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Fireworks — Category 4 —

Part 2: Requirements

Artifices de divertissement — Catégorie 4 —

Partie 2: Exigences

Reference number
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Foreword

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

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

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

A list of all the parts in the ISO 26261 series can be found on the ISO website.

Fireworks — Category 4 —

Part 2: Requirements

1 Scope

This document specifies requirements for the construction, performance and protective packaging of Category 4 fireworks, as listed in ISO 26261-1.

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

— arsenic or arsenic compounds;

— polychlorobenzenes;

— lead or lead compounds (except for igniters);

— mercury compounds;

— white phosphorus;

— picrates or picric acid.

This document does not apply for theatrical pyrotechnic articles which are designed for indoor or outdoor stage use, including film and television productions or similar use.

2 Normative references

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

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

ISO 26261-1, *Fireworks — Category 4 — Part 1: Terminology*

ISO 26261-3:2017, *Fireworks — Category 4 — Part 3: Test methods*

ISO 26261-4:2017, *Fireworks — Category 4 — Part 4: Minimum labelling requirements and instructions for use*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 26261-1 apply.

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

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

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

4 Pyrotechnic composition

No limits are given for the net explosive content (NEC) of Category 4 articles in this document.

The NEC has an influence (directly or indirectly) on the safety distances. For Category 4 fireworks, it is agreed that no fixed minimum safety distances are defined, contrary to Category 1, 2 and 3 fireworks. The safe use of Category 4 fireworks is one of the major responsibilities of the person with specialist knowledge who should determine the minimum safety distance by using the information given in ISO 26261-4:2017, Clause 4.

5 Construction (type test and batch test)

When tested in accordance with ISO 26261-3:2017, 6.1 and 6.2, the article dimensions and gross mass shall be in accordance with the manufacturer's declaration (including tolerances).

The orientation of mortars shall be verified by inspection according to ISO 26261-3:2017, 6.3, during type test.

When the orientation of mortars in combinations is not visible, the maximum firing angle shall be displayed on the label and verified by visual inspection according to ISO 26261-3:2017, 6.7.

6 Means of ignition

6.1 Identification (type test and batch test)

The means of ignition shall be clearly visible or shall be indicated by labelling or instructions, where applicable.

Conformity to this requirement shall be verified by visual examination according to ISO 26261-3:2017, 6.7.

6.2 Protection (type test and batch test)

Where appropriate, the means of ignition shall be protected to avoid accidental ignition of the fireworks.

Conformity to this requirement shall be verified by visual examination according to ISO 26261-3:2017, 6.7.

7 Performance

7.1 Properties to be checked before functioning tests

7.1.1 Loose pyrotechnic composition after mechanical conditioning (type test)

When tested in accordance with ISO 26261-3:2017, 6.8, the loose pyrotechnic composition found outside the article after mechanical conditioning shall be weighed. The mass of the whole loose material shall comply with manufacturer's specifications (if any) and the mass of loose pyrotechnic composition shall not exceed 3 % of the NEC and not more than 1 g for each item tested. If the pyrotechnic composition cannot be separated from the loose material, the same limits shall apply to the whole loose material.

7.1.2 Integrity (type test and batch test)

7.1.2.1 General requirements

There shall be no holes, splits, dents or bulges either in the body of the firework case or in the end closures, except those technically necessary for the correct functioning of the firework. If the end closures are separate components, they shall be in place. There shall be no pyrotechnic leakage of the article to be tested when it is received for testing.

Conformity to these requirements shall be verified by visual examination according to ISO 26261-3:2017, 6.7.

7.1.2.2 Specific requirements

For combinations, each individual element shall be securely attached to the other elements or to the framework. Attachment by the transmitting fuse(s) alone shall be allowed if it is sufficient to keep the elements joined together during normal handling.

Conformity to above requirements shall be checked by visual examination according to ISO 26261-3:2017, 6.7.

7.2 Properties to be checked during functioning tests

7.2.1 Principal effects (type test and batch test)

When tested in accordance with ISO 26261-3:2017, 6.10, the principal effects of each firework shall conform to those specified by the manufacturer or importer as described in ISO 26261-1.

7.2.2 Functioning (type test and batch test)

For type test only, functioning test in accordance with ISO 26261-3:2017, 6.10, shall be performed in as received conditions and, after mechanical and thermal conditions in accordance with ISO 26261-3:2017, 6.8 and 6.9.

For type test and batch test, when tested in accordance with ISO 26261-3:2017, 6.10, the article shall function as intended and shall not function in an erratic and unforeseeable manner.

7.2.3 Stability during functioning (type test and batch test)

When used according to the instructions for use, the article shall remain in its initial position and maintain its integrity while functioning, if applicable. Conformity to these requirements shall be checked by the method described in ISO 26261-3:2017, 6.10.

7.2.4 Performance parameters (type test and batch test)

The mandatory parameters listed in Table A.1 shall be measured and recorded according to ISO 26261-3:2017, 6.4, 6.5, 6.10.3 and 6.10.4 (if applicable).

During type tests, all test results shall be within a tolerance of ±20 % of the measured average, except as otherwise justified by the manufacturers. The measured average value shall be displayed on the label. This value may be rounded. Tolerances regarding performance parameters are only applicable to articles in as-received condition. During batch tests, all test results shall be within a tolerance of ±30 % from the value which is displayed on the label.

These tolerances are not applicable for sound pressure.

7.2.5 Sound pressure level (type test and batch test)

For articles which have report, explosion and/or whistling effects as part of their performance, the sound pressure level shall be measured and recorded at a predefined distance from the firing point according to ISO 26261-3:2017, 6.5.

The maximum measured value or a higher value if specified by the manufacturer shall be displayed on label.

During batch test, the measured value shall not exceed the displayed value.

7.2.6 Extinguishing of flames (type test)

When tested in accordance with ISO 26261-3:2017, 6.6, the existence of flames observed more than 2 min after the end of functioning of the article shall be displayed on the label or in the instructions for use.

Conformity to this requirement shall be tested by visual examination according to ISO 26261-3:2017, 6.7.

7.2.7 Projected debris (type test and batch test)

If the type test has shown projection of debris, the design of the firework shall be examined in accordance with ISO 26261-3:2017, 6.2 to establish whether the debris is a result of the design or malfunction of the article.

If the debris is the result of design, the instructions for use shall be checked according to ISO 26261-3:2017, 6.7, to establish whether the projection of debris has been addressed (including expected distance according to ISO 26261-3:2017, 6.10.2).

When tested in accordance with ISO 26261-3:2017, 6.7, the maximum debris distance found during batch tests shall not exceed the distance displayed on the label.

7.2.8 Burning or incandescent matter (type test and batch test)

The fall of burning or incandescent matter to the ground shall be checked during the functioning test (see ISO 26261-3:2017, 6.10).

8 Protective pack (type test and batch test)

Protective packs (if any) shall provide on their label the necessary information as required by ISO 26261-4:2017, 4.10. This shall be verified according to ISO 26261-3:2017, 6.7, by visual examination.

The means of ignition of pyrotechnic articles within protective pack shall be protected according to 6.2. This shall be verified by visual examination according to ISO 26261-3:2017, 6.7.

9 Type testing

9.1 General

Each firework to be type tested shall meet the requirements indicated in the following:

— Clause 5;

— Clause 6;

— Clause 7;

— Clause 8;

— ISO 26261-4.

9.2 Number of items to be tested

A total number of nine pyrotechnic articles shall be tested in accordance with Table 1.

Table 1 — Number of items to be tested

Number of fireworks to be tested	Condition	Tests in accordance with
3	As received	— Clause 5 — Clause 6 — Clause 7 — ISO 26261-4 — Clause 8
3	After thermal conditioning (see ISO 26261-3:2017, 6.9)	— Clause 6 — Clause 7
3	After mechanical conditioning (see ISO 26261-3:2017, 6.8)	— Clause 6 — Clause 7

For aquatic fireworks and for each condition presented in Table 1, two items shall be tested to determine the effect range and one to check the waterproofness in accordance with ISO 26261-3:2017, 6.10.4.

9.3 Fireworks supplied in protective packs

Fireworks that are supplied in protective packs shall be tested for thermal and mechanical conditioning within the protective pack.

9.4 Test report

The test report shall include at least the following:

a) a reference to this document, i.e. ISO 26261-2;

b) the complete identification of the sample under test;

c) the date of completion of testing;

d) the relevant observations concerning the applicable test requirements for the articles under test according to Table 1;

e) information about the observations concerning the labelling, instructions for use, the chosen protection of the means of ignition (where appropriate) and whether a protective pack is used for labelling.

For combinations, the participating elements should be listed.

10 Batch testing

10.1 General

For the purposes of batch testing, acceptance sampling in accordance with 10.2 to 10.4 shall be applied.

10.2 Sampling plans

10.2.1 General 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.

10.2.2 Sample size for small batches (destructive tests)

In the case of batches smaller than 35 001 articles, the sampling plans of ISO 2859-1 are not applicable for the AQL specified in 10.2 and the single sampling plan given in Table 2 shall be applied.

Table 2 — Batch test sampling plan for lot sizes smaller than 35 001

Lot size	Number of destructive tests	Acceptable critical non-conformities	Acceptable major non-conformities	Acceptable minor non-conformities
2 to 15	1	0	0	0
16 to 25	2	0	0	0
26 to 90	3	0	0	0
91 to 150	5	0	0	1
151 to 500	8	0	0	2
501 to 1 200	13	0	0	3
1 201 to 10 000	32	0	2	7
10 001 to 35 000	80	1	5	14

10.3 Fireworks in protective packs

For fireworks supplied in protective packs, the appropriate number of protective packs shall be sampled and examined.

10.4 Nonconformities

10.4.1 Construction and performances

Nonconformities are classed in accordance with Table 3.

Table 3 — Nonconformities

Requirement	Type of nonconformity	Comments
Construction (see Clause 5)	Major: For shells when their calibre is outside the manufacturer's declaration including tolerances.	—
	Minor: Articles dimensions (other than calibre for shells) when they are outside the manufacturer's declaration including tolerances.	
	Major: Gross mass when it is outside the manufacturer's declaration including tolerances.	
Identification of means of ignition (see 6.1)	Minor	—
Protection of means of ignition, where appropriate (see 6.2)	Critical	—
Integrity (see 7.1.2): Pyrotechnic leakage	Critical	—
Integrity (see 7.1.2): Other cases	Major	—
Principal effects (see 7.2.1)	Minor	—
NOTE Tolerances are those that were declared by the manufacturer for type certification or tighter.		

Table 3 *(continued)*

Requirement	Type of nonconformity	Comments
Functioning (see 7.2.2): Incomplete functioning	Critical for projected or propelled articles, minor in other cases	See Annex B. For cases not mentioned in Table B.1, the general rule as stated in column "Type of non-conformity" is applicable
Functioning (see 7.2.2): Erratic or unforeseeable manner	Critical, Major or minor depending on the possible impact on the correct functioning of the item	See Annex B. For cases not mentioned in Table B.1, the general rule as stated in column "Type of non-conformity" is applicable
Stability during functioning (see 7.2.3)	Critical	—
Performance parameters (see 7.2.4)	Major	See Annex A.
Sound pressure level (see 7.2.5)	Major	—
Projected debris (see 7.2.7)	Major for unexpected projected debris	—
Protective pack (see Clause 8)	Major	—
Verification of labelling and instructions for use	Critical: For combinations where the orientation of mortars is not visible, if the maximum firing angle is not displayed on the label	
	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.
NOTE Tolerances are those that were declared by the manufacturer for type certification or tighter.		

10.4.2 Labelling

In the case where the same label is used throughout a batch, the text of one label shall be examined.

In the case where a batch contains 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 shall be examined in accordance with the minimum labelling requirements in ISO 26261-4.

The information on the label shall not be misleading or incomplete.

EXAMPLE

— Wrong or incomplete type.

— Wrong or incomplete performance data which could lead to an incorrect safety distance being determined.

No spelling mistake that changes the meaning of the text shall be allowed.

A maximum of three spelling mistakes that do not change the meaning of the text shall be allowed.

10.5 Test report

The test report shall include at least the following:

a) a reference to this document, i.e. ISO 26261-2;

b) the complete identification of the sample under test;

c) the date of completion of testing;

d) the relevant observations concerning the applicable batch test requirements for the articles under tests given in Table 3.

e) information about the observations concerning the labelling, instructions for use, the chosen protection of the means of ignition (where appropriate) and whether a protective pack is used for labelling.

For combinations, the participating elements should be listed.

10.6 Acceptance or rejection of a batch

10.6.1 Nonconforming units

Acceptance or rejection of the batch shall be determined by the number of nonconforming units of each type, in accordance with 10.6.2 to 10.6.4.

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.

10.6.2 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.

10.6.3 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.

10.6.4 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.

Annex A
(normative)

Mandatory performance parameters

Table A.1 — Mandatory performance parameters for generic type

Generic type	Effect/burst height (see NOTE 1)	Drop height[a]	Sound pressure level	Additional parameters	Comments
Aerial wheel	n/a	n/a	See 7.2.5	(Overall duration) **X**	n/a
Aquatic firework	n/a	n/a	See 7.2.5	(Range) **T**	n/a
Combination	n/a	n/a	See 7.2.5	n/a	As per constituent types (See NOTE 2)
Fountain	**X**	n/a	See 7.2.5	n/a	n/a
Guided firework	n/a	**T**	See 7.2.5	n/a	n/a
Mine	**X**	n/a	See 7.2.5	n/a	n/a
Report	n/a	n/a	**X**		n/a
Rocket	**X**	**T**	See 7.2.5	n/a	n/a
Roman candle	**X**	**T**	See 7.2.5	n/a	Applies to shot tubes as well
Shell	**X**	**T**	**X**	n/a	n/a
Smoke/aerosol generator	n/a	n/a	n/a	n/a	n/a

T = Type test.

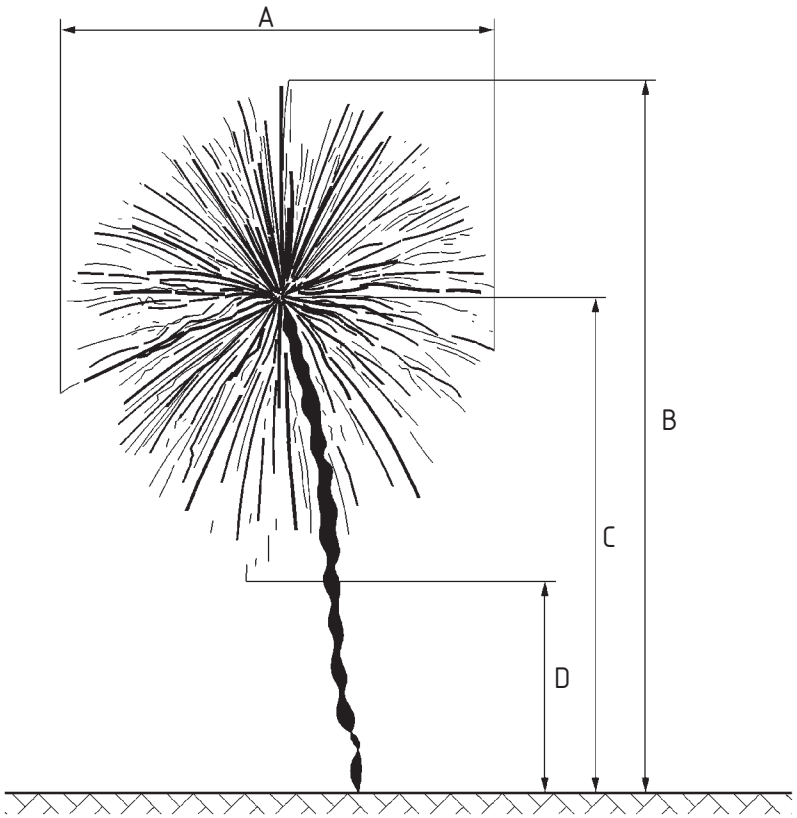
X = Type test and Batch test.

n/a = not applicable.

NOTE 1 The burst height is chosen for all effects that burst (see Figure A.1). The effect height is chosen in all other cases (see Figure A.2).

NOTE 2 For combinations, the effect/burst height is the maximum effect/burst height.

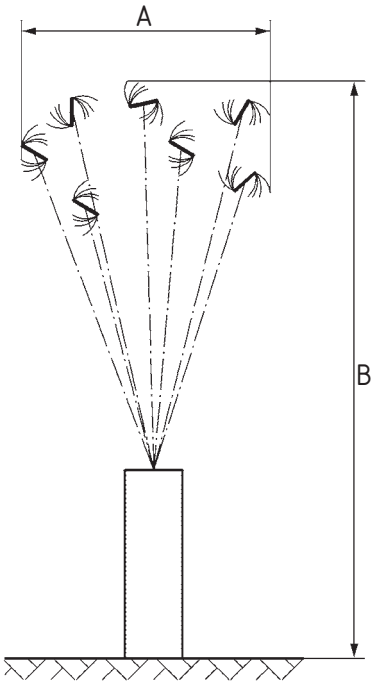
[a] Drop height will not be measured, but information will be given if the effects reach the ground.



Key

A effect width
B effect height
C rising/bursting height
D drop height

Figure A.1 — Example of burst height for shells



Key

A effect width

B effect height

Figure A.2 — Example of effect height for fountains

Annex B
(normative)

List of nonconformities for Category 4 fireworks regarding safety in functioning

Table B.1 — List of nonconformities for articles regarding safety in functioning

GENERIC TYPE	CRITICAL nonconformities	MAJOR nonconformities	MINOR nonconformities
Aerial wheel	— Explosion (in the event that the internal pressure exceeds the strength of the tubes) — Falling to the ground during functioning — No stability during flight or angle of ascent >45°	— If drivers flight from (or devices are thrown from) the wheel	
Aquatic firework	— Observed effect range is more than 30 % greater than as declared by the manufacturer	— No functioning on the water	
Combination	— As per constituents parts	— As per constituents parts	— As per constituents parts
	— Unintentional explosion leading to loss of physical integrity of the combination during functioning	— Unintentional loss of integrity (except by intended explosion) during functioning	— Interrupted ignition of the combination (not all parts/ tubes functioned)
Fountain	— Explosion (in the event that the internal pressure exceeds the strength of the tube)		
Guided firework	— Malfunction of the guided firework by separation from the guide — Unintentional explosion of the guided firework		
Mine	— Violent explosion within the mortar leading to loss of integrity of the mortar	— Incandescent or burning matter projected to the ground (if not part of the effect)	
Rocket	— No stability during flight or angle of ascent >30°	— Incandescent or burning matter falling to the ground — Explosion of the rocket at an altitude of more than 30 % below the average height	
Roman candle	— In-tube explosions leading to loss of integrity	— Incandescent or burning matter falling to the ground	— Not all effects ejected
Shell	— In-mortar explosion leading to loss of integrity of the mortar	— Incandescent or burning matter falling to the ground — Explosion of the shell at an altitude of more than 30 % below the average height	
Smoke/fog generator	— Explosion of the generator		

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