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Firework displays — General guidance

Artifices de divertissement — Lignes directrices générales

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Foreword

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

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

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

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is intended to provide guidance on the organization of fireworks displays carried out by professionals in countries where such events are not fully covered by national legislation or industry codes of practice.

The target readership for this document is the following:

- the parties involved in fireworks displays;
- the designing, operating and management personnel for fireworks displays;
- the relevant authorities in charge of monitoring fireworks displays.

The recommendations of the present guidance were drawn up with a view to improve the approach of public safety where national provisions may be inadequate. In no case they are a full guarantee against the hazards and risks of the use of fireworks. Other practices may exist leading to better results and possible revisions of the present guidance. Organizers and operators of fireworks displays should be aware that the proposed recommendations are only a step on the way toward better practices and that only risk analyses can lead to maximize public safety in real and foreseeable conditions of firing, taking into account local culture and risk acceptability and the conditions that prevail when the display is fired. The examples given in this document are provided reference for the countries where they may be applicable.

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Firework displays — General guidance

1 Scope

This document provides guidance on the operation of fireworks displays by professional teams of people with specialized knowledge. It is not applicable to the use of theatrical pyrotechnic articles on stage, in filming locations, or any other locations. It is not applicable to displays that involve only fireworks of categories 1, 2 and 3.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

fireworks displays

operations that are carried out at certain site and time, with choreography and design, by professional personnel handling and firing a certain number of fireworks such as display shells, batteries and combinations, lance fireworks, special fireworks, etc.

Note 1 to entry: This definition is also applicable to hand-fired fireworks.

3.2

display operation

operations that are related to *fireworks displays* (3.1) including installation, loading, connecting, firing system test, firing control and after show check and clean-up

3.3

electric firing device

device that delivers the firing electric current to the electric igniters of the fireworks

3.4

electric firing system

system that includes the *electric firing device* (3.3) and commands and controls the whole sequences of fireworks displays

3.5

electric igniter

electric igniting element that consists of leading wires, chips or bridge wires, ignition charge, protective paint, varnish or cover and short circuit caps or twisted bare conductors at the ends of the leading wires

3.6

effect radius

maximum horizontal distance to which the firework effect expands from the burst point

3.7

firing spot

place where a firework or group of fireworks is set and fired

3.8

firing zone

area where several *firing spots* (3.7) are located

3.9

operation zone

area where the operators carry out all operations that are necessary for preparing and setting up the *fireworks display* (3.1)

3.10

safety distance

minimum distance(s) of persons or flammable materials or obstructions from the article in the direction of the effect to reduce the risk to as low as reasonably practicable

Note 1 to entry: The notion of acceptable “risk” depends on national regulations and/or national best practices.

3.11

firing safety distance

minimum distance between the *firing zone* (3.8) and the operators of the *fireworks display* (3.1), taking into account the possible special protections that are set up

3.12

hazard zone

protection zone

area that is determined by the envelope of all safety distances of all the *firing spots* (3.7)

3.13

security zone

area where the access of unauthorised persons is forbidden by local authorities

Note 1 to entry: A security zone can be defined for the setup of the show and another security zone can be defined for the firing of the show.

Note 2 to entry: The security zone extends beyond the operation zone and may be merged with it (e.g. during the setup) or with the hazard zone (e.g. during the firing).

3.14

product group

several products to be fired in a sequence in a *firing spots* (3.7) and located at the same *firing spot* (3.7)

3.15

internal distance

minimum distance between products or *product groups* (3.14)

3.16

ground fireworks display

fireworks display (3.1) where no projected and/or propelled fireworks are fired

Note 1 to entry: For example, lancework, fountains, waterfalls, wheels etc.

3.17

aerial fireworks display

fireworks display (3.1) where projected and/ or propelled fireworks are fired

Note 1 to entry: For example, shells, rockets, batteries and combinations, Roman candles, aerial wheels etc. An aerial fireworks display may include the firing of ground effects (for example, lancework, fountains, waterfalls, wheels etc.).

4 Types, safety distance and categories of fireworks displays

4.1 Types of fireworks display

Fireworks displays are classified into two types, ground fireworks displays and aerial fireworks displays.

4.2 Safety distance

4.2.1 General

The meaning and interpretation of “safety distance” vary according to the countries and their local understanding of acceptable risk. It must be kept in mind that, whatever their definition and their calculation rules, the objective of determining safety distances is to reduce the risk to as low as reasonably practicable according to local cultures and rules.

4.2.2 Factors that should be considered for the determination of safety distances

4.2.2.1 Performance characteristics of products

The burst height of different types of firework products is one of the main factors considered to determine safety distances, but not the only one. The burst height is subject to the type and size of firework products. The larger the burst height, the larger the safety distances required. Other performance factors that could determine safety distances are the noise level of fireworks, the possibility of projections, the nature, type and weight of fallouts (e.g. rocket sticks), the nature of effects (e.g. multi-break shells).

The burst height of firework products (especially shells, rockets and aerial wheels) may be subject to limitations by local regulations.

4.2.2.2 Product installation methods

The products for fireworks displays may be installed vertically or obliquely, which is an important factor to be considered to determine safety distances. If the products are installed obliquely, the safety distances shall be increased accordingly in the direction of firing and may be reduced in the opposite direction. Appropriate software, charts or coefficients should be made available to calculate the safety distances for fireworks that are installed obliquely.

4.2.2.3 Environmental conditions

The environmental conditions for fireworks displays include wind speed and wind direction, which affect safety distances to a certain extent. The safety distance in the downwind direction should be increased according to the wind speed, as well as to the type and performance of fireworks. It may be done by application of a given additional percentage to a standard safety distance determined in reference conditions (e.g. vertical firing with a tolerance of $\pm Y^\circ$ and wind speed smaller than X m/s). The additional percentage to be applied to the safety distance should be determined on the national basis, taking into account the local definition of safety distance, the level of risks acceptable and experience, etc.

The safety distance in the upwind direction may be reduced according to real conditions.

It should be reminded that wind speed measurements close to ground level give underestimated values of the wind speed profile along the shell trajectories. Weather forecasts may be a useful source of information in the preparation of fireworks displays.

If a weather front is approaching at display time, particular protection must be taken if there is a sudden change in wind strength or direction.

4.2.2.4 Other factors

Protection measures, constructions and natural geomorphic environment should be taken into consideration, and the safety distances may be changed accordingly, depending on real conditions of firing.

4.2.3 Determination of safety distance

The safety distance should be determined by considering the factors specified in 4.2.2, and in some countries the manner the safety distance should be calculated is defined by local regulations and/or agreed professional best practices

For information, [Annex A](#) gives examples of safety distances calculated in calm atmosphere according to the methods of various countries. These methods may change in the future and the displayed values don't replace the obligation of determining safety distances according to the applicable and possibly updated methods in real conditions of use.

4.3 Categories of firework display

According to the calibre and quantity of display shells of similar effect on the same firing conditions, batteries and combinations to be fired in fireworks displays, fireworks displays may be classified in categories, see [Annex B](#) for information.

5 Operating technology of fireworks displays

5.1 Personnel

The personnel involved in fireworks displays should be a team of persons with specialist knowledge. Applicants to such knowledge assessment may participate in the preparation of fireworks displays provided that they are placed under the responsibility of persons with specialist knowledge with the appropriate limitations in the tasks they are allowed to carry out.

The setup and the firing of the fireworks displays should be placed under the responsibility of a person who has the appropriate specialist knowledge and the appropriate license (in the countries where local regulations require it).

When the size of the firework display justifies separate firing zones, each zone should be placed under the responsibility of one person who have the appropriate specialist knowledge and refer to the person responsible of the whole display or have been given the appropriate delegations to take every necessary decision.

Each country may refer to the local regulations for the specialist knowledge and corresponding training to be required for the setting and firing of fireworks displays.

5.2 Site

5.2.1 The site where the firework display is to take place should be a large unobstructed area in the foreseen directions of trajectories and effects of all projected / propelled fireworks to be used. As mentioned in 4.2.2.4, some characteristics of the site may be used for their screening effect allowing to reduce safety distances in the desired or required directions.

For aquatic fireworks, moisture-protection measures should be taken for functioning in the expected effect.

When the firing of fireworks is authorized indoors, the area should be clean, flat, well-ventilated and non-flammable. The distance between the firing spot and the audience should meet the requirements on safety distances of 4.2. The presence of a roof should give a limitation to the effect height of projected

and/ or propelled effects. In any case, the use of fireworks of categories 1, 2, 3 and 4 indoors should be submitted to local restrictions.

5.2.2 Safety distances are determined as specified in [4.2](#).

5.2.3 If appropriate, local regulations should be considered for the width of safety evacuation passageways.

5.3 Operation plan

5.3.1 Display operation plan may consist of technical design plan and/or organization and implementation plans.

5.3.2 Technical design plan may include the following content:

- a) Description of category (if any required by local regulations), types and corresponding quantities of firework articles (including calibres of shells and other projected or propelled articles), total net explosive content of the whole display, time, site and event theme of firework display;
- b) Layout diagram of the display site showing firing zones and corresponding firework products;,,
- c) Basic information of display equipment and firing methods;
- d) Hazard zone, security zone and operation zone (see [Figure 1](#)) for protection of public and property.
- e) A risk analysis is strongly recommended. Risk analysis may be mandatory by national regulations in some contexts (See [Clause 7](#)).