INTERNATIONAL STANDARD

ISO 7240-22

First edition
2007-05-15

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

Reference number
ISO 7240-22:2007(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 7240-22 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

ISO 7240 consists of the following parts, under the general title *Fire detection and alarm systems*:

— *Part 1: General and definitions*

— *Part 2: Control and indicating equipment*

— *Part 4: Power supply equipment*

— *Part 5: Point-type heat detectors*

— *Part 6: Carbon monoxide fire detectors using electro-chemical cells*

— *Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization*

— *Part 8: Carbon monoxide fire detectors using an electro-chemical cell in combination with a heat sensor*

— *Part 9: Test fires for fire detectors* [Technical specification]

— *Part 10: Point-type flame detectors*

— *Part 11: Manual call points*

— *Part 12: Line type smoke detectors using a transmitted optical beam*

— *Part 13: Compatibility assessment of system components*

— *Part 14: Guidelines for drafting codes of practice for design, installation and use of fire detection and fire alarm systems in and around buildings* [Technical report]

— *Part 15: Point type fire detectors using scattered light, transmitted light or ionization sensors in combination with a heat sensor*

— *Part 16: Sound system control and indicating equipment*

— *Part 19: Design, installation, commissioning and service of sound systems for emergency purposes*

— *Part 21: Routing equipment*

— *Part 22: Smoke-detection equipment for ducts*

The following parts are under preparation:

— *Part 26, dealing with oil-mist detectors*

— *Part 27, dealing with carbon fire detectors using optical or ionization smoke sensors, electrochemical cell carbon monoxide sensors and heat sensors*

— *Part 28, dealing with fire protection control equipment*

Introduction

Smoke-detection equipment for ducts (s.d.e.d.) 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.

A fire-detection and alarm system 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 s.d.e.d. under such conditions.

The performance of s.d.e.d. is assessed from results obtained in specific tests. This part of ISO 7240 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 part of ISO 7240 specifies requirements, test methods and performance criteria for smoke-detection equipment for ducts (s.d.e.d.) for use in fire-detection and fire alarm systems installed in buildings; see ISO 7240-1.

The s.d.e.d. 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 s.d.e.d. can use smoke detectors complying with ISO 7240-7 or other detectors complying with tests specified in this part of ISO 7240.

A common application for s.d.e.d. 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 part of ISO 7240 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 part of ISO 7240 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 part 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 209-1, *Wrought aluminium and aluminium alloys — Chemical composition and forms of products — Part 1: Chemical composition*

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

ISO 7240-7:2003, *Fire detection and fire 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 60068-2-27:1987, *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*

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

3.1
response threshold value
A_{th}
aerosol concentration in the proximity of the specimen at the moment that it generates a signal which indicates the presence of smoke, when tested as specified in 5.1.5

NOTE The response threshold value may depend on signal processing in the detector and in the control and indicating equipment.

3.2
smoke-detection equipment for ducts
s.d.e.d.
apparatus with an integral or associated point-type smoke detector that samples the air moving in a duct and detects smoke in the sample

4 General requirements

4.1 Compliance

In order to comply with this part of ISO 7240, the s.d.e.d. shall meet the requirements in 4.2 to 4.8, which shall be verified by visual inspection or engineering assessment, shall be tested as described in Clause 5 and shall meet the requirements of these tests.

4.2 Visual alarm indication

Each s.d.e.d. shall be provided with a red visual indicator, by which the s.d.e.d. 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 s.d.e.d. can be visually indicated, they shall be clearly distinguishable from the alarm indication, except when the s.d.e.d. 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 s.d.e.d.

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 s.d.e.d. 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 s.d.e.d.

4.4 Monitoring of detachable detectors

For detachable detectors, a means shall be provided for a remote monitoring system (e.g. the 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

If there is provision for on-site adjustment of the response behaviour of the s.d.e.d., then

a) for all of the settings at which the manufacturer claims compliance with this part of ISO 7240, the s.d.e.d. shall comply with the requirements of this part of ISO 7240 and access to the adjustment means shall be possible only by the use of a code or special tool or by removing the s.d.e.d. from its base or mounting;

b) any setting(s) at which the manufacturer does not claim compliance with this part of ISO 7240 shall be accessible only by the use of a code or special tool, and it shall be clearly marked on the s.d.e.d. or in the associated data that if these setting(s) are used, the s.d.e.d. does not comply with this part of ISO 7240.

These adjustments may be carried out at the s.d.e.d., the detector or the control and indicating equipment.

4.7 Marking

Each s.d.e.d. shall be clearly marked with the following information:

a) number of this part of ISO 7240 (i.e. ISO 7240-22);

b) name or trademark of the manufacturer or supplier;

c) model designation (type or number);

d) wiring-terminal designations;

e) some mark(s) or code(s) (e.g. serial number or batch code), by which the manufacturer can identify at least the date or batch and place of manufacture, and the version number(s) of any software contained within the s.d.e.d.

Where any marking on the s.d.e.d. uses symbols or abbreviations not in common use, then these should be explained in the data supplied with the device.

The marking shall be visible during installation of the s.d.e.d. and shall be accessible during maintenance.

The markings shall not be placed on screws or other easily removable parts.

4.8 Data

Either the s.d.e.d. shall be supplied with sufficient technical, installation and maintenance data to enable correct installation and operation or, if all of this data is not supplied with each s.d.e.d. unit, reference to the appropriate data sheet shall be given on, or with, each s.d.e.d. unit. These data shall include

— the range of operating differential pressures between the inlet and outlet sampling tubes and the recommended method for measuring the pressures,

— the range of operating duct air velocities,

— the range of applicable duct sizes for specific sampling tube lengths, and

— the models of point smoke detectors for which the s.d.e.d. meets the requirements of this part of ISO 7240.

NOTE Additional information can be required by organizations certifying that s.d.e.d. units produced by a manufacturer conform to the requirements of this part of ISO 7240.

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

4.9.1 General

The requirements of 5.8.2 and 5.8.3 shall be met for s.d.e.d. that rely on software control in order to fulfil the requirements of this part of ISO 7240.

4.9.2 Software documentation

4.9.2.1 The manufacturer shall submit documentation that gives an overview of the software design. This documentation shall be in sufficient detail for the design to be inspected for compliance with this part of ISO 7240 and shall include at least the following:

a) functional description of the main program flow (e.g. as a flow diagram or structogram) including

   1) a brief description of the modules and the functions that they perform,

   2) the way in which the modules interact,

   3) the overall hierarchy of the program,

   4) the way in which the software interacts with the hardware of the detector, and

   5) the way in which the modules are called, including any interrupt processing;

b) description of which areas of memory are used for the various purposes (e.g. the program, site-specific data and running data);

c) designation by which the software and its version can be uniquely identified.

4.9.2.2 The manufacturer shall have available detailed design documentation, which needs to be provided only if required by the testing authority. It shall be comprised of at least the following:

a) overview of the whole system configuration, including all software and hardware components;

b) description of each module of the program, containing at least

   1) the name of the module,

   2) a description of the tasks performed, and

   3) a description of the interfaces, including the type of data transfer, the valid data range and the checking for valid data;

c) full source-code listings, as hard copy or in machine-readable form (e.g. ASCII-code), including all global and local variables, constants and labels used, and sufficient comment for the program flow to be recognized;

d) details of any software tools used in the design and implementation phase (e.g. CASE-Tools, Compilers etc.).

4.9.3 Software design

In order to ensure the reliability of the s.d.e.d., 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.

4.9.4 The storage of programs and data

The program necessary to comply with this part of ISO 7240 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.

Site-specific data shall be held in memory that retains data for at least two weeks without external power to the s.d.e.d., 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 Operating conditions for tests

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.

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

5.1.3 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.

5.1.4 Tolerances

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).

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

5.1.5 Response threshold value

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 s.d.e.d. can fit inside the smoke tunnel. Where the sampling apparatus is too large, it will be necessary to agree other arrangements with the manufacturer.

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

Unless otherwise specified in the test procedure, the air temperature in the tunnel shall be (23 $\pm$ 5) °C and shall not vary by more than 5 K for all the measurements on a particular s.d.e.d. type.

Connect the specimen to its supply and monitoring equipment as specified in 5.1.2, and allow it to stabilize for a period of at least 15 min, unless otherwise specified by the manufacturer.

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 s.d.e.d. incorporating detectors using scattered or transmitted light, in decibels per metre per minute: $0{,}015 \leqslant \frac{\Delta m}{\Delta t} \leqslant 0{,}1$;

— for s.d.e.d. incorporating detectors using ionization, per minute: $0{,}05 \leqslant \frac{\Delta y}{\Delta t} \leqslant 0{,}3$.

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

The rate of increase in aerosol density shall be similar for all measurements on a particular s.d.e.d. type.

Conduct tests on the s.d.e.d. specimen at each of the following air velocities:

a) the minimum specified by the manufacturer,

b) the maximum specified by the manufacturer, and

c) the mean of the minimum and maximum.

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 (see Annex C).

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

The following shall be provided for testing compliance with this part of ISO 7240:

a) 13 s.d.e.d. specimens;

b) data required in 4.7.

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 twelve 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 s.d.e.d. 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 s.d.e.d. 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.