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Fire detection and alarm systems —

Part 22: Smoke-detection equipment for ducts

Systèmes de détection et d'alarme d'incendie —

Partie 22: Équipement de détection des fumées dans les conduits

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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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document 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 7240-22:2007), which has been technically revised.

The main changes compared to the previous edition are as follows:

— in 5.16 (electromagnetic compatibility immunity tests), EN 50130-4 has been replaced by IEC 62599-2;

— marking has been moved to a new Clause 7;

— data and software requirements have been moved to Clause 8.

A list of all parts in the ISO 7240 series can be found in the ISO website.

Introduction

Smoke-detection equipment for ducts (SDED) is used as part of a fire detection system to sample the environment within air ducts of a building. Detection of smoke releases a signal to the connected control and indicating equipment and can be used as a signal to an air-handling system to prevent the spread of smoke within the building.

SDED is required to function satisfactorily not only in the event of a fire, but also during and after exposure to conditions likely to be met in practice such as corrosion, vibration, direct impact, indirect shock and electromagnetic interference. Some tests specified are intended to assess the performance of the SDED under such conditions.

The performance of SDED is assessed from results obtained in specific tests. This document is not intended to place any other restrictions on the design and construction of such equipment.

Fire detection and alarm systems —

Part 22: Smoke-detection equipment for ducts

1 Scope

This document specifies requirements, test methods and performance criteria for smoke-detection equipment for ducts (SDED) for use in fire detection and alarm systems installed in buildings (see ISO 7240-1).

The SDED samples the air from a duct and detects smoke in the sample.

NOTE 1 A common method of operation is to use differential pressure arising from airflow in the duct.

The SDED can use smoke detectors complying with ISO 7240-7 or other detectors complying with tests specified in this document.

A common application for SDED is to detect visible smoke, for which detectors using scattered light or transmitted light can be more suitable. However, requirements for detectors using ionization are also included in this document for use in applications where detection of less visible fire aerosols is desired.

For the testing of other types of smoke detectors or smoke detectors working on different principles, this document can be used for guidance. Smoke detectors with special characteristics, developed for specific risks, are not covered.

NOTE 2 Certain types of detectors contain radioactive materials. The national requirements for radiation protection differ from country to country and are not specified in this document.

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 209, *Aluminium and aluminium alloys — Chemical composition*

ISO 7240-1, *Fire detection and alarm systems — Part 1: General and definitions*

ISO 7240-7:2011, *Fire detection and alarm systems — Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization*

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

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

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

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

IEC 60068-2-27, *Environmental testing — Part 2: Test Ea and guidance: Shock*

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

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

IEC 62599-2, *Alarm systems — Part 2: Electromagnetic compatibility — Immunity requirements for components of fire and security alarm systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7240-1 and the following 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

3.1
response threshold value
A_{th}
aerosol density in the proximity of the specimen at the moment that it generates an alarm signal, when tested as specified in 5.1.5

Note 1 to entry: The response threshold value may depend on signal processing in the detector and in the control and indicating equipment.

4 Requirements

4.1 Compliance

In order to comply with this document, the SDED shall:

a) meet the requirements of Clause 4, which shall be verified by visual inspection or engineering assessment;

b) be tested as specified in Clause 5, and shall meet the requirements of the tests;

c) meet the requirements of Clauses 7 and 8, which shall be verified by visual inspection.

4.2 Visual alarm indication

4.2.1 Each SDED shall be provided with a red visual indicator, by which the SDED can be identified when the associated detector releases an alarm and which remains illuminated until the alarm condition is reset. Where other conditions of the SDED can be visually indicated, they shall be clearly distinguishable from the alarm indication, except when the SDED is switched into a service mode. The alarm indicator may be the smoke detector indicator provided the indicator is visible when the detector is *in situ* as part of the SDED.

4.2.2 The visual indicator shall be visible from a distance of 6 m in an ambient light intensity up to 500 lx at an angle of up to

a) 5° from the axis of the detector in any direction, and

b) 45° from the axis of the detector in at least one direction.

4.3 Connection of ancillary devices

The SDED may provide for connections to ancillary devices (remote indicators, control relays, etc.), but open- or short-circuit failures of these connections shall not prevent the correct operation of the SDED.

4.4 Monitoring of detachable detectors

For detachable detectors, a means shall be provided for a remote monitoring system (e.g. the fire detection control and indicating equipment) to detect the removal of the head from the base, in order to give a fault signal.

4.5 Manufacturer's adjustments

It shall not be possible to change the manufacturer's settings except by special means (e.g. the use of a special code or tool) or by breaking or removing a seal.

4.6 On-site adjustment of response behaviour

4.6.1 If there is provision for on-site adjustment of the response behaviour of the SDED, then

a) for all of the settings at which the manufacturer claims compliance with this document, the SDED shall comply with the requirements of this document and access to the adjustment means shall be possible only by the use of a code or special tool or by removing the SDED from its base or mounting;

b) any setting(s) at which the manufacturer does not claim compliance with this document shall be accessible only by the use of a code or special tool, and it shall be clearly marked on the SDED or in the associated data that if these setting(s) are used, the SDED does not comply with this document.

4.6.2 These adjustments may be carried out at the SDED, the detector or the control and indicating equipment.

4.7 Requirements for software-controlled smoke-detection equipment for ducts

4.7.1 General

The requirements of 4.7.2 and 4.7.3 shall be met for SDED that rely on software control in order to fulfil the requirements of this document.

4.7.2 Software design

In order to ensure the reliability of the SDED, the following requirements for software design shall apply.

a) The software shall have a modular structure.

b) The design of the interfaces for manually and automatically generated data shall not permit invalid data to cause an error in the program operation.

c) The software shall be designed to avoid the occurrence of deadlock of the program flow.

4.7.3 Storage of programs and data

4.7.3.1 The program necessary to comply with this document and any preset data, such as manufacturer's settings, shall be held in non-volatile memory. Writing to areas of memory containing this program and data shall be possible only by the use of some special tool or code and shall not be possible during normal operation of the detector.

4.7.3.2 Site-specific data shall be held in memory that retains data for at least two weeks without external power to the SDED, unless provision is made for the automatic renewal of such data, following loss of power, within 1 h of power being restored.

5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

Unless otherwise stated in a test procedure, the testing shall be carried out after the test specimen has been allowed to stabilize in the standard atmospheric conditions for testing as described in IEC 60068-1 as follows:

— temperature: (15 to 35) °C;

— relative humidity: (25 to 75) %;

— air pressure: (86 to 106) kPa.

The temperature and humidity shall be substantially constant for each environmental test where the standard atmospheric conditions are applied.

5.1.2 Mounting arrangements

Mount the specimen by its normal means of attachment in accordance with the manufacturer's instructions. If these instructions describe more than one method of mounting, then the method considered to be least favourable shall be chosen for each test.

5.1.3 Operating conditions for tests

5.1.3.1 If a test method requires a specimen to be operational, then the specimen shall be connected to suitable supply and monitoring equipment with characteristics as required by the manufacturer's data. Unless otherwise specified in the test method, the supply parameters applied to the specimen shall be set within the manufacturer's specified range(s) and shall remain substantially constant throughout the tests. The value chosen for each parameter shall normally be the nominal value or the mean of the specified range. If a test procedure requires a specimen to be monitored to detect any alarm or fault signals, then connections shall be made to any necessary ancillary devices (e.g. through wiring to an end-of-line device for collective detectors) to allow a fault signal to be recognized.

5.1.3.2 The details of the supply and monitoring equipment and the alarm criteria used shall be given in the test report (Clause 6).

5.1.4 Tolerances

5.1.4.1 Unless otherwise stated, the tolerances for the environmental test parameters shall be as given in the basic reference standards for the test (e.g. the relevant part of IEC 60068).

5.1.4.2 If a specific tolerance or deviation limit is not specified in a requirement or test procedure, then a tolerance of ±5 % shall be applied.

5.1.5 Response threshold value

5.1.5.1 Install the specimen for which the response threshold value, A_{th}, is being measured in the smoke tunnel described in Annex A, in its normal operating position, by its normal means of attachment.

NOTE This measurement can be taken only where the sampling apparatus of the SDED can fit inside the smoke tunnel. Where the sampling apparatus is too large, it will be necessary to agree on other arrangements with the manufacturer.

5.1.5.2 Before commencing each measurement, purge the smoke tunnel to ensure that the tunnel and the specimen are free from the test aerosol.

5.1.5.3 Unless otherwise specified in the test procedure, the air temperature in the tunnel shall be (23 ± 5) °C and shall not vary by more than 5 K for all the measurements on a particular SDED type.

5.1.5.4 Connect the specimen to its supply and monitoring equipment as specified in 5.1.3, and allow it to stabilize for a period of at least 15 min, unless otherwise specified by the manufacturer.

5.1.5.5 Introduce the test aerosol, as specified in Annex B, into the tunnel such that the rate of increase of aerosol density is as follows:

— for SDED incorporating detectors using scattered or transmitted light, in decibels per metre per minute, as shown in Formula (1):

$$0{,}015 < \frac{\Delta m}{\Delta t} < 0{,}1 \tag{1}$$

— for SDED incorporating detectors using ionization, per minute, as shown in Formula (2):

$$0{,}05 < \frac{\Delta y}{\Delta t} < 0{,}3 \tag{2}$$

NOTE These ranges are intended to allow the selection of a convenient rate, depending upon the sensitivity of the SDED, so that a response can be obtained in a reasonable time.

5.1.5.6 The rate of increase in aerosol density shall be similar for all measurements on a particular SDED type.

5.1.5.7 Conduct tests on the SDED specimen at each of the following air velocities:

a) the minimum specified by the manufacturer;

b) the maximum specified by the manufacturer;

c) the mean of the minimum and maximum.

5.1.5.8 The response threshold value is the aerosol density (in terms of m or y) at the moment that the specimen gives an alarm at each air velocity. This shall be recorded as m, expressed in decibels per metre, for detectors using scattered or transmitted light, or as y for detectors using ionization (as specified in Annex C).

5.1.5.9 Designate the greater of the response threshold value as y_{max} or m_{max} for each air velocity; the lesser as y_{min} or m_{min} for each air velocity.

5.1.6 Provision for tests

5.1.6.1 The following shall be provided for testing compliance with this document:

a) 13 SDED specimens;

b) data required in Clause 8.

5.1.6.2 The specimens submitted shall be deemed representative of the manufacturer's normal production with regard to their construction and calibration. This implies that the mean response threshold value of the 12 specimens found in the reproducibility test (5.3) should also represent the

production mean, and that the limits specified in the response threshold value test should also be applicable to the manufacturer's production.

5.1.7 Test schedule

The specimens shall be tested according to the test schedule given in Table 1. After the reproducibility test, number the two least sensitive specimens (i.e. those with the highest response thresholds) 12 and 13, and the others 1 to 11 arbitrarily.

Table 1 — Test schedule

Test	Subclause	Specimen number(s)
Repeatability	5.2	One chosen arbitrarily
Reproducibility	5.3	All specimens
Variation of supply parameters[a]	5.4	1
Dazzling[b]	5.5	2
Dry heat (operational)	5.6	3
Cold (operational)	5.7	4
Damp heat, steady-state (operational)	5.8	5
Damp heat, steady-state (endurance)	5.9	6
Sulfur dioxide, SO_2, corrosion (endurance)	5.10	7
Shock (operational)	5.11	8
Impact (operational)	5.12	9
Vibration, sinusoidal (operational)	5.13	10
Vibration, sinusoidal (endurance)	5.14	10
Air leakage[c]	5.15	7, 10
Electromagnetic compatibility (EMC), Immunity tests (operational)	5.16	11
Fire sensitivity	5.17	12, 13

[a] This test duplicates a test undertaken as part of the assessment of point type smoke detectors for conformance to ISO 7240-7. Where the SDED includes a smoke detector conforming to ISO 7240-7 and does not include any additional active electronic components, this test may be omitted.

[b] This test only applies to detectors using scattered or transmitted light principle of operation. Where the SDED includes a smoke detector conforming to ISO 7240-7 or the sensing element is mounted within an opaque enclosure, this test may be omitted.

[c] Air leakage test is undertaken after the corrosion test and the vibration tests.

5.1.8 Test report

The test results shall be reported in accordance with Clause 6.

5.2 Repeatability

5.2.1 Object of test

To show that the SDED has stable behaviour with respect to its sensitivity even after a number of alarm conditions.

5.2.2 Test procedure

5.2.2.1 Mount the specimen to be tested as specified in 5.1.2 and connect to the supply and monitoring equipment specified in 5.1.3.

5.2.2.2 Measure the response threshold value of the specimen to be tested six times for each air velocity as specified in 5.1.5.

5.2.2.3 Designate the maximum response threshold value as y_{max} or m_{max} for each air velocity, the minimum value as y_{min} or m_{min} for each air velocity.

5.2.3 Requirements

5.2.3.1 The ratio of the response threshold values, $y_{max} : y_{min}$ or $m_{max} : m_{min}$, shall not be greater than 1,6 for each air velocity.

5.2.3.2 The lower response threshold value, y_{min}, shall not be less than 0,2, or m_{min} shall not be less than 0,05 dB/m.

5.3 Reproducibility

5.3.1 Object of test

To show that the sensitivity of the SDED does not vary unduly from specimen to specimen and to establish response threshold value data for comparison with the response threshold values measured after the environmental tests.

5.3.2 Test procedure

5.3.2.1 Mount the specimen to be tested as specified in 5.1.2 and connect to the supply and monitoring equipment specified in 5.1.3.

5.3.2.2 Measure the response threshold value of each of the test specimens for each air velocity as specified in 5.1.5.

5.3.2.3 Calculate the mean of these response threshold values for each air velocity, which shall be designated as $\bar{y}$ or $\bar{m}$.

5.3.2.4 Designate the maximum response threshold value as y_{max} or m_{max} and the minimum value as y_{min} or m_{min} for each air velocity.

5.3.3 Requirements

5.3.3.1 The ratio of the response threshold values, $y_{max} : \bar{y}$ or $m_{max} : \bar{m}$, shall not be greater than 1,33 for each air velocity, and the ratio of the response threshold values, $\bar{y} : y_{min}$ or $\bar{m} : m_{min}$, shall not be greater than 1,5 for each air velocity.

5.3.3.2 The lower response threshold value, y_{min}, shall not be less than 0,2, or m_{min} shall not be less than 0,05 dB/m.

5.4 Variation in supply parameters

5.4.1 Object of test

To show that, within the specified range(s) of the supply parameters (e.g. voltage), the sensitivity of the SDED is not unduly dependent on these parameters.