Draft for Public Comment

Form 36
Version 8.0

DPC: 09/30170243 DC

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Date: 15 April 2009

Origin: European

Latest date for receipt of comments: 31 July 2009

Project no.: 2007/02208

Responsible committee: FSH/12/2 Fire detectors

Interested committees: FSH/12, FSH/12/1

Title: Draft BS EN 54-12 Fire detection and fire alarm systems - Part 12: Smoke detectors - Line detectors using an optical beam

Supersession information: If this document is published as a standard, the UK implementation of it will supersede BSEN54-12 : 2002 and partially supersede. NONE If you are aware of a current national standard which may be affected, please notify the secretary (contact details below).

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Cross-references

The British Standards which implement International or European publications referred to in this draft may be found via the British Standards Online Service on the BSI web site http://www.bsigroup.com .

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Introduction
This draft standard is based on European discussions in which the UK has taken an active part. Your comments on this draft are welcome and will assist in the preparation of the consequent British Standard. Comment is particularly welcome on national, legislative or similar deviations that may be necessary.

Even if this draft standard is not approved by the UK, if it receives the necessary support in Europe, the UK will be obliged to publish the official English Language text unchanged as a British Standard and to withdraw any conflicting standard.

UK Vote
Please indicate whether you consider the UK should submit a negative (with reasons) or positive vote on this draft.

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The guidance given below is intended to ensure that all comments receive efficient and appropriate attention by the responsible BSI committee. **Annotated drafts are not acceptable and will be rejected.**

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Template for comments and secretariat observations

Date: xx/xx/200x	Document: **ISO/DIS xxxxx**

1 2 (3) 4 5					(6)	(7)
MB	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/Table/ Note** (e.g. Table 1)	**Type of com-ment**	**Comment (justification for change) by the MB**	**Proposed change by the MB**	**Secretariat observations** on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '... so that the mains connector to which no connection ...	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 54-12

April 2009

ICS 13.220.20

Will supersede EN 54-12:2002

English Version

Fire detection and fire alarm systems - Part 12: Smoke detectors - Line detectors using an optical beam

Systèmes de détection et d'alarme incendie - Partie 12 : Détecteurs de fumée - Détecteurs linéaires fonctionnant suivant le principe de la transmission d'un faisceau d'ondes optiques rayonnées

Brandmeldeanlagen - Teil 12: Rauchmelder -Linienförmiger Melder nach dem Durchlichtprinzip

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 72.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. prEN 54-12:2009: E

Contents

Page

Foreword

This document (prEN 54-12:2009) 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 is currently submitted to the CEN Enquiry.

This document will supersede EN 54-12:2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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

This standard has been prepared in cooperation with EURALARM (Association of European Manufacturers of Fire and Intruder Alarm Systems)

Information on the relationship between this European Standard and other standards of the EN 54 series is given in annex A of EN 54-1:1996

1 Scope

This European Standard specifies requirements, test methods and performance criteria for line smoke detectors utilising the attenuation and/or changes in attenuation of an optical beam, for use in fire detection systems installed in buildings.

This European Standard does not cover:

a) line smoke detectors designed to operate with separations between opposed components of less than 1 m;

b) line smoke detectors whose optical path length is defined or adjusted by an integral mechanical connection;

c) line smoke detectors with special characteristics, which cannot be assessed by the test methods in this European Standard.

NOTE The term "optical" is used to describe that part of the electromagnetic spectrum produced by the transmitter to which the receiver is responsive; this is not restricted to visible wavelengths.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 54-1:1996, *Fire detection and fire alarm systems — Part 1: Introduction*

EN 54-2:1997, *Fire detection and fire alarm systems — Part 2: Control and indicating equipment*

EN 54-2:1997/A1:2006, *Fire detection and fire alarm systems — Part 2: Control and indicating equipment*

EN 54-4:1997, *Fire detection and fire alarm systems — Part 4: Power supply equipment*

EN 54-4:1997/A1:2002, *Fire detection and fire alarm systems — Part 4: Power supply equipment*

EN 54-4:1997/A2:2006, *Fire detection and fire alarm systems — Part 4: Power supply equipment*

EN 54-7:2000; *Fire detection and fire alarm systems — Part 7: Point-type smoke detectors*

EN 54-7:2000/A1:2002; *Fire detection and fire alarm systems — Part 7: Point-type smoke detectors*

EN 54-7:2000/A2:2006; *Fire detection and fire alarm systems — Part 7: Point-type smoke detectors*

EN 50130-4:1995, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

EN 50130-4/A1:1998, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

EN 50130-4/A2:2003, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

EN 60068-1:1994, *Environmental testing — Part 1: General and guidance*

EN 60068-2-1:2007, *Environmental testing — Part 2-1: Tests; Tests A: cold*

EN 60068-2-2:1993 +A1:1993, *Environmental testing - Part 2: Tests; Test B: dry heat*

EN 60068-2-27:1993, *Environmental testing - Part 2-27: Tests, Test Ea: shock*

EN 60068-2-30:2005, *Environmental testing - Part 2-30: Variant 1 test cycle and controlled recovery conditions: Damp heat, cyclic*

EN 60068-2-42:2003, *Environmental testing - Part 2-42: Tests, Test Kc: Sulphur dioxide, steady state*

EN 60068-2-6:1995, *Environmental testing - Part 2: Tests - Test Fc: Vibration, sinusoidal*

EN 60068-2-75:1997, *Environmental testing - Part 2-75: Tests, Test Eh for test Ehb: impact*

EN 60068-2-78:2001, *Environmental testing - Part 2-78: Tests, Test Cab: Damp heat, steady state*

3 Terms and definitions

For the purposes of this European Standard the terms and definitions given in EN 54-1:1996 and the following apply.

3.1
line smoke detector using an optical beam
detector consisting at least of a transmitter and a receiver and which may include reflector(s) for the detection of smoke by the attenuation and/or changes in attenuation of an optical beam

3.2
transmitter
component from which the optical beam emanates

3.3
receiver
component which receives the optical beam

3.4
optical path length
total distance traversed by the optical beam between the transmitter and the receiver

3.5
opposed component
component [transmitter and receiver or transmitter-receiver and reflector(s)] of the beam detector whose position determines the optical path

3.6
separation
physical distance between the opposed components [transmitter and receiver or transmitter-receiver and reflector(s)]

3.7
attenuation
value “*A*", expressed in dB, of the reduction in intensity of the optical beam at the receiver, defined by the following equation:

$A = 10 \log_{10}(I_0/I)$

where

I_0 is the received intensity without reduction in intensity;

I is the received intensity after reduction in intensity.

3.8
response threshold value

Is given by the following equation :

$C = F * n_f / n_v$ dB
Where:
F is the value of the filter obscuration when an alarm signal is generated by a specimen, when tested in accordance with 5.1.5, it's expressed in dB, of the reduction in intensity of the optical beam, defined by the following equation:
$F = 10 \log_{10}(I_0/ I)$
I_0 is the received intensity without reduction in intensity
I is the received intensity after reduction in intensity with the filter F
n_f is the number of times the beam passes through the filter
n_v is the number of times the beam passes through the protected volume

4 Requirements

4.1 Compliance

In order to comply with this standard the detector shall meet the requirements of this clause, which shall be verified by visual inspection or engineering assessment, shall be tested in accordance with clause 5 and shall meet the requirements of the tests.

4.2 Individual alarm indication

Each detector shall be provided with an integral red visible indicator, by means of which each individual detector which releases an alarm can be identified, until the alarm condition is reset.

4.3 Connection of ancillary devices

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

4.4 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).

4.5 On-site adjustment of response threshold value

If there is provision for on-site adjustment of the response threshold value 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 this standard.

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

4.6 Protection against ingress of foreign bodies

The detector shall be designed so that a sphere of diameter (1,3 $\pm$ 0,05) mm cannot pass into any enclosure containing active opto-electronic components, when the detector is in operational condition.

4.7 Monitoring of detachable detectors and connections

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.

If there are cables connecting separate parts of the detector, then a means shall be provided for a remote monitoring system (e.g. the control and indicating equipment) to detect a short or open circuit on those cables, in order to give a fault signal.

4.8 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.

An assessment of the detector's response to slow increases in smoke density shall be made by analysis of the circuit/software, and/or simulations. If this is not possible a physical test may be carried out at the minimum rate of increase smoke density.

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 $C/4$ per hour (where C is the detector's initial uncompensated response threshold value), the time for the detector to give an alarm does not exceed $1{,}6 \cdot C/R$ 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 threshold 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 H.

4.9 Marking

Each component (receiver, transmitter, transmitter - receiver) shall be clearly marked with the following information:

a) the number of this standard (i.e. EN 54-12);

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

c) the component designation (type or number);

   1) the wiring terminal designations;

   2) a mark or code (e.g. a 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 detector;

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

The information corresponding to a), b) and c) shall be marked clearly on each reflector.

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 and shall be accessible during maintenance.

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

NOTE Further marking requirements are defined in annex ZA

4.10 Documentation

4.10 General

Detectors shall either be supplied with sufficient technical, installation and maintenance data to ensure their correct installation and operation or, if all of these data are not supplied with each detector, reference to the appropriate data sheet be given on, or with each detector. These data shall include at least:

a) the maximum angular misalignment. If this is different for the transmitter, receiver or reflector or different for vertical or horizontal misalignment, this shall be stated;

b) the response threshold value of the detector in dB. If the response can be adjusted the minimum and maximum response threshold values, and any setting of response behaviour that does not comply with this standard, shall be stated; The recommended sensitivity settings corresponding to different separations shall be provided in the documentation from the manufacturer;

c) the minimum and maximum separation.

NOTE Additional information may be required by organisations certifying that the detectors produced by a manufacturer conform to the requirements of this standard. The manufacturer shall supply documents that provide the information as requested in point b.

4.11 Additional requirements for software controlled detectors

4.11.1 General

For detectors which rely on software control in order to fulfil the requirements of this standard, the requirements of 4.9.2, 4.9.3 and 4.9.4 shall be met.

4.11.2 Software documentation

4.11.2.1 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.

NOTE 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.

4.11.2.2 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.

4) 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;

5) details of any software tools used in the design and implementation phase (e.g. CASE-tools, compilers).

4.11.3 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.

4.11.4 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.

5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

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

- temperature: 15 °C to 35 °C;
- relative humidity: 25 % to 75 %;
- air pressure: 86 kPa to 106 kPa.

NOTE 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, 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 detectors) to allow a fault signal to be recognised.

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

5.1.3 Mounting arrangements

The specimen shall be mounted by its normal means of attachment and aligned in accordance with the manufacturer's instructions. If these instructions describe more than one method of mounting, 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 IEC/EN 60068).

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

5.1.5 Measurement of response threshold value

5.1.5.1 General

The specimen, for which the response threshold value is to be measured, shall be installed on the measuring bench, conforming to annex A, in its normal operating position, by its normal means of attachment in accordance with 5.1.3.

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

The response threshold value shall be recorded as C.

5.1.5.2 Operating conditions

On a rigid support assemble the receiver at a longitudinal distance of at least 500 mm from the transmitter or the transmitter - receiver at the same distance from the reflector (see Figure A.1), then place a filter holder as close as possible to the front of the receiver, adjusting the filter holder so that the whole beam passes through the filter. This filter holder shall be used to mount the filters used during the measurement of response threshold value.

The height h separating the axis of the optical beam above the support shall be 10 times the diameter (or the vertical dimension) of the optical system of the receiver.

Adjustment for path length or alignment, if required, shall be carried out in accordance with the manufacturer's instructions.

Unless otherwise stated in a test procedure, the response threshold value shall be measured with a simulated maximum separation carried out using means agreed by the manufacturer.

5.1.5.3 Measurements

The response threshold value is determined by the value of the lowest value test filter required to give an alarm within 30 s after introduction in the beam. The minimum resolution for optical density filters shall be in accordance with Table A.1 (see annex A).

5.1.6 Provision for tests

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

a) seven detectors;

b) the documentation required in 4.10

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

NOTE This implies that the mean response threshold value of the seven 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 in accordance with the test schedule in Table 1. After the reproducibility test, the two least sensitive specimens (i.e. those with the highest response thresholds) shall be numbered 6 and 7, and the others shall be numbered 1 to 5.

Table 1 — Test Schedule

Test Clause		Specimen N°(s)
Reproducibility 5.2		all specimens
Repeatability 5.3		2
Tolerance to beam misalignement	5.4	1
Variation of supply parameters	5.5	1
Rapid changes in attenuation	5.6	1
Optical path length dependence	~~5.7~~ 1	–
Fire sensitivity	5.8	6 and 7
Stray light	5.9	6
Dry heat (operational)	5.10	3
Cold (operational)	5.11	3
Damp heat, steady state (operational)	5.12	2
Damp heat, steady state (endurance)	5.13	2
Vibration (endurance)	5.14	7
Electromagnetic compatibility (EMC), immunity tests (operational)	5.15	4 [a] 6 [a]
Sulphur dioxide SO_2 corrosion (endurance)	5.16 5	
Impact (operational)	5.17	1

[a] 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 clause 4 of EN 50130-4:1995).

5.2 Reproducibility

5.2.1 Object

The detector is tested to show that the sensitivity does not vary unduly from specimen to specimen.

5.2.2 Test procedure

Adjust the specimens to the maximum sensitivity.

Measure the response threshold value of each of the specimens in accordance with 5.1.5.

The mean of these response threshold values shall be calculated and shall be designated C_{rep}.

The maximum response threshold value shall be designated C_{max} and the minimum value shall be designated C_{min}.

5.2.3 Requirements

C_{min} shall not be less than 0,4 dB.

The ratio of the response threshold values $C_{max} : C_{rep}$ shall not be greater than 1,33, and the ratio of the response threshold values $C_{rep} : C_{min}$ shall not be greater than 1,5.

5.3 Repeatability

5.3.1 Object

The detector is tested to show that it has stable behaviour with respect to its sensitivity even after a number of alarm conditions.

5.3.2 Test procedure

Adjust the specimen to the maximum sensitivity.

Measure the response threshold value of the specimen three times in accordance with 5.1.5.

The period between successive determinations shall not be less than 15 min or more than 1 h.

The specimen is then powered without interruption or disturbance to the optical beam for 3 days. Again measure the response threshold value of the specimen in accordance with 5.1.5, once.

The maximum response threshold value shall be designated C_{max} and the minimum value shall be designated C_{min}.

5.3.3 Requirements

No alarm or fault signals shall be emitted during the 3 days between testing.

C_{min} shall not be less than 0,4 dB.

The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

5.4 Tolerance to beam misalignment

5.4.1 Object

The detector is tested to show that small angular inaccuracies in alignment (within the maximum stated by the manufacturer), resulting from installation and/or movement in the structure of a building does not unduly affect the operation of the detector.

5.4.2 Test procedure

5.4.2.1 State of the specimen during conditioning

Adjust the specimen to the maximum sensitivity, and mount in accordance with 5.1.3 with the maximum separation. Connect in accordance with 5.1.2.

With the agreement of the manufacturer this test may be carried out outside of the limits of atmospheric conditions of 5.1.1.

5.4.2.2 Conditioning

Subject each opposed component to the following procedures whilst holding the other component stationary.

a) Rotate the component in a clockwise direction about a vertical axis at a rate of $(0,3 \pm 0,05)° \text{ min}^{-1}$ up to the maximum angular misalignment declared by the manufacturer in accordance with 4.10. After 2 min in this position, measure the response threshold value in accordance with 5.1.5.

b) Remove the attenuator and reset the detector.

c) Return the rotated component to its original position, reset the detector and allow it to stabilize;

d) Repeat the procedure described in a) but rotate the component in a counter-clockwise direction;

e) Repeat the procedures described in a) and b) but rotate the component about a horizontal axis normal to the beam.

The greatest of the five values of response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lowest shall be designated C_{min}.

5.4.3 Requirements

The specimen shall not emit a fault or an alarm signal whilst being rotated in the directions specified within the angular tolerances stated by the manufacturer (see 4.10).

The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

The maximum angle of misalignment declared by the manufacturer shall be greater than 0,2 degrees.

5.5 Variation of supply parameters

5.5.1 Object

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

5.5.2 Test procedure

Adjust the specimen to the maximum sensitivity.

Measure the response threshold value of the specimen in accordance with 5.1.5 under the extremes of the specified conditions (e.g. minimum and maximum voltage).

The maximum response threshold value shall be designated C_{max} and the minimum value shall be designated C_{min}.

NOTE For conventional detectors the supply parameter is the dc voltage applied to the detector. For other types of 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

C_{min} shall not be less than 0,4 dB.

The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

5.6 Rapid changes in attenuation

5.6.1 Object

The detector is tested to ensure that it will produce alarm or fault signals, within an acceptable time, after a sudden large sustained increase in beam attenuation.

5.6.2 Test procedure

Adjust the specimen to the minimum sensitivity, and mount and connect in accordance with 5.1.5.

The following attenuators equivalent to a response threshold value shall be used:

attenuator A: response threshold value 6 dB;

attenuator B: response threshold value 10 dB.

Place the attenuator A in the optical path. The time to reach maximum obscuration shall not be greater than 1 s. Keep the attenuator A in place for 40 s.

Remove attenuator A, reset the detector and place the attenuator B in the optical path. The time to reach maximum obscuration shall not be greater than 1 s. Keep the attenuator B in place for 70 s

5.6.3 Requirements

The specimen shall emit an alarm signal no more than 30 s after the total introduction of the attenuator A between the components.

The specimen shall emit a fault or alarm signal no more than 60 s after the total introduction of the attenuator B between the components.

A fire alarm signal shall not be cancelled by a fault resulting from a rapid change in obscuration

5.7 Optical path length dependence

5.7.1 Object

The detector is tested to ensure that the response threshold does not change significantly when it is tested over the minimum and maximum optical path length stated by the manufacturer.

5.7.2 Test procedure

Adjust the specimen to the maximum sensitivity, and mount and connect in accordance with 5.1.5.

With the agreement of the manufacturer this test may be carried out outside of the limits of atmospheric conditions of 5.1.1.

Measure the response threshold value in accordance with 5.1.5 at the minimum and maximum separations in accordance with the manufacturer's instructions.

The maximum response threshold value shall be designated C_{max} and the minimum value shall be designated C_{min}.

5.7.3 Requirements

C_{min} shall not be less than 0,4 dB.

The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

5.8 Fire sensitivity

5.8.1 Object

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

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.

5.8.2 Test procedure

5.8.2.1 Fire test room

The fire sensitivity tests shall be conducted in a rectangular room with a flat horizontal ceiling, of 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 B:

Measuring ionization chamber (MIC): *y* value;

Obscuration meter: *m* value (in dB m^{-1});

Temperature probe: *T* value (in °C)

The measuring ionization chamber (MIC) and the obscuration meter shall be in accordance with EN 54-7.

5.8.2.2 Test fires

Subject the specimens to the four test fires TF2 to TF5. The type, quantity, condition (e.g. moisture content) and arrangement of the fuel and the method of ignition shall be in accordance with annexes C to F for each test fire, along with the end of the test condition and the required profile curve limits.

An additional test fire is required if the manufacturer claims a minimum separation which is less than the 8±0.5m length of the fire test room. Clause 5.8.2.5 defines the method of recording the value of m_a for each specimen for each test fire. The test fire which produced the greater value of ma measured in section 5.8.2.5 should be used.'

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 the test condition is reached, whichever is the earlier. If these conditions are not met, the test shall be deemed invalid and repeated.

NOTE It is permissible, and can be necessary, to adjust the quantity and arrangement of the fuel to obtain valid test fires.

5.8.2.3 State of the specimens during the test

Adjust the sensitivity to the minimum recommended for the separation applied, as indicated in manufacturer's data.

Any adjustment for path length or alignment shall be carried out in accordance with the manufacturer's instructions.

Install the specimens on the fire test room ceiling in the designated place, in accordance with annex B.

Mount each specimen in accordance with 5.1.3, connect to its supply and monitoring equipment in accordance with 5.1.2 and allow to stabilize in its quiescent condition before the start of each test fire.

If the size of the test room does not allow the detector to be tested at its maximum specified separation, means agreed by the manufacturer shall be placed in the optical path to simulate the specified separation for this test.

NOTE Detectors which dynamically modify their sensitivity in response to varying ambient conditions can 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 detector at the start of each test fire is representative of its normal quiescent state.

5.8.2.4 Initial conditions

Before each test fire clean the specimens and any attenuator(s) in accordance with the manufacturer's guidelines.

Before each test fire ventilate the room with clean air until it is free from smoke and so that the following conditions can be obtained.

Switch off the ventilation system and close all doors, windows and other openings. Allow the air in the room to be stabilized and obtain the following conditions before the test is started:

temperature T: (23 ± 5) °C;

air movement: negligible (see NOTE);

y: $\leq$ 0,05;

m: $\leq$ 0,02 dB m^{-1}.

NOTE 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 minimum disturbance to the air.

5.8.2.5 Recording of the fire parameters and response values

During each test fire record the fire parameters in Table 2 against the time from the start of the test. Each parameter shall be recorded continuously or at least once per second.

Table 2 — The fire parameters

Paramete r Symbol		Units
Temperature	dT	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 the response of each specimen shall be recorded along with the fire parameters dT_a, y_a and m_a, at the moment of response. Ignore any response of the detector after the end of test condition has been reached.

5.8.3 Requirements

The two specimens shall emit an alarm signal, in each test fire, with m_a < 0,7 dB m^{-1}.

5.9 Stray light

5.9.1 Object

The detector is tested to demonstrate its immunity to stray light generated by artificial light sources.

5.9.2 Test procedure

5.9.3 Apparatus

The test apparatus shall generally be in accordance with annex G. The test shall be conducted in accordance with 5.10.2.2 to 5.10.2.4.

5.9.4 State of specimen during conditioning

Ad just the specimen to the maximum sensitivity and connect in accordance with 5.1.2 for 1 h before the test.

Before the test turn on the fluorescent lamps for a period of 5 min.

5.9.5 Conditioning

The following test procedure shall be applied:

a) all lights: off;

b) incandescent lights: on for 10 s and off for 10 s, 20 times;

c) fluorescent lights: on for 10 s and off for 10 s, 20 times;

d) all lights: on for 2 h.

5.9.6 Measurements during conditioning

After the end of period 5.10.2.3 d), and with the lamps on, measure the response threshold value in accordance with 5.1.5 but in the conditions of annex G.

The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

5.9.7 Requirements

No alarm or fault signals shall be given during the periods 5.10.2.3 a), b), c) and d).

C_{min} shall not be less than 0,4 dB.

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

5.10 Dry heat (operational)

5.10.1 Object

The detector is tested to demonstrate its ability to function correctly at high ambient temperatures, which may occur for short periods in the service environment.

5.10.2 Test procedure

5.10.2.1 Apparatus

The test shall be conducted in accordance with EN 60068-2-2:1993, Test Bb and 5.11.2.2 to 5.11.2.6.

5.10.2.2 State of the specimen during conditioning

Adjust the specimen to the maximum sensitivity, and mount and connect in accordance with 5.1.5.

5.10.2.3 Conditioning

The following conditioning shall be applied:

Temperature: (55 ± 2) °C;

Duration: 16 h.

5.10.2.4 Measurements during conditioning

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

5.10.2.5 Intermediate measurements

At the end of the conditioning period, whilst the specimen is still in the conditioning atmosphere, place an attenuator equivalent to response threshold value of 6 dB in the optical path.

5.10.2.6 Final measurements

After a recovery period of at least 1h at the standard atmospheric conditions, measure the response threshold in accordance with 5.1.5.

The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

5.10.3 Requirements

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

The detector shall emit an alarm signal no more than 30 s after the total introduction of the attenuator specified in 5.11.2.5.

C_{min} shall not be less than 0,4 dB.

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

5.11 Cold (operational)

5.11.1 Object

The detector is tested to demonstrate its ability to function correctly at low ambient temperatures appropriate to the anticipated service environment.

5.11.2 Test procedure

5.11.2.1 Apparatus

The test shall be conducted in accordance with EN 60068-2-1:1993, Test Ab and 5.12.2.2 to 5.12.2.6.

5.11.2.2 State of the specimen during conditioning

Adjust the specimen to the maximum sensitivity, and mount and connect in accordance with 5.1.5.

5.11.2.3 Conditioning

The following conditioning shall be applied:

Temperature: (-10 ± 3) °C;

Duration: 16 h.

There shall be no ice or frost on the detector during the conditioning.

5.11.2.4 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any alarm or fault signals.

5.11.2.5 Intermediate measurements

At the end of the conditioning period, whilst the specimen is still in the conditioning atmosphere, place an attenuator equivalent to response threshold value of 6 dB in the optical path.

5.11.2.6 Final measurements

After a recovery period of at least 1 h at the standard atmospheric conditions, measure the response threshold in accordance with 5.1.5.

The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

5.11.3 Requirements

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

The detector shall emit an alarm signal no more than 30 s after the total introduction of the attenuator specified in 5.12.2.5.

C_{min} shall not be less than 0,4 dB.

The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

5.12 Damp heat, steady state (operational)

5.12.1 Object

The detector is tested to demonstrate its ability to function correctly at high relative humidity (without condensation), which may occur for short periods in the anticipated service environment.

5.12.2 Test procedure

5.12.2.1 Apparatus

The test shall be conducted in accordance with HD 323.2.56 S1:1990, Test Cb and 5.13.2.2 to 5.13.2.5.

5.12.2.2 State of the specimen during conditioning

Adjust the specimen to the maximum sensitivity, and mount and connect in accordance with 5.1.5.

5.12.2.3 Conditioning

The following conditioning shall be applied:

Temperature: (40 ± 2) °C;

Relative humidity: (93 ± 3) %;

Duration: 4 days.

5.12.2.4 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any alarm or fault signals.

5.12.2.5 Final measurements

After a recovery period of at least 1 h at the standard atmospheric conditions, measure the response threshold in accordance with 5.1.5.

The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

5.12.3 Requirements

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

C_{min} shall not be less than 0,4 dB.

The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

5.13 Damp heat, steady state (endurance)

5.13.1 Object

The detector is tested to demonstrate its ability 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).

5.13.2 Test procedure

5.13.2.1 Apparatus

The test shall be conducted in accordance with as described in HD 323.2.56 S1:1990, Test Cb and 5.14.2.2 to 5.14.2.4.

5.13.2.2 State of the specimen during conditioning

Adjust the specimen to the maximum sensitivity and mount in accordance with 5.1.5 but it shall not be supplied with power during the conditioning.

5.13.2.3 Conditioning

The following conditioning shall be applied:

Temperature: (40 ± 2) °C;

Relative humidity: (93 ± 3) %;

Duration: 21 days.

5.13.2.4 Final measurements

After a recovery period of at least 1h at the standard atmospheric conditions, measure the response threshold in accordance with 5.1.5.

The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

5.13.3 Requirements

C_{min} shall not be less than 0,4 dB.

The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

5.14 Vibration (endurance)

5.14.1 Object

The detector is tested to demonstrate its ability to withstand the long term effects of vibration at levels appropriate to the service environment.

5.14.2 Test procedure

5.14.2.1 Apparatus

The test is conducted in accordance with EN 60068-2-6:1995, Test Fc, and 5.15.2.2 to 5.15.2.4.

5.14.2.2 State of the specimen during conditioning

Adjust the specimen to the maximum sensitivity.

Each component (one after the other or together) shall be mounted in accordance with 5.1.3 to a rigid fixture but shall not be supplied with power during conditioning.

The vibration shall be applied in each of three mutually perpendicular axes, in turn. The component shall be mounted so that one of the three axes is perpendicular to its normal mounting axis.

5.14.2.3 Conditioning

The following conditioning shall be applied:

Frequency range: 10 Hz to 150 Hz;

Acceleration amplitude: 9,81 ms^{-2}(1,0 g_n) ;

Number of axes: 3;

Sweep rate: 1 octave/min;

Number of sweep cycles: 20.

It is necessary to ensure that the alignment of the vibration equipment should not significantly change after the test.

5.14.2.4 Final measurements

After the conditioning, measure the response threshold in accordance with 5.1.5 without readjusting angular alignment.

The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

5.14.3 Requirements

C_{min} shall not be less than 0,4 dB.

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

5.15 Electromagnetic compatibility (EMC), immunity tests (operational)

The following EMC immunity tests shall be conducted in accordance with EN 50130-4:

a) electrostatic discharge;

b) radiated electromagnetic fields;

c) conducted disturbances induced by electromagnetic fields;

d) fast transient bursts;

e) slow high energy voltage surges.

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

1) The functional test, called for in the initial and final measurements, shall be a measurement of response threshold values in accordance with 5.1.5.

2) The initial measurement is the measurement of response threshold value made on the specimen during the reproducibility test;

3) The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

4) The required operating condition shall be in accordance with 5.1.2;

5) The acceptance criterion for the functional test after conditioning shall be as follows:

6) C_{min} shall not be less than 0,4 dB;

7) The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

5.16 Sulphur dioxide SO_2 corrosion (endurance)

5.16.1 Object

The detector is tested to demonstrate its ability to withstand the corrosive effects of sulphur dioxide as an atmospheric pollutant.

5.16.2 Test procedure

5.16.2.1 Apparatus

The test shall be conducted in accordance with in IEC 60068-2-42:1982, test Kc and 5.17.2.2 to 5.17.2.4.

5.16.2.2 State of the specimen during conditioning

Adjust the specimen to the maximum sensitivity.

The detector shall be mounted in accordance with 5.1.3. It shall not be supplied with power during the conditioning, but it shall have untinned copper wires, of appropriate diameter, connected to sufficient terminals to allow the final measurements to be made, without making further connections to the component(s).

5.16.2.3 Conditioning

The following conditioning shall be applied:

Temperature: (25 ± 2) °C;

Relative humidity: (93 ± 3) %;

SO_2 concentration: a volume fraction of (25 ± 5) ppm (by volume) ;

Duration: 21 days.

5.16.2.4 Final measurements

Immediately after the conditioning, the specimen shall be subjected to a drying period of 16 h at (40 ± 2) °C and a relative humidity not greater than 50 %, followed by a recovery period of 1 h to 2 h at the standard laboratory conditions.

After this recovery period, measure the response threshold as described in 5.1.5.

The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

5.16.3 Requirements

C_{min} shall not be less than 0,4 dB.

The ratio of the response threshold values $C_{max} : C_{min}$ shall not be greater than 1,6.

5.17 Impact (operational)

5.17.1 Object

The detector is tested to demonstrate its immunity to mechanical impacts upon its surface, which it may sustain in the normal service environment and which it can reasonably be expected to withstand.

5.17.2 Test procedure

5.17.2.1 Apparatus

The test shall be conducted in accordance with EN 60068-2-75 and 5.18.2.2 to 5.18.2.5.

5.17.2.2 State of the specimen during conditioning

Adjust the specimen to the maximum sensitivity, and mount and connect in accordance with 5.1.5.

5.17.2.3 Conditioning

The following conditioning shall be applied:

Impact energy: (0,5 ± 0.04) J;

Number of impacts per point: 3.

For each component of the detector in turn, apply impacts to each point on the component which is deemed to be susceptible to mechanical damage that would impair the correct operation of the detector, up to a maximum of 20 points on each component (e.g. lenses, windows and devices used for adjusting alignment may be deemed susceptible to damage). No two points at which the impacts are applied shall be less than 20 mm apart.

Care shall be taken to ensure that the results from one series of three blows do not influence subsequent series. In case of doubt with regard to the influence of preceding blows, the defect shall be disregarded and a further three blows shall be applied to the same position on a new specimen.

5.17.2.4 Monitoring during conditioning

Where the application of the impact apparatus does not obscure the optical beam, monitor the specimen to detect any alarm or fault signals.

5.17.2.5 Final measurements

After the conditioning, measure the response threshold in accordance with 5.1.5.

The greater of the response threshold values measured in this test and that measured for the same specimen in the reproducibility test, shall be designated C_{max} and the lesser shall be designated C_{min}.

5.17.3 Requirements

No alarm or fault signals shall be given during the conditioning except when the beam is obstructed by the impact apparatus.

C_{min} shall not be less than 0,4 dB.

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

Annex A
(normative)

Bench for response threshold value measurements

A.1 Technical characteristics of the attenuators

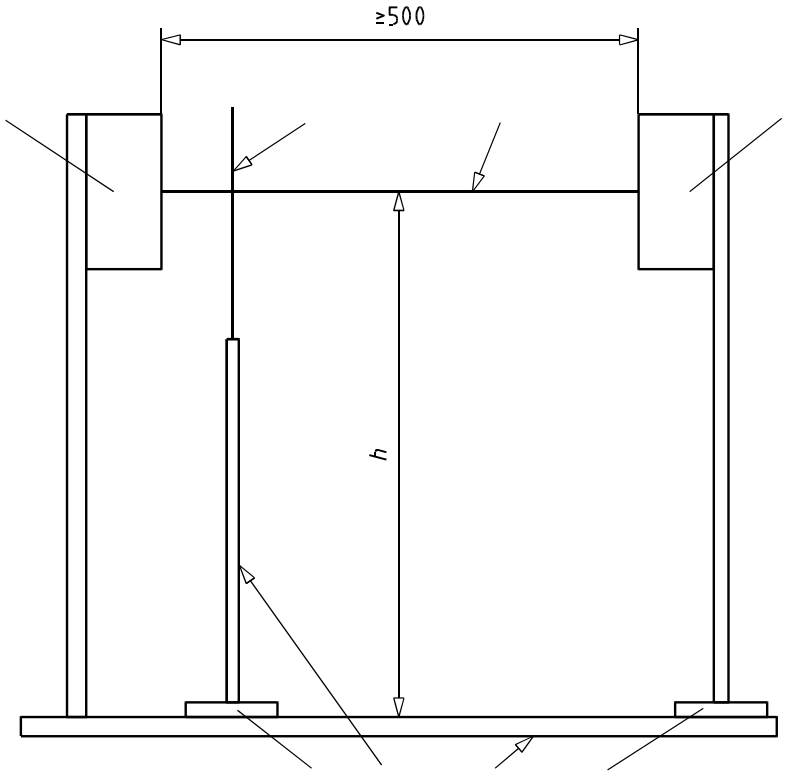
To simulate the effect of smoke on the detector, an attenuation shall be achieved by obscuration with a filter (agreed by the detector's manufacturer) covering the complete optics of the receiver and none of the transmitter. For detector with separate reflector, if it is not possible to cover only the receiver, then it is allowed to cover both transmitter and receiver (see clause 3.8). The filter must be placed as close as possible to the receiver.

Filters shall be neutral over the spectral wavelength band used for the detector.

Table AA.1 — Minimum resolution for optical density filters

Filter obscuration dB	Minimum resolution DB
less than 1,0	0,1
1,0 to less than 2.0	0,2
2,0 to less than 4.0	0,3
4,0 to 6,0	0,4
more than 6,0	1,0

A.2 Measuring bench



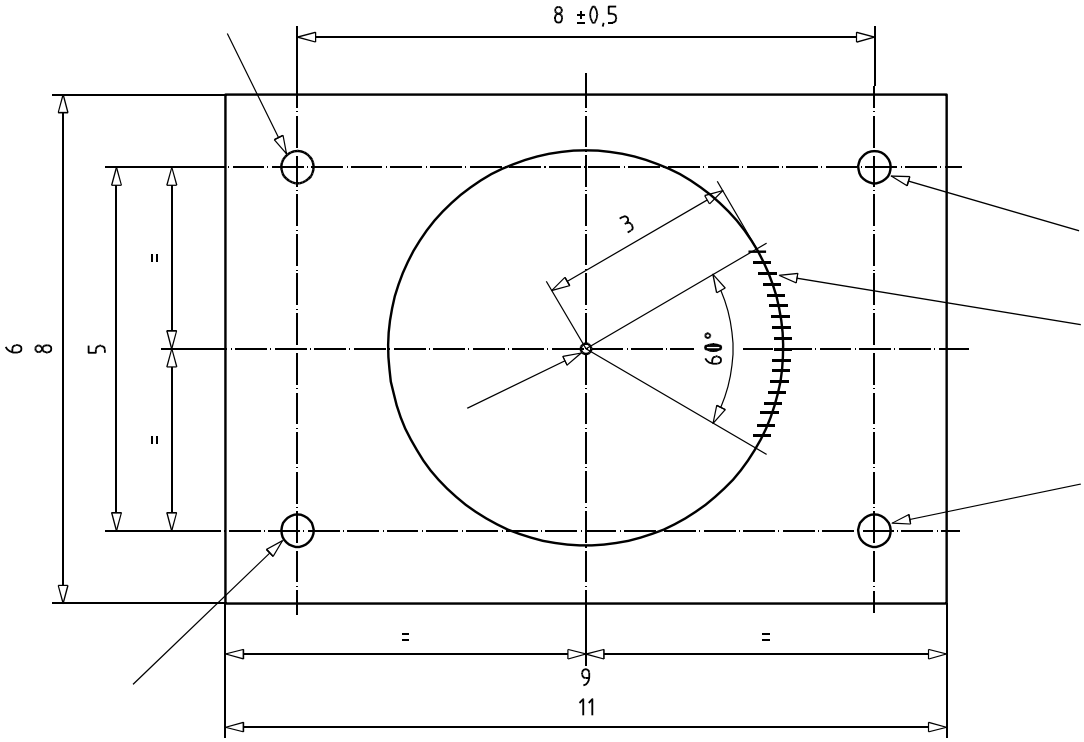
Key
1 Receiver or transmitter - receiver
2 Attenuator
3 Axis of beam
4 Transmitter or reflector
5 Adjustment of the distance
6 Adjustment of the height
7 Support
h Height of the axis of beam above the support. Height should be a minimum of 5 times the diameter of the optics

Figure A.1 - Optical bench arrangement

Annex B

(normative)

Fire test room

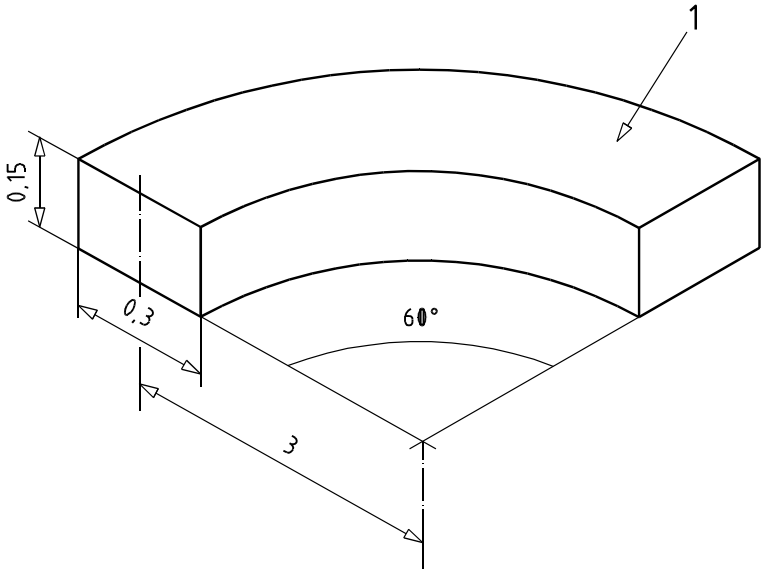


Key

1 Transmitter or transmitter - receiver
2 Receiver or reflector
3 Test fire
4 Measuring instruments
5 8 ± 0,5 m or maximum separation if maximum separation is less than 8 m (apart for additional fire test at minimum separation if it is < 8 ± 0,5 m).

Figure B.1 -Plan view of detectors, position of fire and measuring instruments

The specimens shall be mounted such that the optical axis is at the distance from the ceiling as defined by the manufacturer.



Key

1 Ceiling

Figure B.2 - Mounting positions for measuring instruments

The Measuring Ionization Chamber (MIC), the temperature probe and the measuring part of obscuration meter shall be within the above volume.

The MIC, and the mechanical parts of the obscuration meter shall be at least 100 mm apart, measured to the nearest edges.

Annex C

(normative)

Smouldering pyrolysis wood fire (TF2)

C.1 Fuel

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

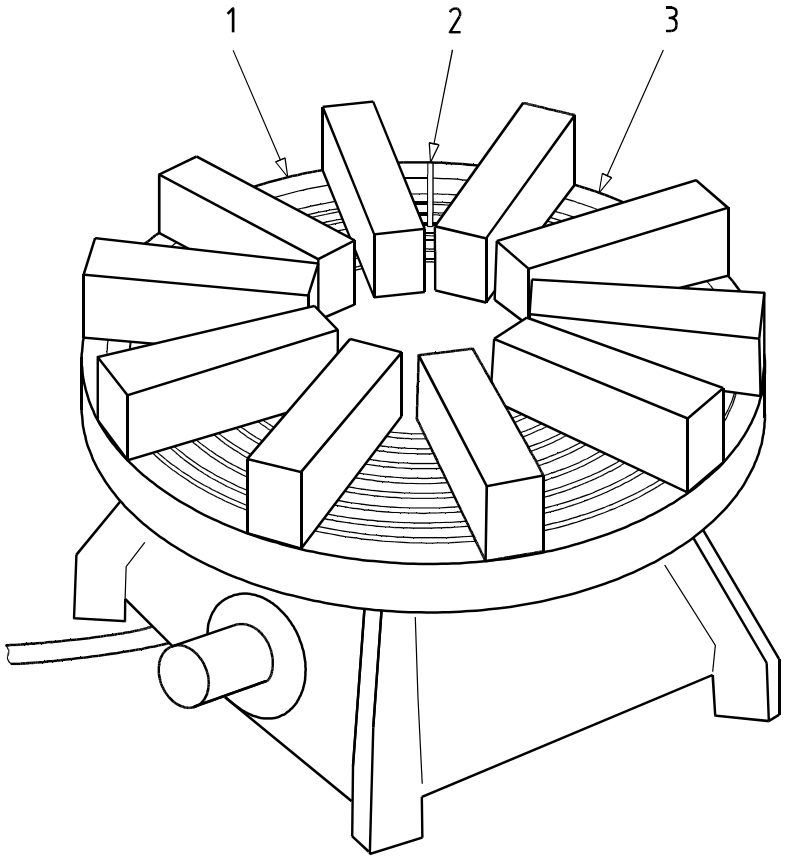
C.2 Hotplate

The hotplate shall have a 220 mm diameter grooved surface with 8 concentric grooves, each being 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 hotplate shall have a rating of approximately 2 kW.

The temperature of the hotplate surface shall be measured by a sensor attached to the 5th groove, counted from the edge of the hotplate, and secured to provide a good thermal contact.

C.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 C.1.



Key
1 Grooved hot plate
2 Temperature sensor
3Wooden sticks

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

C.4 Heating rate

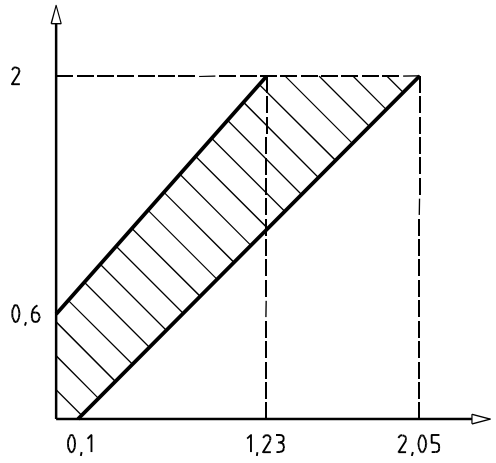
The hotplate shall be powered such that a temperature of 600 °C is reached in approximately 11 min and that flaming does not occur during the test.

C.5 End of test condition

m_E = 2 dB m^{-1}

C.6 Test validity criteria

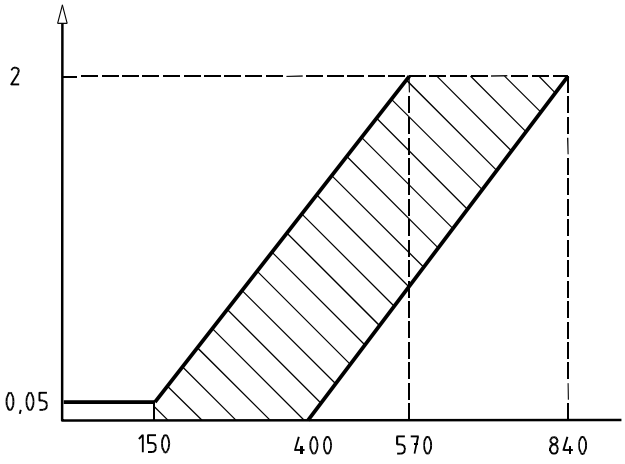
The development of the fire shall be such that the curves of *m* against *y*, and *m* against time, fall within the limits shown in Figures C.2 and C.3 respectively, up to the time when both of the specimens have generated an alarm signal, or *m* = 2 dB m^{-1}, whichever is the earlier.



Key

1 *m* value
2 *y* value

Figure C.2 - Fire TF2
limits for *m* against *y*



Key

1 *m* value
2Time

Figure C.3 – Fire TF2
limits for *m* against time

Annex D
(normative)

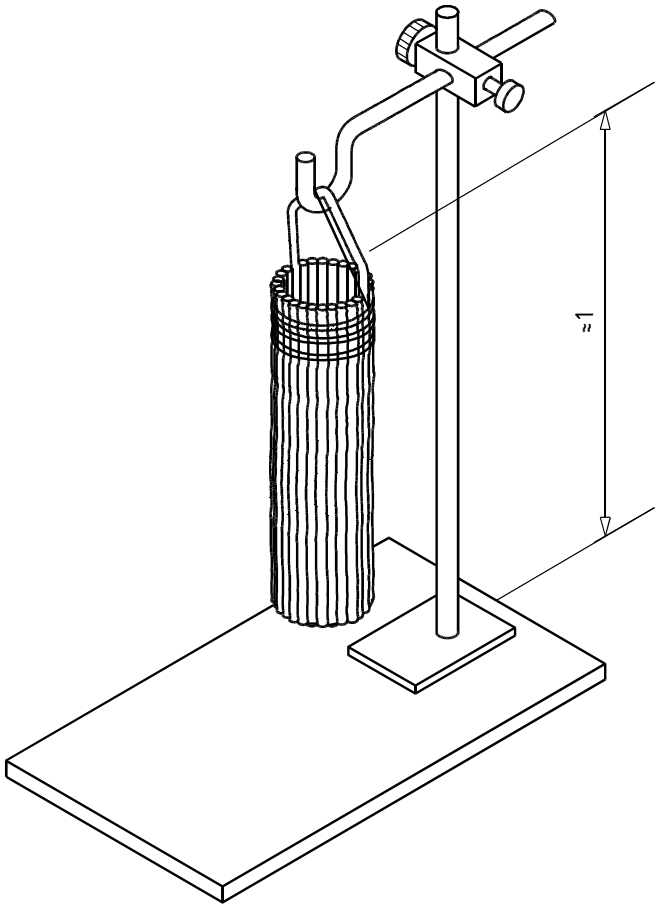
Glowing smouldering cotton fire (TF3)

D.1 Fuel

Approximately 90 pieces of woven 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.

D.2 Arrangement

The wicks shall be fastened to a ring approximately 10 cm in diameter and suspended over a non-combustible plate as shown in Figure D.1.



Key

1 1 m approximately

Figure D.1 – Arrangement of the cotton wicks

D.3 Ignition

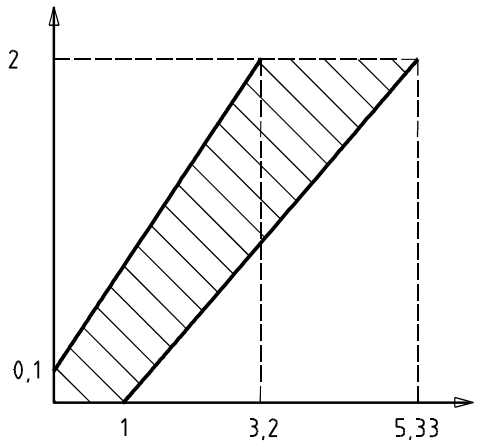
The lower end of each wick shall be ignited so that the wicks continue to glow. Any flaming shall be blown out immediately.

D.4 End of test condition

m_E = 2 dB m^{-1}

D.5 Test validity criteria

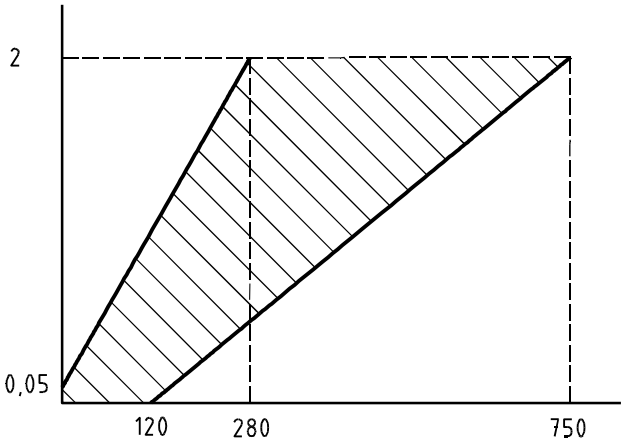
The development of the fire shall be such that the curves of *m* against *y*, and *m* against time, fall within the limits shown in Figures D.2 and D.3 respectively, up to the time when both of the specimens have generated an alarm signal, or *m* = 2 dB m^{-1}, whichever is the earlier.



Key

1 *m* value
2 *y* value

Figure D.2 – Fire TF3
limits for *m* against *y*



Key

1 *m* value
2Time

Figure D.3 - Fire TF3
limits for *m* against time

Annex E
(normative)

Flaming plastics (polyurethane) fire (TF4)

E.1 Fuel

Three mats approximately 50 cm x 50 cm x 2 cm, made of soft polyurethane foam, without flame retardant additives, having a density of approximately 20 kg/m^3.

E.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.

E.3 Ignition

The mats shall normally be ignited at a corner of the lower mat.

NOTE1 The exact position of ignition may be adjusted to obtain valid tests.

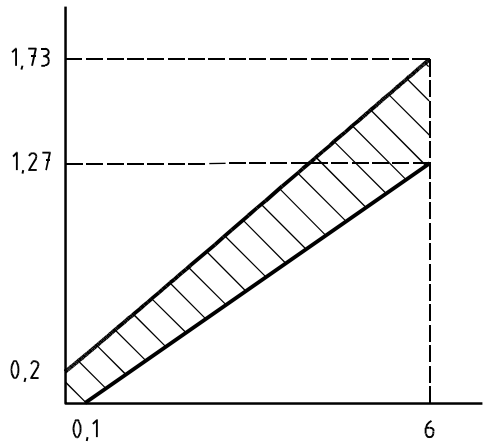
NOTE 2 A small quantity of a clean burning material (e.g. 5 cm^3 of methylated spirit) can be used to assist the ignition.

E.4 End of test condition

y_E = 6

E.5 Test validity criteria

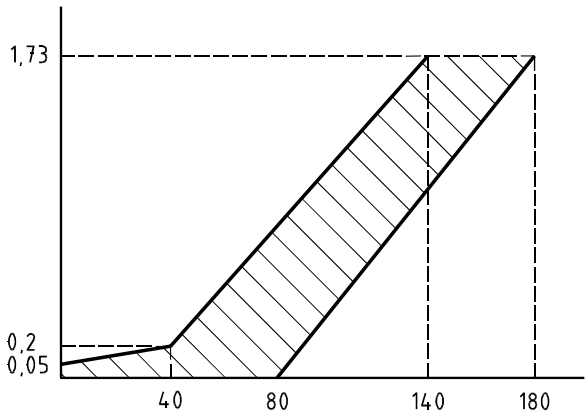
The development of the fire shall be such that the curves of *m* against *y*, and *m* against time, fall within the limits shown in Figures E.1 and E.2 respectively, up to the time when both of the specimens have generated an alarm signal, or *y* = 6, whichever is the earlier.



Key

1 *m* value
2 *y* value

Figure E.1 – Fire TF4
limits for *m* against *y*



Key

1 *m* value
2Time

Figure E.2 – Fire TF4
limits for *m* against time

Annex F
(normative)

Flaming liquid (n-heptane) fire (TF5)

F.1 Fuel

Approximately 650 g of a mixture of n-heptane (purity ≥ 99 %) with approximately 3 % of toluene (purity ≥ 99 %), by volume.

NOTE The precise quantities may be varied to obtain valid tests.

F.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.

F.3 Ignition

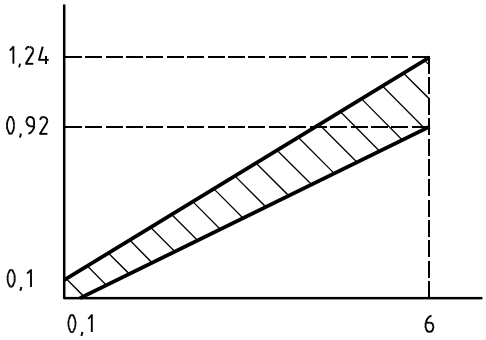
Ignition shall be by, for example, flame or spark.

F.4 End of test condition

$y_E = 6$

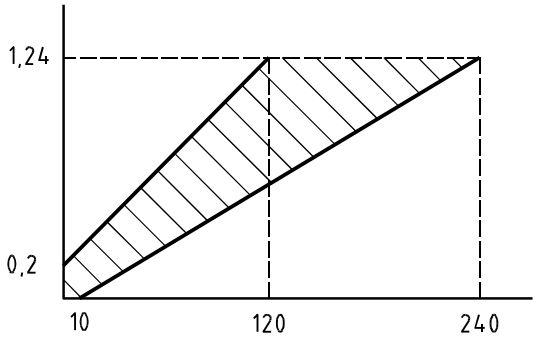
F.5 Test validity criteria

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 F.1 and F.2 respectively, up to the time when both of the specimens have generated an alarm signal, or $y = 6$, whichever is the earlier.



Key Key
1 *m* value
2 *y* value

Figure F.1 - Fire TF5
limits for *m* against *y*



1 *m* value
2Time

Figure F.2 - Fire TF5
limits for *m* against time

Annex G
(normative)

Apparatus for stray light

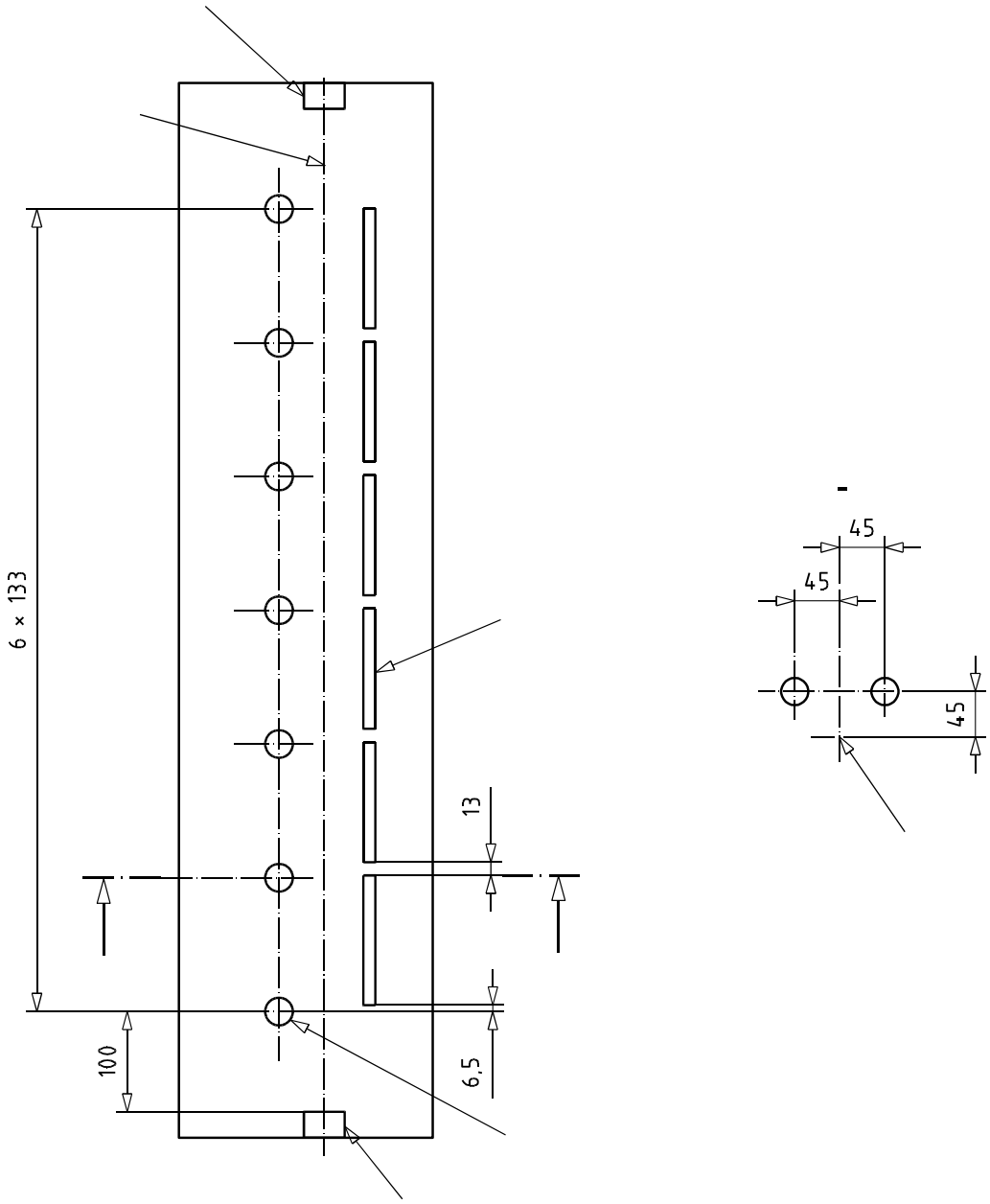
G.1 Installation

Mount the components of the detector on two rigid supports separated by longitudinal distance of

(10 ± 1) m, or separated by the maximum separation of the detector if less than 10 m.

Simulate the maximum separation given by the manufacturer if greater than 10 m.

Care shall be taken with the electrical connections to the fluorescent lamps and the ancillary equipments to avoid electrical interference with the detection system.



Key

1 Transmitter or reflector
2 Receiver or transmitter – receiver
3 Tubular fluorescent lamps (Nb: 6)
4 Incandescent lamps (Nb: 7)
5 Axis of beam
6 Centre line of optical beam
7 Section A-A

Figure G.1 –Installation for stray light

G.2 The light source

The light source shall consist of:

a) seven identical 100 W tungsten incandescent lamps, with an approximate colour temperature of

b) 2 900 K; and

c) six identical 36 W tubular fluorescent lamps, 1,2 m long, with an approximate colour temperature of 6 500 K (day light).

The incandescent lamps shall be pear-shaped with clear glass envelopes and shall conform to EN 60064.

The tubular fluorescent lamps shall conform to EN 60081.

To obtain a stable output of light, the fluorescent lamps shall be aged for 100 h before the initial use and discarded after 2 000 h.

The light source shall be supplied with a 50 Hz alternating current.

Annex H
(informative)
Information concerning the requirements for the response to slowly developing fires

References to ‘A’ below should be ‘C’ to be consistent with 4.8.

A simple detector operates by comparing the signal from the sensor with a certain fixed threshold (alarm threshold). When the sensor signal reaches the threshold, the detector generates an alarm signal. The smoke density at which this occurs is the response threshold value for the detector. In this simple 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 detector. Such changes can be caused, for example, by contamination of the surface of lenses or frontal glass/plastic 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 threshold 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.

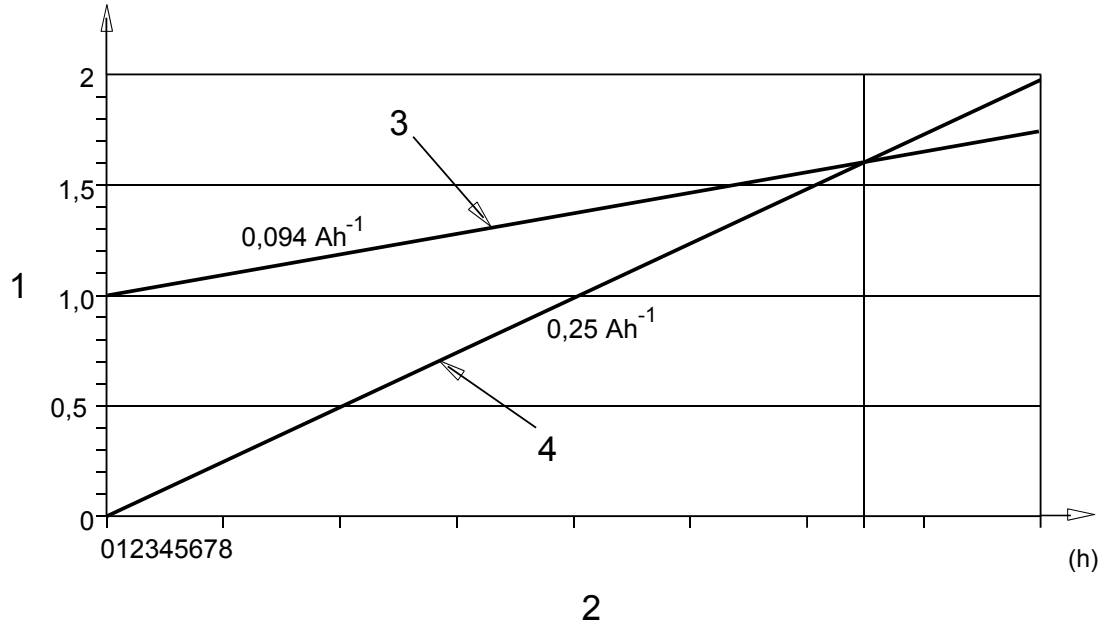
Any compensation for drift can reduce the sensitivity of the detector to slow changes in the sensor output even if these changes are caused by a real, but gradual, increase in smoke level. The object of requirement 4.8 a) is to ensure that the compensation does not reduce the sensitivity to a slowly 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 threshold value of the 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 detector to respond to these lower rates of change.

In order not to restrict the way in which compensation is achieved, 4.8 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.

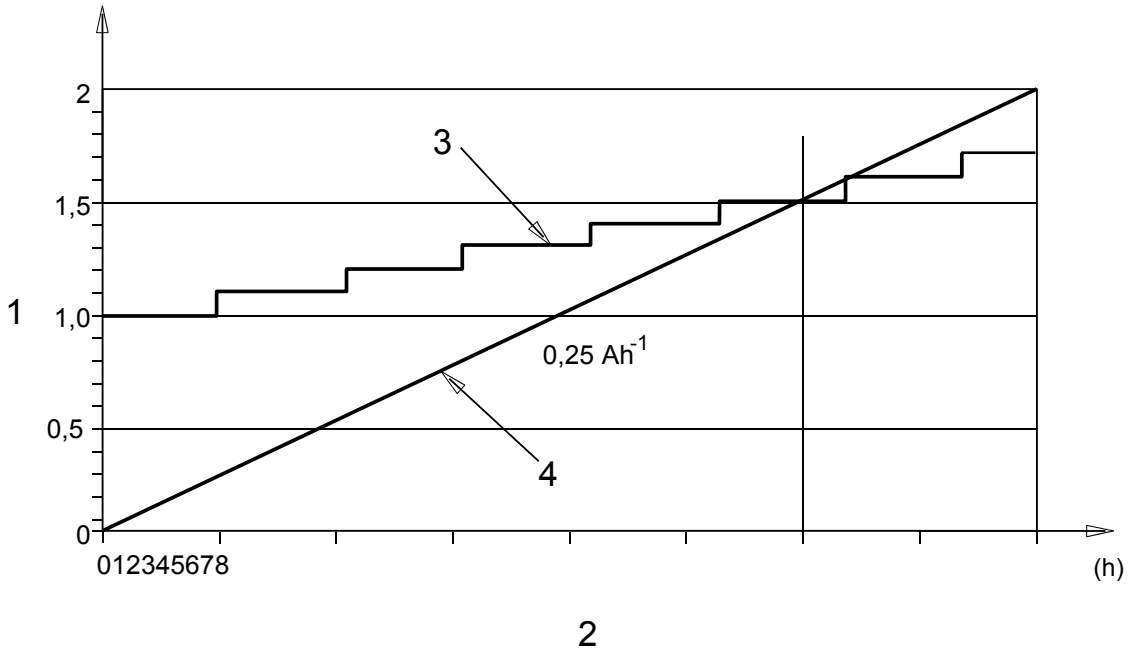
Although it has been assumed above that the threshold is compensated linearly and continuously, the process need not be linear nor continuous. For example, the stepwise adjustment shown in Figure H.2 also meets the requirement since, in this case, an alarm is reached in 6 h, which is less than the limiting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



Key

1 Relative alarm threshold (relative to *A*)
2 Time
3 Compensated alarm threshold
4 Sensor output

Figure H.1 — Linear compensation - limiting case

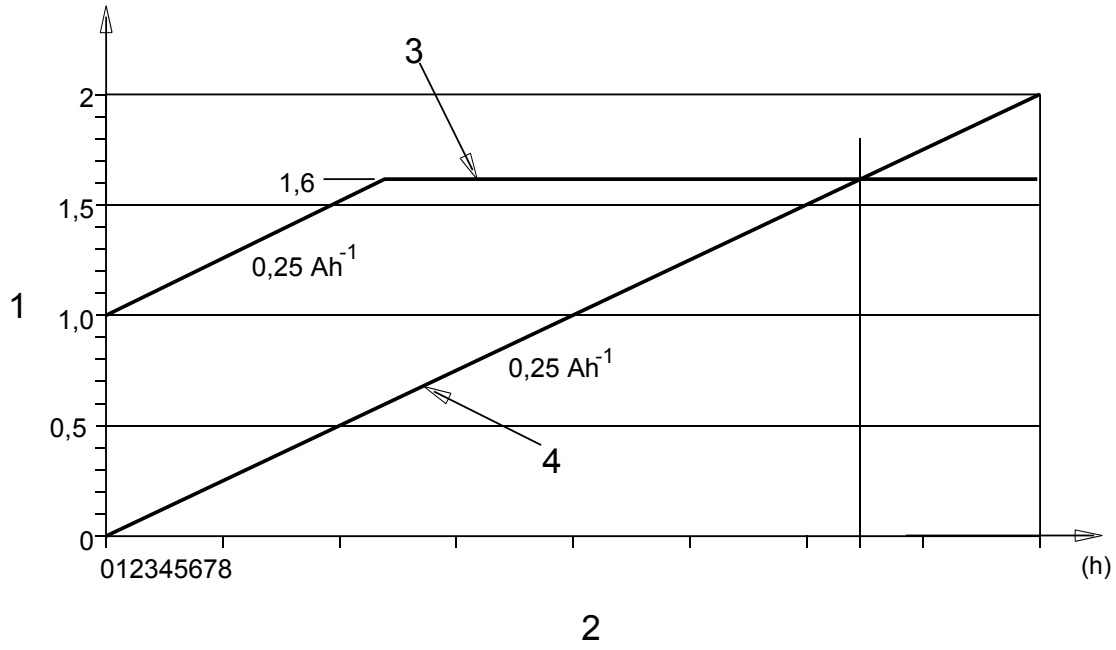


Key

1 Relative alarm threshold (relative to *A*)
2 Time
3 Compensated alarm threshold
4 Sensor output

Figure H. 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 H.3 also meets the requirement in reaching an alarm condition in 6,4 hours. In this case the maximum rate of compensation will be limited only by the requirements of the test fires.



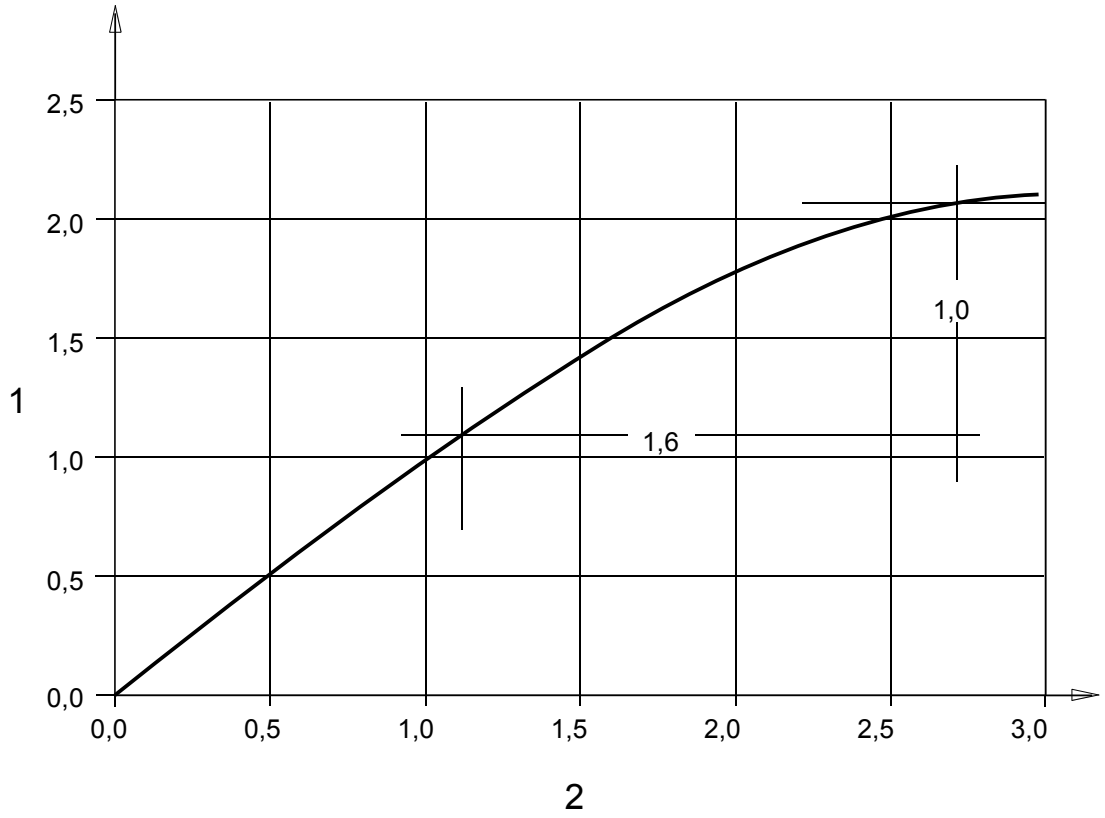
Key

1 Relative alarm threshold (relative to *A*)
2 Time
3 Compensated alarm threshold
4 Sensor output

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

The requirements of 4.8 a) allow considerable freedom in the way in which compensation for slow changes is achieved. However, it is recognised that in any practical 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 non-linear region then the sensitivity of the detector could become degraded to an unacceptable degree.

As an example, consider a detector having the transfer characteristic shown in figure H.4, in which both axes are expressed in terms of response threshold value *A*. The non-linearity 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 has to increase from 1,1 · *A* to 2,7 · *A*. This reduction in sensitivity by a factor of 1,6 represents the maximum allowed by 4.8 b).



Key

1 Output
2 Stimulus

Figure H. 4 — Example of non-linear transfer characteristic

Annex ZA
(informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under the mandate M/109 given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard, shown in this Annex, meet the requirements of the Mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the construction product covered by this European Standard for its intended use according to clause 1 (Scope) of this standard.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

NOTE In addition to any specific clauses relating to dangerous substances contained in this Standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). These requirements need also to be complied with, when and where they apply.

An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (CREATE, accessed through http://europa.eu.int/comm/entreprise/construction/internal/hygiene.htm)

This Annex has the same scope, in relation to the products covered, as clause 1 of this standard. This Annex establishes the conditions for the CE marking of control and indicating equipment intended for the use shown below and identifies the relevant clauses applicable.

This Annex establishes the conditions for the CE marking of line detectors using an optical beam intended for the use shown below and identifies the relevant clauses applicable.

Construction product: Line detector using an optical beam.

Intended use: Fire Safety.

Table ZA.1 - Relevant clauses

Essential characteristics	Clauses in this European Standard	Mandated levels or classes
Nominal activation conditions/ sensitivity	4.5, 4.8, 4.10, 5.2, 5.4, 5.7, 5.8, 5.9, 5.10	
Response delay (response time)	5.3, 5.6	
Operational reliability	4.3, 4.4, 4.6, 4.7, 5.16, 5.18, 4.9 [a]	
Tolerance to supply voltage	5.5	
Performance parameters under fire conditions	4.2	
Durability of operational reliability; temperature resistance	5.11, 5.12	
Durability of operational reliability; vibration resistance	5.15	
Durability of operational reliability; humidity resistance	5.13, 5.14	
Durability of operational reliability; corrosion resistance	5.17	
[a] Applies only to software controlled detector		

ZA.2 Procedures for the attestation of conformity of line detector using an optical beam

ZA.2.1 Attestation of conformity

ZA.2.1.1 System of attestation of conformity

The mandate requires that the attestation of conformity system to be applied shall be that shown in Table ZA.2.

Table ZA.2 - Attestation of conformity system

Product	Intended use	Levels or classes	Attestation of conformity system
Line detector using an optical beam	Fire safety		1
System 1: see CPD Annex III.2(i), without audit-testing of samples.			

This requires:

a) Tasks to be provided by the manufacturer:

1) factory production control (see ZA.2.2b));

2) testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;

b) Tasks to be undertaken under the authority of a Notified Product Certification Body [1]:

1) type testing of the product (see ZA.2.2a));

2) inspection of the factory and factory production control;

3) continuous/periodic surveillance, assessment and approval of the factory production control.

ZA.2.2 Evaluation of conformity

The evaluation of conformity of a line detector using an optical beam covered by this European Standard shall be by the following:

a) Type testing

Type testing of the product shall be carried out in accordance with the clauses shown in Table ZA.1, before the CE marking CE is affixed. The products tested shall be representative of the manufacturer's normal production with regard to their construction, operation and calibration.

Tests previously performed in accordance with the provisions of this standard may be taken into account providing that they were made to the same system of attestation of conformity on the same product or products of similar design, construction and functionality, such that the results may be considered applicable to the product in question.

Wherever a change, for example in the product design, materials or supplier of the components or of the production process occurs, which could change significantly one or more of the characteristics, the type testing shall be repeated for the relevant product performance.

b) Factory production control

The manufacturer shall establish, document and maintain a permanent factory production control system to ensure that the products placed on the market conform with the stated performance characteristics.

The factory production control system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control incoming materials or components, equipment, the production process and the product.

The production control procedure shall be adequately extensive and detailed so that the conformity of the products is made apparent to the manufacturer and so that irregularities can be detected at the earliest possible stage.

[1]) A Notified Product Certification Body is an approved product certification body notified to the Commission by a member state, for this purpose, in accordance with article 18 of the Construction Products Directive (89/106/EEC).

A factory production control system conforming with the requirements of EN ISO 9001, and made specific to the requirements of this standard, shall be considered to satisfy the above requirements.

The production control procedure shall be recorded in a manual, which shall be made available for inspection.

The factory production control shall be recorded. These records shall be available for inspection and shall include at least the following:

a) identification of the product tested;

b) the dates of sampling;

c) the test methods applied;

d) the test and inspection results;

e) the date of tests;

f) the identification of the responsible authority within the factory;

g) calibration records;

h) actions taken.

ZA.3 CE Marking

The CE marking symbol (in accordance with Directive 93/68/EEC) shall be placed on the product and be accompanied by:

a) the identification number of the Notified Product Certification Body; and

b) the number of the EC certificate of conformity.

c) The CE marking symbol shall in addition be shown on the packaging and/or on the accompanying commercial documentation supplemented by

d) the identification number of the Notified Product Certification Body;

e) the name or identifying mark and registered address of the manufacturer;

f) the last two digits of the year in which the marking was affixed;

g) the number of the EC certificate of conformity;

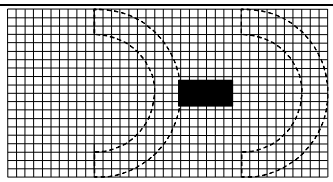
h) the reference to this European Standard (EN 54-12);

i) the description of the product and intended use (line detector using an optical beam; fire safety);

j) the reference to documentation required in 6.2.

Where the product exceeds the minimum performance levels stated in this standard, and where the manufacturer so desires, the CE marking may be accompanied by an indication of the parameter(s) concerned and the actual test result(s).

Figure ZA.1 gives an example of the information to be shown on the accompanying commercial documents.



0123

AnyCo Ltd, P.O. Box21, B1050
01
0123 – CPD - 001

EN54-12
Line detector using an optical beam
Fire safety

Documentation: see doc.123/2000

Figure ZA.1 - Example of CE marking

ZA.4 EC certificate and declaration of conformity

The manufacturer or his agent established in the EEA, shall prepare and retain a declaration of conformity, which authorises the affixing of the CE marking. This declaration shall include:

- name and address of the manufacturer, or his authorised representative established in the EEA, and the place of production;
- description of the product (type, identification, use), and a copy of the information accompanying the CE marking;
- provisions to which the product conforms (e.g. Annex ZA of this standard);
- if necessary, particular conditions applicable to the use of the product;
- name and address or identification number of the Notified Product Certification Body;
- name of and position held by the person empowered to sign the declaration on behalf of the manufacturer or of his authorized representative.

The declaration shall contain a certificate of conformity with, in addition to the information above, the following information:

the name and address of the Notified Product Certification Body;

the certificate number;

conditions and period of validity of the certificate, where applicable;

name of and position held by the person empowered to sign the certificate.

The above mentioned declaration and certificate shall be presented (if requested) in the official language or languages of the Member State in which the product is to be used.

Bibliography

EN ISO 9001 *Quality management systems - Requirements (ISO 9001:2000).*