BS ISO 7240-15:2014

BSI Standards Publication

Fire detection and alarm systems

Part 15: Point-type fire detectors using smoke and heat sensors

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National foreword

This British Standard is the UK implementation of ISO 7240-15:2014. It supersedes BS ISO 7240-15:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee FSH/12/2, Fire detectors.

A list of organizations represented on this committee can be obtained on request to its secretary.

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INTERNATIONAL STANDARD

ISO 7240-15

Second edition
2014-07-01

Fire detection and alarm systems —

Part 15: Point-type fire detectors using smoke and heat sensors

Systèmes de détection et d'alarme d'incendie —

Partie 15: Détecteurs linéaires de fumée utilisant une transmission par faisceaux lumineux

Reference number
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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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is 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 7240-15:2004), which has been technically revised.

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 3: Audible alarm devices*

— *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*

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— *Part 14: Design, installation, commissioning and service of fire detection and fire alarm systems in and around buildings*

— *Part 15: Point-type fire detectors using smoke and heat sensors*

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

— *Part 17: Short-circuit isolators*

— *Part 18: Input/output devices*

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

— *Part 20: Aspirating smoke detectors*

— *Part 21: Routing equipment*

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

— *Part 23: Visual alarm devices*

— *Part 24: Sound-system loudspeakers*

— *Part 25: Components using radio transmission paths*

— *Part 27: Point-type fire detectors using a scattered-light, transmitted-light or ionization smoke sensor, an electrochemical-cell carbon-monoxide sensor and a heat sensor*

— *Part 28: Fire protection control equipment*

The following part is under preparation:

— *Part 29: Video fire detectors*

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Introduction

This part of ISO 7240 is prepared by ISO/TC 21/SC 3, the secretariat of which is held by SA, and is based on ISO 7240-15:2004.

Point-type fire detectors using smoke and heat sensors are general purpose fire detectors for installation in and around buildings. Multi-sensor detectors respond to a broad range of fires and can be designed to achieve high stability against deceptive phenomena that can result in unwanted alarms.

A fire detection and alarm system is required to function satisfactorily not only in the event of fire, but also during and after exposure to conditions it is likely to meet in practice, including corrosion, vibration, direct impact, indirect shock and electromagnetic interference. Specific tests are intended to assess the performance of detectors under such conditions.

This edition introduces a requirement that smoke sensors that operate on the principle of scattered or transmitted light to be marked with one of two possible nominal response threshold bands. The availability of two of response threshold bands provides installation designers with a detector selection choice to further reduce the risk of unwanted alarms in installations where unfavourable environmental conditions are present.

This edition introduces additional requirements for smoke detectors with more than one smoke sensor.

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INTERNATIONAL STANDARD **ISO 7240-15:2014(E)**

Fire detection and alarm systems —

Part 15: Point-type fire detectors using smoke and heat sensors

1 Scope

This part of ISO 7240 specifies requirements, test methods, and performance criteria for point-type fire detectors using smoke and heat sensors, incorporating in one mechanical enclosure at least one smoke sensor and at least one other sensor which responds to heat, and in which the signal(s) of the smoke sensor(s) is (are) combined with the signal(s) of the heat sensor(s).

The performance of a single sensor within the detector covered by this part of ISO 7240 cannot be sufficient for conformity to other parts of ISO 7240 for the single sensor detector.

Certain types of detectors can contain radioactive materials. The national requirements for radiation protection differ from country to country and they are not therefore specified in this standard. However, such detectors are expected to conform to the national requirements and be in line with the recommendations of the Nuclear Energy Agency (NEA) of the Organization for Economic Co-operation and Development (OECD)[1)].

For the testing of other types of detectors, or detectors working on different principles, this part of ISO 7240 can be used only for guidance. Detectors with special characteristics, developed for specific risks, are not covered in this part of ISO 7240.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 7240-5:2012, *Fire detection and alarm systems — Part 5: Point-type heat detectors*

ISO 7240-7, *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 2-1: Tests. Tests A: Cold*

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

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

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

IEC 60068-2-30, *Environmental testingPart 2-30: Tests. Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

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1) OECD, *Recommendations for ionization smoke detectors in implementation of radiation protection standards. Nuclear Energy Agency, Organisation for economic Co-operation and Development, Paris, France*

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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*

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, definitions, and abbreviations

3.1 Terms and definitions

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

3.2 Abbreviated terms

FDCIE fire detection control and indicating equipment

4 Requirements

4.1 Compliance

In order to comply with this part of ISO 7240, the detector shall meet the following requirements.

a) Clause 4, which shall be verified by visual inspection or engineering assessment, shall be tested in accordance with Clause 5 and shall meet the requirements of the tests.

b) Clauses 7 and 8, which shall be verified by visual inspection.

4.2 Design considerations

Detectors shall be so designed that the signal(s) from the smoke sensor(s), combined with the signal(s) from the heat sensor(s), release an alarm signal.

NOTE In some cases, an alarm signal can result from only one element, but the overall fire performance is dependent on signals from more than one sensor being combined in some form of signal processing.

4.3 Smoke-response value of detectors using scattered or transmitted light

Detectors using scattered or transmitted light shall conform to one of the two response threshold value bands specified in Table 1 and the corresponding end-of-test conditions for the test fires specified in 5.22.

Table 1 — Smoke-response value for detectors using scattered or transmitted light

Smoke-response value in smoke tunnel (aerosol) dB/m		**Test fires end-of-test conditions**					
		TF1 dB/m	**TF2** dB/m	**TF3** dB/m	**TF4** dimensionless	**TF5** dimensionless	**TF8** dB/m
1	$0{,}05 < m < 0{,}3$	$m = 2$	$m = 2$	$m = 2$	$y = 6$	$y = 6$	$m = 1{,}7$
2	$0{,}2 < m < 0{,}6$	$m = 2$	$m = 2$	$m = 2$	$y = 6{,}5$	$y = 7{,}5$	$m = 1{,}7$
NOTE The smaller the *m* value, the higher the sensitivity of the detectors.							

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4.4 Individual alarm indication

Each detector shall be provided with an integral red visual indicator, by which the individual detector releasing an alarm can be identified, until the alarm condition is reset. Where other conditions of the detector can be visually indicated, they shall be clearly distinguishable from the alarm condition, except when the detector is switched into a service mode. For detachable detectors, the indicator can be integral with the base or the detector head.

NOTE The alarm condition is reset manually at the FDCIE.

The visual indicator shall be visible from a distance of 6 m in 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.

4.5 Indication of other conditions

Where the detector visually indicates other status conditions, they shall be clearly distinguishable from the alarm indication.

4.6 Connection of ancillary devices

Where the detector provides for connections to ancillary devices (e.g. remote indicators, control relays), open- or short-circuit failures of these connections shall not prevent the correct operation of the detector.

4.7 Monitoring of detachable detectors

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

4.8 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.

4.9 On-site adjustment of response behaviour

4.9.1 If there is provision for on-site adjustment of the response value of the detector, then

a) for all of the settings at which the manufacturer claims compliance, the detector 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 detector from its base or mounting, and

b) any setting or settings 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 detector or in the associated data that if these setting or settings are used, the detector does not comply with this part of ISO 7240.

4.9.2 Adjustments can be carried out at the detector or at the FDCIE.

4.9.3 Where means are provided (remotely or internally) to switch off signals from a sensing element or to change the sensitivity of the detector so that it no longer meets the requirements of this part of ISO 7240, this change in status shall be made available to the FDCIE.

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4.10 Response to slowly developing fires

4.10.1 The provision of "drift compensation" (e.g. to compensate for sensor drift due to the build-up of dirt in the detector) shall not lead to a significant reduction in the sensitivity of the detector to slowly developing fires (see Annex A).

4.10.2 Since it is not practical to make tests with very slow increases in smoke density, an assessment of the response of the detector to slow increases in smoke density shall be made by analysis of the circuit/software and/or physical tests and simulations.

4.10.3 The detector shall be deemed to meet the requirements of this subclause if this assessment shows the following.

a) For any rate of increase in smoke density, R, which is greater than 25 % of the initial uncompensated smoke response value of the detector, $A_{sr,u}$, per hour, the time for the detector to give an alarm does not exceed 1,6 × ($A_{sr,u}/R$) by more than 100 s.

b) That the range of total compensation, C_t, is limited such that $C_t < 0{,}6\ A_{sr,u}$ throughout this range, and that the fully compensated smoke response value of the detector, $A_{sr,c}$, does not exceed its initial value by a factor greater than 1,6.

4.11 Protection against ingress of foreign bodies

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

NOTE This requirement is intended to restrict the access of insects into the smoke measuring chamber of the detector. 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 access holes can introduce the danger of clogging by dust, etc. It might therefore be necessary to take other precautions against false alarms due to the entry of small insects.

4.11.2 For detectors that do not have physical protection against ingress of foreign bodies, the resistance of the detector against the adverse effect of such ingress shall be proven by the manufacturer.

4.12 Software-controlled detectors

4.12.1 General requirements

The requirements of 4.12.2, 4.12.3, and 4.12.4 shall be met for detectors that rely on software control in order to fulfil the requirements of this part of ISO 7240.

4.12.2 Software documentation

4.12.2.1 The manufacturer shall prepare documentation which 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

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

b) Description of those areas of memory 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.

4.12.2.2 The manufacturer shall prepare detailed design documentation. This shall be available for inspection in a manner that respects the manufacturer's rights of confidentiality. It shall comprise at least the following:

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

b) a 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 (CASE-Tools, compilers, etc.).

NOTE This detailed documentation can be reviewed at the manufacturers' premises.

4.12.3 Software design

In order to ensure the reliability of the detector, the following requirements for software design 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 error in the program operation.

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

4.12.4 Storage of programs and data

4.12.4.1 The program necessary to comply with this part of ISO 7240 and any present 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.

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

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5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

5.1.1.1 Unless otherwise stated in a test procedure, conduct the testing after the test specimen has been allowed to stabilize in the standard atmospheric conditions for testing as specified in IEC 60068-1 as follows:

— temperature: 15 °C to 35 °C;

— relative humidity: 25 % to 75 %;

— air pressure: 86 kPa to 106 kPa.

5.1.1.2 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 most unfavourable for each test shall be chosen.

5.1.3 Operating conditions for tests

5.1.3.1 If a test method requires a specimen to be operational, then connect the specimen to suitable supply and monitoring equipment having the characteristics required by the manufacturer's data. Unless otherwise specified in the test method, set the supply parameters applied to the specimen within the manufacturer's specified range(s) and maintain them 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 connect the specimen to any necessary ancillary devices (e.g. through wiring to an end-of-line device for non-addressable 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 Measurement of the smoke-response value

5.1.5.1 Install the specimen for which the smoke-response value, A_{sr}, is to be measured in a smoke tunnel, described in Annex B, in its normal operating position, by its normal means of attachment. The orientation of the specimen, relative to the direction of air flow, shall be the least sensitive orientation as determined in the directional dependence of smoke response test (5.3), unless otherwise specified in the test procedure.

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

5.1.5.3 The air velocity in the proximity of the specimen shall be (0,2 ± 0,04) m/s unless otherwise specified in the test procedure.

5.1.5.4 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 and not faster than 0,2 K/min for all the measurements on a specimen.

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

5.1.5.6 Introduce the test aerosol as specified in B.3 into the tunnel at such a rate that the increase of aerosol density is as follows:

— for detectors using scattered or transmitted light, in decibels per metre per min:

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

where

m is the aerosol density in dB/m;

t is the time in min.

— for detectors using ionization, per minute:

$$0{,}05 \leq \frac{\Delta y}{\Delta t} \leq 0{,}3$$

where

y is a dimensionless variable;

t is the time in min.

NOTE These ranges are intended to allow the selection of a convenient rate, depending upon the sensitivity of the detector, to get a response in a reasonable time.

5.1.5.7 The initially selected rate of increase in aerosol density shall be similar for all measurements on a particular detector type.

5.1.5.8 Record the aerosol density (m or y) at the moment the specimen gives an alarm. This shall be taken as the smoke-response value.

5.1.6 Measurement of the heat-response value

5.1.6.1 Install the specimen for which the heat-response value is to be measured in a heat tunnel, as specified in Annex C, in its normal operating position, by its normal means of attachment. The orientation of the specimen, relative to the direction of air flow, shall be the least sensitive one as determined in the directional dependence of heat response test (5.4), unless otherwise specified in the test procedure.

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

5.1.6.3 Before the test, stabilize the temperature of the air stream and the specimen at (25 ± 2) °C. The air flow shall be maintained at a constant mass flow equivalent to a velocity of (0,8 ± 0,1) m/s at 25 °C.

5.1.6.4 Raise the air temperature until the heat sensor produces a signal (this might be a fire signal), as specified by the manufacturer. The rate of rise of the air temperature and the associated tolerances shall correspond to one of the values, except for 0,2 K/min, 1 K/min and 30 K/min, as specified in ISO 7240-5. The choice of the rate within the range of 3 K/min to 20 K/min shall be specified by the manufacturer.

5.1.6.5 For this purposes of this test, the manufacturer can supply specimens with special outputs or specially modified software to indicate when the air temperature has caused an internal threshold to be reached. However, it is essential that the output signal be routed through the amplification path of the detector.

5.1.6.6 Record the temperature at which this signal is produced, T (s). This shall be taken as the heat-response value.

5.1.7 Provision for tests

5.1.7.1 Provide the following for testing in compliance with this part of ISO 7240:

— for detachable detectors: 23 detector heads and bases;

— for non-detachable detectors: 23 specimens;

— the data specified in Clause 7 and Clause 8.

5.1.7.2 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 smoke-response value of the specimens as measured in the reproducibility of smoke response test (5.5) should also represent the production mean, and that the deviation limits specified for the reproducibility test should also be applicable to the manufacturer's production.

5.1.8 Test schedule

Test the specimens as specified in Table 2. After the reproducibility of smoke response test (5.5), number the four specimens with the least sensitive smoke response (i.e. those with the highest smoke response value) 18 to 23. Number the others 1 to 17 arbitrarily.

Table 2 — Test schedule

Test	Subclause	Specimen no(s). to be tested
Repeatability of smoke response	5.2	one chosen arbitrarily
Directional dependence of smoke response	5.3	one chosen arbitrarily
Directional dependence of heat response	5.4	one chosen arbitrarily
Reproducibility of smoke response	5.5	all specimens

[a] This test applies only to detectors using a scattered or transmitted light principle of operation.

[b] In the interests of test economy, it is permitted to use the same specimen for more than one EMC test. In that case, intermediate functional test(s) on the specimen(s) used for more than one test can be deleted, and the full functional test conducted at the end of the sequence of tests. However, it should be noted that in the event of a failure, it cannot be possible to identify which test exposure caused the failure.

[c] This test defines measurement and assessment changes that apply to other tests if the detector has more than one smoke sensor

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Table 2 *(continued)*

Test	Subclause	Specimen no(s). to be tested
Reproducibility of heat response	5.6	all specimens
Lower limit of heat response	5.7	1
Air movement	5.8	2
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[a] This test applies only to detectors using a scattered or transmitted light principle of operation.

[b] In the interests of test economy, it is permitted to use the same specimen for more than one EMC test. In that case, intermediate functional test(s) on the specimen(s) used for more than one test can be deleted, and the full functional test conducted at the end of the sequence of tests. However, it should be noted that in the event of a failure, it cannot be possible to identify which test exposure caused the failure.

[c] This test defines measurement and assessment changes that apply to other tests if the detector has more than one smoke sensor

5.1.9 Test report

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

5.2 Repeatability of smoke response

5.2.1 Object of test

To show that the detector 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 in accordance with 5.1.2 and connect it to supply and monitoring equipment in accordance with 5.1.3.

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5.2.2.2 Measure the smoke-response value of the specimen six times as specified in 5.1.5. The orientation of the specimen relative to the direction of air flow is arbitrary, but it shall be the same for all six measurements.

5.2.2.3 Designate the maximum of the measured smoke-response values as y_{max} or m_{max} and the minimum value as y_{min} or m_{min}.

5.2.3 Requirements

5.2.3.1 The ratio of the smoke-response values y_{max}: y_{min} or m_{max}: m_{min} shall be not greater than 1,6.

5.2.3.2 The lower smoke-response value y_{min} shall be not less than 0,2.

5.2.3.3 The lower smoke-response value, m_{min}, shall be not less than

— 0,05 dB/m for detectors with a declared smoke-response value band of $0,05 < m < 0,3$, or

— 0,2 dB/m for detectors with a declared smoke-response value band of $0,2 < m < 0,6$.

5.2.3.4 The higher smoke-response value, $m_{max,}$ shall be not greater than

— 0,3 dB/m for detectors with a declared smoke-response value band of $0,05 < m < 0,3$, or

— 0,6 dB/m for detectors with a declared smoke-response value band of $0,2 < m < 0,6$.

5.3 Directional dependence of smoke response

5.3.1 Object of test

To show that the sensitivity of the detector is not unduly dependent on the direction of air flow around the detector.

5.3.2 Test procedure

5.3.2.1 Mount the specimen in accordance with 5.1.2 and connect it to supply and monitoring equipment in accordance with 5.1.3.

5.3.2.2 Measure the smoke-response value of the specimen eight times as specified in 5.1.5, the specimen being rotated 45° about its vertical axis between each measurement, so that the measurements are taken at eight different orientations relative to the direction of air flow.

5.3.2.3 Designate the maximum of the measured smoke-response values as y_{max} or m_{max} and the minimum value as y_{min} or m_{min}.

5.3.2.4 Record the orientations for which the maximum and minimum smoke-response values were measured.

5.3.3 Requirements

5.3.3.1 The ratio of the smoke-response values y_{max}: y_{min} or m_{max}: m_{min} shall be not greater than 1,6.

5.3.3.2 The lower smoke-response value y_{min} shall be not less than 0,2.

5.3.3.3 The lower smoke-response value, m_{min}, shall be not less than

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— 0,05 dB/m for detectors with a declared smoke-response value band of 0,05 < m < 0,3, or

— 0,2 dB/m for detectors with a declared smoke-response value band of 0,2 < m < 0,6.

5.3.3.4 The higher smoke-response value, m_{max}, shall be not greater than

— 0,3 dB/m for detectors with a declared smoke-response value band of 0,05 < m < 0,3, or

— 0,6 dB/m for detectors with a declared smoke-response value band of 0,2 < m < 0,6.

5.4 Directional dependence of heat response

5.4.1 Object of test

To show that the sensitivity of the detector is not unduly dependent on the direction of air flow around the detector.

5.4.2 Test procedure

5.4.2.1 Mount the specimen in accordance with 5.1.2 and connect it to supply and monitoring equipment in accordance with 5.1.3.

5.4.2.2 Stabilize the specimen at 25 °C before each measurement.

5.4.2.3 Measure the heat-response value of the specimen eight times as specified in 5.1.6, at a rate of rise of 10 K/min, the specimen being rotated 45° about its vertical axis between each measurement, so that the measurements are taken at eight different orientations relative to the direction of air flow.

5.4.2.4 Record the heat-response value at each of the eight orientations.

5.4.2.5 Designate the maximum of the measured heat-response value as T_{max} and the minimum value as T_{min}.

5.4.2.6 Record the orientations for which the maximum and minimum heat-response values were measured. The orientation for which the maximum response time was measured is referred to as the *least sensitive* heat orientation. The orientation for which the minimum response time was measured is referred to as the *most sensitive* heat orientation.

5.4.3 Requirements

The ratio of (T_{max} – 25):(T_{min} – 25) shall be not greater than 1,6.

5.5 Reproducibility of smoke response

5.5.1 Object of test

To show that the smoke sensitivity of the detector does not vary unduly from specimen to specimen.

5.5.2 Test procedure

5.5.2.1 Mount the specimen in accordance with 5.1.2 and connect it to supply and monitoring equipment in accordance with 5.1.3.

5.5.2.2 Measure the smoke-response value of each specimen as specified in 5.1.5.

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5.5.2.3 Calculate the mean of these smoke-response values and designate it as $\bar{y}$ or $\bar{m}$ as appropriate.

5.5.2.4 Designate the maximum of the measured smoke-response values as y_{max} or m_{max} and the minimum value as y_{min} or m_{min}.

5.5.3 Requirements

5.5.3.1 The ratio of the smoke-response values y_{max}: $\bar{y}$ or m_{max}: $\bar{m}$ shall be not greater than 1,33, and the ratio of the smoke-response values $\bar{y} : y_{min}$ or $\bar{m} : m_{min}$ shall be not greater than 1,5.

5.5.3.2 The lower smoke-response value y_{min} shall be not less than 0,2.

5.5.3.3 The lower smoke-response value, m_{min}, shall be not less than

— 0,05 dB/m for detectors with a declared smoke-response value band of $0{,}05 < m < 0{,}3$, or

— 0,2 dB/m for detectors with a declared smoke-response value band of $0{,}2 < m < 0{,}6$.

5.5.3.4 The higher smoke-response value, m_{max}, shall be not greater than

— 0,3 dB/m for detectors with a declared smoke-response value band of $0{,}05 < m < 0{,}3$, or

— 0,6 dB/m for detectors with a declared smoke-response value band of $0{,}2 < m < 0{,}6$.

5.6 Reproducibility of heat response

5.6.1 Object of test

To show that the heat sensitivity of the detector does not vary unduly from specimen to specimen.

5.6.2 Test procedure

5.6.2.1 Mount the specimen in accordance with 5.1.2 and connect it to supply and monitoring equipment in accordance with 5.1.3.

5.6.2.2 Stabilize the specimen at 25 °C.

5.6.2.3 Measure the heat-response value of the specimen as specified in 5.1.6, at a rate of rise of 20 K/min.

5.6.2.4 Designate the maximum of the measured heat-response value as T_{max} and the minimum value as T_{min}.

5.6.3 Requirements

The ratio of T_{max}: T_{min} shall be not greater than 1,3.

5.7 Lower limit of heat response

5.7.1 Object of the test

To show that detectors in the absence of smoke, are not more sensitive to heat alone, than is permitted in ISO 7240-5.

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5.7.2 Test procedure

5.7.2.1 Mount the specimen in accordance with 5.1.2 and connect it to supply and monitoring equipment in accordance with 5.1.3.

5.7.2.2 Measure the heat-response value of the specimen in its most sensitive orientation, using the methods described in 5.3 and ISO 7240-5:2012, 5.4. For the purposes of these tests, use the test parameters for class A1 detectors according to ISO 7240-5:2012.

NOTE The minimum static response temperature needs to be greater than that which is required to comply with the dry heat (operational) test (5.11).

5.7.3 Requirements

5.7.3.1 In the test for static response temperature (5.3 of ISO 7240-5:2012), the specimen shall not give an alarm signal at a temperature less than the minimum static response temperature specified in Table 1 of ISO 7240-5:2012 for a class A1 detectors according to ISO 7240-5:2012.

5.7.3.2 The specimen shall not give an alarm signal at each rate of rise of air temperature in a time less than the lower response time limits specified in Table 4 of ISO 7240-5:2012 for a class A1 detector according to ISO 7240-5:2012.

5.8 Air movement

5.8.1 Object of test

To show that the sensitivity of the detector is not unduly affected by the rate of the air flow, and that it is not unduly prone to false alarms in draughts or in short gusts.

5.8.2 Test procedure

5.8.2.1 Mount the specimen in accordance with 5.1.2 and connect it to supply and monitoring equipment in accordance with 5.1.3.

5.8.2.2 Measure the smoke-response value of the specimen as described in 5.1.5 in the most and the least sensitive orientation. Designate these appropriately as $y_{(0,2)\max}$ and $y_{(0,2)\min}$ or $m_{(0,2)\max}$ and $m_{(0,2)\min}$.

5.8.2.3 Repeat these measurements but with an air velocity in the proximity of the detector of (1 ± 0,2) m/s. Designate the smoke-response values in these tests as $y_{(1,0)\max}$ and $y_{(1,0)\min}$ or $m_{(1,0)\max}$ and $m_{(1,0)\min}$.

5.8.2.4 Additionally, for detectors containing an ionization chamber, subject the specimen to be tested, in its most sensitive orientation, to an aerosol-free air flow at a velocity of (5 ± 0,5) m/s for a period of not less than 5 min and not more than 7 min, and then, at least 10 min later, to a gust at a velocity of (10 ± 1) m/s for a period of not less than 2 s and not more than 4 s.

5.8.2.4 Record any signal that is emitted.

5.8.3 Requirements

5.8.3.1 One of the following relationships shall apply:

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— for detectors using scattered or transmitted light: $0{,}625 < \frac{\left[m_{(0,2)\max} + m_{(0,2)\min}\right]}{\left[m_{(1,0)\max} + m_{(1,0)\min}\right]} < 1{,}6$;

— for detectors using ionization: $0{,}625 < \frac{\left[y_{(0,2)\max} + y_{(0,2)\min}\right]}{\left[y_{(1,0)\max} + y_{(1,0)\min}\right]} < 1{,}6$.

5.8.3.2 For ionization-chamber detectors, the detector shall not emit either a fault signal or an alarm signal during the test with aerosol free-air.

5.9 Dazzling

5.9.1 Object of test

To show that the sensitivity of the detector is not unduly influenced by the close proximity of artificial light sources. This test is only applicable to detectors using scattered light or transmitted light, as ionization chamber detectors are considered unlikely to be influenced.

5.9.2 Test procedure

5.9.2.1 Mount the apparatus for the dazzling test (see Annex D) in the smoke tunnel as specified in B.1.

5.9.2.2 Install the specimen in the apparatus in the least sensitive orientation and connect it to its supply and monitoring equipment in accordance with 5.1.3.

5.9.2.3 Measure the smoke-response value of the specimen as specified in 5.1.5.

5.9.2.4 Switch the four lamps ON simultaneously for 10 s and then OFF for 10 s. Repeat this 10 times.

5.9.2.5 Switch the four lamps ON again and, after at least 1 min, measure the smoke-response value as specified in 5.1.5, with the lamps ON.

5.9.2.6 Switch the four lamps OFF.

5.9.2.7 Repeat 5.9.2.3 to 5.9.2.6, but with the detector rotated 90° in one direction (either direction can be chosen), from the least sensitive orientation.

5.9.2.8 For each orientation, designate the maximum smoke-response value as m_{max} and the minimum smoke-response value as m_{min}.

5.9.3 Requirements

During the periods when the switching sequences are being conducted and when the lamps are all ON for at least 1 min, the specimen shall not emit either an alarm or fault signal.

For each orientation, the ratio of the smoke response values m_{max}: m_{min} shall be not greater than 1,6.

5.10 Variation in supply parameters (voltage)

5.10.1 Object of test

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

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