BS EN 54-7:2018

BSI Standards Publication

Fire detection and fire alarm systems

Part 7: Smoke detectors - Point smoke detectors that operate using scattered light, transmitted light or ionization

bsi.

National foreword

This British Standard is the UK implementation of EN 54-7:2018. It supersedes BS EN 54-7:2001, which is withdrawn.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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Fire detection and fire alarm systems - Part 7: Smoke detectors - Point smoke detectors that operate using scattered light, transmitted light or ionization

Systèmes de détection et d'alarme incendie - Partie 7 : Détecteurs de fumée - Détecteurs ponctuels fonctionnant suivant le principe de la diffusion de la lumière, de la transmission de la lumière ou de l'ionisation

Brandmeldeanlagen - Teil 7: Rauchmelder - Punktförmige Melder nach dem Streulicht-, Durchlicht- oder Ionisationsprinzip

This European Standard was approved by CEN on 16 November 2015.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 54-7:2018) has been prepared by Technical Committee CEN/TC 72 “Fire detection and fire alarm systems”, the secretariat of which is held by BSI.

This document supersedes EN 54-7:2000.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2019, and conflicting national standards shall be withdrawn at the latest by August 2022.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports the basic requirements of Regulation (EU) 305/2011.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

EN 54-7 has been revised so as to align the second answer to the mandate M/109. It includes new clauses and annexes as follow:

— Clause 6, Assessment and verification of constancy of performance (AVCP);

— Clause 7, Classification;

— Clause 8, Marking, labelling and packaging;

— Annex N (normative), Test set up for testing the protection against the effect of moving objects;

— Annex O (normative), Apparatus open detector static object test;

— Annex P (informative), Data supplied with point smoke detectors;

— Annex ZA updated to the latest template.

The main technical changes are as follow:

— applying the latest EN 50130-4:2011, EMC for immunity tests;

— introducing the open type smoke detector and related test methods and requirements;

— removing Annex N, Additional requirements and test methods for smoke detectors with more than one smoke sensor.

EN 54, *Fire detection and fire alarm systems*, consists of the following parts:

— *Part 1: Introduction*;

— *Part 2: Control and indicating equipment*;

— *Part 3: Fire alarm devices — Sounders*;

— *Part 4: Power supply equipment*;

— *Part 5: Heat detectors — Point heat detectors*;

— *Part 7: Smoke detectors — Point smoke detectors that operate using scattered light, transmitted light or ionization* [the present document]*;*

— *Part 10: Flame detectors — Point detectors*;

— *Part 11: Manual call points*;

— *Part 12: Smoke detectors — Line detectors using an optical light beam*;

— *Part 13: Compatibility and connectability assessment of system components*;

— *Part 14: Guidelines for planning, design, installation, commissioning, use and maintenance* [CEN Technical Specification];

— *Part 16: Voice alarm control and indicating equipment*;

— *Part 17: Short circuit isolators*;

— *Part 18: Input/output devices*;

— *Part 20: Aspirating smoke detectors*;

— *Part 21: Alarm transmission and fault warning routing equipment*;

— *Part 22: Resettable line-type heat detectors* [currently at acceptance stage];

— *Part 23: Fire alarm devices — Visual alarms devices*;

— *Part 24: Components of voice alarm systems — Loudspeakers*;

— *Part 25: Components using radio links*;

— *Part 26: Carbon monoxide detectors — Point smoke detectors*;

— *Part 27: Duct smoke detectors*;

— *Part 28: Non-resettable line type heat detectors*;

— *Part 29: Multi-sensor fire detectors — Point smoke detectors using a combination of smoke and heat sensors*;

— *Part 30: Multi-sensor fire detectors — Point smoke detectors using a combination of carbon monoxide and heat sensors*;

— *Part 31: Multi-sensor fire detectors — Point smoke detectors using a combination of smoke, carbon monoxide and optionally heat sensors*;

— *Part 32: Planning, design, installation, commissioning, use and maintenance of voice alarm systems*.

NOTE This list includes standards that are in preparation and other standards may be added. For current status of published standards refer to www.cen.eu.

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

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies requirements, test methods and performance criteria for point smoke detectors that operate using scattered light, transmitted light or ionization, intended for use in fire detection and fire alarm systems installed in and around buildings (see EN 54-1:2011).

This European standard provides for the assessment of verification of constancy of performance (AVCP) of point smoke detectors to this EN.

For other types of smoke detector, or smoke detectors working on different principles, this standard should only be used for guidance. Smoke detectors with special characteristics and developed for specific risks are not covered by this standard.

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.

EN 54-1:2011, *Fire detection and fire alarm systems - Part 1: Introduction*

EN 50130-4:2011, *Alarm systems - Part 4: Electromagnetic compatibility - Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems*

EN 60068-1:2014, *Environmental testing - Part 1: General and guidance (IEC 60068-1:2013)*

EN 60068-2-1:2007, *Environmental testing - Part 2-1: Tests - Test A: Cold (IEC 60068-2-1:2007)*

EN 60068-2-6:2008, *Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:2007)*

EN 60068-2-27:2009, *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock (IEC 60068-2-27:2008)*

EN 60068-2-42:2003, *Environmental testing - Part 2-42: Tests - Test Kc: Sulphur dioxide test for contacts and connections (IEC 60068-2-42:2003)*

EN 60068-2-78:2013, *Environmental testing — Part 2-78: Tests - Test Cab: Damp heat, steady state (IEC 60068-2-78:2012)*

ISO 209:2007, *Aluminium and aluminium alloys — Chemical composition*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 54-1:2011 and the following apply.

3.1
closed detector
optical or ionization detector with the sensing volume(s) inside the enclosure

3.2
open detector
optical smoke detector with the sensing volume(s) outside the enclosure

3.3
response value
aerosol density in the proximity of the specimen at the moment that it generates an alarm signal, when tested as described in 5.1.5

Note 1 to entry: The response 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 standard the detector shall meet the requirements of Clause 4, which shall be verified by visual inspection, engineering assessment or testing as described in Clause 5.

4.2 Operational reliability

4.2.1 Individual alarm indication

Each detector shall be provided with an integral red visual indicator, by which the individual detector, which released 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 indication, except when the detector is switched into a service mode. For detachable detectors the indicator may be integral with the base or the detector head. The visual indicator shall be visible from a distance of 6 m directly below the detector, in an ambient light intensity up to 500 lx. To confirm this, the detector shall be assessed in accordance with 5.2.1.

NOTE The alarm condition is reset manually at the control and indicating equipment (see EN 54–2.)

4.2.2 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. To confirm this, the detector shall be assessed in accordance with 5.2.2.

4.2.3 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. To confirm this, the detector shall be assessed in accordance with 5.2.3.

4.2.4 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. To confirm this, the detector shall be assessed in accordance with 5.2.4.

4.2.5 On-site adjustment of response behaviour

If there is provision for on-site adjustment of the response behaviour of the detector then:

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

b) any setting(s), at which the manufacturer does not claim compliance with this standard, shall only be accessible 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(s) are used, the detector does not comply with the standard.

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

To confirm this, the detector shall be assessed in accordance with 5.2.5.

4.2.6 Protection against the ingress of foreign bodies

4.2.6.1 Closed detectors

Closed detectors shall be so designed that a sphere of diameter (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 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 may introduce the danger of clogging by dust, etc. It may therefore be necessary to take other precautions against false alarms due to the entry of small insects.

To confirm this, the detector shall be assessed in accordance with 5.2.6.1.

4.2.6.2 Open detectors

Open detector shall be designed such that:

a) a sphere of (1,3 ± 0,05) mm cannot pass into any enclosure containing active optoelectronic components;

b) a total block of the detector surface shall not cause a false alarm and shall signal a fault;

c) an object moving with minimum distance of 6 mm ± 1 mm to the nearest point of the surface of the detector shall not cause false alarm but may give fault signal.

To confirm this, the detector shall be assessed in accordance with 5.2.6.2.

4.2.7 Response to slowly developing fires

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 detector's sensitivity to slowly developing fires.

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

The detector shall be deemed to meet the requirements of this clause if this assessment shows that:

a) for any rate of increase in smoke density R, which is greater than $A/4$ per hour (where A is the detector's initial uncompensated response value), the time for the detector to give an alarm does not exceed 1,6 × A/R by more than 100 s; and

b) the range of compensation is limited such that, throughout this range, the compensation does not cause the response value of the detector to exceed its initial value by a factor greater than 1,6.

NOTE Further information about the assessment of these requirements is given in Annex L.

To confirm this, the detector shall be assessed in accordance with 5.2.7.

4.2.8 Software controlled detector (when provided)

4.2.8.1 General

For detectors which rely on software control in order to fulfil the requirements of this standard, the requirements of 4.2.8.2, 4.2.8.3 and 4.2.8.4 shall be met.

4.2.8.2 Software documentation

4.2.8.2.1 The manufacturer shall submit 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 standard and shall include at least the following:

a) 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;

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

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

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

4.2.8.2.2 The manufacturer shall have available detailed design documentation, which only needs to be provided if required by the testing authority. 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;

    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).

4.2.8.3 Software design

In order to ensure the reliability of the detector, 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 error in the program operation;

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

4.2.8.4 The storage of programs and data

The program necessary to comply with this standard 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 only be possible 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 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.

To confirm this, the detector shall be assessed in accordance with 5.2.8.

4.3 Nominal activation conditions/sensitivity

4.3.1 Repeatability

The detector shall demonstrate a stable behaviour with respect to its sensitivity even after a number of alarm conditions. To confirm this, the detector shall be tested in accordance with 5.3.1.

4.3.2 Directional Dependence

The response time of the detector shall not be unduly dependent on the direction of airflow around the detector. In addition, that an open detector is not unduly affected by static objects within close proximity of the detector. To confirm this, the detector shall be tested in accordance with 5.3.2.

4.3.3 Reproducibility

The sensitivity of the detector shall not vary unduly from specimen to specimen and establish response value data for comparison with the response values measured after the environmental tests. To confirm this, the detector shall be tested in accordance with 5.3.3.

4.4 Response delay (response time)

4.4.1 Air movement

The sensitivity of the detector shall not unduly be affected by the rate of the air flow, and ionization detectors shall not unduly prone to false alarms in draughts or in short gusts. To confirm this, the detector shall be tested in accordance with 5.4.1.

4.4.2 Dazzling

The sensitivity of the point smoke detector shall not unduly be influenced by the close proximity of artificial light sources. To confirm this, the point smoke detector shall be tested in accordance with 5.4.2.

4.5 Tolerance to supply voltage — Variation in supply parameters

Within the specified range(s) of the supply parameters (e.g. voltage), the point smoke detector shall not be unduly dependent on these parameters. To confirm this, the point smoke detector shall be tested in accordance with 5.5.

4.6 Performance parameters under fire conditions — Fire sensitivity

The point smoke detector shall demonstrate adequate sensitivity to a broad spectrum of smoke types as required for general application in fire detection systems for buildings. To confirm this, the point smoke detector shall be tested in accordance with 5.6.1.

4.7 Durability of Nominal activation conditions/sensitivity

4.7.1 Temperature resistance

4.7.1.1 Cold (operational)

The point smoke detector shall function correctly at low ambient temperatures appropriate to the anticipated service environment. To confirm this, the point smoke detector shall be tested in accordance with 5.7.1.1.

4.7.1.2 Dry heat (operational)

The point smoke detector shall function correctly at high ambient temperatures appropriate to the anticipated service environment. To confirm this, the point smoke detector shall be tested in accordance with 5.7.1.2.

4.7.2 Humidity resistance

4.7.2.1 Damp heat, steady-state (operational)

The point smoke detector shall function correctly at high relative humidity (without condensation), which may occur for short periods in the anticipated service environment. To confirm this, the point smoke detector shall be tested in accordance with 5.7.2.1.

4.7.2.2 Damp heat, steady-state (endurance)

The point smoke detector shall withstand the long term effects of humidity in the service environment (e.g. changes in electrical properties of materials, chemical reactions involving moisture, galvanic corrosion, etc.). To confirm this, the point smoke detector shall be tested in accordance with 5.7.2.2.

4.7.3 Corrosion resistance — Sulfur dioxide (SO_2) corrosion (endurance)

The point smoke detector shall withstand the corrosive effects of sulfur dioxide as an atmospheric pollutant. To confirm this, the point smoke detector shall be tested in accordance with 5.7.3.

4.7.4 Vibration resistance

4.7.4.1 Shock (operational)

The point smoke detector shall withstand mechanical shocks, which are likely to occur, albeit infrequently, in the anticipated service environment. To confirm this, the point smoke detector shall be tested in accordance with 5.7.4.1.

4.7.4.2 Impact (operational)

The point smoke detector shall withstand mechanical impacts upon its surface, which it may sustain in the normal service environment, and which it can reasonably be expected to withstand. To confirm this, the point smoke detector shall be tested in accordance with 5.7.4.2.

4.7.4.3 Vibration, sinusoidal, (operational)

The point smoke detector shall withstand vibration at levels considered appropriate to the normal service environment. To confirm this, the point smoke detector shall be tested in accordance with 5.7.4.3.

4.7.4.4 Vibration, sinusoidal (endurance)

The point smoke detector shall withstand the long term effects of vibration at levels appropriate to the service environment. To confirm this, the point smoke detector shall be tested in accordance with 5.7.4.4.

4.7.5 Electrical stability — Electromagnetic Compatibility (EMC), Immunity tests (operational)

The point smoke detector shall be immune to Electromagnetic influences. To confirm this, the point smoke detector shall be tested in accordance with 5.7.5.1.

5 Testing, assessment and sampling methods

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 EN 60068-1 as follows:

a) temperature: (15 to 35) °C;

b) relative humidity: (25 to 75) %;

c) air pressure: (86 to 106) kPa.

If variations in these parameters have a significant effect on a measurement, then such variations should be kept to a minimum during a series of measurements carried out as part of one test on one specimen.

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 conventional point smoke detectors) to allow a fault signal to be recognized.

The details of the supply and monitoring equipment and the alarm criteria used should be given in the test report.

5.1.3 Mounting arrangements

The specimen shall be mounted 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 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 EN 60068).

If a requirement or test procedure does not specify a tolerance or deviation limits, then deviation limits of ± 5 % shall be applied.

5.1.5 Measurement of response value

The specimen, for which the response value shall be measured, shall be installed in the smoke tunnel, described in Annex A, in its normal operating position, by its normal means of attachment. The orientation of the specimen, relative to the direction of airflow, shall be the least sensitive orientation, as determined in the directional dependence test, unless otherwise specified in the test procedure.

Before commencing each measurement the smoke tunnel shall be purged to ensure that the tunnel and the specimen are free from the test aerosol.

The air velocity in the proximity of the specimen shall be (0,2 ± 0,04) m s^{-1} during the measurement, unless otherwise specified in the test procedure.

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 point smoke detector type.

The specimen shall be connected to its supply and monitoring equipment as described in 5.1.2, and shall be allowed to stabilize for a period of at least 15 min, unless otherwise specified by the manufacturer.

The test aerosol, as described in Annex B, shall be introduced into the tunnel such that the rate of increase of aerosol density is as follows:

$$0{,}015 \leq \frac{\Delta m}{\Delta t} \leq 0{,}1 \quad \text{dB m}^{-1}\ \text{min}^{-1}$$

for point smoke detectors using scattered or transmitted light, or

$$0{,}05 \leq \frac{\Delta y}{\Delta t} \leq 0{,}3 \quad \text{min}^{-1}$$

for point smoke detectors using ionization.

NOTE 1 These ranges are intended to allow the selection of a convenient rate, depending upon the point smoke detector's sensitivity, to get a response in a reasonable time.

NOTE 2 The equations for *m* and *y* are given in Annex C.

The rate of increase in aerosol density shall be similar for all measurements on a particular point smoke detector type.

The aerosol density at the moment that the specimen gives an alarm shall be recorded as *m* (dB m^{-1}) for point smoke detectors using scattered or transmitted light, or as *y* for point smoke detectors using ionization (see Annex C). This shall be taken as the response value.

5.1.6 Provision for tests

The following shall be provided for testing compliance with this standard:

a) For detachable point smoke detectors: 20 point smoke detector heads and bases;

   For non-detachable point smoke detectors: 20 specimens;

b) The data required in Clause 8 and Annex P.

NOTE Detachable point smoke detectors comprise at least two parts; a base (socket) and a head (body). If the specimens are detachable point smoke detectors, then the two, or more, parts together are regarded as a complete point smoke detector.

The specimens submitted shall be representative of the manufacturer's normal production with regard to their construction and calibration.

This implies that the mean response value of the 20 specimens, found in the reproducibility test should also represent the production mean, and that the limits specified in the reproducibility test should also be applicable to the manufacturer's production.

5.1.7 Test schedule

The specimens shall be tested according to the following test schedule (see Table 1). After the reproducibility test, the four least sensitive specimens (i.e. those with the highest response thresholds) shall be numbered 17 to 20, and the others shall be numbered 1 to 16 arbitrarily:

Table 1 — Test schedule

Test	Subclause	Specimen No(s)
Repeatability	5.3.1	one chosen arbitrarily
Directional dependence	5.3.2	one chosen arbitrarily
Reproducibility	5.3.3	all specimens
Air movement	5.4.1	1
Dazzling[a]	5.4.2	2
Variation in supply parameters	5.5	3
Fire sensitivity	5.6.1	17, 18, 19 and 20
Cold (operational)	5.7.1.1	4
Dry heat (operational)	5.7.1.2	5
Damp heat, steady-state (operational)	5.7.2.1	6
Damp heat, steady-state (endurance)	5.7.2.2	7
Sulfur dioxide (SO_2) corrosion (endurance)	5.7.3	8
Shock (operational)	5.7.4.1	9
Impact (operational)	5.7.4.2	10
Vibration, sinusoidal (operational)	5.7.4.3	11
Vibration, sinusoidal (endurance)	5.7.4.4	11
Electromagnetic Compatibility (EMC), Immunity tests (operational)	5.7.5.1	
a) Electrostatic discharge (operational)		12[b]
b) Radiated electromagnetic fields (operational)		13[b]
c) Conducted disturbances induced by electromagnetic fields (operational)		14[b]
d) Fast transient bursts (operational)		15[b]
e) Slow high energy voltage surge (operational)		16[b]

[a] This test only applies to point smoke detectors using scattered or transmitted light.

[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 may be deleted, and the functional test conducted at the end of the sequence of tests. However it should be noted that in the event of a failure, it may not be possible to identify which test exposure caused the failure (see EN 50130–4:2011, Clause 4).

5.2 Operational reliability

5.2.1 Individual alarm indication

The visual indicator shall be visually inspected from a distance of 6 m directly below the point smoke detector, in an ambient light intensity up to 500 lx as specified in the requirements in 4.2.1.

5.2.2 Connection of ancillary devices

Open- and short-circuit shall be applied at the connections for ancillary devices.

An engineering assessment shall be carried out for the correct operation of the point smoke detector as specified requirements in 4.2.2.

5.2.3 Monitoring of detachable detectors

An engineering assessment shall be carried out to verify that the point smoke detector meets, the requirements for monitoring of detachable point smoke detectors as specified in 4.2.3.

5.2.4 Manufacturer's adjustments

A visual inspection of a specimen and supporting data shall be conducted to verify that the point smoke detector meets, the requirements for manufacturer adjustments as specified in 4.2.4.

5.2.5 On-site adjustment of response behaviour

A visual inspection and supporting data shall be conducted in conjunction with the appropriate operation of the point smoke detector to verify that the point smoke detector meets the requirements for on-site adjustment of response behaviour as specified in 4.2.5.

5.2.6 Protection against the ingress of foreign bodies

5.2.6.1 For closed type detectors

A sphere of diameter (1,3 ± 0,05) mm shall be used to verify that the point smoke detector meets the requirements for protection against the ingress of foreign bodies as specified in 4.2.6.1.

5.2.6.2 For open type detectors

5.2.6.2.1 A sphere of diameter (1,3 ± 0,05) mm shall be used to verify that the point smoke detector meets the requirements for protection against the ingress of foreign bodies as specified in 4.2.6.2 a).

5.2.6.2.2 A total cover of the point smoke detector surface shall be applied using a non-reflective material (e.g. black paper) applied to verify that the point smoke detectors meets the requirements for protection against the ingress of foreign bodies as specified in 4.2.6.2 b).

5.2.6.2.3 An object as specified in Annex N with minimum distance of 6 mm ± 1 mm to the nearest point of the surface of the point smoke detector and moving for 60 s per velocity as described in Annex N shall be applied to verify that the point smoke detectors meets the requirements for protection against the ingress of foreign bodies as specified in 4.2.6.2 c).

The starting position of the rod shall be at maximum distance from the nearest point of the surface of the point smoke detector.

The point smoke detector shall be tested 8 times as described in Annex N, the specimen being rotated 45 degrees about its vertical axis between each test.

5.2.7 Response to slowly developing fires

A practical or a technical assessment shall be applied to verify that the point smoke detector meets the requirements for response to slowly developing fires as specified in 4.2.7.

5.2.8 Software controlled detector (when provided)

For point smoke detectors that rely on software for their operation, a visual inspection of samples of documentation provided by the manufacturer shall be conducted to verify that the device complies with the requirements specified in 4.2.8.

5.3 Nominal activation conditions/sensitivity

5.3.1 Repeatability

5.3.1.1 Object

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

5.3.1.2 Test procedure

The response value of the specimen to be tested shall be measured as described in 5.1.5 six times.

The specimen's orientation relative to the direction of air flow is arbitrary, but it shall be the same for all six measurements.

The maximum response value shall be designated y_{max} or m_{max}, the minimum value shall be designated y_{min} or m_{min}.

5.3.1.3 Requirements

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

The lower response value y_{min} shall be not less than 0,2 or m_{min} shall be not less than 0,05 dB m^{-1}.

5.3.2 Directional dependence

5.3.2.1 Object

To confirm that the sensitivity of the point smoke detector is not unduly dependent on the direction of airflow around the point smoke detector. In addition, that an open point smoke detector is not unduly affected by static objects within close proximity of the point smoke detector.

5.3.2.2 Test procedure

The response value of the specimen to be tested shall be measured eight times as described in 5.1.5, the specimen being rotated 45° about its vertical axis between each measurement, so that the measurements are taken for eight different orientations relative to the direction of air flow.

The maximum response value shall be designated y_{max} or m_{max}, the minimum value shall be designated y_{min} or m_{min}.

The orientations, for which the maximum and minimum response values were measured, shall be noted.

In the following tests the orientation, for which the maximum response threshold was measured, is referred to as the least sensitive orientation and the orientation, for which the minimum response threshold was measured, is referred to as the most sensitive orientation.

For an open point smoke detector, the above measurements shall be performed using the apparatus described in Annex O, installed in the smoke tunnel described in Annex A.

5.3.2.3 Requirements

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

The lower response value y_{min} shall not be less than 0,2 or m_{min} shall not be less than 0,05 dB m^{-1}.

5.3.3 Reproducibility

5.3.3.1 Object

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

5.3.3.2 Test procedure

The response value of each of the test specimens shall be measured as described in 5.1.5.

The mean of these response values shall be calculated and shall be designated $\overline{y}$ or $\overline{m}$.

The maximum response value shall be designated y_{max} or m_{max} the minimum value shall be designated y_{min} or m_{min}.

5.3.3.3 Requirements

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

The lower response value y_{min} shall not be less than 0,2 or m_{min} shall not be less than 0,05 dB m^{-1}.

5.4 Response delay (response time)

5.4.1 Air movement

5.4.1.1 Object

To show that the sensitivity of the point smoke 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.

5.4.1.2 Test Procedure

The response value of the specimen to be tested shall be measured as described in 5.1.5 in the most and least sensitive orientations, and shall be appropriately designated $y_{(0,2)max}$ and $y_{(0,2)min}$ or $m_{(0,2)max}$ and $m_{(0,2)min}$.

These measurements shall then be repeated but with an air velocity, in the proximity of the point smoke detector, of (1 ± 0,2) m s^{-1}. The response values in these tests shall be designated $y_{(1,0)max}$ and $y_{(1,0)min}$ or $m_{(1,0)max}$ and $m_{(1,0)min}$.

Additionally, for point smoke detectors using ionization, the specimen to be tested shall be subjected, in its most sensitive orientation, to an aerosol-free air flow at a velocity of (5 ± 0,5) m s^{-1} for a period of not less than 5 min and not more that 7 min, and then at least 10 min later, to a gust at a velocity of (10 ± 1) m s^{-1} for a period of not less than 2 s and not more than 4 s. The specimen shall be monitored during the exposure to aerosol-free air to detect any alarm or fault signals.

NOTE These exposures can be generated by plunging the specimen to be tested into an airflow with the appropriate velocity for the required time.

5.4.1.3 Requirements

For point smoke detectors using ionization the following shall apply:

$$0{,}625 \leq \frac{y_{(0,2)\,\max} + y_{(0,2)\,\min}}{y_{(1,0)\,\max} + y_{(1,0)\,\min}} \leq 1{,}6$$

and the point smoke detector shall emit neither a fault signal nor an alarm signal during the test with aerosol-free air.

For point smoke detectors using scattered or transmitted light the following shall apply:

$$0{,}625 \leq \frac{m_{(0,2)\,\max} + m_{(0,2)\,\min}}{m_{(1,0)\,\max} + m_{(1,0)\,\min}} \leq 1{,}6$$

5.4.2 Dazzling

5.4.2.1 Object

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

5.4.2.2 Test procedure

The dazzling apparatus, described in Annex D is installed in the smoke tunnel described in Annex A, shall be used for the closed type point smoke detectors. The dazzling apparatus, described in Annex D shall be modified by covering one side by light absorbing material as in Annex O for the open type point smoke detector. The specimen is installed in the dazzling apparatus in the least sensitive orientation and connected to its supply and monitoring equipment. The following test procedure is then applied:

a) The response value is measured as described in 5.1.5.

b) The four lamps are switched simultaneously ON for 10 s and then OFF for 10 s, 10 times.

c) The four lamps are then switched ON again and after at least 1 min the response value is measured, as described in 5.1.5, with the lamps ON.

d) The four lamps are then switched OFF.

The above procedure is then repeated for closed type point smoke detectors but with the point smoke detector rotated 90°, in one direction (either direction can be chosen), from the least sensitive orientation.

For each orientation, the maximum response value shall be designated $m_{\max}$ and the minimum response value shall be designated $m_{\min}$.

5.4.2.3 Requirements

During the periods when the lamps are being switched ON and OFF, and when the lamps are ON before the response value is measured, the specimen shall emit neither an alarm nor a fault signal.

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

5.5 Tolerance to supply voltage — Variation in supply parameters

5.5.1 Object

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

5.5.2 Test procedure

The response value of the specimen shall be measured as described in 5.1.5, at the upper and lower limits of the supply parameter (e.g. voltage) range(s) specified by the manufacturer.

The maximum response value shall be designated y_{max} or m_{max} and the minimum value shall be designated y_{min} or m_{min}.

For conventional point smoke detectors the supply parameter is the dc voltage applied to the point smoke detector. For other types of point smoke detector (e.g. analogue addressable) signal levels and timing may need to be considered. If necessary the manufacturer may be requested to provide suitable supply equipment to allow the supply parameters to be changed as required.

5.5.3 Requirements

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

The lower response value y_{min} shall not be less than 0,2 or m_{min} shall not be less than 0,05 dB m^{-1}.

5.6 Performance parameters under fire conditions

5.6.1 Fire sensitivity

5.6.1.1 Object

To show that the point smoke detector has adequate sensitivity to a broad spectrum of smoke types as required for general application in fire detection systems for buildings.

5.6.1.2 Principle

The specimens are mounted in a standard fire test room and are exposed to a series of test fires designed to produce smoke, representative of a wide spectrum of types of smoke and smoke flow conditions.

5.6.1.3 Test procedure

5.6.1.3.1 Fire test room

The fire sensitivity tests shall be conducted in a rectangular room with a flat horizontal ceiling, and the following dimensions:

Length: 9 m to 11 m;

Width: 6 m to 8 m;

Height: 3,8 m to 4,2 m.

The fire test room shall be equipped with the following measuring instruments arranged as indicated in Annex F:

Measuring ionization chamber (MIC);

Obscuration meter;

Temperature probe.

5.6.1.3.2 Test Fires

The specimens shall be subjected to the four test fires TF2 to TF5 (see NOTE and Annexes G to J). The type, quantity and arrangement of the fuel and the method of ignition are described in Annexes G to J, for each test fire, along with the end of test condition and the required profile curve limits.

In order to be a valid test fire, the development of the fire shall be such that the profile curves of m against y and m against time fall within the specified limits, up to the time when all of the specimens have generated an alarm signal or the end of test condition is reached, whichever is the earlier. If these conditions are not met then the test is invalid and shall be repeated. It is permissible, and may be necessary, to adjust the quantity, condition (e.g. moisture content) and arrangement of the fuel to obtain valid test fires.

5.6.1.3.3 Mounting of the specimens

The four specimens (Nos. 17, 18, 19 and 20) shall be mounted on the fire test room ceiling in the designated area (see Annex F). The specimens shall be mounted in accordance with the manufacturer's instructions, such that they are in the least sensitive orientation, relative to an assumed air flow from the centre of the room to the specimen.

Each specimen shall be connected to its supply and monitoring equipment, as described in 5.1.2, and shall be allowed to stabilize in its quiescent condition before the start of each test fire.

Point smoke detectors which dynamically modify their sensitivity in response to varying ambient conditions, may require special reset procedures and/or stabilization times. The manufacturer's guidance should be sought in such cases to ensure that the state of the point smoke detectors at the start of each test is representative of their normal quiescent state.

5.6.1.3.4 Initial conditions

Before each test fire the room shall be ventilated with clean air until it is free from smoke, and so that the conditions listed below can be obtained.

The ventilation system shall then be switched off and all doors, windows and other openings shall be closed. The air in the room shall then be allowed to stabilize, and the following conditions shall be obtained before the test is started:

Air temperature T:	(23 ± 5) °C;
Air movement:	negligible;
Smoke density (ionization):	$y \leq 0{,}05$;
Smoke density (optical):	$m \leq 0{,}02$ dB m^{-1}.

The stability of the air and temperature affects the smoke flow within the room. This is particularly important for the test fires, which produce low thermal lift for the smoke (e.g. TF2 and TF3). It is therefore recommended that the difference between the temperature near the floor and the ceiling is < 2 K, and that local heat sources that can cause convection currents (e.g. lights and heaters) should be avoided. If it is necessary for people to be in the room at the beginning of a test fire, they should leave as soon as possible, taking care to produce the minimum disturbance to the air.

5.6.1.3.5 Recording of the fire parameters and response values

During each test fire the following fire parameters shall be recorded continuously or at least once per second.

Parameter	Symbol	Units
Temperature change	ΔT	K
Smoke density (ionization)	y	dimensionless
Smoke density (optical)	m	dB m^{-1}

The alarm signal given by the supply and monitoring equipment shall be taken as the indication that a specimen has responded to the test fire.

The time of response of each specimen shall be recorded along with the fire parameters y_a and m_a, at the moment of response.

5.6.1.4 Requirements

All four specimens shall generate an alarm signal, in each test fire, before the specified end of test condition is reached.

5.7 Durability of Nominal activation conditions/sensitivity

5.7.1 Temperature resistance

5.7.1.1 Cold (operational)

5.7.1.1.1 Object

To demonstrate the ability of the point smoke detector to function correctly at low ambient temperatures appropriate to the anticipated service environment.

5.7.1.1.2 Test procedure

5.7.1.1.2.1 Reference

The test apparatus and procedure shall be as described in EN 60068-2-1:2007, Test Ab, and as described below.

5.7.1.1.2.2 State of the specimen during conditioning

The specimen shall be mounted as described in 5.1.3 and shall be connected to supply and monitoring equipment as described in 5.1.2.

5.7.1.1.2.3 Conditioning

The following conditioning shall be applied:

Temperature: (−10 ± 3) °C

Duration: 16 h

NOTE Test Ab specifies rates of change of temperature of ≤ 1 K min^{-1} for the transitions to and from the conditioning temperature.

5.7.1.1.2.4 Measurements during conditioning

The specimen shall be monitored during the conditioning period to detect any alarm or fault signals.

5.7.1.1.2.5 Final measurements

After a recovery period of at least 1 h at the standard laboratory conditions, the response value shall be measured as described in 5.1.5.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.1.1.3 Requirements

No alarm or fault signal shall be given during the transition to the conditioning temperature or during the period at the conditioning temperature.

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

5.7.1.2 Dry heat (operational)

5.7.1.2.1 Object

To demonstrate the ability of the point smoke detector to function correctly at high ambient temperatures appropriate to the anticipated service environment.

5.7.1.2.2 Test procedure

The specimen to be tested shall be installed in the smoke tunnel described in Annex A, in its least sensitive orientation, with an initial air temperature of (23 ± 5) °C, and shall be connected to its supply and monitoring equipment.

The air temperature in the smoke tunnel shall then be increased to (55 ± 2) °C, at a rate not exceeding 1 K min^{-1}, and maintained at this temperature for 2 h.

The response value shall then be measured as described in 5.1.5 but with the temperature at (55 ± 2) °C.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.1.2.3 Requirements

No alarm or fault signal shall be given during the period that the temperature is increasing to the conditioning temperature or during the conditioning period until the response value is measured.

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

5.7.2 Humidity resistance

5.7.2.1 Damp heat, steady-state (operational)

5.7.2.1.1 Object

To demonstrate the ability of the point smoke detector to function correctly at high relative humidity (without condensation), which may occur for short periods in the anticipated service environment.

5.7.2.1.2 Test procedure — Reference

The test apparatus and procedure shall be as described in EN 60068-2-78, Test Cab, and as described below.

5.7.2.1.3 State of the specimen during conditioning

The specimen shall be mounted as described in 5.1.3 and shall be connected to supply and monitoring equipment as described in 5.1.2.

5.7.2.1.4 Conditioning

The following conditioning shall be applied:

Temperature:	(40 ± 2) °C
Relative Humidity:	(93 ± 3) %
Duration:	4 d

5.7.2.1.5 Measurements during conditioning

The specimen shall be monitored during the conditioning period to detect any alarm or fault signals.

5.7.2.1.6 Final measurements

After a recovery period of at least 1 h at the standard laboratory conditions, the response value shall be measured as described in 5.1.5.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.2.1.7 Requirements

No alarm or fault signal shall be given during the conditioning.

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

5.7.2.2 Damp heat, steady-state (endurance)

5.7.2.2.1 Object

To demonstrate the ability of the point smoke detector to withstand the long term effects of humidity in the service environment (e.g. changes in electrical properties of materials, chemical reactions involving moisture, galvanic corrosion, etc.).

5.7.2.2.2 Test procedure

5.7.2.2.2.1 Reference

The test apparatus and procedure shall be as described in EN 60068-2-78:2013, Test Cab, and as described below.

5.7.2.2.2.2 State of the specimen during conditioning

The specimen shall be mounted as described in 5.1.3 but shall not be supplied with power during the conditioning.

5.7.2.2.2.3 Conditioning

The following conditioning shall be applied:

Temperature:	(40 ± 2) °C
Relative Humidity:	(93 ± 3) %
Duration:	21 d

5.7.2.2.2.4 Final measurements

After a recovery period, of at least 1 h in standard laboratory conditions, the response value shall be measured as described in 5.1.5.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.2.2.3 Requirements

No fault signal, attributable to the endurance conditioning, shall be given on reconnection of the specimen.

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

5.7.3 Corrosion resistance — Sulfur dioxide (SO_2) corrosion (endurance)

5.7.3.1 Object

To demonstrate the ability of the point smoke detector to withstand the corrosive effects of sulfur dioxide as an atmospheric pollutant.

5.7.3.2 Test procedure

5.7.3.2.1 Reference

The test apparatus and procedure shall be as described in EN 60068-2-42, Test Kc, except that the conditioning shall be as described below.

5.7.3.2.2 State of the specimen during conditioning

The specimen shall be mounted as described in 5.1.3. It shall not be supplied with power during the conditioning, but it shall have untinned copper wires, of the appropriate diameter, connected to sufficient terminals, to allow the final measurement to be made, without making further connections to the specimen.

5.7.3.2.3 Conditioning

The following conditioning shall be applied:

Temperature:	(25 ± 2) °C
Relative humidity:	(93 ± 3) %
SO_2 concentration:	(25 ± 5) µl/l
Duration:	21 d

5.7.3.2.4 Final measurements

Immediately after the conditioning, the specimen shall be subjected to a drying period of 16 h at (40 ± 2) °C, ≤ 50 % RH, followed by a recovery period of at least 1 h at the standard laboratory conditions. After this, the response value shall be measured as described in 5.1.5.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.3.3 Requirements

No fault signal, attributable to the endurance conditioning, shall be given on reconnection of the specimen.

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

5.7.4 Vibration resistance

5.7.4.1 Shock (operational)

5.7.4.1.1 Object

To demonstrate the immunity of the point smoke detector to mechanical shocks, which are likely to occur, albeit infrequently, in the anticipated service environment.

5.7.4.1.2 Test procedure

5.7.4.1.2.1 Reference

The test apparatus and procedure shall be as described in EN 60068-2-27, Test Ea, except that the conditioning shall be as described below.

5.7.4.1.2.2 State of the specimen during conditioning

The specimen shall be mounted as described in 5.1.3 to a rigid fixture, and shall be connected to its supply and monitoring equipment as described in 5.1.2.

5.7.4.1.2.3 Conditioning

For specimens with a mass ≤ 4,75 kg the following conditioning shall be applied:

Shock pulse type:	Half sine
Pulse duration:	6 ms
Peak acceleration:	$10 \times (100 - 20M)$ m s^{-2} (Where M is the specimen's mass in kg)
Number of directions:	6
Pulses per direction:	3

No test is applied to specimens with a mass > 4,75 kg.

5.7.4.1.2.4 Measurements during conditioning

The specimen shall be monitored during the conditioning period and for a further 2 min to detect any alarm or fault signals.

5.7.4.1.2.5 Final measurements

After the conditioning the response value shall be measured as described in 5.1.5.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.4.1.3 Requirements

No alarm or fault signal shall be given during the conditioning period or the additional 2 min.

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

5.7.4.2 Impact (operational)

5.7.4.2.1 Object

To demonstrate the immunity of the point smoke detector to mechanical impacts upon its surface, which it may sustain in the normal service environment, and which it can reasonably be expected to withstand.

5.7.4.2.2 Test procedure

5.7.4.2.2.1 Apparatus

The test apparatus shall consist of a swinging hammer incorporating a rectangular-section aluminium alloy head (Aluminium alloy Al Cu_4 Si Mg complying with ISO 209:2007, solution treated and precipitation treated condition) with the plane impact face chamfered to an angle of 60° to the horizontal, when in the striking position (i.e. when the hammer shaft is vertical). The hammer head shall be (50 ± 2,5) mm high, (76 ± 3,8) mm wide and (80 ± 4) mm long at mid height as shown in Figure E.1. A suitable apparatus is described in Annex E.

5.7.4.2.2.2 State of the specimen during conditioning

The specimen shall be rigidly mounted to the apparatus by its normal mounting means and shall be positioned so that it is struck by the upper half of the impact face when the hammer is in the vertical position (i.e. when the hammerhead is moving horizontally). The azimuthal direction and position of impact, relative to the specimen shall be chosen as that most likely to impair the normal functioning of the specimen. The specimen shall be connected to its supply and monitoring equipment as described in 5.1.2.

5.7.4.2.2.3 Conditioning

The following conditioning shall be applied:

Impact energy:	(1,9 ± 0,1) J
Hammer velocity:	(1,5 ± 0,13) m s^{-1}
Number of impacts:	1

5.7.4.2.2.4 Measurements during conditioning

The specimen shall be monitored during the conditioning period and for a further 2 min to detect any alarm or fault signals.

5.7.4.2.2.5 Final measurements

After the conditioning the response value shall be measured as described in 5.1.5.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.4.2.3 Requirements

No alarm or fault signal shall be given during the conditioning period or the additional 2 min.

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

5.7.4.3 Vibration, sinusoidal, (operational)

5.7.4.3.1 Object

To demonstrate the immunity of the point smoke detector to vibration at levels considered appropriate to the normal service environment.

5.7.4.3.2 Test procedure

5.7.4.3.2.1 Reference

The test apparatus and procedure shall be as described in EN 60068-2-6, Test Fc, and as described below.

5.7.4.3.2.2 State of the specimen during conditioning

The specimen shall be mounted on a rigid fixture as described in 5.1.3 and shall be connected to its supply and monitoring equipment as described in 5.1.2. The vibration shall be applied in each of three mutually perpendicular axes, in turn. The specimen shall be mounted so that one of the three axes is perpendicular to its normal mounting plane.

5.7.4.3.2.3 Conditioning

The following conditioning shall be applied:

Frequency range:	(10 to 150) Hz
Acceleration amplitude:	5 m s^{-2} (approximately 0,5 g_n)
Number of axes:	3
Sweep rate:	1 octave min^{-1}
Number of sweep cycles:	1 per axis

The vibration operational and endurance tests may be combined such that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in one axis before changing to the next axis. Only one final measurement need be made.

5.7.4.3.2.4 Measurements during conditioning

The specimen shall be monitored during the conditioning period to detect any alarm or fault signals.

5.7.4.3.2.5 Final measurements

The final measurements, as specified in 5.7.4.4.2.4, are normally made after the vibration endurance test and only need be made here if the operational test is conducted in isolation.

5.7.4.3.3 Requirements

No alarm or fault signal shall be given during the conditioning.

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

5.7.4.4 Vibration, sinusoidal (endurance)

5.7.4.4.1 Object

To demonstrate the ability of the point smoke detector to withstand the long term effects of vibration at levels appropriate to the service environment.

5.7.4.4.2 Test procedure

5.7.4.4.2.1 Reference

The test apparatus and procedure shall be as described in EN 60068-2-6, Test Fc, and as described below.

5.7.4.4.2.2 State of the specimen during conditioning

The specimen shall be mounted on a rigid fixture as described in 5.1.3, but shall not be supplied with power during conditioning. The vibration shall be applied in each of three mutually perpendicular axes, in turn. The specimen shall be mounted so that one of the three axes is perpendicular to its normal mounting axis.

5.7.4.4.2.3 Conditioning

The following conditioning shall be applied:

Frequency range:	(10 to 150) Hz
Acceleration amplitude:	10 m s^{-2} (≈1,0 g_n)
Number of axes:	3
Sweep rate:	1 octave min^{-1}
Number of sweep cycles:	20 per axis

The vibration operational and endurance tests may be combined such that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in one axis before changing to the next axis. Only one final measurement need be made.

5.7.4.4.2.4 Final measurements

After the conditioning the response value shall be measured as described in 5.1.5.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.4.4.3 Requirements

No fault signal, attributable to the endurance conditioning, shall be given on reconnection of the specimen.

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

5.7.5 Electrical stability

5.7.5.1 EMC, immunity (operational)

5.7.5.1.1 Object of the tests

To demonstrate the immunity of the point smoke point smoke detector to electromagnetic disturbances appropriate to the service environment.

5.7.5.1.2 Test procedures

5.7.5.1.2.1 Reference

EMC, immunity tests shall be carried out as described in EN 50130-4. The following tests shall be conducted:

a) electrostatic discharge;

b) radiated electromagnetic fields;

c) conducted disturbances induced by electromagnetic fields;

d) fast transient burst;

e) slow high energy voltage surges.

5.7.5.1.2.2 State of the specimen during conditioning

For tests a) to e) in 5.7.5.1.2.1, the conditioning shall be applied to the specimen only in the quiescent state. The specimen shall be connected to supply and monitoring equipment as described in 5.1.2.

5.7.5.1.2.3 Conditioning

The tests conditions specified in EN 50130-4 for the tests listed in 5.7.5.1.2.1 shall be applied.

5.7.5.1.2.4 Measurements during conditioning

The specimen(s) shall be monitored during the conditioning period to detect any alarm or fault signals.

5.7.5.1.2.5 Final measurements

The response value of the specimen(s) shall be measured as described in 5.1.5.

The greater of the response value measured in this test and that measured for the same specimen in the reproducibility test, shall be designated y_{max} or m_{max}, and the lesser shall be designated y_{min} or m_{min}.

5.7.5.1.3 Requirements

For these tests the criteria for compliance specified in EN 50130-4 and the following shall apply:

No alarm or fault signal shall be given during the conditioning.

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

6 Assessment and verification of constancy of performance (AVCP)

6.1 General

The compliance of the point smoke detectors using scattered light, transmitted light or ionization with the requirements of this Standard and with the performances declared by the manufacturer in the DoP shall be demonstrated by:

— determination of product type,

— factory production control by the manufacturer, including product assessment.

The manufacturer shall always retain the overall control and shall have the necessary means to take responsibility for the conformity with its declared performance(s).

6.2 Type testing

6.2.1 General

All performances related to characteristics included in this standard shall be determined when the manufacturer intends to declare the respective performances unless the standard gives provisions for declaring them without performing tests (e.g. use of previously existing data, CWFT and conventionally accepted performance).

Assessment previously performed in accordance with the provisions of this standard, may be taken into account provided that they were made to the same or a more rigorous test method, under the same AVCP system on the same product or products of similar design, construction and functionality, such that the results are applicable to the product in question.

NOTE Same AVCP system means testing by an independent third party under the responsibility of a notified product certification body.

For the purpose of assessment manufacturer's products may be grouped into families where it is considered that the results for one or more characteristics from any one product within the family are representative for that same characteristics for all products within that same family.

Products may be grouped in different families for different characteristics.

Reference to the assessment method standards should be made to allow the selection of a suitable representative sample.

In addition, the determination of the product type shall be performed for all characteristics included in the standard for which the manufacturer declares the performance:

— at the beginning of the production of a new or modified point smoke detectors using scattered light, transmitted light or ionization (unless a member of the same product range), or

— at the beginning of a new or modified method of production (where this may affect the stated properties); or

they shall be repeated for the appropriate characteristic(s), whenever a change occurs in the point smoke detectors using scattered light, transmitted light or ionization design, in the raw material or in the supplier of the components, or in the method of production (subject to the definition of a family), which would affect significantly one or more of the characteristics.

Where components are used whose characteristics have already been determined, by the component manufacturer, on the basis of assessment methods of other product standards, these characteristics need not be re-assessed. The specifications of these components shall be documented.

Products bearing regulatory marking in accordance with appropriate harmonized European specifications may be presumed to have the performances declared in the DoP, although this does not replace the responsibility on the manufacturer to ensure that the point smoke detectors using scattered light, transmitted light or ionization as a whole is correctly manufactured and its component products have the declared performance values.

6.2.2 Test samples, testing and compliance criteria

The number of samples of point smoke detectors using scattered light, transmitted light or ionization to be tested/assessed shall be in accordance with Table *2.*

Table 2 — Number of samples to be tested and compliance criteria

Characteristic	Requirement	Assessment method	No. of samples	Compliance criteria
Operational reliability	*4.2*	*5.2*	*1* [a]	*4.2*
Nominal activation conditions/sensitivity	*4.3*	*5.3*	*20* [a]	*5.3*
Response delay (response time)	*4.4*	*5.4*	*2* [a]	*5.4*
Tolerance to supply voltage	*4.5*	*5.5*	*1* [a]	*5.5*
Performance parameters under fire conditions	*4.6*	*5.6*	*4* [a]	*5.6*
Durability of Nominal activation conditions/sensitivity	*4.7*	*5.7*	*13* [a]	*5.7*

[a] Samples may be used for more than one test/assessment where tests are judged to be non-destructive or not affecting performance.

6.2.3 Test reports

The results of the determination of the product type shall be documented in test reports. All test reports shall be retained by the manufacturer for at least 10 years after the last date of production of the point smoke detectors using scattered light, transmitted light or ionization to which they relate.

6.3 Factory production control (FPC)

6.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market comply with the declared performance of the essential characteristics.

The FPC system shall consist of:

a) procedures,

b) regular inspections and tests or assessments or both

c) the use of the results to control:

   1) raw and other incoming materials or components,

   2) equipment,

   3) the production process and the product.

All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures. This factory production control system documentation shall:

— ensure a common understanding of the evaluation of the constancy of performance,

— enable the achievement of the required product performances,

— enable the effective operation of the production control system to be checked.

Factory production control, therefore, brings together operational techniques and all measures allowing maintenance and control of the compliance of the product with the declared performance(s) of the essential characteristics.

6.3.2 Requirements

6.3.2.1 General

The manufacturer is responsible for organizing the effective implementation of the FPC system in line with the content of this product standard. Tasks and responsibilities in the production control organization shall be documented and this documentation shall be kept up-to-date.

The responsibility, authority and the relationship between personnel that manages, performs or verifies work affecting product constancy shall be defined. This applies in particular to personnel that need to initiate actions preventing product non-constancies from occurring, actions in case of non-constancies and to identify and register product constancy problems.

Personnel performing work affecting the constancy of performance of the product shall be competent on the basis of appropriate education, training, skills and experience for which records shall be maintained.

In each factory the manufacturer may delegate the action to a person having the necessary authority to:

— identify procedures to demonstrate constancy of performance of the product at appropriate stages;

— identify and record any instance of non-constancy;

— identify procedures to correct instances of non-constancy.

The manufacturer shall draw up and keep up-to-date documents defining the FPC. The manufacturer's documentation and procedures should be appropriate to the product and manufacturing process and the FPC system should achieve an appropriate level of confidence in the constancy of performance of the product. This involves:

a) the preparation of documented procedures and instructions relating to factory production control operations, in accordance with the requirements of the technical specification to which reference is made;

b) the effective implementation of these procedures and instructions;

c) the recording of these operations and their results;

d) the use of these results to correct any deviations, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary, revise the FPC to rectify the cause of non-constancy of performance.

Where subcontracting takes place, the manufacturer shall retain the overall control of the product and ensure that he receives all the information that is necessary to fulfil his responsibilities according to this European Standard.

If the manufacturer has part of the product designed, manufactured, assembled, packed, processed and/or labelled by subcontracting, the FPC of the subcontractor may be taken into account, where appropriate for the product in question.

The manufacturer who subcontracts all of his activities may in no circumstances pass these responsibilities on to a subcontractor.

NOTE Manufacturers having an FPC system, which complies with EN ISO 9001 standard and which addresses the provisions of the present European standard are considered as satisfying the FPC requirements of the Regulation (EU) No 305/2011.

6.3.2.2 Equipment

6.3.2.2.1 Testing

All weighing, measuring and testing equipment shall be calibrated or verified or both and regularly inspected according to documented procedures, frequencies and criteria to ensure consistency with the monitoring and measuring requirements. All calibrated or verified equipment shall have identification in order to determine their status.

6.3.2.2.2 Manufacturing

All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

6.3.2.3 Raw materials and components

The specifications of all incoming raw materials and components shall be documented, as shall the inspection scheme for ensuring their compliance. In case supplied kit components are used, the constancy of performance system of the component shall be that given in the appropriate harmonized technical specification for that component.

6.3.2.4 Traceability and marking

Individual products shall be identifiable and traceable with regard to their production origin. The manufacturer shall have written procedures ensuring that processes related to affixing traceability codes and/or markings are inspected regularly.

6.3.2.5 Controls during manufacturing process

The manufacturer shall plan and carry out production under controlled conditions.

6.3.2.6 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the declared performance of the characteristics is maintained. The characteristics, and the means of control, are indicated in Clauses 4 and 5.

6.3.2.7 Non-complying products

The manufacturer shall have written procedures which specify how non complying products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures.

Where the product fails to satisfy the acceptance criteria, the provisions for non-complying products shall apply, the necessary corrective action(s) shall immediately be taken and the products or batches not complying shall be isolated and properly identified.

Once the fault has been corrected, the test or verification in question shall be repeated.

The results of controls and tests shall be recorded. The product description, date of manufacture, test method adopted, test results and acceptance criteria shall be entered in the records under the signature of the person responsible for the control/test.

With regard to any control result not meeting the requirements of this European standard, the corrective measures taken to rectify the situation (e.g. a further test carried out, modification of manufacturing process, throwing away or putting right of product) shall be indicated in the records.

6.3.2.8 Corrective action

The manufacturer shall have documented procedures that instigate action to eliminate the cause of non-conformities in order to prevent recurrence.

6.3.2.9 Handling, storage and packaging

The manufacturer shall have procedures providing methods of product handling and shall provide suitable storage areas preventing damage or deterioration.

6.3.3 Product specific requirements

The FPC system shall:

— address this European Standard, and

— ensure that the products placed on the market comply with the declaration of performance.

The FPC system shall include a product specific test plan, which identifies procedures to demonstrate compliance of the product at appropriate stages, i.e.:

a) the controls and tests to be carried out prior to and/or during manufacture according to a frequency laid down in the test plan, and/or

b) the verifications and tests to be carried out on finished products according to a frequency laid down in the test plan.

If the manufacturer uses only finished products, the operations under b) shall lead to an equivalent level of conformity of the product as if FPC had been carried out during the production.

If the manufacturer carries out parts of the production himself, the operations under b) may be reduced and partly replaced by operations under a). Generally, the more parts of the production that are carried out by the manufacturer, the more operations under b) may be replaced by operations under a).

In any case the operation shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

NOTE Depending on the specific case, it can be necessary to carry out the operations referred to under a) and b), only the operations under a) or only those under b).

The operations under a) centre as much on the intermediate states of the product as on manufacturing machines and their adjustment, and measuring equipment, etc. These controls and tests and their frequency shall be chosen based on product type and composition, the manufacturing process and its complexity, the sensitivity of product features to variations in manufacturing parameters, etc.

The manufacturer shall establish and maintain records that provide evidence that the production has been sampled and tested. These records shall show clearly whether the production has satisfied the defined acceptance criteria and shall be available for at least three years.

6.3.4 Initial inspection of factory and FPC

Initial inspection of factory and of FPC shall be carried out when the production process has been finalized and in operation. The factory and FPC documentation shall be assessed to verify that the requirements of 6.3.2 and 6.3.3 are fulfilled.

During the inspection it shall be verified:

a) that all resources necessary for the achievement of the product characteristics included in this European Standard are in place and correctly implemented,

and

b) that the FPC-procedures in accordance with the FPC documentation are followed in practice

and

c) that the product complies with the product type samples, for which compliance of the product performance to the DoP has been verified.

All locations where final assembly or at least final testing of the relevant product is performed shall be assessed to verify that the above conditions a) to c) are in place and implemented.

If the FPC system covers more than one product, production line or production process, and it is verified that the general requirements are fulfilled when assessing one product, production line or production process, then the assessment of the general requirements does not need to be repeated when assessing the FPC for another product, production line or production process.

All assessments and their results shall be documented in the initial inspection report.

6.3.5 Continuous surveillance of FPC

Surveillance of the FPC shall be undertaken once a year.

The surveillance of the FPC shall include a review of the FPC test plan(s) and production processes(s) for each product to determine if any changes have been made since the last assessment or surveillance. The significance of any changes shall be assessed.

Checks shall be made to ensure that the test plans are still correctly implemented and that the production equipment is still correctly maintained and calibrated at appropriate time intervals.

The records of tests and measurement made during the production process and to finished products shall be reviewed to ensure that the values obtained still correspond with those values for the samples submitted to the determination of the product type and that the correct actions have been taken for non-compliant products.

6.3.6 Procedure for modifications

If modifications are made to the product, production process or FPC system that could affect any of the product characteristics declared according to this standard, then all characteristics for which the manufacturer declares performance, which may be affected by the modification, shall be subject to the determination of the product type as described in 6.2.1.

Where relevant, a re-assessment of the factory and of the FPC system shall be performed for those aspects, which may be affected by the modification.

All assessments and their results shall be documented in a report.

6.3.7 One-off products, pre-production products, (e.g. prototypes) and products produced in very low quantities

The point detectors using scattered light, transmitted light or ionization produced as a one-off, prototypes assessed before full production is established and products produced in very low quantities (less than 50 per year) are assessed as follows:

For type assessment, the provisions of 6.2.1, 3rd paragraph apply, together with the following additional provisions:

— in the case of prototypes, the test samples shall be representative of the intended future production and shall be selected by the manufacturer;

— on request of the manufacturer, the results of the assessment of prototype samples may be included in a certificate or in test reports issued by the involved third party.

The FPC system of one-off products and products produced in very low quantities shall ensure that raw materials and/or components are sufficient for production of the product. The provisions on raw materials and/or components shall apply only where appropriate. The manufacturer shall maintain records allowing traceability of the product.

For prototypes, where the intention is to move to series production, the initial inspection of the factory and FPC shall be carried out before the production is already running and/or before the FPC is already in practice. The FPC-documentation and the factory shall be assessed.

In the initial assessment of the factory and FPC it shall be verified:

a) that all resources necessary for the achievement of the product characteristics included in this European Standard will be available, and

b) that the FPC procedures in accordance with the FPC documentation will be implemented and followed in practice, and

c) that procedures are in place to demonstrate that the factory production processes can produce a component complying with the requirements of this European Standard and that the component will be the same the samples used for the determination of the product type, for which compliance with this European standard has been verified.

Once series production is fully established, the provisions of 6.3 shall apply.

7 Classification

No classification of point detectors using scattered light, transmitted light or ionization is specified in this European Standard.

8 Marking, labelling and packaging

Each point detectors using scattered light, transmitted light or ionization shall be clearly marked with the following information:

a) the number of this standard and its date (i.e. EN 54-7:2018);

b) the name or trademark of the manufacturer or supplier;

c) the model designation (type or number);

d) the 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 point smoke detector.

For detachable point smoke detectors, the detector head shall be marked with a), b), c) and e), and the base shall be marked with, at least c) (i.e. its own model designation) and d).

Where any marking on the device uses symbols or abbreviations not in common use then these shall be explained in the data supplied with the device.

The marking shall be visible during installation of the point smoke detector and shall be accessible during maintenance.

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

The marking requirement in this clause may be verified by Inspection of manufacturing drawings or artwork representative of the product marking.

Where regulatory marking provisions require information on some or all items listed in this clause, the requirements of this clause concerning those common items are deemed to be met.

The point detectors using scattered light, transmitted light or ionization shall either be supplied with sufficient data to enable their correct operation or, if all of these data are not supplied with each point detectors using scattered light, transmitted light or ionization reference to the appropriate data sheet(s) or technical manual shall be given on, or with each point detectors using scattered light, transmitted light or ionization.

NOTE Further data also considered beneficial when installing, maintaining and operating the point smoke detectors are given in Annex P.

Annex A
(normative)

Smoke tunnel for response value measurements

The following specifies those properties of the smoke tunnel which are of primary importance for making repeatable and reproducible measurements of response values of point smoke detectors. However, since it is not practical to specify and measure all parameters which can influence the measurements, the background information in Annex K should be carefully considered and taken into account when a smoke tunnel is designed and used to make measurements in accordance with this standard.

The smoke tunnel shall have a horizontal working section containing a working volume. The working volume is a defined part of the working section where the air temperature and air flow are within the required test conditions. Conformance with this requirement shall be regularly verified under static conditions, by measurements at an adequate number of points distributed within and on the imaginary boundaries of the working volume. The working volume shall be large enough to fully enclose the point smoke detector to be tested and the sensing parts of the measuring equipment. The working section shall be designed to allow the dazzling apparatus described in Annex D to be inserted. The point smoke detector to be tested shall be mounted in its normal operating position on the underside of a flat board aligned with the airflow in the working volume. The board shall be of such dimensions that the edge(s) of the board are at least 20 mm from any part of the point smoke detector. The point smoke detector mounting arrangement shall not unduly obstruct the air flow between the board and the tunnel ceiling.

Means shall be provided for creating an essentially laminar air flow at the required velocities (i.e. (0,2 ± 0,04) m s^{-1} or (1,0 ± 0,2) m s^{-1}) through the working volume. It shall be possible to control the temperature at the required values and to increase the temperature at a rate not exceeding 1 K min^{-1} to 55 °C.

Both aerosol density measurements, *m* and *y*, shall be made in the working volume in the proximity of the point smoke detector.

Means shall be provided for the introduction of the test aerosol such that a homogeneous aerosol density is obtained in the working volume.

Only one point smoke detector shall be mounted in the tunnel, unless it has been demonstrated that measurements made simultaneously on more than one point smoke detector are in close agreement with measurements made by testing point smoke detectors individually. In the event of a dispute the value obtained by individual testing shall be accepted.

Annex B
(normative)

Test aerosol for response value measurements

A polydisperse aerosol shall be used as the test aerosol. The maximum of the aerosol mass distribution shall correspond to particle diameters between 0,5 μm and 1 μm with the refractive index of the aerosol particles of approximately 1,4.

The test aerosol shall be reproducible and stable with regard to the following parameters:

— particle mass distribution;

— optical constants of the particles;

— particle shape;

— particle structure.

NOTE One possible method to ensure that the aerosol is stable is to measure and monitor the stability of the ratio $m : y$.

It is recommended that an aerosol generator producing a paraffin oil mist is used (e.g. using pharmaceutical grade paraffin oil).

Annex C
(normative)

Smoke measuring instruments

C.1 Obscuration meter

The response threshold of point smoke detectors using scattered light or transmitted light is characterized by the absorbance index (extinction module) of the test aerosol, measured in the proximity of the point smoke detector, at the moment that it generates an alarm signal.

The absorbance index is designated *m* and given the units of decibels per metre (dB m^{-1}). The absorbance index *m* is given by the following equation:

$$m = \frac{10}{d} \log \left(\frac{P_0}{P}\right) \quad \text{dB m}^{-1}$$

where:

- d is the distance, in metres, travelled by the light in the test aerosol or smoke, from the light source to the light receiver;
- P_0 is the radiated power received without test aerosol or smoke;
- P is the radiated power received with test aerosol or smoke.

For all aerosol or smoke concentrations up to 2 dB m^{-1}, the measuring error of the obscuration meter shall not exceed 0,02 dB m^{-1} + 5 % of the measured aerosol or smoke concentration.

The optical system shall be arranged so that any light scattered by more than 3° by the test aerosol or smoke is disregarded by the light point smoke detector.

The effective radiated power[1)] of the light beam shall be as follows:

a) at least 50 % shall be within a wavelength range from 800 nm to 950 nm;

b) not more than 1 % shall be in the wavelength range below 800 nm; and

c) not more than 10 % shall be in the wavelength range above 1 050 nm.

C.2 Measuring ionization chamber (MIC)

C.2.1 General

The response threshold of point smoke detectors using ionization is characterized by a non-dimensional quantity *y* which is derived from the relative change of the current flowing in a measuring ionization chamber, and which is related to the particle concentration of the test aerosol, measured in the proximity of the point smoke detector, at the moment that it generates an alarm signal.

1) The effective radiated power in each wavelength range is the product of the power emitted by the light source, the transmission level of the optical measuring path in clean air and the sensitivity of the receiver, within this wavelength range.

C.2.2 Operating method and basic construction

The mechanical construction of the measuring ionization chamber is shown in Annex M.

The measuring device consists of a measuring chamber, an electronic amplifier and a method of continuously sucking in a sample of the aerosol or smoke to be measured.

The principle of operation of the measuring ionization chamber is shown in Figure C.1. The measuring chamber contains a measuring volume and a suitable means by which the sampled air is sucked in and passes the measuring volume in such a way that the aerosol/smoke particles diffuse into this volume. This diffusion is such that the flow of ions within the measuring volume is not disturbed by air movements.

The air within the measuring volume is ionized by alpha radiation from an americium radioactive source, such that there is a bipolar flow of ions when an electrical voltage is applied between the electrodes. This flow of ions is affected by the aerosol or smoke particles in a known manner. The relative variation in the current of ions is used as a measurement of the aerosol or smoke concentration.

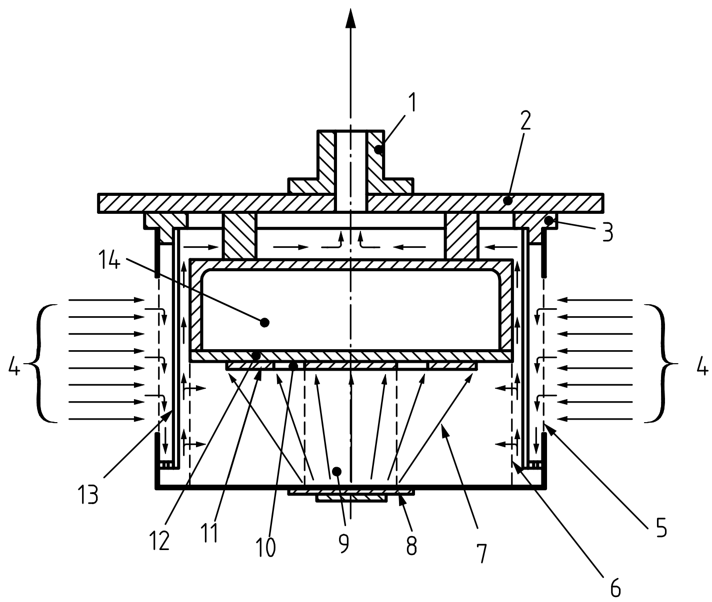
The measuring chamber is so dimensioned and operated that the following relationships apply:

$$Z \times \bar{d} = \eta \times y \quad \text{and} \quad y = \left(\frac{I_0}{I}\right) - \left(\frac{I}{I_0}\right)$$

where

- I_0 is the chamber current in air without test aerosol or smoke;
- I is the chamber current in air with test aerosol or smoke;
- η is the chamber constant;
- Z is the particle concentration in particles per m^3;
- $\bar{d}$ is the average particle diameter.

The non-dimensional quantity y, which is approximately proportional to the particle concentration for a particular type of aerosol or smoke, is used as a measure of response value for point smoke detectors using ionization.



Key

1 suspension nozzle

1 suction nozzle	6 inner grid	11 guard ring
2 assembly plate	7 *α* rays	12 insulating material
3 insulating ring	8 *α* source	13 windshield
4 air/smoke entry	9 measuring volume	14 electronics
5 outer grid	10 measuring electrode	

Figure C.1 — Measuring ionization chamber — method of operation

C.2.3 Technical data

a) Radiation source:

Isotope:	Americium Am^{241};
Activity:	130 kBq (3,5 µCi) ± 5 %;
Average α energy:	4,5 MeV ± 5 %;
Mechanical construction:	Americium oxide embedded in gold between two layers of gold. Covered with a hard gold alloy. The source is in the form of a circular disc with a diameter of 27 mm, which is mounted in a holder such that no cut edges are accessible.

b) Ionization chamber:

The chamber impedance (i.e. the reciprocal of the slope of the current vs voltage characteristic of the chamber in its linear region (chamber current ≤ 100 pA)) shall be $1,9 \times 10^{11}$ Ω ± 5 %, when measured in aerosol- and smoke-free air at:

pressure:	(101,3 ± 1) kPa;
temperature:	(25 ± 2) °C;
relative humidity:	(55 ± 20) %;

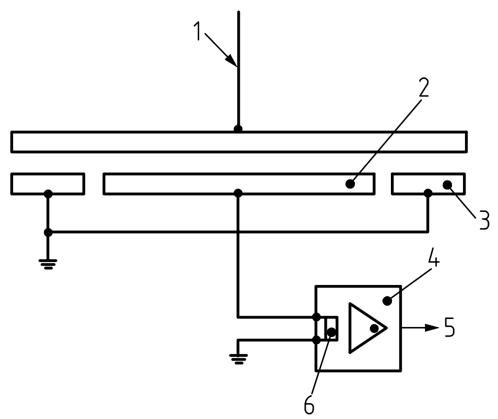
with the potential of the guard ring within ± 0,1 V of the voltage of the measuring electrode.

c) Current measuring amplifier:

The chamber is operated in the circuit shown in Figure C.2, with the supply voltage such that the chamber current between the measuring electrodes is 100 pA in aerosol- or smoke-free air. The input impedance of the current measuring device shall be < 10^9 Ω.

d) Suction system:

The suction system shall draw air through the device at a continuous steady flow of 30 l min^{-1} ± 10 % at atmospheric pressure.



Key

1 supply voltage

2 measuring electrode

3 guard ring

4 current measuring amplifier

5 output voltage proportional to chamber current

6 input impedance, Z_{in} < 10^9 Ω

Figure C.2 — Measuring ionization chamber — Operating circuit

Annex D
(normative)

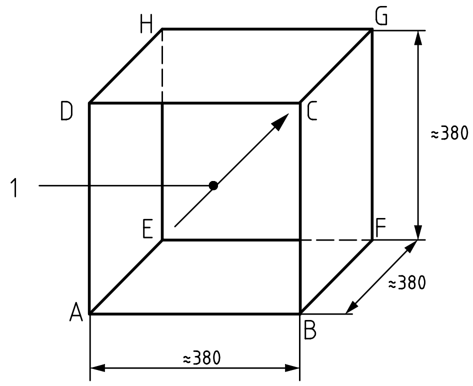
Apparatus for dazzling test

The apparatus (see Figure D.1) shall be constructed so that it can be inserted in the working section of the smoke tunnel. Four of the cube faces shall be closed and lined on the inside with high gloss aluminium foil; two opposing cube faces shall be open so that the test aerosol can flow through the device. Circular fluorescent lamps (32 W) with a diameter of approximately 30 cm shall be fitted to the closed surfaces of the cube.

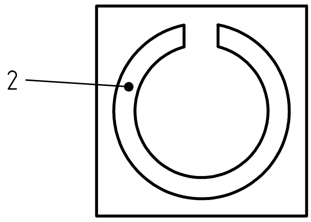
The point smoke detector to be tested shall be installed within the cube (see Figure D.1) so that light can play on it from above, below and from two sides.

Care should be taken with the electrical connections to the fluorescent lamps to avoid electrical interference with the detection system.

Dimensions in millimetres



a) Sides ABCD and EFGH shall be open to allow for the flow of aerosol.



b) Sides ABFE, AEHD, BFGC and DCGH shall have lamps mounted as shown above:

Key

1 stream of aerosol

2 fluorescent lamp

Figure D.1 — Dazzling apparatus

Annex E
(informative)

Apparatus for impact test

The apparatus (see Figure E.1) consists essentially of a swinging hammer comprising a rectangular section head (striker), with a chamfered impact face, mounted on a tubular steel shaft. The hammer is fixed into a steel boss, which runs on ball bearings on a fixed steel shaft mounted in a rigid steel frame, so that the hammer can rotate freely about the axis of the fixed shaft. The design of the rigid frame is such as to allow complete rotation of the hammer assembly when the specimen is not present.

The striker is of dimensions 76 mm wide, 50 mm high and 94 mm long (overall dimensions) and is manufactured from aluminium alloy (Al Cu_4 Si Mg to ISO 209), solution treated and precipitation treated condition. It has a plane impact face chamfered at (60 ± 1)° to the long axis of the head. The tubular steel shaft has an outside diameter of (25 ± 0,1) mm with walls (1,6 ± 0,1) mm thick.

The striker is mounted on the shaft so that its long axis is at a radial distance of 305 mm from the axis of rotation of the assembly, the two axes being mutually perpendicular. The central boss is 102 mm in outside diameter and 200 mm long and is mounted coaxially on the fixed steel pivot shaft, which is approximately 25 mm in diameter, however the precise diameter of the shaft will depend on the bearings used.

Diametrically opposite the hammer shaft are two steel counter balance arms, each 20 mm in outside diameter and 185 mm long. These arms are screwed into the boss so that the length of 150 mm protrudes. A steel counter balance weight is mounted on the arms so that its position can be adjusted to balance the weight of the striker and arms, as in Figure E.1. On the end of the central boss is mounted a 12 mm wide x 150 mm diameter aluminium alloy pulley and round this an inextensible cable is wound, one end being fixed to the pulley. The other end of the cable supports the operating weight.

The rigid frame also supports the mounting board on which the specimen is mounted by its normal fixings. The mounting board is adjustable vertically so that the upper half of the impact face of the hammer will strike the specimen when the hammer is moving horizontally, as shown in Figure E.1.

To operate the apparatus the position of the specimen and the mounting board is first adjusted as shown in Figure E.1 and the mounting board is then secured rigidly to the frame. The hammer assembly is then balanced carefully by adjustment of the counter balance weight with the operating weight removed. The hammer arm is then drawn back to the horizontal position ready for release and the operating weight is reinstated. On release of the assembly the operating weight will spin the hammer and arm through an angle of 3π/2 radians to strike the specimen. The mass of the operating weight to produce the required impact energy of 1,9 J equals:

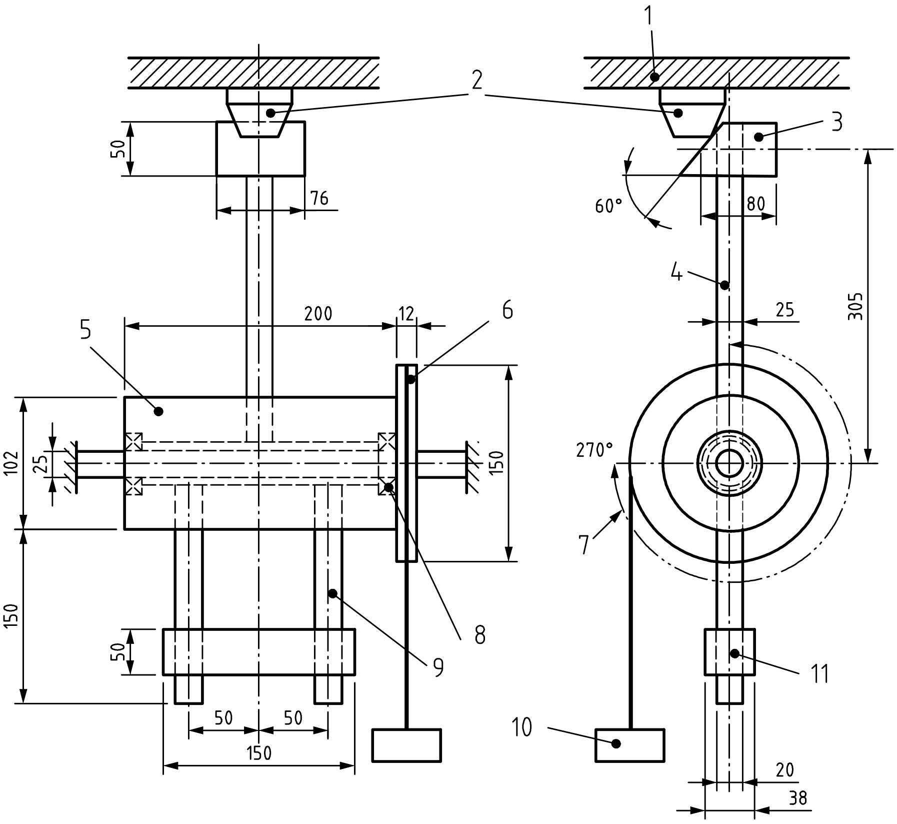
$$\frac{0,388}{3 \pi r} \quad \text{kg}$$

where

r is the effective radius of the pulley in metres. This equals approximately 0,55 kg for a pulley radius of 75 mm.

As the standard calls for a hammer velocity at impact of (1,5 ± 0,13) m s^{-1} the mass of the hammer head will need to be reduced by drilling the back face sufficiently to obtain this velocity. It is estimated that a head of mass of about 0,79 kg will be required to obtain the specified velocity, but this will have to be determined by trial and error.

Dimensions in millimetres



Key

1 mounting board
2 detector
3 striker
4 striker shaft
5 boss
6 pulley
7 270° angle of movement
8 ball bearings
9 counter balance arms
10 operating weight
11 counter balance weight

NOTE The dimensions shown are for guidance, apart from those relating to the hammer head.

Figure E.1 — Impact apparatus

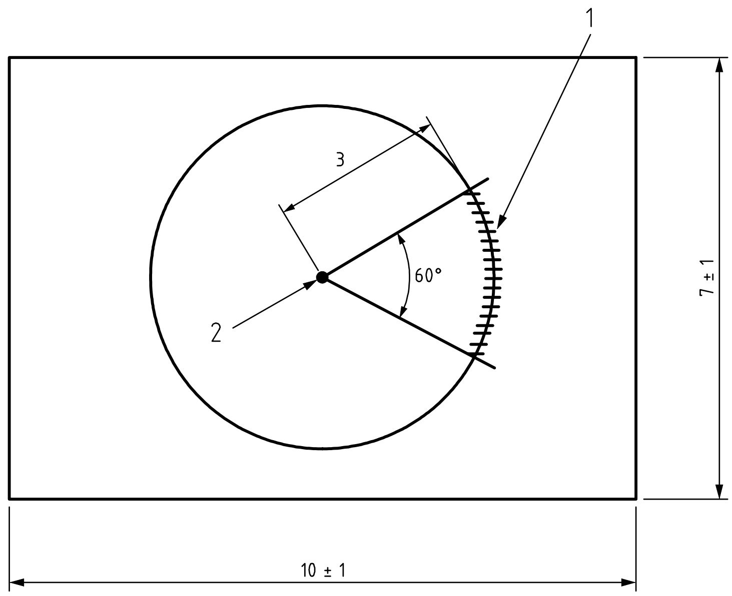
Annex F
(normative)

Fire test room

The specimens to be tested, the MIC, the temperature probe and the measuring part of the obscuration meter shall all be located within the volume shown in Figures F.1 and F.2.

The specimens, the MIC and the mechanical parts of the obscuration meter shall be at least 100 mm apart, measured to the nearest edges. The centre line of the beam of the obscuration meter shall be at least 35 mm below the ceiling.

Dimensions in metres

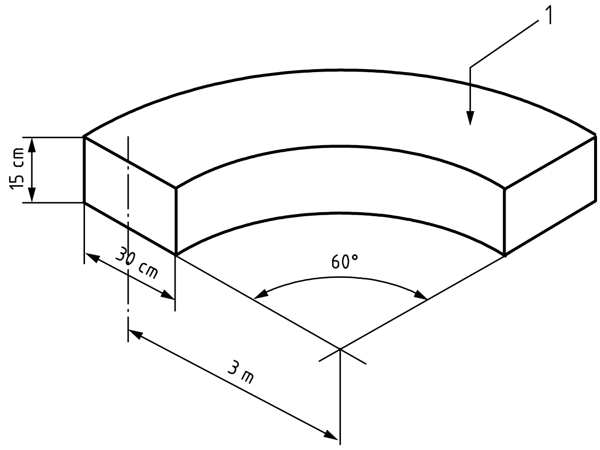


Key

1 specimens and measuring instruments (see Figure F.2)

2 position of test fire

Figure F.1 — Plan view of the fire test room



Key

1 ceiling

Figure F.2 — Mounting position for specimens and measuring instruments

Annex G
(normative)

Smouldering (pyrolysis) wood fire (TF2)

G.1 Fuel

Approximately 10 dried beechwood sticks (moisture content approximately 5 %), each stick having dimensions of 75 mm x 25 mm x 20 mm.

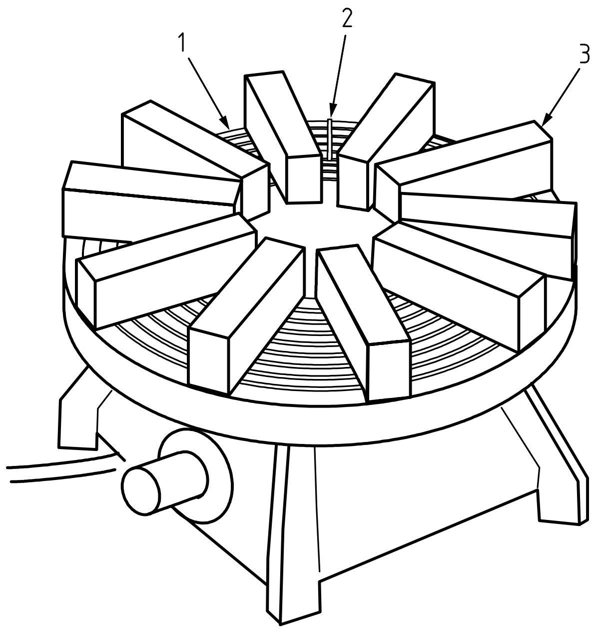
G.2 Hotplate

The hot plate shall have a 220 mm diameter grooved surface with eight concentric grooves, each 2 mm deep and 5 mm wide, with the outer groove 4 mm from the edge and a distance of 3 mm between grooves. The hot plate shall have a rating of approximately 2 kW.

The temperature of the hot plate shall be measured by a sensor attached to the fifth groove, counted from the edge of the hot plate, and secured to provide a good thermal contact.

G.3 Arrangement

The sticks shall be arranged on the grooved hotplate surface, with the 20 mm side in contact with the surface such that the temperature probe lies between the sticks and is not covered, as shown in Figure G.1.



Key

1 grooved hot plate

2 temperature sensor

3 wooden sticks

Figure G.1 — Arrangement of the sticks on the hotplate

G.4 Heating rate

The hot plate shall be powered such that its temperature rises from ambient to 600 °C in approximately 11 min.

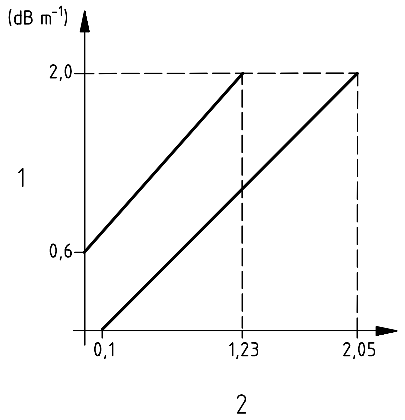
G.5 End of test condition

m_E = 2 dB m^{-1}.

G.6 Test validity criteria

The development of the fire shall be such that the curves of *m* against *y*, and *m* against time, fall within the limits shown in Figures G.2 and G.3 respectively and no flaming occurs, up to the time when all of the specimens have generated an alarm signal, or *m* = 2 dB m^{-1}, whichever is the earlier.

If the end of test condition, m_E = 2 dB m^{-1}, is reached before all the specimens of point smoke detectors using ionization have responded, then the test is only considered valid if a *y*-value of 1,6 has been reached.

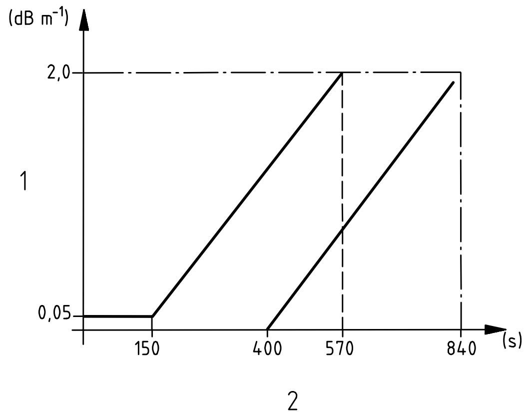


Key

1 *m*-value

2 *y*-value

Figure G.2 — Limits for m against y, Fire TF2



Key

1 *m*-value

2 time

Figure G.3 — Limits for m against time, Fire TF2

Annex H
(normative)

Glowing smouldering cotton fire (TF3)

H.1 Fuel

Approximately 90 pieces of braided cotton wick, each approximately 80 cm long and weighing approximately 3 g. The wicks shall be free from any protective coating and shall be washed and dried if necessary.

H.2 Arrangement

The wicks shall be fastened to a ring approximately 10 cm in diameter and suspended approximately 1 m above a non combustible plate as shown in Figure H.1.

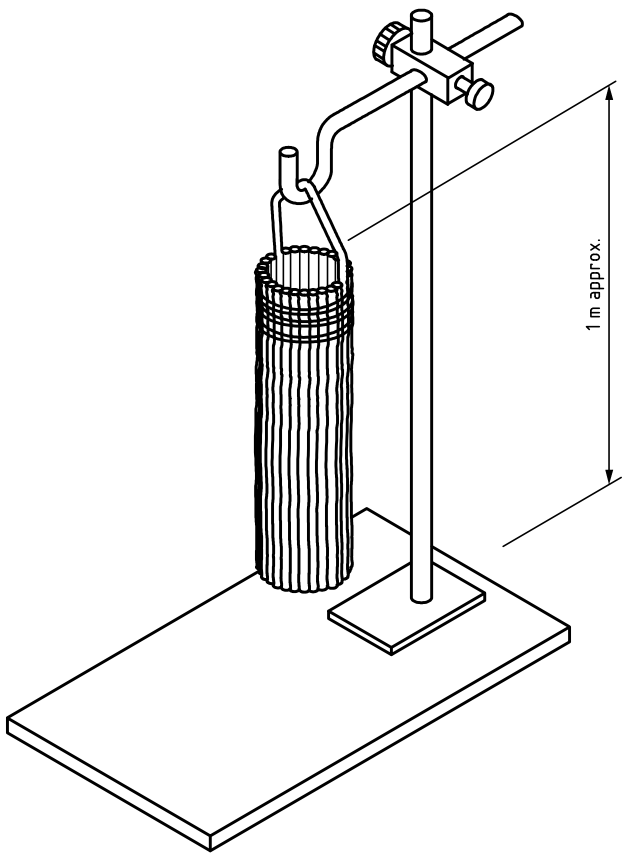


Figure H.1 — Arrangement of the cotton wicks

H.3 Ignition

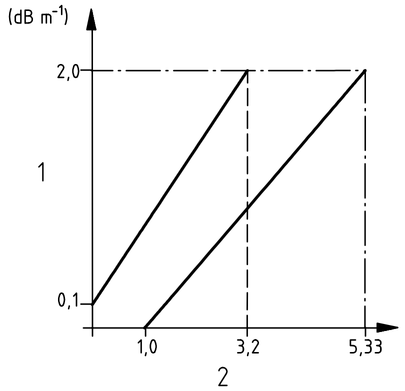
The lower end of each wick shall be ignited so that the wicks continue to glow. Any flaming shall be blown out immediately. The test time shall start when all wicks are glowing.

H.4 End of test condition

m_E = 2 dB m^{-1}.

H.5 Test validity criteria

The development of the fire shall be such that the curves of *m* against *y*, and *m* against time, fall within the limits shown in Figures H.2 and H.3 respectively, up to the time when all of the specimens have generated an alarm signal, or *m* = 2 dB m^{-1}, whichever is the earlier.

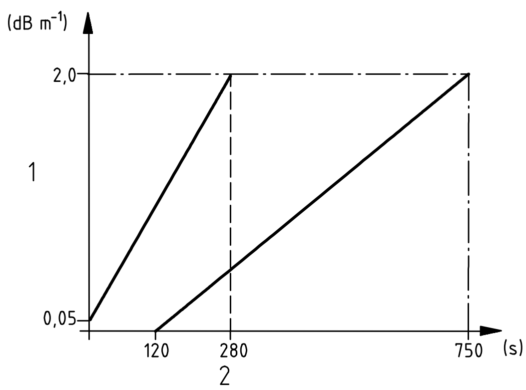


Key

1 *m*-value

2 *y*-value

Figure H.2 — Limits for *m* against *y*, Fire TF3



Key

1 *m*-value

2 time

Figure H.3 — Limits for *m* against time, Fire TF3

Annex I
(normative)

Flaming plastics (polyurethane) fire (TF4)

I.1 Fuel

Soft polyurethane foam, without flame retardant additives and having a density of approximately 20 kg m^{-3}. Three mats, approximately 50 cm × 50 cm × 2 cm are usually found sufficient, however the exact fuel quantity may be adjusted to obtain valid tests.

I.2 Arrangement

The mats shall be placed one on top of another on a base formed from aluminium foil with the edges folded up to provide a tray.

I.3 Ignition

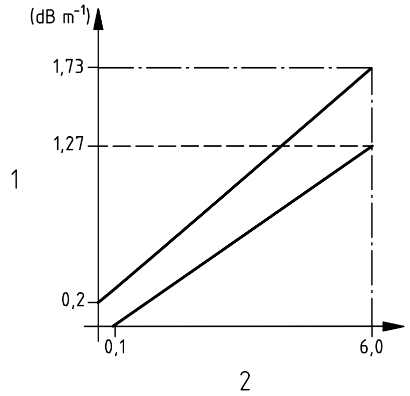
The mats shall normally be ignited at a corner of the lower mat, however the exact position of ignition may be adjusted to obtain valid tests. A small quantity of a clean burning material (e.g. Five cm^3 of methylated spirit) may be used to assist the ignition.

I.4 End of test condition

$y_E = 6$.

I.5 Test validity criteria

The development of the fire shall be such that the curves of *m* against *y*, and *m* against time, fall within the limits shown in Figures I.1 and I.2 respectively, up to the time when all of the specimens have generated an alarm signal, or $y = 6$, whichever is the earlier.

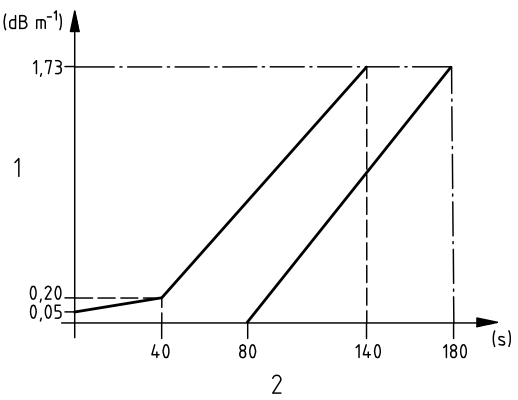


Key

1 *m*-value

2 *y*-value

Figure I.1 — Limits for *m* against y, Fire TF4



Key

1 *m*-value

2 time

Figure I.2 — Limits for *m* against time, Fire TF4

Annex J
(normative)

Flaming liquid (n-heptane) fire (TF5)

J.1 Fuel

Approximately 650 g of a mixture of n-heptane (purity ≥ 99 %) with approximately 3 % of toluene (purity ≥ 99 %), by volume. The precise quantities may be varied to obtain valid tests.

J.2 Arrangement

The heptane/toluene mixture shall be burnt in a square steel tray with dimensions approximately 33 cm x 33 cm x 5 cm.

J.3 Ignition

Ignition shall be by flame or spark, etc.

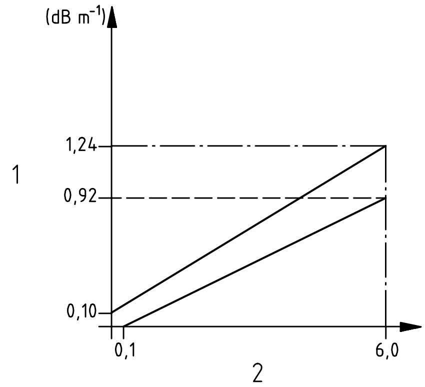
J.4 End of test condition

$y_E = 6$.

J.5 Test validity criteria

The development of the fire shall be such that the curves of m against y, and m against time, fall within the limits shown in Figures J.1 and J.2 respectively, up to the time when all of the specimens have generated an alarm signal, or $y = 6$, whichever is the earlier.

If the end of test condition, $y_E = 6$, is reached before all the specimens of point smoke detectors using scattered or transmitted light have responded, then the test is only considered valid if an m-value of 1,1 dB m^{-1} has been reached.

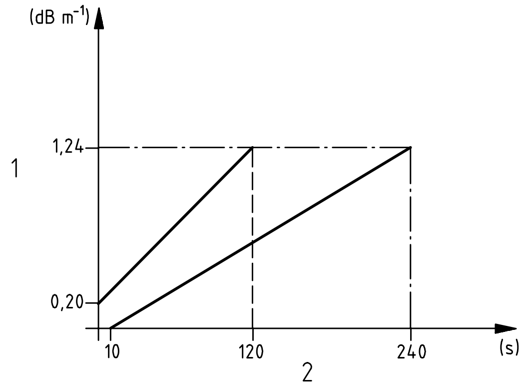


Key

1 *m*-value

2 *y*-value

Figure J.1 — Limits for *m* against *y*, Fire TF5



Key

1 *m*-value

2 time

Figure J.2 — Limits for *m* against time, Fire TF5

Annex K
(informative)

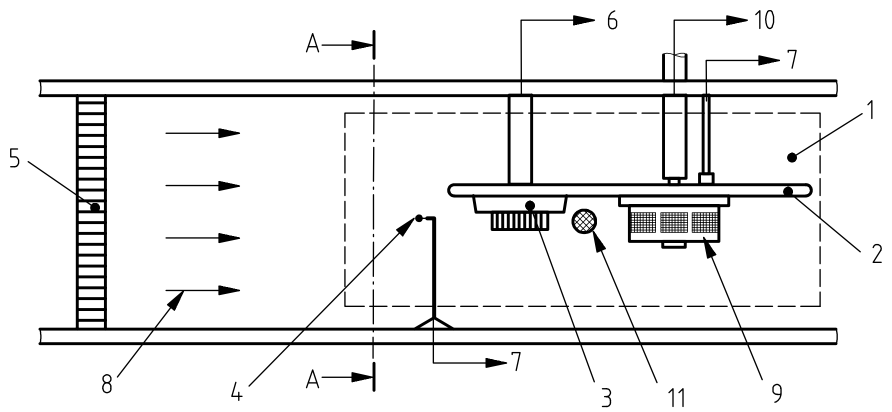
Information concerning the construction of the smoke tunnel

Point smoke detectors respond when the signal(s) from one or more smoke sensors fulfil certain criteria. The smoke concentration at the sensor(s) is related to the smoke concentration surrounding the point smoke detector but the relation is usually complex and dependent on several factors, such as orientation, mounting, air velocity, turbulence, rate of rise of smoke density, etc. The relative change of the response value measured in the smoke tunnel is the main parameter considered when the stability of smoke point smoke detectors is evaluated by testing in accordance with this standard.

Many different smoke tunnel designs are suitable for the tests specified in this standard but the following points should be considered when designing and characterizing a smoke tunnel.

The response value measurements require increasing aerosol density until the point smoke detector responds. This can be facilitated in a closed circuit smoke tunnel. A purging system is required to purge the smoke tunnel after each aerosol exposure.

The air flow created by a fan in the tunnel will be turbulent, and needs to pass through an air straightener to create a nearly laminar and uniform air flow in the working volume (see Figure K.1 and K.2). This can be facilitated by using a filter, honeycomb or both, in line with, and upstream of the working section of the tunnel. If a filter is used it should be coarse enough to let the aerosol pass. Care should be taken to ensure that the airflow is well mixed to give a uniform temperature and aerosol density before entering the flow straightener. Efficient mixing can be obtained by feeding the aerosol to the tunnel upstream of the fan.



Key

1 working volume

2 mounting board

3 detector(s) under test

4 temperature sensor

5 flow straightener

6 supply and monitoring equipment

7 control and measuring equipment

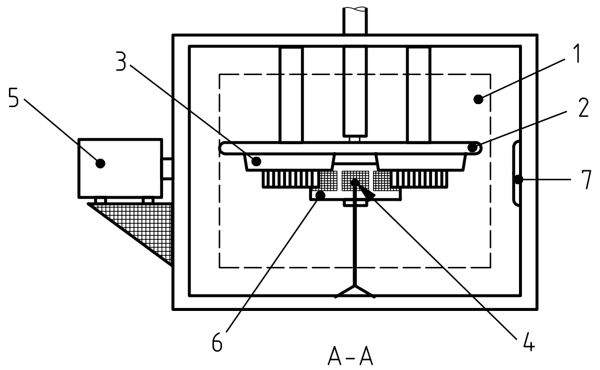
8 air flow

9 MIC, measuring ionization chamber

10 MIC suction

11 obscuration meter

Figure K.1 — Smoke tunnel, working section, side view



Key

1 working volume

2 mounting board

3 detector(s) under test

4 temperature sensor

5 obscuration meter

6 MIC, measuring ionization chamber

7 reflector for obscuration meter

Figure K.2 — Smoke tunnel, working section, cross section A-A

Means for heating the air before it enters the working section are required. The tunnel should have a system capable of controlling the heating as to achieve the specified temperatures and temperature profiles in the working volume. The heating should be achieved by means of low temperature heaters to avoid the production of extraneous aerosols or alteration of the test aerosol.

Special attention should be given to the arrangement of the elements in the working volume in order to avoid disturbance of the test conditions e.g. due to turbulence. The suction through the MIC creates a mean air velocity of approximately 0,04 m s^{-1} in the plane of the entrance openings in the chamber housing. However, the effect of the suction will be negligible if the MIC is placed 10 cm to 15 cm downstream of the point smoke detector position.

The smoke tunnel may be designed for aerosol-free wind exposures with 5 m s^{-1} and 10 m s^{-1}, provided this does not interfere with the operation when the tunnel is used for response value measurements.

Annex L
(informative)

Information concerning the requirements for the response to slowly developing fires

A simple point smoke detector operates by comparing the signal from the sensor with a certain fixed threshold (alarm threshold). When the sensor signal reaches the threshold, the point smoke detector generates an alarm signal. The smoke density at which this occurs is the response value for the point smoke detector. In this simple point smoke detector the alarm threshold is fixed and does not depend on the rate of change of sensor signal with time.

It is known that the sensor signal in clean air can change over the life of the point smoke detector. Such changes can be caused, for example, by contamination of the sensing chamber with dust or by other long-term effects such as component ageing. This drift can, in time, lead to increased sensitivity and eventually to false alarms.

It may be considered beneficial therefore to provide compensation for such drift in order to maintain a more constant level of response value with time. For the purposes of this discussion it is assumed that the compensation is achieved by increasing the alarm threshold to offset some or all of the upward drift in the sensor output.

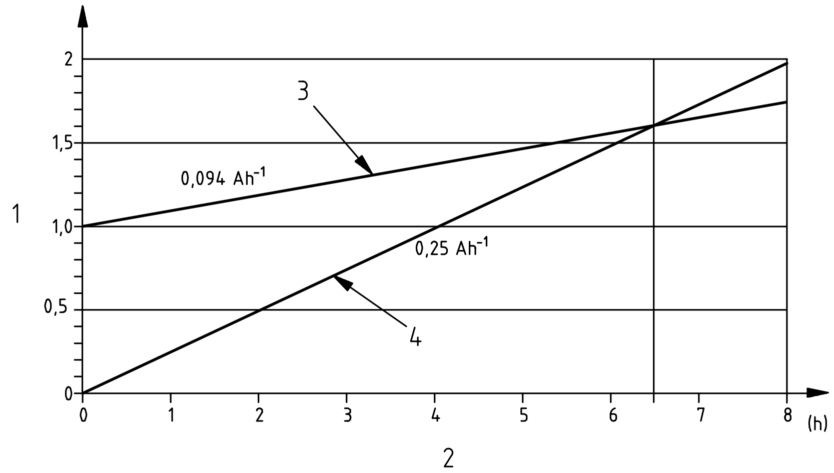
Any compensation for drift will reduce the sensitivity of the point smoke detector to slow changes in the sensor output even if these changes are caused by a real, but gradual, increase in smoke level. The object of requirement 4.2.7 a) is to ensure that the compensation does not reduce the sensitivity to a slowly developing fire to an unacceptable degree.

For the purposes of this standard it is assumed that the development of any fire which presents a serious danger to life or property will be such that the sensor output will change at a rate of at least $A/4$ per hour where A is the nominal response value of the point smoke detector. The response to rates of change less than $A/4$ per hour is not specified in this standard, and there is therefore no requirement for the point smoke detector to respond to these lower rates of change.

In order not to restrict the way in which compensation is achieved, 4.2.7 requires only that the time to alarm, for all rates of change greater than $A/4$ per hour, does not exceed 1,6 × the time to alarm, if the compensation were not present.

If the threshold increases in a linear fashion with time in response to a rise in the sensor signal, and if the extent of the compensation is not limited, then the maximum rate of compensation allowed can be seen from Figure L.1 to be $0{,}6A/6{,}4 = 0{,}094A$ per hour, since at this compensation rate the sensor output will reach the compensated threshold in exactly 6,4 h.

Although it has been assumed above that the threshold is compensated linearly and continuously, the process need not be linear nor continuous. For example, the stepwise adjustment shown in Figure L.2 also meets the requirement since, in this case, an alarm is reached in 6 h, which is less than the limiting value of 6,4 h.



Key

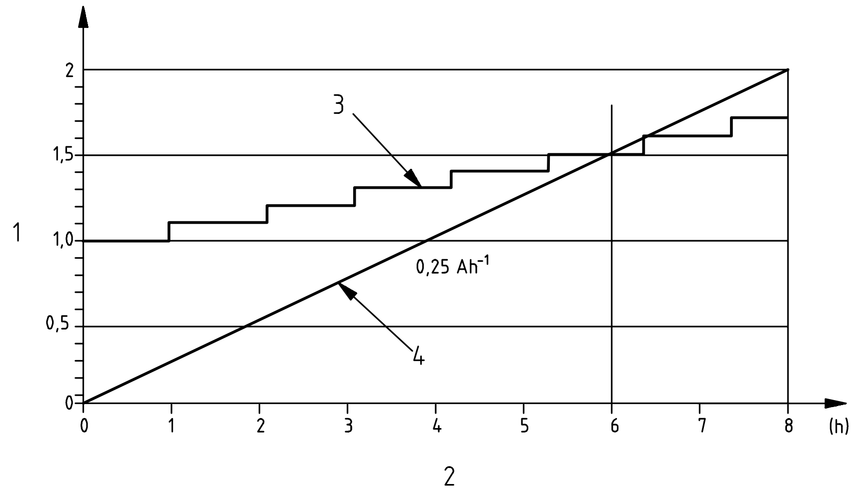
1 relative alarm threshold (relative to *A*)

2 time

3 compensated alarm threshold

4 sensor output

Figure L.1 — Linear compensation - limiting case



Key

1 relative alarm threshold (relative to *A*)

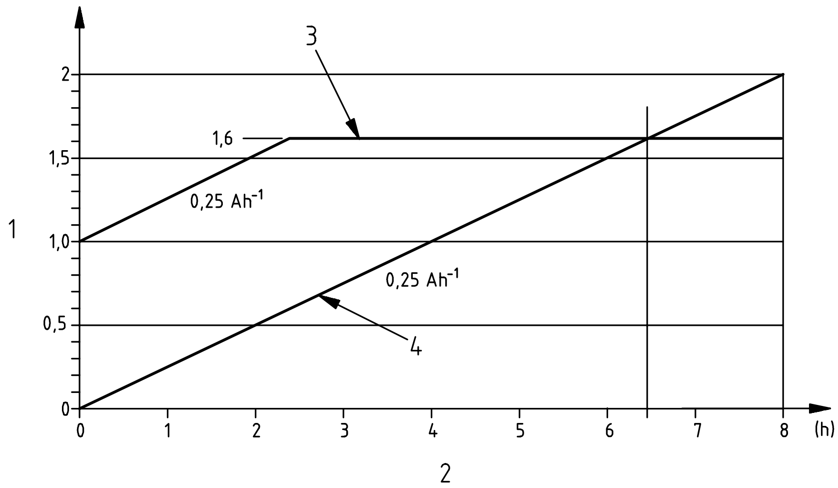
2 time

3 compensated alarm threshold

4 sensor output

Figure L.2 — Stepwise compensation - limiting case

Furthermore, the rate of compensation need not be limited to 0,094*A* per hour if the extent of the compensation is restricted to 0,6*A*. The relatively rapid rate of compensation shown in Figure L.3 also meets the requirement in reaching an alarm condition in 6,4 h. In this case the maximum rate of compensation will be limited only by the requirements of the test fires.



Key

1 relative alarm threshold (relative to *A*)

2 time

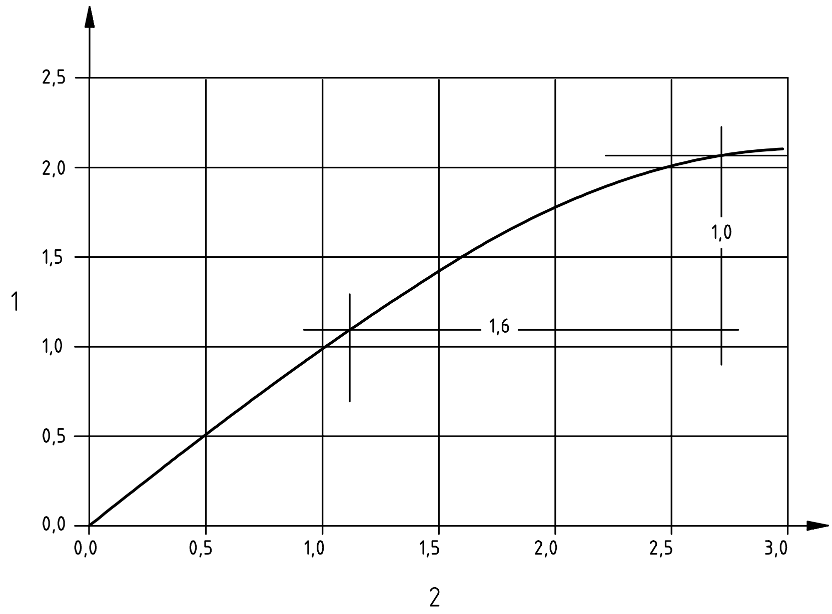
3 compensated alarm threshold

4 sensor output

Figure L.3 — High-rate, limited-extent compensation

The requirements of 4.2.7 a) allow considerable freedom in the way in which compensation for slow changes is achieved. However, it is recognized that in any practical point smoke detector the range over which the output of the sensor is linearly related to smoke (or other stimulus which is equivalent to smoke) is finite. If the range of compensation takes the sensor output into this nonlinear region then the sensitivity of the point smoke detector could become degraded to an unacceptable degree.

As an example, consider a point smoke detector having the transfer characteristic shown in Figure L.4, in which both axes are expressed in terms of response value *A*. The nonlinearity of the characteristic causes the effective sensitivity to reduce at higher values of stimulus. In this instance, it is necessary to limit the compensation to less than 1,1 × *A*, since in order to produce a change in output of *A*, the stimulus shall increase from 1,1 × *A* to 2,7 × *A*. This reduction in sensitivity by a factor of 1,6 represents the maximum allowed by 4.2.7 b).



Key

1 output

2 stimulus

Figure L.4 — Example of nonlinear transfer characteristic

Annex M
(informative)

Information concerning the construction of the measuring ionization chamber

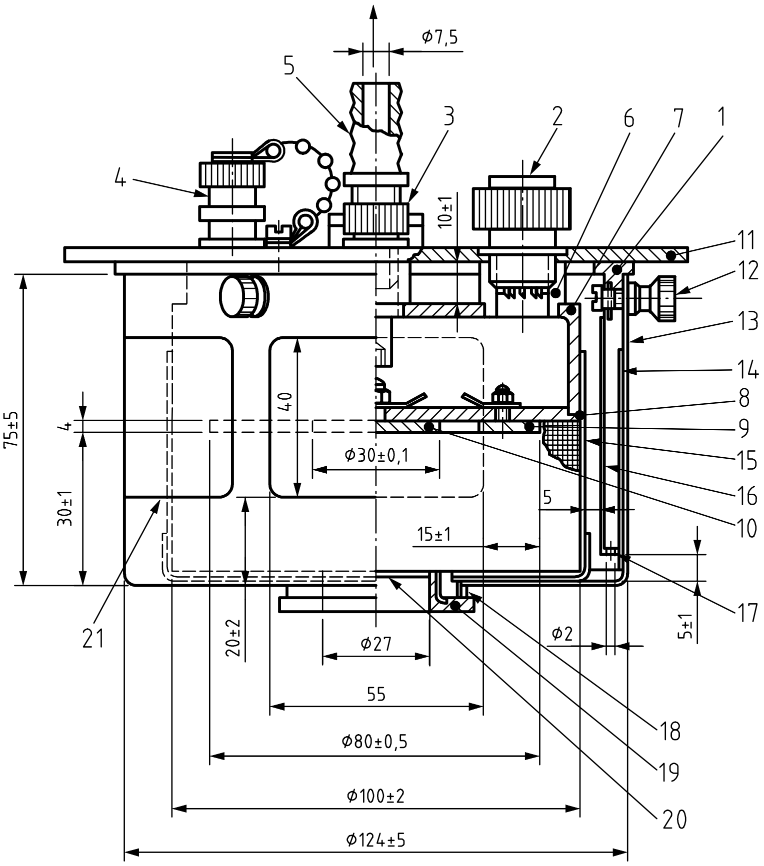
The mechanical construction of the measuring ionization chamber[2)] is shown in Figure M.1. The functionally important dimensions are marked with their tolerances. Further details of the various parts of the device are given in Table M.1.

2) The measuring ionization chamber is fully described in "Investigation of ionization chamber for reference measurements of smoke density" by M. Avlund, published by DELTA Electronics, Venlighedsvej 4 DK-2970 Hørsholm, Denmark.

Table M.1 — List of parts of the measuring ionization chamber

Reference No.	Item	Number provided	Dimensions, Special features	Material
1	Insulating ring	1		Polyamide
2	Multipole socket	1	10-pole	
3	Measuring electrode terminal	1	To chamber supply	
4	Measuring electrode terminal	1	To amplifier or current measuring device	
5	Suction Nozzle	1		
6	Guide socket	4		Polyamide
7	Housing	1		Aluminium
8	Insulating plate	1		Polycarbonate
9	Guard ring	1		Stainless steel
10	Measuring electrode	1		Stainless steel
11	Assembly plate	1		Aluminium
12	Fixing screw with milled nut	3	M3	Nickel plated brass
13	Cover	1	Six openings	Stainless steel
14	Outer grid	1	Wire 0,2 mm diameter 0,8 mm internal mesh width	Stainless steel
15	Inner grid	1	Wire 0,4 mm diameter 1,6 mm internal mesh width	Stainless steel
16	Windshield	1		Stainless steel
17	Intermediate ring	1	With 72 equispaced holes each 2 mm diameter	
18	Threaded ring	1		Nickel plated brass
19	Source holder	1		Nickel plated brass
20	Source	1	27 mm diameter	See C.2.3
21	Openings on the periphery	6		

Dimensions in millimetres



NOTE 1 See Table M.1 for the list of parts.

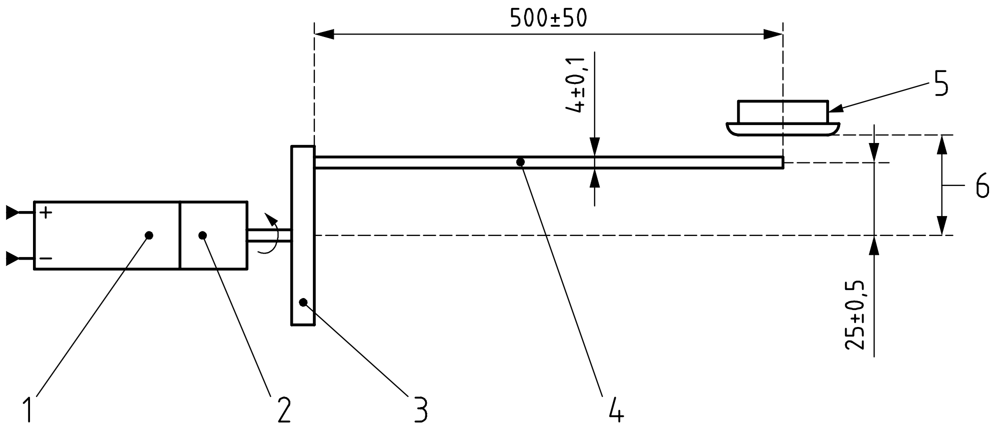
NOTE 2 Dimensions without a tolerance marked are recommended dimensions.

Figure M.1 — Mechanical construction of the measuring ionization chamber

Annex N
(normative)

Test set-up for testing the protection against the effect of moving objects

Dimensions in millimetres



Key

1 motor

2 gear

3 eccentric disc

4 moving rod

5 detector under test

6 distance of the detector from the axis of the test set-up – (33 ± 1) mm

Figure N.1 — Apparatus for testing the protection against the effect of moving objects

A test set-up shall be constructed in the following way:

A suitable electric motor is connected to the device for generating the required speed of rotation.

A disc shall be fixed to the shaft of the gear. A moving object in the form of a rod shall be fixed to the disc, so that it is parallel to the axis of the gear. The distance of the rod to the axis of the gear is e and the diameter is *d*. The length of the rod is *g*. The rod shall be made from a sufficiently stable material, so that it does not touch the point smoke detector when the testing device is in operation. The rod shall have a smooth surface painted matt black (e.g. optical flat paint).

The distance b is distance of the point smoke detector from the axis of the test set-up.

The point smoke detector under test shall be mounted at a distance *b* from the axis of the gear. The centre of the point smoke detector shall be at a distance g from the eccentric disc.

It shall be possible to rotate the point smoke detector under test so that its surface remains parallel to the axis of the test set-up.

The test device shall be constructed in such a way so that it is easy to set the parameters to the following values. These values shall apply if not stated otherwise in the specifications of the test.

a = 0,2 to 2	revolutions per second
b = (33,0 ± 1) mm	distance of the detector from the axis of the test set-up
d = (4,0 ± 0,1) mm	diameter of the rod

e = (25 ± 0,5) mm	eccentricity
g = (500 ± 50) mm	distance of the detector to the eccentric disc
φ = 45°	angle between test positions of the detector
v = (0,2 ± 0,02)rps	velocity step size:
vdw = 60 s	velocity step dwell time:

Annex O
(normative)

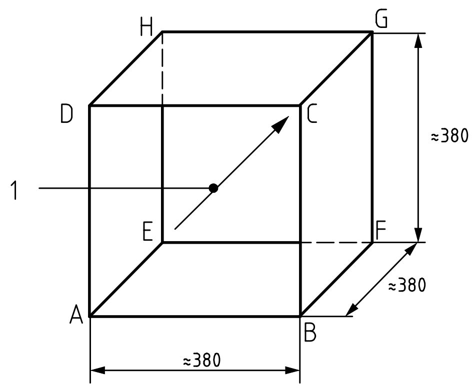
Apparatus for open detector static object test

This apparatus shall be used for measurement of open point smoke detectors during the directional dependence test (see 5.3).

The apparatus (see Figure O.1) shall be constructed so that it can be inserted in the working section of the smoke tunnel. Three of the cube faces shall be closed and lined on the inside with high gloss aluminium foil, the cube face BFGC shall be covered with a light absorbing material (e.g. a painted metal surface with matt black paint e.g. optical flat paint); two opposing cube faces shall be open so that the test aerosol can flow through the device.

The point smoke detector to be tested shall be installed within the cube (see Figure O.1) so that the centre of the sensing surface of the point smoke detector is about 190mm from each of the cube faces.

Dimensions in millimetres



Sides ABCD and EFGH shall be open to allow for the flow of aerosol.

Key

1 stream of aerosol

Figure O.1 — Apparatus for the open detector static test

Annex P
(informative)

Data supplied with point smoke detectors

To ensure correct operation of point smoke detector, manufacturers should make available, in addition to the marking information listed in Clause 8, the following data:

Point smoke detectors shall either be supplied with sufficient technical, installation and maintenance data to enable their correct installation and operation[3)] or, if all of these data are not supplied with each point smoke detector, reference to the appropriate data sheet(s) shall be given on, or with each point smoke detector.

For point smoke detectors with provision for on-site adjustment of their sensitivity or parameters, these data shall identify the applicable sensitivity/parameters and shall describe the method of programming (e.g. by selecting a switch position on the point smoke detector or a setting from a menu in the control and indicating equipment).

Additional information may be required by organizations certifying that point smoke detectors produced by a manufacturer conform to the requirements of this standard.

3) To enable correct operation of the detectors, these data should describe the requirements for the correct processing of the signals from the detector. This may be in the form of a full technical specification of these signals, a reference to the appropriate signalling protocol or a reference to suitable types of control and indicating equipment, etc.

Annex ZA
(informative)

Relationship of this European Standard with Regulation (EU) No.305/2011

(When applying this standard as a harmonized standard under Regulation (EU) No. 305/2011, manufacturers and Member States are obliged by this regulation to use this Annex)

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under standardization request M /109 for fire alarm/detection, fixed fire-fighting, fire and smoke control and explosion suppression products given to CEN and CENELEC by the European Commission (EC) and the European Free Trade Association (EFTA).

When this European Standard is cited in the Official Journal of the European Union (OJEU), under Regulation (EU) No 305/2011, it shall be possible to use it as a basis for the establishment of the Declaration of Performance (DoP) and the CE marking, from the date of the beginning of the co-existence period as specified in the OJEU.

Regulation (EU) No 305/2011, as amended, contains provisions for the DoP and the CE marking.

Table ZA.1 — Relevant clauses for point smoke detectors that operate using scattered light, transmitted light or ionization and intended use in fire detection and fire alarm systems installed in and around buildings

Product: point smoke detectors that operate using scattered light, transmitted light or ionization **Intended use:** Fire detection and fire alarm systems installed in and around buildings			
Essential characteristics	**Clauses in this and other European Standard(s) related to essential characteristics**	**Regulatory classes**	**Notes**
Operational reliability:		None	
Individual alarm indication	4.2.1		description
Connection of ancillary devices	4.2.2		description
Monitoring of detachable detectors	4.2.3		description
Manufacturer's adjustments	4.2.4		description
On site adjustment of response behaviour	4.2.5		Description
Protection against the ingress of foreign bodies	4.2.6		description
Response to slowly developing fires	4.2.7		Description
software controlled detector (when provided)	4.2.8		description

Product: point smoke detectors that operate using scattered light, transmitted light or ionization **Intended use:** Fire detection and fire alarm systems installed in and around buildings			
Essential characteristics	**Clauses in this and other European Standard(s) related to essential characteristics**	**Regulatory classes**	**Notes**
Nominal activation conditions/Sensitivity:			
Repeatability	4.3.1	Threshold	ratio (m or y)+min limits
Directional dependence	4.3.2	Threshold	ratio (m or y)+min limits
Reproducibility	4.3.3	Threshold	ratio (m or y)+min limits
Response delay (response time):			
Air movement	4.4.1	Threshold	ratio (m or y)+description
Dazzling	4.4.2	Threshold	ratio (m)+description
Tolerance to supply voltage:			
Variation in supply parameters	4.5	Threshold	ratio (m or y)+min limits
Performance parameters under fire conditions:			
Fire sensitivity	4.6		description
Durability of Nominal activation conditions/Sensitivity:			
Temperature resistance:			
Cold (operational)	4.7.1.1	Threshold	ratio (m or y)+description
Dry heat (operational)	4.7.1.2	Threshold	ratio (m or y)+description
Humidity resistance:			
Damp heat, steady-state (operational)	4.7.2.1	Threshold	ratio (m or y)+description
Damp heat, steady-state (endurance)	4.7.2.2	Threshold	ratio (m or y)+description
Corrosion resistance:			
Sulfur dioxide (SO2) corrosion (endurance)	4.7.3	Threshold	ratio (m or y)+description

Product: point smoke detectors that operate using scattered light, transmitted light or ionization **Intended use:** Fire detection and fire alarm systems installed in and around buildings			
Essential characteristics	**Clauses in this and other European Standard(s) related to essential characteristics**	**Regulatory classes**	**Notes**
Vibration Resistance:			
Shock (operational)	4.7.4.1	Threshold	ratio (m or y)+description
Impact (operational)	4.7.4.2	Threshold	ratio (m or y)+description
Vibration, sinusoidal (operational)	4.7.4.3	Threshold	ratio (m or y)+description
Vibration, sinusoidal (endurance)	4.7.4.4	Threshold	ratio (m or y)+description
Electrical stability:	4.7.5	Threshold	ratio (m or y)+description
EMC, immunity (operational)			

ZA.2 System of Assessment and Verification of Constancy of Performance (AVCP)

The AVCP system(s) of point smoke detector indicated in Table(s) ZA.1 can be found in the EC legal act(s) adopted by the EC: EC Decision 1996/577/EC (OJEU L254 of 1996-10-08), as amended by EC Decision 2002/592/EC (OJEU L192 of 2002-07-20).

ZA.3 Assignment of AVCP tasks

The AVCP system(s) of point smoke detectors as provided in Table ZA.1 is defined in Table ZA.3.1 resulting from application of the clauses of this or other European Standards indicated therein. The content of the tasks assigned to the notified body shall be limited to those essential characteristics, if any, as provided for in Annex III of the relevant standardization request and to those that the manufacturer intends to declare.

Taking into account the AVCP systems defined for the products and the intended uses the following tasks are to be undertaken by the manufacturer and the notified body respectively for the assessment and verification of the constancy of performance of the product.

Table ZA.3.1 — Assignment of AVCP tasks for point smoke detectors under system 1

Tasks		**Content of the task**	**AVCP clauses to apply**
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which are declared	6.3
	Further testing of samples taken at factory according to the prescribed test plan	Essential characteristics of Table ZA.1 relevant for the intended use which are declared	6.3.2.6
Tasks for the notified product certification body	An assessment of the performance of the construction product carried out on the basis of testing (including sampling), type calculation, tabulated values or descriptive documentation of the product	Essential characteristic of Table ZA.1 relevant for the intended use which are declared	6.2
	Initial inspection of the manufacturing plant and of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use, which are declared, Documentation of FPC	6.3
	Continuous surveillance, assessment and evaluation of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use, which are declared. Documentation of FPC	6.3

Bibliography

EN ISO 9001:2015, *Quality management systems Requirements (ISO 9001:2015)*

EN 60068-2-75:2014, *Environmental testing - Part 2-75: Tests - Test Eh: Hammer tests (IEC 60068-2-75:2014)*

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