
**Smoke alarms using scattered light,
transmitted light or ionization**

*Détecteurs de fumée à lumière dispersée, lumière transmise
ou ionisation*

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ISO 12239:2010

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 12239 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

This second edition cancels and replaces the first edition (ISO 12239:2003), which has been technically revised.

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Introduction

This International Standard for smoke alarms is drafted on the basis of functions that are to be provided on all smoke alarms covered by this standard, and optional functions with requirements which may be provided. It is intended that the options shall be used for specific applications, as recommended in application guidelines.

Each optional function is included as a separate entity, with its own set of associated requirements, in order to permit smoke alarms covered by this standard with different combinations of functions to conform to this International Standard.

Two optional sound output levels are specified in this International Standard. The options allow national regulators to specify minimum sound output levels (70 dBA or 85 dBA) as required under national regulations.

Two optional sound output patterns are specified in this International Standard. The options allow national regulators to choose a sound pattern complying with ISO 8201 or ISO 7731 depending on the desired response by building occupants to an alarm condition.

An optional extended temperature-range test is included for smoke alarms installed in areas subject to a greater temperature range, such as leisure accommodation vehicles.

Other functions may also be provided, even if not specified in this International Standard, if they do not jeopardize any function required by this document.

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Smoke alarms using scattered light, transmitted light or ionization

IMPORTANT — Certain types of smoke alarms contain radioactive materials. The national requirements for radiation protection differ from country to country and they are not specified in this International Standard. Such smoke alarms should, however, comply with the applicable national standards, which should be consistent with the recommendations of the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD).

1 Scope

This International Standard specifies requirements, test methods, performance criteria, and manufacturer's instructions for smoke alarms that operate using scattered light, transmitted light, or ionization, and are intended for household or similar residential applications.

For the testing of other types of smoke alarms, or smoke alarms working on different principles, this International Standard should be used only for guidance. Smoke alarms with special characteristics and developed for specific risks are not covered by this International Standard.

This International Standard allows, although it does not require, the inclusion within the smoke alarm of facilities for the following:

- visual alarm condition indication, [ISO 12239:2010](https://standards.iteh.ai/catalog/standards/sist/56015186-9980-4978-941b-831e0b3650ed/iso-12239-2010)
- visual fault condition indication;
- extended temperature-range operation;
- interconnection with other similar smoke alarms or accessories;
- alarm-silencing facility.

Where such facilities are included, this International Standard specifies applicable requirements.

This International Standard does not cover devices intended for incorporation in systems using separate control and indicating equipment. Such systems are specified in all parts of ISO 7240.

2 Normative references

The following referenced documents are indispensable for the application 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 209, *Aluminium and aluminium alloys — Chemical composition*

ISO 2919, *Radiation protection — Sealed radioactive sources — General requirements and classification*

ISO 7240-3, *Fire detection and alarm systems — Part 3: Audible alarm devices*

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ISO 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 8201, *Acoustics — Audible emergency evacuation signal*

EN 50130-4, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

IEC 60065:2005, *Audio, video and similar electronic apparatus — Safety requirements*

IEC 60068-1, *Environmental testing — Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing — Part 2-1: Tests — Test A: Cold*

IEC 60068-2-2, *Environmental testing — Part 2-2: Tests — Test B: Dry heat*

IEC 60068-2-6, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

IEC 60068-2-42, *Environmental testing — Part 2-42: Tests — Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-78, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state*

IEC 60950-1:2005, *Information technology equipment — Safety — Part 1: General requirements*

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

OECD, Recommendations for ionization chamber smoke detectors in implementation of radiation protection standards. Nuclear Energy Agency, Organisation for Economic Co-operation and Development, Paris, France. 1977

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3 Terms and definitions

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

3.1

aerosol density

smoke density

amount of particulates per volume as described operationally by one of two parameters:

- m (3.9)
- y (3.18)

NOTE These parameters are not concentrations *sensu stricto*, but represent values which are proportional to the concentration and have been shown to function in lieu of a true concentration value for the purposes of these tests.

3.2

alarm condition

audible signal specified by the manufacturer as indicating the existence of a fire

3.3

alarm-silence facility

means of temporarily disabling or desensitizing a smoke alarm

3.4

battery-low condition

combination of battery voltage and series resistance which results in a fault warning

3.5**fault condition**

condition in which the smoke alarm is affected by an adverse condition of a component

3.6**fault warning**

audible signal specified by the manufacturer as indicating the existence of an actual or incipient fault that may prevent an alarm condition

3.7**interconnectable smoke alarm**

smoke alarm which may be interconnected with other smoke alarms to provide a common alarm condition

3.8**least sensitive orientation**

point of rotation, relative to air flow, about the vertical axis where a detector produces the maximum response threshold value

3.9

m

absorbance index

measured light attenuation characterizing the concentration of particulates in smoke or an aerosol

NOTE The equation for *m* is given in Annex C.

3.10**most sensitive orientation**

point of rotation, relative to air flow, about the vertical axis where a detector produces the minimum response threshold value

3.11**normal condition**

condition in which the smoke alarm is supplied with power but is not giving either an alarm condition or a fault condition, although able to give such signals if the occasion arises

3.12**primary power source**

source of power intended to supply the smoke alarm

3.13**response threshold**

A_{th}

smoke concentration at which the smoke alarm changes to its alarm condition

3.14**secondary power source**

source of power intended to supply the smoke alarm in the event that the primary power source is unavailable

3.15**smoke alarm**

device containing within one housing all the components, except possibly the power source, necessary for detecting smoke and generating an alarm condition

3.16**type A smoke alarm**

type A

smoke alarm that does not contain radioactive materials

3.17

type B smoke alarm

type B

smoke alarm containing radioactive materials

3.18

y

dimensionless variable, reflecting the change in the current flowing in an ionization chamber as a known function of the concentration of particulates in the smoke or aerosol

NOTE The equation for y is given in Annex C.

4 General requirements

4.1 Compliance

In order to comply with this International Standard, the smoke alarm shall meet the requirements of this clause, shall be tested as specified in Clause 5 and shall meet the requirements of the tests.

4.2 Alarm condition

4.2.1 Aural indicator

4.2.1.1 Signal pattern

4.2.1.1.1 Where the smoke alarm is used to alert occupants to *evacuate* the area, the alarm condition shall be the emergency evacuation signal defined in ISO 8201.

4.2.1.1.2 Where the smoke alarm is used to alert occupants to *investigate* the area for the cause of the alarm condition, the alarm condition shall be the auditory danger signal defined in ISO 7731.

4.2.1.2 Signal level — Optional function

The alarm condition aural indicator shall commence sounding at a level not greater than 45 dBA, rising gradually to the maximum level of not more than 105 dBA over a period of between 3 s to 10 s (see 5.18 and 5.19).

4.2.1.3 Signal frequency characteristics — Optional function

The audible alarm signal shall have a fundamental frequency of 520 Hz with odd harmonics to approximate a square wave.

4.2.2 Visual indicator

4.2.2.1 Interconnectable smoke alarms

Interconnectable smoke alarms shall be provided with an integral red visual indicator, by which the individual smoke alarm, when in alarm condition, may be identified. Visual indicators shall not operate on interconnected smoke alarms that have not detected smoke. This visual indicator may also perform other additional functions, but the alarm indication needs to be distinct from any additional function.

4.2.2.2 Non-interconnectable smoke alarms — Optional function

Smoke alarms that do not include an interconnection function shall be provided with an integral red visual alarm condition indicator. The indicator shall flash or be continuously illuminated when the alarm condition is present. The indicator may be combined with the fault condition visual indicator. The failure of any visual alarm condition indicator shall not prevent the alarm condition.

4.3 Mains-on visual indicator

A smoke alarm intended for connection to the a.c. mains shall be provided with a mains-on visual indicator. The indicator shall be continuously illuminated when the mains power is present. The indicator shall be green.

4.4 Fault condition visual indicator — Optional function

The smoke alarm shall be provided with an integral amber or yellow visual fault condition indicator. The indicator shall flash or be continuously illuminated when the fault condition is present. The indicator may be combined with the alarm condition visual indicator. The failure of any visual fault condition indicator shall not prevent the alarm condition.

4.5 Smoke alarm signals

The following conditions shall apply to smoke alarms which employ features in addition to the requirements of this International Standard.

- The alarm condition shall take precedence over any other signal, even when such other signal is initiated first.
- The alarm signal shall be distinctive from the signals of non-alarm condition functions. Use of a common sounder is permitted if distinctive signals are obtained.
- If an aural fault condition is provided, it shall be distinctive from alarm condition signals but may be common to all functions employed.
- Any fault condition associated with features, in addition to the requirements of this International Standard, shall not interfere with the operation and supervision of the smoke alarm.

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4.6 Test facility <https://standards.iteh.ai/catalog/standards/sist/56015186-9980-4978-941b-831e0b3650ed/iso-12239-2010>

A test facility shall be provided to simulate the ability of the sensing assembly to detect the presence of smoke. The test facility shall be accessible from outside the smoke alarm when installed as specified in the installation instructions.

4.7 Means of calibration

The manufacturer's means of calibration shall not be readily adjustable after manufacture.

4.8 User-replaceable components

Except for batteries or fuses, a smoke alarm shall have no user-replaceable or serviceable components.

4.9 Primary power source

4.9.1 General

The primary power source of the smoke alarm may be internal or external to the smoke alarm housing.

4.9.2 Internal

Where the primary power source is internal to the smoke alarm, the source shall meet the following requirements:

- a) be capable of supplying the quiescent load of the smoke alarm together with the additional load resulting from weekly operation of the test facility of 10 s for at least 1 year before the battery-low condition is given;

- b) provide a distinctive battery-low condition before the battery is incapable of operating for alarm condition purposes (see 5.17);
- c) at the point when a battery-low condition commences, have sufficient capacity for the smoke alarm to produce an alarm condition, as specified in 5.18 or 5.19 as appropriate, for at least 4 min or, in the absence of smoke, a battery-low condition for at least 30 d;
- d) be replaceable by the user, unless the power-source operating life in the smoke alarm is 10 years or greater.

In the absence of suitable test procedures to verify battery capacity, data concerning the smoke-alarm loads and the battery characteristics shall be provided by the manufacturer to indicate that the above requirement can be met.

4.9.3 External

Where the primary power source is external to the smoke alarm, an internal or external secondary power source shall be provided (see 4.10).

4.10 Secondary power source

4.10.1 General

4.10.1.1 For smoke alarms intended for connection to an external primary power source, a secondary power source shall be provided and the following requirements shall apply.

- a) Primary-cell secondary power source: the secondary power source shall be capable of meeting the requirements of 4.9.2.
- b) Rechargeable-cell secondary power source: the secondary power source shall be capable of supplying the quiescent load of the smoke alarm for a minimum period of 72 h, followed by an alarm condition as specified in 5.18 or 5.19 as appropriate, for at least 4 min in the event of fire or, in the absence of smoke, a fault warning for at least 24 h.

4.10.1.2 In the absence of suitable test procedures to verify the secondary power source, data concerning the smoke alarm loads and the secondary facility characteristics shall be provided by the manufacturer to indicate that the above requirements can be met.

4.10.2 Monitoring of secondary power source

The secondary power source shall be monitored for fault conditions. These conditions shall include battery-low condition and open- and short-circuit failure of the secondary power source.

4.11 Battery connections

4.11.1 Except where a polarized connector is used, lead or terminal connections to batteries shall be identified with the correct polarity (e.g. plus or minus). The polarity may be indicated on the unit adjacent to the battery terminals or leads.

4.11.2 Any leads connecting the terminal connectors of batteries in smoke alarms to the smoke-alarm circuit board shall be provided with strain-relieving devices adjacent to both battery terminal connectors and the smoke alarm circuit board so that when the leads are subjected to a pull of 20 N without jerks for 1 min in any direction allowed by the design, the pull is not transmitted to the joints between the leads and the battery terminal connectors or between the leads and the smoke alarm circuit board.

4.12 User-replaceable battery

4.12.1 General

Removal and replacement of user-replaceable batteries shall not require the use of tools.

4.12.2 Indication

The removal of any user-replaceable battery shall result in a visual, mechanical or aural warning that the battery has been removed. The visual warning shall not depend upon a power source.

Conformity may be achieved by, but is not restricted to, one of the following examples:

- a warning flag that will be exposed with the battery removed and the cover closed;
- a hinged cover or battery compartment that cannot be closed when the battery is removed;
- a unit that cannot be replaced upon its mounting base/bracket with the battery removed.

4.13 Electrical safety

The apparatus shall be designed and constructed so as to present no danger, either in normal use or under fault conditions, as determined by 5.26.

4.14 Connection of external ancillary devices

The smoke alarm may provide for connections to external ancillary devices (e.g. remote indicators, control relays, transmitters). Open- or short-circuit failure of these connections shall not prevent the correct operation of the smoke alarm.

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4.15 Terminals for external conductors

4.15.1 The smoke alarm or base, as appropriate, if intended to have external connections, shall provide for the connection of conductors by means of screws, nuts or equally effective devices.

4.15.2 For mains-powered smoke alarms which utilize a “flying lead”-type connector, the connector shall be regarded as a conductor. “Flying lead”-type connectors shall be subjected to a pull test, such that when the connector is subjected to a pull of 20 N without jerks for 1 min in any direction allowed by the design, the connector does not become detached.

4.15.3 If terminals are provided, they shall allow the connection of conductors having nominal cross-sectional areas of between 0,4 mm² and 1,5 mm². Terminals shall be designed so that they clamp the conductor between metal surfaces without rotation of those surfaces but with sufficient contact pressure and without damage to the conductor. Disconnection of the conductors, or access to the conductors for disconnection, shall not be possible without the use of a tool.

4.16 Protection against the ingress of foreign bodies

The smoke alarm shall be so designed that a sphere of diameter larger than (1,3 ± 0,05) mm cannot pass into the sensor chamber(s).

NOTE This requirement is intended to restrict the access of insects into the sensitive parts of the smoke alarm. It is known that this requirement is not sufficient to prevent the access of all insects; however, it is considered that extreme restrictions on the size of the access holes may introduce the danger of clogging by dust, etc. It may, therefore, be necessary to take other measures.

4.17 Interconnectable smoke alarms — Optional function

If a means of connecting a number of smoke alarms to give a common alarm condition is provided, the following shall apply.

- a) The audible alarm condition shall be emitted by all of the interconnecting smoke alarms when smoke is detected by any of the interconnected smoke alarms.
- b) If the smoke alarms are provided with an alarm-silence facility, initiation of the alarm-silence period of one of the smoke alarms shall not prevent the audible alarm condition being emitted by that smoke alarm when smoke is detected by any of the other smoke alarms.
- c) The interconnection of the maximum number of smoke alarms allowed by the manufacturer shall not have a significant effect on the sensitivity of the smoke alarms nor on their ability to meet the battery capacity (see 5.17) or sound output requirements (see 5.18 or 5.19 as applicable).
- d) For battery-operated smoke alarms, open- or short-circuits of the interconnecting leads either shall not prevent the smoke alarms from functioning individually or shall result in an alarm condition or fault condition.

This requirement does not apply to mains- or mains/battery-supplied smoke alarms for which the supply and interconnect wiring should be installed in accordance with the appropriate national regulations.

4.18 Alarm-silence facility — Optional function

If means of temporarily disabling or desensitizing a smoke alarm are provided, the following shall apply.

- a) The initiation of the alarm-silence period shall require the operation of a manual control. This control may be the same as a manual control provided for the test facility (see 4.6). This control may be integral or separate to the smoke alarm.
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- b) Operation of the alarm-silence control shall disable or desensitize the smoke alarm for at least 5 min. The sensitivity of the smoke alarm shall be restored within 15 min of operation of the alarm-silence control. If the alarm-silence period is adjustable, it shall not be possible to set it to less than 5 min or to more than 15 min.
- c) Continuous operation of the alarm-silence control shall not lead to the smoke alarm being disabled or desensitized for more than 15 min without an alarm condition, a fault warning occurring.

NOTE This requirement is intended to prevent the permanent loss of sensitivity due to accidental or deliberate jamming of the control.

4.19 Radioactive material in type B smoke alarms

4.19.1 Direct contact with radioactive sources shall not be possible without the use of tools.

4.19.2 Radioactive sources shall be sealed in compliance with the relevant requirements of ISO 2919, with a minimum classification of C32222.

4.19.3 The normal activity of the radio-nuclide shall be not more than 37 kBq. Radium-226 shall not be used.

4.20 Smoke alarms with voice — Optional function

4.20.1 Smoke alarms using voice messages shall be capable of producing an audible warning signal and a voice message or messages.

4.20.2 All messages related to fire safety shall be declared by the manufacturer and shall be considered by the testing authority. The message determined to be worst case shall be subject to a conformance assessment.

When selecting the worst case message, message length, loudness and repetition timing should be considered.

4.20.3 For messages that require immediate action, the warning signal and message sequence broadcast by the device shall be within the following limits:

- a) warning signal, lasting for 2 s to 10 s; followed by
- b) silence, lasting for 0,25 s to 2 s; followed by
- c) voice message; followed by
- d) silence, lasting for 0,25 s to 5 s.

The time for each cycle shall not exceed 30 s.

The periods of silence may need to be longer than indicated in certain circumstances, for example in spaces with long reverberation times, but shall not be such that the time between the start of each cycle exceeds 30 s.

NOTE For other messages, it is permitted to extend either the silence period after the voice message or the period within which the message is repeated, or both.

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4.21 Marking

4.21.1 Smoke-alarm

4.21.1.1 Each smoke alarm shall be legibly and indelibly marked with the following:

- a) the number and date of this International Standard (i.e. ISO 12239:2010);
- b) the name or trademark and address of the manufacturer or supplier;
- c) the model designation (type or number);
- d) the type of smoke alarm (type A or type B) and an explanation of the meaning of the type designation;
- e) the nominal sound level output as measured in 5.18 or 5.19 as appropriate;
- f) the aural alarm condition signal (ISO 8201 or ISO 7731);
- g) the date of manufacture or the batch number;
- h) the manufacturer's recommended date for replacement, subject to normal, regular maintenance (provision may be made for a place to note the date of change of the smoke alarm);
- i) for smoke alarms incorporating user-replaceable batteries, the type and number of batteries recommended by the manufacturer and the following instruction to the user, which shall be visible during the operation of changing the batteries:

“Test the smoke alarm for correct operation using the test facility whenever the battery is replaced”