations.

Table ZB.1 — Correspondence between EN 16263–4 and Directive 2013/29/EU on the placing on the market of pyrotechnic articles

Essential Requirements (ESR) of Directive 2013/29/EU	Clause(s)/sub-clause(s) of this EN	Qualifying remarks/Notes
(4) (a)	1	
(4) (b)	1	
(4) (c)	1	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this European Standard, in particular Directive 2007/23/EC. See Annex ZA for details.

Bibliography

[1] Directive 2007/23/EC of the European Parliament and of the Council of 23 May 2007 on the placing on the market of pyrotechnic articles, OJ L 154, 14.6.2007, p. 1–21, available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:154:0001:0021:EN:PDF.

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

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

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

[5] EN 13631-4, *Explosives for civil uses — High explosives — Part 4: Determination of sensitiveness to impact of explosives*

[6] EN 13631-3, *Explosives for civil uses — High explosives — Part 3: Determination of sensitiveness to friction of explosives*

[7] Directive 2013/29/EU of the European Parliament and of the Council of 12 June 2013 on the harmonisation of the laws of the Member States relating to the making available on the market of pyrotechnic articles (recast), OJL 178; 28.6.2013, available from http://eurlex.europa.eu/LexUriServ.do?uri=OJ:L:2013:178:0027:0065:en:PDF

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