

BS EN 16265:2015



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Pyrotechnic articles — Other pyrotechnic articles — Ignition devices

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National foreword

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

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COMITÉ EUROPÉEN DE NORMALISATION
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Contents

Page

European foreword.....	6
1 Scope	7
2 Normative references	7
3 Terms and definitions	8
3.1 General terms	8
3.2 Technical terms	8
4 Categories and types of ignition devices.....	14
4.1 Generic types	14
4.2 Subtypes	14
4.3 Conditions determining whether an article is P1 or P2	16
4.3.1 Igniters.....	16
4.3.2 Components for pyrotechnic trains.....	16
4.3.3 Pyrotechnic cords and fuses.....	16
4.3.4 Delay fuses.....	16
4.3.5 Fuzes	17
5 Requirements.....	17
5.1 Verification of construction and design.....	17
5.1.1 General.....	17
5.1.2 Incompatible substances.....	17
5.1.3 Igniters.....	17
5.1.4 Delay fuses.....	18
5.1.5 Fuzes and components for pyrotechnic trains	18
5.2 Verification of labelling and instructions for use.....	18
5.3 Verification of specified functioning characteristics	18
5.3.1 General.....	18
5.3.2 Igniters.....	18
5.3.3 Components of pyrotechnic trains.....	19
5.3.4 Delay fuses, pyrotechnic cords and fuses.....	19
5.3.5 Fuzes	20
5.4 Thermal stability.....	20
5.5 Safety features.....	20
5.6 Sensitivity to normal, foreseeable handling and transportation	20
5.7 Resistance to moisture.....	21
5.8 Resistance to mechanical damage	21
5.8.1 Leading wires of electric igniters and electrically triggered fuzes.....	21
5.8.2 Leading optical fibre of optical igniters and optically triggered fuzes	21
5.8.3 Crush test	22
5.8.4 Pyrotechnic cords and fuses.....	22
5.9 All-Fire / No-Fire levels of igniters	22
5.10 Series firings of electric igniters.....	23
5.11 Electrical characteristics	23
5.12 Electrostatic discharge.....	23
5.13 Sensitivity of pyrotechnic composition.....	23
5.14 Type testing.....	23
5.14.1 General.....	23

5.14.2	Number of items to be tested	23
5.14.3	Test report	25
5.15	Batch testing.....	25
5.15.1	General	25
5.15.2	Sampling plans.....	25
5.15.3	Sample size for small batches (destructive tests).....	26
5.15.4	Nonconformities	27
5.15.5	Labelling and instructions for use.....	28
5.15.6	Test report	28
5.15.7	Acceptance or rejection of a batch	28
6	Test methods.....	29
6.1	General	29
6.2	Apparatus	29
6.2.1	Calliper	29
6.2.2	Ruler	29
6.2.3	Balance	29
6.2.4	Climatic chamber.....	29
6.2.5	Sound level meter.....	29
6.2.6	Electric firing sources	29
6.2.7	Time-measuring equipment.....	30
6.2.8	Optical sensors	30
6.2.9	Pressure sensors.....	30
6.2.10	Video camera.....	30
6.2.11	Stills photographic camera	30
6.2.12	Microphone.....	30
6.2.13	Shock apparatus.....	30
6.2.14	Drop-test apparatus.....	30
6.2.15	Ohmmeters	30
6.2.16	ESD generator	31
6.2.17	Magnifying equipment.....	31
6.2.18	Transparent type size sheet	31
6.3	Test methods.....	31
6.3.1	Construction	31
6.3.2	Verification of design	31
6.3.3	Verification of labelling and instructions for use	32
6.3.4	Initiation (or reaction) time	32
6.3.5	Closed vessel test.....	33
6.3.6	Aspect of flame or flow of reacting species	35
6.3.7	Fire transmission.....	37
6.3.8	Linear burning rate or delay time	38
6.3.9	Thermal conditioning	41
6.3.10	Mechanical conditioning.....	41
6.3.11	Mechanical impact (drop test).....	42
6.3.12	Resistance of leading wires to abrasion	43
6.3.13	Resistance of leading wires or fibres to traction	50
6.3.14	Crush test.....	52
6.3.15	Resistance of cords and fuses to tension.....	54
6.3.16	Series firing of electric igniters	55
6.3.17	Electrical resistance of electric igniters	56
6.3.18	Insulation resistance of electric igniters.....	56
6.3.19	Electrostatic discharge	57
6.3.20	Sensitivity testing	59

6.3.21	Water immersion test.....	63
6.3.22	Determination of the detonative / non- detonative characteristics.....	63
6.3.23	Visual examination.....	64
7	Minimum labelling requirements and instructions for use	64
7.1	General.....	64
7.2	Labelling requirements	64
7.2.1	Name and type.....	64
7.2.2	CE marking and identification number.....	64
7.2.3	Category and registration number	64
7.2.4	Age limit and specialist knowledge labelling.....	65
7.2.5	Net Explosive Content.....	65
7.2.6	Details on manufacturer or importer	65
7.2.7	“Use by” date	65
7.2.8	Printing.....	65
7.2.9	Marking of very small items.....	66
7.2.10	Ignition input.....	66
7.3	Instructions for use	66
	Annex A (informative) Bruceton method	68
A.1	General.....	68
A.2	Procedure.....	68
A.3	Calculation of results	68
A.4	Values at 95 % confidence level.....	69
A.5	Example	70
A.6	Curves of <i>G</i> and <i>H</i> functions.....	72
A.7	Table of Student-t distribution.....	72
	Annex B (informative) Dichotomic (or Langlie) method	74
B.1	General.....	74
B.2	Procedure.....	74
B.3	Calculation of results	75
B.4	Values at 95 % confidence level.....	78
B.5	Example	79
	Annex C (informative) Mechanical Conditioning (Shock Apparatus)	83
	Annex D (informative) Mechanical Impact Test (Drop Test)	86
	Annex E (informative) Adjustment of the ESD generator.....	87
E.1	Apparatus.....	87
E.2	Procedure.....	88
	Annex F (informative) Specification of grinding steel for wire abrasion test.....	89
F.1	Type.....	89
F.2	Material.....	89
F.3	Dimensions.....	89
F.4	Availability of abrasive strips (informative).....	91

Annex G (normative) Determination of the duration of accelerated ageing test to demonstrate the correct functioning at the “use by ” date 92

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 95

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 97

Bibliography 98

European foreword

This document (EN 16265:2015) 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 June 2016, and conflicting national standards shall be withdrawn at the latest by June 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 European standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential safety requirements of EU Directive 2007/23/EC and 2013/29/EU on the placing on the market of pyrotechnic articles.

For relationship with EU Directives 2007/23/EC and 2013/29/EU on the placing on the market of pyrotechnic articles, see informative Annexes ZA and ZB, which are an integral part of this document.

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 defines the terms and specifies the requirements, means of categorization, test methods, minimum labelling requirements and instructions for use, for ignition devices (except ignition devices for pyrotechnic articles for vehicles) of the following generic types:

- igniters;
- components for pyrotechnic trains;
- pyrotechnic cords and fuses;
- delay fuses;
- fuzes.

NOTE Safety fuses are subject to Directive 93/15/EEC and therefore not considered in this European Standard.

This European Standard does not apply for articles containing pyrotechnic compositions that include any of the following substances:

- arsenic or arsenic compounds;
- polychlorobenzenes;
- mercury compounds;
- white phosphorus;
- picrates or picric acid.

This European Standard does not apply to pyrotechnic articles that contain detonative explosives other than black powder and/or flash composition, except igniters if these detonative explosives:

- can be easily extracted from the pyrotechnic article, or
- can initiate secondary explosives, or
- can function in a detonative manner, although the article is not designed to detonate and the article belongs to the category P2.

2 Normative references

The following documents, in whole or in part, are normatively 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 ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Callipers; Design and metrological characteristics (ISO 13385-1)*

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

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 General terms

3.1.1

type

sample representative of the production envisaged

3.1.2

generic type

set of articles with common, very general, design features and/or with common characteristic effects

3.1.3

subtype

set of articles within a generic type with specific design features

3.1.4

individual item

article within a generic type and/or subtype for which every possible feature and characteristic has been fixed

Note 1 to entry: Each feature and characteristic will be specified in the technical name or a technical data sheet, as appropriate.

3.1.5

technical name

general description of an individual item

3.2 Technical terms

3.2.1

Acceptance Quality Limit

AQL

quality level that is the worst tolerable process average when a continuing series of lots is submitted for acceptance sampling

3.2.2

acceptor charge

acceptor component

charge of pyrotechnic composition or component receiving a stimulus from another charge (See “donor charge”)

Note 1 to entry: The term acceptor charge is also known as acceptor component.

3.2.3

all-fire current

minimum current (generally expressed in Amperes DC) needed to ensure that an electric igniter is fired within a given time frame (See “All-fire level”)

3.2.4

all-fire level

minimum level of the initiation input (e.g. electric current in Amperes, mechanical force in Newtons, optical power in Watts, etc.) needed to ensure that an igniter or an ignition device is fired within a given time frame

Note 1 to entry: All-fire level is a characteristic given in the instructions for use of every igniter. It is generally associated with a probability level (e.g. 99,9 % at 95 % confidence level) within a specified time frame (e.g. 50 ms).

3.2.5

ancillary equipment

any device which does not form part of a pyrotechnic article, but which is supplied with it and is required in order that the article functions safely and correctly when used in accordance with the instructions for use

3.2.6

batch test

test performed on one or more sample(s) of products taken at random from a production batch to check compliance with a given specification

Note 1 to entry: Batch testing needs all products in the production batch to comply with the characteristics the standard requires to ensure homogeneity of the whole batch. It aims at proving all products which are placed on the market are in conformity with the type which is described in the EC type-examination certificate and have been successfully submitted to type tests determined by the standard.

3.2.7

black powder

intimate mixture of charcoal and sodium nitrate or potassium nitrate with or without sulfur

3.2.8

booster

pyrotechnic device used as a donor charge to amplify the energy supplied to the acceptor charge

3.2.9

bridgewire

resistive element connecting the leading wires inside an electric igniter or primer

3.2.10

burning time

time in seconds for a defined mass or length of pyrotechnic composition to burn from its ignition to its consumption

3.2.11

critical nonconformity

nonconformity that judgement and experience indicate is likely to result in hazardous or unsafe conditions

Note 1 to entry: This type of nonconformity is referred to as a 'class A nonconformity' in ISO 2859-1.

3.2.12

critical nonconforming unit

nonconforming unit with one or more critical nonconformities, with or without major or minor nonconformities

3.2.13

deflagration

reaction of fast combustion through a pyrotechnic composition at subsonic velocity in the reacting explosive

3.2.14

delay fuse duration

time delay of a delay fuse

3.2.15

detonation

reaction which propagates through an explosive at supersonic velocity in the reacting explosive

3.2.16

detonative explosive

substance or mixture of substances which can undergo a fast internal decomposition reaction leading to a detonation in normal use

3.2.17

donor charge

charge of pyrotechnic composition supplying a stimulus to another charge (See “acceptor charge”)

3.2.18

electrostatic discharge

ESD

sudden and momentary electric current that flows between two objects at different electrical potentials

3.2.19

explosive

chemical substance or mixture of chemical substances as defined in Article 1 paragraph 2 of Directive 93/15/EEC

3.2.20

firework

pyrotechnic article intended for entertainment purposes, as defined by Art. 2 No. 3 of Directive 2007/23/EC

3.2.21

firing current

constant electrical direct current required to reliably initiate functioning of an electric igniter or primer

3.2.22

friction head

ignition head designed to be ignited by friction

3.2.23

fusehead

part of an electric igniter consisting of one or more pairs of metal conductors, bridged by fine resistance wire(s), and coated with a pyrotechnic composition which initiates when the firing current is passed through the bridgewire(s)

3.2.24

gross mass

total mass of a pyrotechnic article (not including any ancillary equipment)

3.2.25

ignition head

initial fuse consisting of pyrotechnic composition only

3.2.26

ignition tube

tube usually containing a thin pyrotechnic charge on the inner wall capable on activation of transmitting a deflagration effect from one end of the tube to the other at a subsonic velocity

3.2.27

incompatible substances

substances or materials that react together resulting in unsafe conditions

3.2.28

linear burning rate

length of pyrotechnic composition in millimetres or metres divided by the burning time in seconds

3.2.29

main charge

pyrotechnic composition which produces the principal effect

3.2.30

major nonconformity

nonconformity, other than a critical nonconformity, which is likely to result in failure, to reduce materially the usability of the pyrotechnic article, or to increase the potential hazard

Note 1 to entry: This type of nonconformity is referred to as a “class B nonconformity” in ISO 2859-1.

3.2.31

major nonconforming unit

nonconforming unit with one or more major nonconformities, with or without minor nonconformities, but with no critical nonconformities

3.2.32

minor nonconformity

nonconformity that is not likely to reduce materially the usability of the pyrotechnic article

Note 1 to entry: This type of nonconformity is referred to as a “class C nonconformity” in ISO 2859-1.

3.2.33

minor nonconforming unit

nonconforming unit with one or more minor nonconformities, but with no critical or major nonconformities

3.2.34

misfire

incomplete functioning or non-functioning of a pyrotechnic article after application of initiation stimulus

3.2.35

Net Explosive Content

NEC

total mass of explosive material in a pyrotechnic article

3.2.36

no-fire current

maximum current (generally expressed in Amperes DC) that can be applied without causing an electric igniter to function within a specified time period (See “No-fire level”)

3.2.37

no-fire level

maximum level of the initiation input (e.g. electric current in Amperes, mechanical force in Newtons, optical power in Watts, etc.) that can be applied without causing an igniter to function within a specified time period

Note 1 to entry: No-fire level is a characteristic given in the instructions for use of every igniter. It is generally associated with a probability level (e.g. 99,9 % at 95 % confidence level) within a specified time frame (e.g. 50 ms).

3.2.38

nonconforming unit

pyrotechnic article with one or more nonconformities

3.2.39

nonconformity

non-fulfilment of a requirement

3.2.40

other pyrotechnic article

pyrotechnic article other than fireworks, theatrical pyrotechnic articles and pyrotechnic articles for vehicles

3.2.41

“pin-to-case” configuration

configuration in which the ESD occurs between the two short-circuited leading wire ends and the igniter casing or between the pins and the casing of the connector of the igniter

3.2.42

“pin-to-pin” configuration

configuration in which the ESD occurs through the bridgewire of the igniter

3.2.43

primary pack

package of one or more pyrotechnic articles, offered for retail sale as a single unit

Note 1 to entry: A primary pack is neither necessarily the smallest piece of packaging nor a full enclosure: for instance, pyrotechnic cords and fuses are often delivered coiled around a reel as the smallest piece of retail sale.

3.2.44

principal effect

main effect a pyrotechnic article is designed to produce, as defined by the manufacturer

3.2.45

pyrotechnic component

any component of a pyrotechnic article which contains one or more pyrotechnic compositions

3.2.46

pyrotechnic composition

explosive substance or mixture of explosive substances which is designed, on ignition or initiation, to produce heat, light, sound, gas or smoke or a combination of such effects through self-sustained exothermic chemical reactions

3.2.47

pyrotechnic delay

pyrotechnic device designed in such a manner that it generates a delay in the transmission of ignition in a pyrotechnic train

Note 1 to entry: Delay fuses are specific examples of such pyrotechnic delays (see “Delay fuse”).

3.2.48

pyrotechnic device

any device containing pyrotechnic composition(s) which determine its principal effect

3.2.49

pyrotechnic operation

any operation which leads to the direct application of a mechanical, thermal and/or chemical stress on a pyrotechnic composition without intending to ignite or initiate the article at the time the stress is applied

3.2.50

pyrotechnic train

set of pyrotechnic components which are functionally linked and, after an initial input of energy, function in a designed sequence to transmit, enhance and/or distribute ignition to one or more other pyrotechnic components

3.2.51

relay

charge of pyrotechnic composition that is used to transmit ignition

3.2.52

safe test current

maximum electrical current (generally expressed in Amperes DC) that can be applied without causing an electric igniter to function regardless of the duration

3.2.53

safety friction tip

friction head that can only be ignited when rubbed against a striker component containing a chemical substance with which it reacts, such as red phosphorus, or a combination of such a chemical substance and an abrasive surface

3.2.54

safety fuse

article consisting of a core of fine-grained black powder surrounded by a flexible woven fabric with one or more protective coverings

Note 1 to entry Other names: safety cord, fuse cord, mine or mining fuse. This article is subject to Directive 93/15/EEC and to the corresponding European Standard EN 13630.

3.2.55

slag

condensed reaction products resulting from the combustion of pyrotechnic composition(s)

3.2.56

type test

test performed on a sample of products, representative of the production envisaged, in order to demonstrate their compliance with the essential safety requirements of Annex I and the relevant provisions of the Directive 2007/23/EC

Note 1 to entry: The successful submission to type tests leads to the attribution of a EC type-examination certificate.

3.2.57

use by date

latest date by which an article shall be used if it is to safely exhibit the performance characteristics described in the manufacturer's or importer's specifications

4 Categories and types of ignition devices

4.1 Generic types

The generic types are defined as follows:

4.1.1 Igniter: Article containing pyrotechnic composition(s) used to initiate combustion or deflagration. They may be actuated by chemical, electrical, optical or mechanical means.

NOTE Complex igniters (e.g. some integral rocket igniters) are not considered as subtypes of "igniters", but linked to "gas generators" or "heaters" (see EN 16263-1, EN 16263-2, EN 16263-3, EN 16263-4 and EN 16263-5).

4.1.2 Component for pyrotechnic trains: Article, excluding the other generic types containing pyrotechnic composition(s) designed to transmit a pyrotechnic reaction or effect within a pyrotechnic train. They can include bursting charges and lift charges.

4.1.3 Pyrotechnic cord and fuse: Article consisting of black powder or other pyrotechnic composition(s) either coated on a supporting medium and/or inside a tube with or without a protective covering.

4.1.4 Delay fuse: Article consisting of a casing with a core of compacted pyrotechnic composition. Designed to transmit ignition over a time period.

4.1.5 Fuse: Device which incorporates mechanical, electrical, chemical or hydrostatic components and one or more pyrotechnic composition(s) to initiate a pyrotechnic train.

4.2 Subtypes

The generic types can include the following subtypes:

4.2.1 Black match: *Pyrotechnic cord and fuse* consisting of textile yarns covered with black powder or another fast burning pyrotechnic composition. It burns progressively along its length with an external flame and is used to transmit ignition.

4.2.2 Cord igniter: *Pyrotechnic cord and fuse* consisting of a core of pyrotechnic composition surrounded by a flexible woven fabric, plastic or similar close fitting sheath. It burns progressively along its length with an external flame and is used to transmit ignition.

4.2.3 Delay element: *Delay fuse* consisting of a core of fine grained black powder surrounded by a flexible woven fabric with or without one or more protective outer coverings.

NOTE Frequently, when used as a component of fireworks, it is axially inserted into a solid rigid part.

4.2.4 Delay igniter: *Igniter* with a delay unit designed to transmit ignition over a time period.

NOTE The delay unit may be either pyrotechnic – a *delay fuse* – or non-pyrotechnic (e.g. electronic).

4.2.5 Electric igniter: Electrically actuated *igniter*. Electric current is used to heat a resistive element (e.g. bridge wire). The sensitive pyrotechnic composition in contact with the resistive element is ignited by heat transfer. The article initiates a pyrotechnic train or component by the deflagration that is generated.

4.2.6 Ignition cartridge: See “squib”.

4.2.7 Ignition tube: *Pyrotechnic cord and fuse* as defined in 3.2.27.

4.2.8 Mechanical igniter: Mechanically actuated *igniter*. A mechanical signal (e.g. percussion, friction) is used to ignite a pyrotechnic composition sensitive to the mechanical signal. The article initiates a pyrotechnic train or component by the deflagration of the pyrotechnic composition.

4.2.9 Optical igniter: Optically actuated *igniter*. Optical condensed light, transmitted through an optical fibre, is used to ignite a pyrotechnic composition by radiative heat transfer. The article initiates a pyrotechnic train or component by the deflagration of the pyrotechnic composition.

4.2.10 Pressed fuse: *Delay fuse* where pyrotechnic composition is pressed in a rigid case. Pyrotechnic composition burns progressively along the device length with an internal flame.

4.2.11 Primer: *Igniter* consisting of a cap containing pyrotechnic composition(s) for ignition, with or without an auxiliary charge, designed to ignite the propelling charge in a cartridge case.

4.2.12 Quick match: *Pyrotechnic cord and fuse* consisting of textile yarns covered with black powder or another fast burning pyrotechnic composition wrapped loosely in a paper or plasticised paper pipe or sheath. It burns progressively along its length with an external flame and a linear burning rate of several metres per second.

4.2.13 Squib: *Igniter* with a boosting charge, designed to amplify the pyrotechnic output of the igniter.

4.2.14 Touch paper: Paper impregnated with an oxidizing agent such as potassium nitrate and having self-sustaining combustion properties.

4.3 Conditions determining whether an article is P1 or P2

4.3.1 Igniters

When placed on the market as a separate article, igniters shall be categorized as P2 articles if they do not comply with at least one of the following requirements:

- they shall not exhibit bare pyrotechnic compositions except for friction igniters and electric igniters containing less than 10 mg of pyrotechnic composition. The presence of bare composition shall be verified by visual examination according to 6.3.23;
- the igniter is designed in such manner that its assembly with any other article does not require a pyrotechnic operation as defined in 3.2.49.

4.3.2 Components for pyrotechnic trains

When placed on the market as a separate article, components for pyrotechnic trains shall be categorized as P2 articles if they do not comply with at least one of the following requirements:

- they shall not exhibit bare pyrotechnic compositions or their design shall prevent any inadvertent or unintentional application of mechanical and/or thermal stimuli to bare pyrotechnic compositions. This characteristic shall be checked by visual examination according to 6.3.23;
- the article is designed in such manner that its assembly with any other article does not require a pyrotechnic operation as defined in 3.2.49;
- the NEC of the article shall not exceed 20 g, with any booster not exceeding 2 g.

4.3.3 Pyrotechnic cords and fuses

When placed on the market as a separate article, pyrotechnic cords and fuses shall be categorized as P2 articles except cord igniters and ignition tubes which shall be categorized as P1 if they comply with at least one of the following requirements:

- they do not exhibit bare pyrotechnic compositions, except at their ends; prior to use, the ends shall be protected by an appropriate removable cover;
- they are equipped at their ends with specific connecting parts which allow pure mechanical upstream and downstream connections with pyrotechnic articles.

All the above characteristics shall be checked by visual examination according to 6.3.23.

Touchpaper is submitted to the same requirements as *Pyrotechnic cord and fuse* and is categorized as a P1 article.

4.3.4 Delay fuses

When placed on the market as a separate article, delay fuses shall be categorized as P2 articles if they do not comply with at least one of the following requirements:

- they shall not exhibit bare pyrotechnic compositions or their design shall prevent any inadvertent or unintentional application of mechanical and/or thermal stimuli to bare pyrotechnic compositions. This characteristic shall be checked by visual examination according to 6.3.23;
- the article is designed in such manner that its assembly with any other article does not require a pyrotechnic operation as defined in 3.2.49;

- when they provide a final flash effect that burns in less than 1 s, the NEC of that flash effect shall not exceed 10,0 g of black powder or 4,0 g nitrate/metal based composition or 2,0 g of any other composition that produces a flash effect.

4.3.5 Fuzes

When placed on the market as a separate article, fuzes shall be categorized as P2 articles if they do not comply with at least one of the following requirements:

- they shall not exhibit bare pyrotechnic compositions or their design shall prevent any inadvertent or unintentional application of mechanical and/or thermal stimuli to bare pyrotechnic compositions;
- the article is designed in such manner that its assembly with any other article does not require a pyrotechnic operation as defined in 3.2.49.
- the NEC of the article shall not exceed 20 g, with any booster not exceeding 2 g;
- they shall be equipped with an easily detectable and understandable safe/arm element or safety pin which shall not be easily removable unintentionally during foreseeable conditions of handling and transportation.

All the above characteristics shall be checked by visual examination according to 6.3.23.

5 Requirements

5.1 Verification of construction and design

5.1.1 General

When tested in accordance with 6.3.1 and 6.3.2 the ignition device shall be in accordance with the manufacturer's documentation regarding construction, dimensions, permanent or removable protections, presence of safe/arm components or safety pins (where appropriate), protections against electrostatic discharges and electromagnetic fields (where appropriate).

The manufacturer's documentation shall show any relevant component, e.g. pyrotechnic unit, with its dimensions, with the mass and details of each pyrotechnic composition used in the article.

5.1.2 Incompatible substances

Pyrotechnic articles shall not contain incompatible substances as defined in 3.2.27 unless effective measures have been taken to permanently segregate incompatible substances one from the other and effective measures have been taken to stabilize mixtures of incompatible substances.

This requirement shall be verified by examination of the design and/or construction from the manufacturer's documentation.

5.1.3 Igniters

The following requirements apply to igniters.

- When a varnish is the only protective barrier for the pyrotechnic composition(s), it shall protect against electric and mechanical stresses. This shall be verified according to 6.3.11, 6.3.14 and 6.3.19;
- friction igniters (e.g. friction heads, safety friction tips...) shall be protected against mechanical crushing, shock and friction by removable protections until use. The presence of such protections

shall be checked by visual examination according to 6.3.23 and verification of design according to 6.3.2;

- the net explosive content (NEC) of the pyrotechnic composition which is directly ignited by the stimulus shall not exceed 100 mg; this shall be verified from the manufacturer's documentation according to 6.3.2.2;
- in all cases, the NEC of the igniter shall not exceed 2,0 g; this shall be verified from the manufacturer's documentation according to 6.3.2.2.

When tested according to 6.3.22, igniters shall not have the capacity to initiate the detonation of the charge as defined in 6.3.22.2.

5.1.4 Delay fuses

When delay fuses are sensitive to mechanical crushing, shock and friction, they shall bear removable protections. It shall be checked by visual examination according to 6.3.23 and verification of construction and design according to 6.3.2.2.

5.1.5 Fuzes and components for pyrotechnic trains

The following requirements apply to fuzes and components for pyrotechnic trains.

- When they are sensitive to mechanical crushing, shock and friction, they shall bear removable protections until they are assembled to another article;
- where the main charge burns in less than 1 s, their NEC shall not exceed 10,0 g of black powder or equivalent; 4,0 g nitrate/metal based composition or equivalent; 2,0 g of any other composition.

All the above characteristics shall be checked by visual examination according to 6.3.23 and verification of construction and design according to 6.3.2.

5.2 Verification of labelling and instructions for use

When tested in accordance with 6.3.3 the labelling and instructions for use of the ignition device shall be in accordance with Clause 7.

5.3 Verification of specified functioning characteristics

5.3.1 General

Performance of the ignition device shall be checked by functioning tests as defined in the following 5.3.2 to 5.3.5 and shall be in accordance with the manufacturer's specifications which shall include performance characteristics.

Functioning tests shall be performed at $(20 \pm 5,0)$ °C and, after thermal conditioning according to 6.3.9, at the minimum and maximum operating temperatures specified by the manufacturer.

In every case, possible projections of any fragments, burning material and hot slag shall be checked and a decision whether they are acceptable shall be taken by comparison to manufacturer's specifications for the given ignition device (see safety distances, information on direction of effects in the instructions for use).

5.3.2 Igniters

When measured in accordance with 6.3.4, the initiation time of the igniter for the recommended electrical, mechanical or optical input shall comply with manufacturer's specifications which shall include performance characteristics.

When the peak pressure or the time pressure curve in a closed vessel is specified by the manufacturer, tests shall be performed in accordance with 6.3.5 and records shall comply with manufacturer's specifications which shall include performance characteristics, especially the functioning time.

In other cases, the visual aspect of the flame or flow of reacting species generated by the igniter shall be recorded in accordance with 6.3.6 and shall comply with manufacturer's specifications.

When an igniter is designed to initiate a specific component or a specific family of components, fire transmission tests shall be carried out in accordance with 6.3.7. Fire transmission times shall comply with manufacturer's specifications which shall include performance characteristics.

All recorded values shall be in accordance with the manufacturer's specifications including tolerances.

5.3.3 Components of pyrotechnic trains

The following tests shall be performed, if the following parameters are described in the manufacturer's specifications:

- the initiation time shall be measured in accordance with 6.3.4;
- the functioning time shall be measured in accordance with 6.3.5;
- the time pressure curve in a closed vessel for components containing compressed or compacted pellets and grains, tests shall be performed in accordance with 6.3.5;
- the peak pressure in a closed vessel for relays or boosters containing loose composition or granules shall be recorded in accordance with 6.3.5;
- the aspect of flame for relays or boosters containing loose composition or granules shall be recorded in accordance with 6.3.6.

All results shall comply with manufacturer's specifications.

Where the component is designed to initiate a specific component or a specific family of components, fire transmission tests shall be carried out in accordance with 6.3.7. Fire transmission times shall comply with manufacturer's specifications.

5.3.4 Delay fuses, pyrotechnic cords and fuses

When tested in accordance with 6.3.8, pyrotechnic cords and fuses and delay fuses shall initiate and exhibit continuous and stable burning. The linear burning rate or delay time shall comply with the value and tolerances defined by the manufacturer's specifications.

Ignition time shall comply with manufacturer's specifications when measured in accordance with 6.3.4.

The casing of delay fuses shall prevent all lateral emission of gases, flames or hot particles during functioning. It shall be checked after functioning by visual examination according to 6.3.23.

When designed to protect the surroundings against projection of burning particles and/or hot slag, the protective covering of pyrotechnic cords and fuses shall be intact and without holes after testing in accordance with 6.3.8. This shall be verified by visual examination according to 6.3.23.

When delay fuses include a boosting or fire-enhancing charge, they shall be additionally tested according to 5.3.3, including fire transmission tests according to 6.3.7 where appropriate.

5.3.5 Fuzes

Fuzes shall be tested in the “arm” position according to the manufacturer’s specifications (including the means of application of the initiation stimulus). The functioning of their main charge shall comply with manufacturer’s declarations when tested in accordance with 6.3.5, 6.3.6 or 6.3.7.

The “safe” mode shall be checked by verification of construction and design according to 6.3.2.2. Its effectiveness shall be verified in accordance with 6.3.10 (mechanical conditioning) and 6.3.11 (mechanical impact test). No initiation shall take place during these tests and the safety features shall remain in their “safe” position. This requirement shall be verified by function test on the samples submitted to 6.3.10 and 6.3.11 in accordance with 6.3.5, 6.3.6 or 6.3.7.

5.4 Thermal stability

When tested in accordance with 6.3.9, ignition devices shall neither ignite during the test nor exhibit degradation or mass changes (emission of gases, cracks or expansion of compacted compositions, migration of chemicals). This shall be checked by visual examination according to 6.3.23 and measurement of the gross mass after test in accordance with 6.3.1.3. After the thermal stability test the article shall still function properly at maximum or minimum use temperature according to 5.3.

The leading wires of electric igniters shall not show any cracking or degradation of their insulation after thermal conditioning.

5.5 Safety features

Ignition devices shall include or be equipped with:

- safety protections, e.g. primary pack or protective cover or any other mechanical element specified by the manufacturer to protect pyrotechnic compositions and/or the weakest parts of the article and/or the sensitive parts intended to be triggered to initiate normal functioning of the article;
- safety components, e.g. safe/arm switches, removable safety pins or plugs (where appropriate);
- protection against electromagnetic fields for electric igniters;
- protection against ESD.

The presence of the safety features shall be checked by visual examination and their effectiveness shall be verified in accordance with 5.6, 5.7, 5.8, 5.11 and/or 5.12.

Integral safety features shall be checked by verification of construction and design according to 5.1 and their effectiveness shall be verified in accordance with 5.6, 5.7, 5.8, 5.11 and/or 5.12.

For electrical igniters, when specified by the manufacturer, verification of the presence of a shunting device or application of a shunting method to the leading wires shall be made by visual examination.

Whenever bare composition is not protected, information on the safety characteristics of the composition (shock, friction, ESD) shall be supplied by the manufacturer and comply with 5.13.

5.6 Sensitivity to normal, foreseeable handling and transportation

When tested in accordance with 6.3.10 in their primary pack (if any) and fitted with their safety features (if any), ignition devices shall not ignite during the test and shall still function after this test in accordance with the manufacturers specifications. This shall be verified according to requirements of 5.3. Safety protections and safety components shall remain in place or in their normal “safe” position.

P1 articles shall not exhibit any loss of pyrotechnic composition from the article. It shall be checked by visual examination.

For P2 articles, when tested in accordance with 6.3.10, the loose pyrotechnic composition found outside the article after mechanical conditioning shall be weighed. The mass of loose pyrotechnic composition shall not exceed 2 % of the NEC or 0,5 g whichever is the smaller. If the pyrotechnic composition cannot be separated from the loose material, the same limits shall apply to the whole loose material.

For black match and quick match, this criterion is passed if during mechanical conditioning no functioning occurs and providing that, following mechanical conditioning (6.3.10), the black match and quick match function correctly (6.3.8.2).

A drop test according to 6.3.11 shall be performed on the following unpacked articles:

- articles which are designed to function at impact or shock or designed to arm on acceleration;
- ignition devices (except pyrotechnic cords and fuses) which exhibit bare composition or a protection of their pyrotechnic composition only by varnish or by a deformable or thin casing.

Articles shall not ignite or arm during the test. P1 articles shall still function properly after this drop test in accordance with the requirements of 5.3.

5.7 Resistance to moisture

When the article is intended to be used in humid or wet conditions, thermal conditioning according to 5.4 shall be performed at the highest moisture level specified by the manufacturer. After conditioning the ignition device shall function properly in accordance with the requirements of 5.3.

Up to the point of use, articles that exhibit bare pyrotechnic composition shall be protected against moisture by a cover or primary pack.. When submitted to thermal tests according to 6.3.9, the relative humidity level shall be within the range from 40 % to 60 % and the articles shall be tested without their cover (if removable) or outside their primary pack.

When the article is intended to be used in or under water, the ignition device shall be tested in accordance with 6.3.21 and shall function properly afterwards in accordance with the requirements of 5.3.

5.8 Resistance to mechanical damage

5.8.1 Leading wires of electric igniters and electrically triggered fuzes

The following requirements apply to electric igniters and electrically triggered fuzes where the leading wires are not removable.

When tested in accordance with 6.3.12.2, the insulation shall resist at least one hundred cycles (arithmetic mean of the results of the tests) or, when tested in accordance with 6.3.12.3, no penetration of the insulation which lets the conductor appear shall occur.

When tested in accordance with 6.3.13, the leading wires shall not break, elongate or be pulled out of the igniter or fuze. Electrical resistance of the igniter shall be recorded after test according to 6.3.17 and shall remain within the tolerances specified by the manufacturer. After testing according to this paragraph, the electric igniters and electrically triggered fuzes shall still function according to the manufacturer's specifications. This shall be verified by testing according to 6.3.4.

5.8.2 Leading optical fibre of optical igniters and optically triggered fuzes

This requirement only applies to optical igniters or optically triggered fuzes where the leading optical fibre is not removable.

When tested in accordance with 6.3.13, the leading optical fibre shall not break, elongate or be pulled out of the igniter or fuze.

After testing according to 6.3.13, the optical igniters and optically triggered fuzes shall still function according to the manufacturer's specifications. This shall be verified by testing according to 6.3.4.

5.8.3 Crush test

When submitted to crush test according to 6.3.14, igniters and pyrotechnic cords and fuses shall not ignite or be damaged during the test and shall still function properly after test. This shall be verified by testing according to 6.3.4 or 6.3.8.

This test is not applicable to black match.

5.8.4 Pyrotechnic cords and fuses

When tested according to 6.3.15, pyrotechnic cords and fuses shall not break within 30 min under tension. They shall function properly after test. This shall be verified by testing according to 6.3.8.

This test is not applicable to black match.

5.9 All-Fire / No-Fire levels of igniters

All-fire / no-fire levels shall be determined for igniters by using either "Bruceton Method" as given in Annex A or "Dichotomic / Langlie method" as given in Annex B.

A minimum of 25 igniters shall be submitted to these sequential tests and the all-fire and no-fire levels shall be calculated from test results at a confidence level of 95 % as for the values claimed by the manufacturer. The calculated all-fire and no-fire levels shall be within the interval of values claimed by the manufacturer. In the case where the accuracy is not sufficient to prove this, the sequence of tests may be prolonged.

Functioning tests shall be performed in accordance with 6.3.4.

The type of stimulus which will be applied to the igniters shall be determined in accordance with the intended use of the article:

- electric current in Amperes DC for electric igniters;
- optical power in Watts for optical igniters;
- percussion energy in Joules for mechanical igniters which are triggered by percussion.

The test equipment which will deliver the appropriate stimulus shall be the one which is specified for functioning tests (see 5.3). It shall be capable of varying the stimulus in the range which is necessary to perform the sequential test.

The duration of the electric and optical stimuli shall be the duration which is recommended by the manufacturer in normal use.

A probability level of 99,9 % at 95 % confidence level shall be applied for the tests.

The calculated all-fire level from these tests shall not be greater than the value stated by the manufacturer. The calculated no-fire level from these tests shall not be lower than the value stated by the manufacturer.

Where the igniter is designed to be fired by means of specific ancillary equipment and this equipment has not been used for the tests, compliance of the calculated values from these tests with the characteristics of the stimulus delivered by the ancillary equipment shall be verified.

Igniters which are triggered by friction will not be submitted to such determination of all-fire / no-fire levels. However, the sensitivity level of the friction-sensitive composition shall be checked in accordance with 6.3.20.4 and shall comply with the manufacturer's specifications.

5.10 Series firings of electric igniters

Igniters which are designed or intended to be fired in series shall be tested in accordance with 6.3.16. The quantity of igniters in the series to be tested shall be the maximum number that is recommended by the manufacturer in the instructions for use.

There shall be no misfire of any igniter in the series firing test.

5.11 Electrical characteristics

The electrical resistance of electric igniters shall be tested in accordance with 6.3.17. All test results shall be within the limits stated by the manufacturer or, when no limits are claimed, a tolerance of $\pm 10\%$ of the nominal value stated by the manufacturer shall be applied.

For electric igniters with a metal casing, the insulation “pin-to-case” resistance of electric igniters shall be tested in accordance with 6.3.18. All test results shall be higher than the minimum value stated by the manufacturer.

For double-bridgewire igniters, the insulation “pin-to-pin” resistance between the two bridgewires and the insulation “pin-to-case” resistance between each bridgewire and the casing of the igniter shall be tested. All test results shall be higher than the minimum value stated by the manufacturer.

In every case, the measured values of insulation resistances shall not be lower than 100 M Ω for igniters.

5.12 Electrostatic discharge

Electric igniters shall be tested according to 6.3.19. No igniter shall function at a minimum impulse of 0,2 mJ/ Ω “pin-to-pin” or 0,6 mJ/ Ω “pin-to-case” (where the igniter is fitted with a case).

5.13 Sensitivity of pyrotechnic composition

P1 igniters exhibiting bare compositions shall, where not protected by effective safety features (see 5.5), comply with the following requirements:

- when the article is tested according to 6.3.20.2, its sensitivity to electrostatic discharge shall be higher than 100 mJ;
- when the composition is tested according to 6.3.20.3, its sensitivity to impact shall be higher than 8 J;
- when the composition is tested according to 6.3.20.4, its sensitivity to friction shall be higher than 80 N. This requirement does not apply to friction igniters where the sensitive element is protected by a covering device or an appropriate primary pack.

For electric igniters containing less than 10 mg of bare pyrotechnic composition, the self-ignition temperature of the composition shall be higher than 150 °C. This shall be verified by examination of the manufacturer’s documentation.

5.14 Type testing

5.14.1 General

Each ignition device to be type tested shall meet all requirements as stated in 5.1 to 5.13 (whenever appropriate).

5.14.2 Number of items to be tested

The number of ignition devices to be submitted to type test shall depend on the generic type, in accordance with Table 1.

Table 1 — Number of items to be tested

Requirements	Test methods	Number of items to be tested				
		Igniters	Components for pyrotechnic trains	Pyrotechnic Cords and fuses	Delay fuses	Fuzes ^k
5.1 Verification of construction and design ^a	6.3.1 and 6.3.2 6.3.22	12 3	12	12	12	12
5.2 Verification of labelling and instruction for use ^a	6.3.3	12	12	12	12	12
5.3 Verification of specified functioning characteristics ^b	6.3.4 6.3.5 or 6.3.6 or 6.3.7	12	12	—	—	12
	6.3.8	—	-	12	12	—
5.4 Thermal stability ^c	6.3.9	4 (+4)	4 (+4)	4 (+4)	4 (+4)	4 (+4)
5.5 Safety features ^a	Visual examination	12	12	12	12	12
5.6 Sensitivity to normal, foreseeable handling and transportation ^d	6.3.10 6.3.11 or 6.3.20	6 (+6)	6 (+6)	6 (+6)	6 (+6)	6 (+6)
5.7 Resistance to moisture ^e	6.3.9 or 6.3.21	(4)	(4)	(4)	(4)	(4)
5.8 Resistance to mechanical damage	—	—	—	—	—	—
5.8.1 Leading wires (electric igniters)	6.3.12 6.3.13	20	—	—	—	—
5.8.2 Leading fibre (optical igniters)	6.3.13	20	—	—	—	—
5.8.3 Crush test	6.3.14	10	—	—	—	—
5.8.4 Pyrotechnic cords and fuses ^f	6.3.14 6.3.15	—	—	10 + 5	—	—
5.9 All-fire / no-fire levels	6.3.4 and A.1 or A.2 or equivalent	≥ 25	—	—	—	—
5.10 Series firings of electric igniters ^g	6.3.16	30 + 5xN	—	—	—	—
5.11 Electrical characteristics ^h	6.3.17 6.3.18	(25)	—	—	—	—
5.12 Electrostatic discharge ^j	6.3.19	2 × 12	—	—	—	—
5.13 Sensitivity of pyrotechnic composition	6.3.20.1 or 6.3.20.2 or 6.3.20.3	See note ^m	—	—	—	—
^a The 12 items are the same as those submitted to 5.3. ^b 4 at (20 ± 5) °C, 4 at the minimum and 4 at maximum temperatures specified by the manufacturer. ^c 4 at high temperature (+4 at low temperature where appropriate). ^d 6 for mechanical conditioning (+6 for drop tests where appropriate); mechanical conditioning tests being carried out in packaging, the number of items shall depend on the quantity which is usually present in the packaging adopted by the manufacturer, with a minimum of 6.						

- e The same 4 articles as for thermal conditioning (high temperature).
- f 10 for crush test and 5 for resistance to tension.
- g 30 for determination of current break time and 5 times N where N is the maximum number of igniters to be connected in series which is authorized by the manufacturer.
- h The same 25 igniters as for determination of all-fire and no-fire levels.
- j 12 only in the case of primers with a sole central pin.
- k In the case of complex fuzes associated to small series, the number of articles to be submitted to type tests may be reduced by taking into consideration the results of development tests carried out previously by manufacturers.
- m For the purpose of sensitivity testing the manufacturer will supply 15 igniters and 10 g of composition.

5.14.3 Test report

The test report shall include at least the following information:

- a reference to this European Standard (i.e. EN 16265);
- the complete identification of the sample under test;
- the date of completion of testing;
- the relevant observations concerning the applicable type test requirements for the ignition devices under tests given in Table 1;

The test report shall include information about:

- labelling;
- the chosen protections of the sensitive parts (where appropriate);
- whether the primary pack is used for labelling.

The assessment whether the sample meets the requirements of this European Standard shall be done by a Notified Body.

5.15 Batch testing

5.15.1 General

For the purposes of batch testing, acceptance sampling in accordance with 5.15.2 and 5.15.3 shall be applied.

5.15.2 Sampling plans

Sampling shall be in accordance with ISO 2859-1 using double sampling plans and applying the switching procedures for normal, tightened and reduced inspection. Inspection level S-4 shall apply.

The following tests shall be performed in batch testing:

- verification of design (5.1) and visual examination: 100 % of the sample;
- verification of labelling and instruction for use (5.2): 100 % of the sample;
- verification of proper functioning at $(20 \pm 5,0) ^\circ\text{C}$ (5.3):

- igniters: 50 % of the sample with a maximum of 25 at the recommended electrical, mechanical or optical input by the manufacturer, 50 % of the sample with a maximum of 25 at the No-Fire level claimed by the manufacturer;
- components of pyrotechnic trains: 100 % of the sample;
- pyrotechnic cords and fuses, Delay fuses: 100 % of the sample;
- fuzes: 50 % of the sample in “arm” position, 50 % of the sample in “safe” position;
- safety features (5.5): 100 % of the sample;
- electrical characteristics (5.11): 100 % of the sample;
- method of ignition (7.2.10): 100 % of the sample;
- for igniters, all-fire / no-fire levels shall be determined according to 5.9 on 25 items which can require additional test items to the sample size determined by the inspection level S4.

5.15.3 Sample size for small batches (destructive tests)

For small batches ($\leq 35\,000$), the sampling plan (5.15.2) is not applicable for the Acceptance Quality Levels specified in 5.15.7. The following Table 2 lists the altered sample sizes which are required and the number of acceptable minor nonconformities:

Table 2 — Distribution of test for small batch sizes

Batch size	Minimum sample for functioning tests	Acceptable minor nonconformities
2 to 15	1	0
16 to 25	2	0
26 to 90	3	0
91 to 150	5	1
151 to 500	8	2
501 to 1200	13	3
1201 to 10000	32	7
10001 to 35000	80	14

If Table 2 is applied, no critical or major nonconformities as defined in Table 3 are acceptable.

5.15.4 Nonconformities

Nonconformities shall be classed in accordance with Table 3.

Table 3 — Nonconformities

Requirement	Generic type	Type of nonconformity
Verification of construction and design (5.1) and visual examination (6.3.23)	All	Outer dimensions: Critical (defects of mechanical and electrical interfaces), Major (other defects) Calibre: Critical Gross mass: Minor (<2 %), Major (2 % to 5 %), Critical (>5 %) ^a Visual defects: Critical (integrity and abnormal shape or aspects such as cracks, bulges, deformations, pollution by pyrotechnic compositions, local changes of colours...), Minor (other defects)
Verification of specified functioning characteristics at (20 ± 5,0) °C (5.3)	All	Performances: Critical (>10 %) ^a Major (5 % to 10 %) ^a Minor (<5 %) ^a Quick match: critical if incorrect functioning
	Igniters	Critical (ignition at no-fire level)
	Fuzes	Critical (functioning in "safe" position)
Safety features (5.5)	All	Critical
Electrical characteristics (5.11)	Igniters and electrically triggered articles	Critical (>10 %) ^a Major (5 % to 10 %) ^a Minor (<5 %) ^a
Method of ignition (7.2.10)	All	Major
All-fire / no-fire levels (5.9)	Igniters	Critical
Verification of labelling and instructions for use (5.2)	All	Critical when the information on the label or in the instructions for use changes the meaning of the text, making it misleading or incomplete EXAMPLE: — wrong or incomplete type; — wrong or incomplete performance data which could lead to an incorrect safety distance being determined.
^a (X %) means the percentage by which a measured value V exceeds the tolerance specified by the manufacturer. $\left \frac{V - M}{M} \right - \frac{m}{M} < X \%$		

Requirement	Generic type	Type of nonconformity
where M is the mean and m is the absolute tolerance for the given parameter. Example: $M = 150$ ms $m = 10$ ms $V = 178$ ms $\left \frac{178 - 150}{150} \right - \frac{10}{150} = 12 \% < X \% \quad \text{which means a critical failure.}$		

5.15.5 Labelling and instructions for use

When identical labels are used throughout a batch, the text of one label shall be examined.

For batches containing different variants, the number of different labels used in the batch shall be determined and the text of one label of each kind should be examined.

The label and instructions for use shall be examined in accordance with the requirements for minimum labelling and instructions for use in Clause 7.

5.15.6 Test report

The test report shall include at least:

- a reference to this European Standard,
- the complete identification of the sample under test,
- the date of completion of testing and the relevant observations concerning the applicable batch test requirements for the ignition devices under tests given in 5.15.2.

The test report shall include information about:

- the observations concerning the labelling,
- the instructions for use,
- the chosen protections of the sensitive parts
- whether the primary pack is used for labelling.

5.15.7 Acceptance or rejection of a batch

5.15.7.1 Nonconforming units

Acceptance or rejection of the batch shall be determined by the number of nonconforming units of each type, in accordance with 5.15.7.2 to 5.15.7.4 for normal sampling or Table 2 for small batch size.

NOTE Acceptance or rejection of the batch is determined by the number of nonconforming units of each type and not necessarily by the number of nonconformities found.

5.15.7.2 Critical nonconforming units

For critical nonconforming units an Acceptance Quality Limit (AQL) of 0,65 % shall apply.

If the batch fails to meet this criterion, it shall be rejected. Any critical nonconforming units shall not also be counted as major nonconforming units or minor nonconforming units.

5.15.7.3 Major nonconforming units

For major nonconforming units an AQL of 2,5 % shall apply. If the batch fails to meet this criterion, it shall be rejected. Any major nonconforming units shall not also be counted as minor nonconforming units.

5.15.7.4 Minor nonconforming units

For minor nonconforming units an AQL of 10 % shall apply. If the batch fails to meet this criterion, it shall be rejected.

6 Test methods

6.1 General

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

6.2 Apparatus

6.2.1 Calliper

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

6.2.2 Ruler

Ruler, reading to 1,0 mm.

6.2.3 Balance

6.2.3.1 Balance, read to 0,1 g.

6.2.3.2 Balance, read to 0,01 g.

6.2.3.3 Balance, read to 0,001 g.

6.2.3.4 Balance, read to 0,1 mg.

6.2.4 Climatic chamber

Up to 75 °C or 1,25 times the maximum use temperature of the tested article in degrees Celsius (if higher than 60 °C). Where appropriate, down to 10 °C lower than the minimum use temperature.

Tolerance on temperature shall be $\pm 2,5$ °C.

Where required, capability of storing the test sample at 95 % of relative humidity.

Different climatic chambers may be used for different temperatures and relative humidity situations.

6.2.5 Sound level meter

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

6.2.6 Electric firing sources

Regulated current sources capable of producing square current pulses with adjustable amplitude (Amperes) and time period. The rise and fall times shall not be greater than 50 μ s, the accuracy of the amplitude shall be ± 1 % with a current overshoot of no more than 10 % on pure resistive load.