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# Components of automatic fire detection systems

## Part 7. Specification for point-type smoke detectors using scattered light, transmitted light or ionization

Organes constitutifs des systèmes de détection automatique d'incendie
Partie 7. Détecteurs ponctuels de fumée, fonctionnant suivant le principe de la diffusion de la lumière, de la transmission de la lumière et de l'ionisation

Bestandteile automatischer Brandmeldeanlagen
Teil 7. Punktförmige Rauchmelder, nach dem Streulicht-, Durchlicht-, oder Ionisationsprinzip

British Standards Institution

## Contents



## National foreword

This Part of BS 5445 has been prepared under the direction of the Fire Standards Committee and is the English language version of European Standard EN 54 'Components of automatic fire detection systems' Part 7 : 1982 'Point type smoke detectors; Detectors using scattered light, transmitted light or ionization' of the European Committee for Standardization (CEN).

This Part of BS 5445 specifies the requirements, methods of test and performance criteria for point-type smoke detectors. Point-type heat detectors are specified in Parts 5 and 8; the components of automatic fire detection systems to be specified in other Parts are described in Part 1. The tests are in the nature of 'type tests' and are not intended as manufacturers' tests to maintain uniformity of quality in production. While they are intended to assess the most important features of the design of automatic fire alarm systems, they cannot remove the necessity for regular inspection and maintenance, as described in clause **29** of BS 5839 : Part 1 : 1980, which are essential for reliable operation.

It should be noted that the comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as a decimal marker.

**Cross-references.** Aluminium alloy conforming to material 2014A condition TF as specified in BS 1470 : 1972 'Specification for wrought aluminium and aluminium alloys for general engineering purposes – plate, sheet and strip', is equivalent to aluminium alloy Al-Cu4SiMg to ISO 209 : 1971 'Composition of wrought products of aluminium and aluminium alloys – Chemical composition (percent)', solution treated and precipitation treated condition (see annex 0).

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# Components of automatic fire detection systems Part 7. Point-type smoke detectors; Detectors using scattered light, transmitted light or ionization

Organes constitutifs des systèmes de détection automatique d'incendie; Partie 7: Détecteurs de fumée; Détecteur fonctionnant suivant le prinzipe de diffusion de la lumière, de la transmission de la lumière et de l'ionisation

Bestandteile automatischer Brandmeldeanalgen; Teil 7: Punktförmige Rauchmelder; Rauchmelder nach dem Streulicht-, Durchlicht- oder Ionisationsprinzip

This Amendment was accepted by CEN on 14 May 1987 in accordance with the conditions given on the title page of the European Standard to which this amendment refers and of which it is an integral part.

The CEN members are bound to abide by the Common CEN/CENELEC Rules which define the conditions for making modifications.

CEN members are the national standards organizations of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

**Central Secretariat: rue Bréderode 2, B-1000 Brussels**



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## Brief history

This Amendment 1 to the European Standard EN 54 Part 7 was drawn up by the Technical Committee CEN/TC 72 (the EN has been voted in 1982) 'Automatic fire detection systems', the Secretariat of which is held by BSI. This amendment clarifies the procedures for certain tests.

In accordance with the Common CEN/CENELEC Rules, following countries are bound to implement this Amendment:

Austria, Belgium, Finland, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

# Components of automatic fire detection systems

# Part 7. Point type smoke detectors; detectors using scattered light, transmitted light or ionization

## 1. Object and field of application

This European Standard specifies requirements, test methods and performance criteria for point-type, re-settable smoke detectors that operate using scattered light, transmitted light, or ionization.

For the testing of other types of smoke detectors, 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.

NOTE. Certain types of detector contain radioactive materials. The national requirements differ from country to country and are not specified in this standard.

## 2. Methods of test and test schedules

### 2.1 General requirements for testing

The detectors shall be tested according to the schedule in annex A.

Where applicable in each test, the detector(s) under test shall be connected to supply and indicating equipment in accordance with the data supplied by the manufacturer. If the supply and indicating equipment affects the response behaviour of a detector a special note shall be provided in the test report.

If a detector permits adjustment of the threshold value, it shall meet the requirements of the standard at the extremes of adjustment.

If the requirements of any one of the clauses in this Part are not met, then the type of detector does not comply with this Part 7 of the standard EN 54.

NOTE 1. Smoke detectors are subjected to basic tests and fire sensitivity tests. In the basic tests (clause **5** to **20**) the detectors are tested in various ways to determine whether they are basically capable of withstanding certain ambient conditions that may occur in practice, so as to be sufficiently certain that the detector will remain functional for a sufficiently long period of practical use, or at least for a period between two services or inspections of the installed fire detection system. Furthermore the basic tests verify the constancy of the response threshold of an individual detector and the similarity of response threshold of detectors relative to one another. The behaviour of the detectors in the case of fire is not examined in the basic tests.

NOTE 2. In clause **21**, the fire sensitivity tests according to EN 54-9, the detectors are subjected to various real test fires in a fire test room. In this way, the response behaviour of the detectors to real fires is verified and the sensitivity of the detectors to various defined fires is determined.

### 2.2 General tolerance for methods of test

Where tolerances are not specified in the methods of test given in the annexes, a general tolerance of ± 5 % shall be assumed

## 3. General requirements

### 3.1 Data

The manufacturer shall ensure that any type of detector purporting to comply with this Part of EN 54 is capable of passing all the tests and other requirements given herein. Detectors which are intended for marketing as separate units for installation in different systems shall be marked with sufficient operational data to ensure their performance in accordance with this standard, or alternatively such data shall be provided separately. The manufacturer shall specify the operating principle of the detector.

### 3.2 Marking

Each detector purporting to comply with the requirements of this Part of EN 54 shall be marked with:

(a) the number of this standard (i.e EN 54-7);

(b) the name or trademark of the organization accepting liability for compliance of the detector with this Part of EN 54 (this organization may be the manufacturer or the supplier of the detector);

NOTE. In some countries it is required that certification of compliance with this standard is carried out by an approved test house. Such requirements will normally be given in a national particularity to this standard.

(c) the type number of the detector.

### 3.3 Individual indication of operation

Each smoke detector shall be provided with an indicating lamp, or equivalent visual indication, by which the individual detector releasing an alarm may be identified.

## 4. Response threshold value

Measurement of response threshold value, required for the tests specified in clauses **5** to **17** and **20**, shall be carried out in the manner described in annex B.

NOTE. In this Part of EN 54, $m$ is the response threshold value for scattered light smoke detectors and transmitted light smoke detectors, and $y$ is the response threshold value for ionization smoke detectors. (See annex B.)

## 5. Switch-on

The detector shall be tested in the manner described in annex C.

The detector shall be deemed to comply with the requirements of this clause if the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6, and the lower response threshold value $y_{min}$ is not less than 0,2 or $m_{min}$ is not less than 0,05 dB/m, and if the detector emits neither a fault signal nor an alarm signal during the test.

## 6. Repeatability

The detector shall be tested in the manner described in annex D.

The detector shall be deemed to comply with the requirements of this clause if the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6 and the lower response threshold value $y_{min}$ is not less than 0,2 or $m_{min}$ is not less than 0,05 dB/m.

## 7. Directional dependence

The detector shall be tested in the manner described in annex E.

The detector shall be deemed to comply with the requirements of this clause if the ratio of the response threshold values $y_{max} : y_{min}$ o $m_{max} : m_{min}$ is not greater than 1,6, and the ower response threshold value $y_{min}$ is not less than 0,2 or $m_{min}$ is not less than 0,05 dB/m.

## 8. Reproducibility

The detectors shall be tested in the manner described in annex F.

The detectors shall be deemed to comply with the requirements of this clause if the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6, and the lower response threshold value $y_{min}$ is not less than 0,2 or $m_{min}$ is not less than 0,05 dB/m.

## 9. Variation of supply voltage

The detector shall be tested in the manner described in annex G.

The detector shall be deemed to comply with the requirements of this clause if the ratio of the response values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6, and the lower response threshold value $y_{min}$ is not less than 0,2 or $m_{min}$ is not less than 0,05 dB/m.

## 10. Air movement

### 10.1 Response behaviour

The detector shall be tested in the manner described in annex **H.1**. The detector shall be deemed to comply with the requirements of this clause if:

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

or

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

### 10.2 False alarm behaviour

This test only applies to smoke detectors using ionization.

The detector shall be tested in the manner described in annex **H.2**.

The detector shall be deemed to comply with the requirements of this clause if it emits neither a fault signal nor an alarm signal during the test.

## 11. High ambient temperature

The detector shall be tested in the manner described in annex J.

The detector shall be deemed to comply with the requirements of this clause if the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6.

## 12. Ambient light

This test only applies to smoke detectors using scattered light or transmitted light.

The detector shall be tested in the manner described in annex K.

The detector shall be deemed to comply with the requirements of this clause if

(a) while switching the fluorescent lights on and off and during the period in which all the lights are on, the detector emits neither a fault warning nor an alarm signal;

and

(b) in each directional alignment of the detector the ratio of the response threshold values $m_{max} : m_{min}$ is not greater than 1,6.

## 13. Vibration

The detector shall be tested in the manner described in annex L.

The detector shall be deemed to comply with the requirements of this clause if it emits neither a fault signal nor an alarm signal during the test and if the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6.

## 14.. Humidity

The detectors shall be tested in the manner described in annex M.

The detectors shall be deemed to comply with the requirements of this clause if they emit neither a fault signal nor an alarm signal during the test, and if the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6.

## 15. Shock

The detector shall be tested in the manner described in annex N.

The detector shall be deemed to comply with the requirements of this clause if during and after the test it emits neither a fault signal nor an alarm signal and if the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6.

## 16. Impact

The detector shall be tested in the manner described in annex O.

The detector shall be deemed to comply with the requirements of this clause if:

(a) the detector does not become displaced from its mounting base or socket;

and

(b) no alarm signal is given during the undisturbed period following the impact;

and

(c) the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ does not exceed 1,6.

## 17. Corrosion

The detectors shall be tested in the manner described in annex P.

The detectors shall be deemed to comply with the requirements of this clause if they comply with the requirements of **17.1** and **17.2** as appropriate.

### 17.1 Detectors tested for 4 days

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

### 17.2 Detectors tested for 16 days

After connection to the indicating equipment the detector shall either immediately emit a continuous fault warning or alarm signal, or shall subsequently respond to a test aerosol density of $\leqslant 1{,}6\,y_o$ or $\leqslant 1{,}6\,m_o$ in the wind tunnel.

## 18. Insulation resistance

The detector shall be tested in the manner described in annex Q.

The detector shall be deemed to comply with the requirements of this clause if the insulation resistance is greater than 10 MΩ after pre-conditioning and greater than 1 MΩ after the test.

## 19. Dielectric strength

The detector shall be tested in the manner described in annex R.

The detector shall be deemed to comply with the requirements of this clause if no breakdown or flashover is observed during the test.

## 20. Low ambient temperature

The detector shall be tested in the manner described in annex S.

The detector shall be deemed to comply with the requirements of this clause if

(a) during the fall in temperature and during the stabilization period no fault signal or alarm signal is emitted;

(b) the ratio of the response threshold values $y_{max} : y_{min}$ or $m_{max} : m_{min}$ is not greater than 1,6.

## 21. Fire sensitivity

The four detectors shall be tested in the manner described in EN 54-9 using test fires TF 2, TF 3, TF 4 and TF 5.

The detectors shall be deemed to comply with the requirements of this clause of EN 54-7 if all the detectors detect the test fires TF 2, TF 3, TF 4 and TF 5 and can be classified as being class A, B or C.

# Annex A

## Test schedule

### A.1 Detachable detectors

Sixteen detector sockets and sixteen detector bodies are required for testing detachable detectors. Each detector body shall be connected to a socket and shall then be treated as one detector.

### A.2 Non-detachable detectors

Sixteen detectors are required for testing non-detachable detectors.

### A.3 Test procedure

The detectors shall be randomly numbered from 1 to 16. The tests shall be carried out in accordance with the schedule of table 1. Tests on individual detectors shall be carried out in the order shown in table 1, reading from top to bottom.

## Table 1. Test schedule for smoke detectors

| Clause | Annex | Test | Detectors | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 5 | C | Switch-on | x | | | | | | | | | | | | | | | |
| 6 | D | Repeatability | | x | | | | | | | | | | | | | | |
| 7 | E | Directional dependence | | | x | | | | | | | | | | | | | |
| 8 | F | Reproducibility | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 9 | G | Variation of supply voltage | x | | | | | | | | | | | | | | | |
| 10 | H | Air movement | | | x | | | | | | | | | | | | | |
| 11 | J | High ambient temperature | | | | | | | | | | | x | | | | | |
| 12 | K | Ambient light | | | | x[1)] | | | | | | | | | | | | |
| 13 | L | Vibration | | | | | x | | | | | | | | | | | |
| 14 | M | Humidity | | | | | | x | | | | x | | | | | | |
| 15 | N | Shock | | | | | | | | | | | | x | | | | |
| 16 | O | Impact | | | | x | | | | | | | | | | | | |
| 17 | P | Corrosion | | | x | | | | | | x | | | | | | | |
| 18 | Q | Insulation resistance | | | | | | | | | | | | | x | | | |
| 19 | R | Dielectric strength | | | | | | | x | | | | | | | | | |
| 20 | S | Low ambient temperature | | | | | | | | | | | | | | x | | |
| 21 | EN 54-9 | Fire sensitivity | | x | | | | | | x | | | | | | | x | x |

[1)] This test only applies to smoke detectors using scattered light or transmitted light.

## Annex B

## Measurement of the response threshold values in the wind tunnel

### B.1 Test method

The detector provided for the test shall be installed in the wind tunnel (**B.2**) in its normal operating position with the fastenings provided for this purpose. The detector shall be connected to its control and indicating equipment for 15 min to 20 min before commencing measurement.

The air velocity in the wind tunnel in the proximity of the detector shall be 0,2 ± 0,04 m/s for all tests unless a different value is expressly indicated, e.g. the test according to clause **10.**

The air temperature in the wind tunnel shall be 23 ± 5 °C, unless a different value is expressly indicated, e.g. the test according to clause **11.**

In all the measurements of the response thresholds of a particular type detector, other than those of annex J, the air temperature in the wind tunnel shall not vary by more than 5 °C, unless a different value is expressly indicated, e.g. the test according to clause **11.**

In all tests the supply voltage to the detectors shall be between 99 % and 101 % of the nominal supply voltage, unless a different value is expressly indicated, e.g. the test according to clause **9.**

Before commencing each measurement the wind tunnel and the detector to be tested shall be free from aerosol.

All aerosol density measurements shall be carried out in the proximity of the detector.

A test aerosol (see **B.3**) shall be fed into the wind tunnel so that:

$$\frac{\Delta m}{\Delta t} \leqslant 0{,}2 \quad \frac{\text{dB/m}}{\text{min}} \quad \text{(for optical smoke detectors)}$$

$$\frac{\Delta y}{\Delta t} \leqslant 0{,}15\ \text{min}^{-1} \quad \text{(for ionization smoke detectors)}$$

See **B.4** for the definitions of $m$ and $y$.

The initially selected rate of increase in aerosol density shall be similar for all measurements in the wind tunnel.

At the moment of response of the detector the value $m$ shall be recorded for optical detectors or $y$ for ionization detectors.

### B.2 Wind tunnel

A closed circuit wind tunnel capable of air velocities between 0,1 m/s and 1 m/s shall be used for the test. Means shall be provided for the introduction of the test aerosol such that, in the measuring section, a homogeneous dispersion of aerosol density is obtained over the cross-section.

The air temperature in the wind tunnel shall be capable of being raised from 20 °C to 50 °C at a rate of $< 1$ °C/min.

A plan of the measuring section, and the positions of the measuring instruments and smoke detectors being tested are shown in figure 1.

### B.3 Test aerosol

A polydispersive aerosol shall be used as the test aerosol. The maximum of its particle size d stribution shall be between 0,5 µm and 1 µm. The ref active index of the aerosol particles should be approximately 1,4.

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

- particle size distribution,
- optical constants of the particles,
- particle shape,
- particle structure.

The stability of the aerosol should be ensured. One possible method to ensure that the aerosol is stable is to measure the ratio $m : y$.

It is recommended that an aerosol generator producing a paraffin oil mist is used as the test aerosol (e.g. liquid paraffin which is used for pharmaceutical purposes).

### B.4 Response threshold value, measuring instruments

#### B.4.1 *Optical method*

The response threshold value of optical smoke detectors is characterized by the absorbance index of the test aerosol measured at the moment of response.

The absorbance index is designated $m$ and given in units of decibels per metre (dB/m). The defining equation

$$m = \frac{10}{d} \log_{10} \frac{P_o}{P}$$

applies for the absorbance index, where

$d$ = the optical measuring length in the test aerosol (measured in m);

$P_o$ = the radiated power received without the test aerosol;

$P$ = the rad ated power received with the test aerosol.

The measuring instrument shall have the following properties:

(a) the length of the measuring zone in which the aerosol is measured shall be not more than 1,1 m; greater effective optical measuring lengths can be obtained by reflection of the measuring beam inside the measuring zone;

(b) the optical system shall be arranged so that any light scattered by more than 3° by the test aerosol is disregarded by the light detector;

(c) at least 50 % of the effective power of the light beam shall be within a wavelength range of from 800 nm to 950 nm, not more than 1 % of the effective radiated power shall be within a wavelength range below 800 nm and not more than 10 % of the effective radiated power shall be within a wavelength range above 1050 nm (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 indicator within this wavelength range);

(d) the measurements shall be carried out with a degree of accuracy such that, for all smoke densities between 0 dB/m and 2 dB/m, the error of measurement does not exceed 0,02 dB/m + 5 % of the smoke density indicated.

Before and after each test in which response threshold values are measured, the indication shown on the measuring instrument shall be compared with an indication in clean air. If there is a discrepancy of more than 0,02 dB/m between the two measured values of such a pair, the response threshold value measured shall be deemed invalid and the measurement shall be repeated.

**B.4.2** *Ionization method, ionization measuring chamber*

The measuring device is used for continuously measuring aerosol concentrations in the range of the response threshold values of smoke detectors using ionization.

NOTE. The device is fully described in 'Investigation of ionization chamber for reference measurements of smoke density' by M Avlund, published by Elektronikcentralen, Danish Research Centre for Applied Electronics, Venlighedsvej 4, DK-2970 Hørsholm, Denmark.

**B.4.2.1** *Operating method and basic construction*

The measuring device operates on the suction principle, i.e. the aerosol content of the air to be examined is measured continuously by continuous sampling.

The measuring device consists of a measuring chamber, an electronic amplifier and a fan for sucking in air.

The principle of operation of the measuring chamber is shown in figure 2. As shown in the figure, the measuring chamber contains a measuring volume and suitable means by which the air taken in is passed along the measuring volume in such a way that the aerosol particles diffuse into this volume. This diffusion is such that the air movement does not disturb the flow of ions.

The measuring volume is ionized by a source of radioactive rays (alpha radiation) so that, when an electrical voltage is applied between the electrodes, there is a bipolar flow of ions. This flow of ions is affected by aerosol particles in a known manner. The relative variation in the current of ions is used as a measurement for the aerosol concentration.

The measuring chamber is so dimensioned and operated that the following relationship applies

$$Z \cdot \overline{d} = \eta \cdot y$$

$$y = \frac{I_o}{I} - \frac{I}{I_o}$$

$I_o$ = chamber current in aerosol-free air

$I$ = chamber current in air containing aerosol

$\eta$ = chamber constant

$Z$ = particle concentration in particles per $m^3$

$\overline{d}$ = average particle diameter, m

The non-dimensional quantity $y$, which is proportional to particle concentration, is used as the measure of response threshold value for smoke detectors using ionization.

The measuring chamber is connected to the electronic amplifier by means of a cable, and if necessary an impedance transformer may be incorporated in the measuring chamber.

The air is sucked in by means of a fan connected to the measuring chamber by a hose. The quantity of air which flows through the measuring chamber is regulated so that the test conditions are not affected by the suction process.

**B.4.2.2** *Construction*

The mechanical construction of the measuring chamber is shown in figure 3. The functionally important dimensions are marked with their tolerances. All other dimensions are recommended but not compulsory. They can be seen from the drawing. Details of parts are given in the following list.

*List of parts for the ionization measuring chamber*

| Number provided | Item | Reference number | Dimensions, special features | Material |
|---|---|---|---|---|
| 1 | Assembly plate | 1 | | Aluminium |
| 1 | Multipole socket | 2 | 10-pole | |
| 1 | Measuring electrode terminal | 3 | To chamber supply | |
| 1 | Measuring electrode terminal | 4 | Connection to amplifier or current measuring device | |
| 1 | Suction nozzle | 5 | | Brass |
| 4 | Guide socket | 6 | | Polyamide |
| 1 | Housing | 7 | | Aluminium |
| 1 | Insulating plate | 8 | | Polytetrafluoroethylene |
| 1 | Guard ring | 9 | | Stainless steel |
| 1 | Measuring electrode | 10 | | Stainless steel |
| 1 | Insulating ring | 11 | | Polyamide |
| 3 | Fixing screw with milled nut | 12 | M3 | Nickel-plated brass |
| 1 | Cover | 13 | Six openings for air | Stainless steel |
| 1 | Outer grid | 14 | Wire $\phi$ 0,2 mm $W$ 0,8 mm (internal mesh width) | Stainless steel |
| 1 | Inner grid | 15 | Wire $\phi$ 0,4 mm $W$ 1,6 mm (internal mesh width) | Stainless steel |
| 1 | Windshield | 16 | | Stainless steel |
| 1 | Intermediate ring | 17 | With 72 holes $\phi$ 2 mm on the circumference | |
| 1 | Threaded ring | 18 | | Nickel-plated brass |
| 1 | Source holder | 19 | | Nickel-plated brass |
| 1 | Source | 20 | $\phi$ 27 mm sealed | See **B.4.2.3.** |

B.4.2.3 *Technical data*

(a) *Radiation source:*

| | |
|---|---|
| isotope | $Am^{241}$ |
| activity | 130 kBq (3,5 µCi) ± 5 % |
| average α energy | 4,5 MeV ± 5 % |

The radiation source is gripped by its holder in such a way that no open cut edges are accessible, and its open surface is protected by a noble metal layer so that no americium is accessible on the surface.

Form of radiation source:

circular disc
$\phi$ = 27 mm

(b) *Ionization chamber:*

The current-voltage characteristic of the chamber measured in aerosol free air at:

| | |
|---|---|
| pressure | = 101,3 ± 1 kPa (760 mmHg)(1, 013 bar), |
| temperature | = 25 ± 2 °C, |
| relative humidity | = 55 ± 20 %, |

should be as in figure 4. The chamber impedance (reciprocal of the slope of the current-voltage characteristic) should be $1,9 \times 10^{11}$ Ω ± 5 %.

The chamber is normally operated in the circuit of figure 5. The supply voltage should be such that the current in the measuring electrodes is 100 pA.

(c) *Current measuring amplifier:*

$R_i < 10^9$ Ω

(d) *Suction system:*

quantity of air required 30 l/min ± 10 %.

## Annex C

### Switch on test

The response threshold value of the detector shall be measured according to annex B. The detector shall remain connected to its supply and indicating equipment for 7 days without interruption. After this period the response threshold value shall be once more determined according to annex B.

The flow direction is arbitrary, but it shall be the same for both measurements.

The greater response threshold value is given the symbol $y_{max}$ or $m_{max}$, the lesser value is given the symbol $y_{min}$ or $m_{min}$.

## Annex D

### Repeatability test

The response threshold value of the detector shall be measured 6 times according to annex B.

The flow direction is arbitrary, but it shall be the same for all 6 measurements.

The maximum response threshold value is given the symbol $y_{max}$ or $m_{max}$, the minimum value is given the symbol $y_{min}$ or $m_{min}$.

## Annex E

### Test for directional dependence

The response threshold value of the detector shall be measured according to annex B. A total of 8 measurements shall be taken, the detector being rotated 45° about a vertical axis between each measurement, so that the measurements are taken for 8 different flow directions.

The detector faces facing the air flow for which the maximum and minimum response threshold values were measured, shall be marked accordingly. In the following tests the corresponding directions are called respectively 'most unfavourable' and 'most favourable' direction.

The maximum response threshold value is given the symbol $y_{max}$ or $m_{max}$, the minimum value is given the symbol $y_{min}$ or $m_{min}$.

## Annex F

### Reproducibility test

The response threshold values of the detectors shall be measured and recorded according to annex B for the most unfavourable flow direction.

The maximum response threshold value is given the symbol $y_{max}$ or $m_{max}$, the minimum value is given the symbol $y_{min}$ or $m_{min}$.

## Annex G

### Variations of supply voltage test

The response threshold value of the detector shall be measured twice according to annex B, for the most unfavourable flow direction, once at the upper limit and once at the lower limit of the nominal supply voltage range specified by the manufacturer. If no voltage range is given, the response threshold value shall be measured once at 85 % and once at 110 % of the nominal supply voltage.

The maximum response threshold value is given the symbol $y_{max}$ or $m_{max}$, the minimum value is given the symbol $y_{min}$ or $m_{min}$.

## Annex H

### Test for sensitivity to air movement

#### H.1 Response behaviour

The response threshold value of the detector shall be measured as in annex B for the most and least favourable flow directions. The response threshold values in these tests are $y_{(0,2)max}$ and $y_{(0,2)min}$ or $m_{(0,2)max}$ and $m_{(0,2)min}$. The tests shall be repeated using an air velocity in the proximity of the detector of 1 ± 0,2 m/s. The response threshold values in these tests are $y_{(1,0)max}$ and $y_{(1,0)min}$ or $m_{(1,0)max}$ and $m_{(1,0)min}$.

#### H.2 False alarm behaviour

The detector shall be placed in a suitable wind tunnel and subjected to an aerosol-free air flow at a velocity of $v$ = 5 ± 0,5 m/s for at least 5 min and then to a gust lasting 2 s at a velocity of 10 ± 1 m/s. The most favourable flow direction shall be used. Any signal emitted shall be recorded.

## Annex J

### High ambient temperature test

The detector shall be installed in the wind tunnel in its normal operating position with the most unfavourable flow direction and connected to its control and indicating equipment. The air temperature in the wind tunnel shall be $\theta$ = 23 ± 5 °C. The air temperature in the wind tunnel shall then be increased to 50 ± 2 °C at a rate of ⩽ 1 °C/min.

After the detector has been subjected to the increased temperature for at least 1 h its response threshold (at the increased temperature) shall be measured according to annex B.

Of the two response threshold values measured for the detector in the tests in accordance with clauses **8** and **11**, the greater is given in symbol $y_{max}$ or $m_{max}$, the lesser value is given in the symbol $y_{min}$ or $m_{min}$.

## Annex K

## Sensitivity to ambient light test

### K.1 Test method

A dazzling device (see **K.2**) shall be inserted in the wind tunnel. The detector shall be installed in this device in its normal operating position in the most unfavourable flow direction and then connected to its control and indicating equipment.

The first lamp shall be switched on for 10 s, and then switched off for 10 s, ten times. The sequence shall be repeated for each of the other three lamps in turn.

The four lamps shall then be connected as two pairs of opposite lamps and the sequence shall be repeated for each pair in turn. After that all four fluorescent lights shall be switched on. After a period of at least one minute the response threshold value of the detector shall be measured according to annex B.

All four lights shall be switched off. The detector shall then be rotated in any direction by 90° about its vertical axis and the above process shall be repeated.

The lights shall be switched off, and after a period of at least one minute the response threshold value shall be measured according to annex B.

1 In each directional alignment of the detector, the maximum response threshold value is given the symbol $m_{max}$ and the minimum response threshold value is given the symbol $m_{min}$.

### K.2 Dazzling apparatus

The apparatus (see figure 6) shall be constructed so that it can be inserted in the wind tunnel and there occupy just one flue section. It is cube-shaped. Four of the cube faces are closed and lined on the inside with high gloss aluminium foil; two opposing cube faces are open so that the test smoke can flow through the device. Circular fluorescent lamps (32 W) with a diameter of 312 mm are fitted to the closed surfaces of the cube (edge length 350 mm) (type 'White de luxe', approximate colour temperature: 3800 K). The tubes should not cause turbulence in the tunnel.

To obtain a stable output of light, tubes should be aged for 100 h and discarded at 2000 h.

The detector to be tested shall be installed in the centre of the upper cube face (see figure 6) so that light can play on it from above, below and from two sides. The electrical connections of the fluorescent lamps shall be such that there can be no interference with the detection system through electrical signals.

## Annex L

## Vibration test

The detector shall be mounted in its normal operating position and secured by its normal fixings. The test shall be carried out at a temperature between 15 °C and 25 °C.

The detector shall be connected to the control and indicating equipment and subjected to sinusoidal vibrations in a vertical direction. The frequency of vibration shall be swept from 5 Hz to 60 Hz at a rate of 1,8 ± 0,2 octaves/h. A single such sweep shall be made. This process takes about 2 h. The maximum acceleration ($m/s^2$) of the detector at its point of installation shall be:

$$0{,}7 \times \sqrt{f} \pm 10\ \%$$

where $f$ is the instantaneous frequency in Hz. The test shall be repeated, once in a horizontal direction of acceleration and once in a second horizontal direction of acceleration perpendicular to the first.

The response threshold value shall then be measured according to annex B in the most unfavourable flow direction.

Of the two response values measured in the tests in accordance with clauses **8** and **13**, the greater is given the symbol $y_{max}$ or $m_{max}$, the lesser value is given the symbol $y_{min}$ or $m_{min}$.

## Annex M

## Humidity test

### M.1 Test method

Without being connected to their control and indicating equipment the detectors shall be predried for at least 24 h in a drying oven at a temperature of 40 ± 5 °C.

Immediately afterwards the detectors shall be connected to their control and indicating equipment and subjected to the following conditions in a climatic test chamber:

| | |
|---|---|
| Ambient temperature: | 40 ± 2 °C |
| Relative humidity: | $92\ ^{+3}_{-2}$ % |
| Duration of test: | 4 days |

The response threshold value of detector no. 6 shall be measured according to annex B with the most unfavourable flow direction. The measurement shall commence not later than 5 min after removal from the climatic test chamber. After the humidity test, detector no. 10 shall be subjected for three days to the following standard climate, whilst a transition period of 1 h to 2 h shall be adhered to:

| | |
|---|---|
| Ambient temperature: | 20 ± 2 °C |
| Relative humidity: | 63 ± 3 % |

The transition from one climate to another shall be such that there is no misting over or dew formation and that no condensation water drips on to the detector.

The response threshold value of the detector shall then be measured according to annex B in the most unfavourable flow direction. For each detector separately, of all the response threshold values measured in the tests in accordance with clauses **8** and **14**, the maximum value is given the symbol $y_{max}$ or $m_{max}$, the minimum value is given the symbol $y_{min}$ or $m_{min}$.

### M.2 Climatic test chamber

The climatic test chamber shall be constructed so that at the points where the detectors are located, the above-mentioned temperature and relative humidity can be maintained within the specified tolerances. There shall be no misting-over and no dripping of condensation water on to the detectors. An air circulation system is required for this purpose. However, it shall be possible to shield the detectors from the air-flow so that the flow rate in their vicinity is not greater than 0,5 m/s. At the smoke detector, the temperature set up shall not fluctuate by more than ± 0,5 °C within the tolerance range given above.

## Annex N

### Shock test

The detector shall be mounted by means of its normal fastenings, at the centre of the underside of a timber beam in its normal operating position and shall be connected to the control and indicating equipment. The timber beam shall be of oak (European or American White)[1] and shall have cross-sectional dimensions of 100 mm × 50 mm. It shall be clamped on its narrower face to two oak supports of 50 mm width and of sufficient height that the detector does not touch the floor. The supports shall be placed freely on edge at 900 mm centres on a level concrete floor and at right angles to the longitudinal axis of the beam. A cylindrical steel block weighing 1 kg shall be dropped five times on to the centre of the upper horizontal face of the beam from a height of 700 mm. The area of impact of the weight is 18 $cm^2$ ± 10 %. The block shall be guided by suitable means so as to strike the beam with its longitudinal axis vertical.

A suggested but not compulsory form of apparatus is shown in figure 7.

After the test the response threshold value of the detector shall be measured according to annex B in the most unfavourable flow direction.

Of the two response threshold values measured in clauses **8** and **15**, the greater is given the symbol $y_{max}$ or $m_{max}$, the lesser value is given the symbol $y_{min}$ or $m_{min}$.

## Annex O

### Impact test

#### O.1 Method of test

One detector shall be tested. The detector shall be mounted on a rigid horizontal backing board by means of its normal fastenings, in its normal operating position and connected to the supply and indicating equipment.

It shall be subjected to an impact of 1,9 ± 0,1 J delivered in a horizontal direction, at a velocity of 1,5 ± 0,125 m/s, by a swinging hammer having a hard aluminium head made from aluminium alloy Al-Cu4SiMg to ISO 209[2], solution treated and precipitation treated condition, with a plane impact face at an angle of 60° to the horizontal when in the striking position.

After the impact the detector and its connections shall remain undisturbed for at least 1 minute.

Without any change to the position of the detector relative to its mounting base or socket, the detector shall be disconnected from the supply and indicating equipment and shall be transferred from the impact test apparatus to the test tunnel, together with its backing board.

The response threshold value of the detector shall then be measured according to annex B in the most unfavourable flow direction.

Of the two response threshold values measured in clauses **8** and **16**, the maximum value is given the symbol $y_{max}$ or $m_{max}$ and the minimum value the symbol $y_{min}$ or $m_{min}$.

#### O.2 Apparatus

Unless otherwise specified all dimensions in **O.2** are subject to a tolerance of ± 0,5 mm.

**O.2.1** This apparatus (figure 8) consists essentially of a swinging hammer comprising a rectangular section head 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 detector is not present.

**O.2.2** The striker is of dimensions 76 mm wide × 50 mm deep × 94 mm long (overall dimensions). 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.

**O.2.3** 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 25 mm in diameter. The precise diameter of the shaft will depend on the bearings used.

**O.2.4** Diametrically oppose 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 a 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 8. On one end of the central boss is mounted a 12 mm wide × 150 mm in 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.

**O.2.5** The rigid frame also supports the mounting board on which the detector is mounted by its normal fixings and connected to its normal indicating equipment. The mounting board is adjustable vertically so that the centre of the impact face of the hammer will strike the detector when the hammer is moving horizontally, as shown in figure 8.

The blow shall be struck by the centre of the impact face and the azimuthal direction of impact, relative to the detector, shall be chosen as most likely to impair the normal functioning of the detector. A suitable but not compulsory apparatus is described in **O.2** and shown in figure 8.

**O.2.6** To operate the apparatus the position of the detector and mounting board is first adjusted as shown in figure 8 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

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1) European oak = *Quercus robur L.*
*Quercus petraea Liebl.*

American White oak = *Quercus spp.* principally
*Quercus alba L.*
*Quercus prinus L.*
*Quercus lyrata Walt.*
*Quercus michauxii Nutt.*

2) ISO 209-1971 'Composition of wrought products of aluminium and aluminium alloys – Chemical composition (per cent)' (Edition 3).

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 3/2 $\pi$ radians to strike the detector. The mass of the operating weight for this arrangement equals:

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

where $r$ is the effective radius of the pulley in metres.

This equals approximately 0,55 kg for a pulley radius of 75 mm.

**O.2.7** As the standard calls for a hammer velocity at impact of 1,5 ± 0,125 m/s 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 0,56 kg will be required to obtain the specified velocity, but this will have to be determined by trial and error.

## Annex P

## Corrosion test

**P.1** Not less than 115 mm of 1,38 mm diameter (≙1,5 mm$^2$) single-core copper wire untinned, or cable specified by the manufacturer under clause **3** of this Part of EN 54, shall be connected to the normal terminal connections of each detector or its socket. If the terminals will not accept 1,38 mm diameter wire, wire of the nearest possible equivalent diameter that can be accepted, shall be used.

Detectors and sockets where applicable shall be mounted in their normal operating position on a horizontal platform in the atmosphere specified in **P.2** for the period specified. The lowest point of each detector shall be between 25 mm and 50 mm above the liquid surface. A guard shall be provided to prevent drops of condensed liquid falling on the upper face of a detector. During the corrosion test the detectors are not connected to the supply and indicating equipment.

### P.2 Apparatus

The apparatus (figure 9) consists of a beaker of glass, 10 litres in capacity and fitted with a cover, an electric heater, a water cooling device and a thermostat regulated at 45 ± 3 °C and placed 70 mm above the bottom of the beaker. Two holes shall be provided in the cover for the insertion of thermometers. These holes shall be closed during the test.

A solution of 40 g of sodium thiosulphate ($Na_2S_2O_3.5H_2O$) in 1000 ml of water shall be placed in the beaker.

The detector shall then be suspended in the beaker and 40 ml of acid, consisting of 156 ml of normal $H_2SO_4$ per litre of aqueous solution, shall be added continuously at a rate of 40 ml of acid per 24 h, or twice daily in two 20 ml aliquots.

During the test the temperature near the detector shall be maintained at 45 ± 3 °C by the heater and thermostat and water shall be passed through the cooling coil at a sufficient speed to maintain the temperature of the outflow below 30 °C.

If a test is intended to last more than 8 days, the detector shall be removed after 8 days and the beaker emptied and cleaned. A new solution of 40 g of sodium thiosulphate dissolved in 1000 ml of water shall be put in the beaker, the detector replaced and the corrosive atmosphere produced and maintained as before.

### P.3 Procedure

Because it is not possible to avoid condensation during the corrosion test it shall be ensured that the detector is in its normal operating attitude (tolerance ± 5°) from the beginning of the test to the end of the drying of the detector. This also applies when changing the solution.

Two detectors shall be mounted as described in **P.1** in the atmosphere described in **P.2**, detector no. 3 for a period of 4 days and the detector no. 9 for a period of 16 days. They shall then be removed and dried for 72 h in a heating cabinet at 40 °C. The detectors shall be corroded individually in the corrosion vessel.

**P.3.1** The response threshold value of detector no. 3 shall be measured according to annex B in the most unfavourable flow direction. Of the two response threshold values measured in tests in accordance with clauses **8** and **17**, the greater is given the symbol $y_{max}$ or $m_{max}$, the lesser is given the symbol $y_{min}$ or $m_{min}$.

**P.3.2** If detector no. 9 does not immediately emit a fault or an alarm signal after connection to its control and indicating equipment, its response threshold value shall be measured according to annex B in the most unfavourable flow direction. The response threshold value measured in clause **8** is in this case given the symbol $y_o$ or $m_o$.

## Annex Q

## Insulation resistance test

**Q.1** The detector shall be conditioned for at least 24 h under the following conditions:

Temperature: 25 ± 1 °C

Relative humidity: $92 \begin{smallmatrix}+3\\-2\end{smallmatrix}$ %

The detector shall be mounted in its normal operating position on a metal plate which shall be regarded as the earth connection. A voltage of 500 ± 50 V (d.c.) shall be applied for 60 ± 5 s between the metal plate and the terminals of the detector which are interconnected. The insulation resistance shall be determined.

The detector shall then be heated to, and allowed to stabilize at, 40 ± 5 °C (to prevent the formation of condensation) before being subjected to the following conditions for 10 days:

Ambient temperature: 40 ± 2 °C

Relative humidity: $92 \begin{smallmatrix}+3\\-2\end{smallmatrix}$ %

At the end of this period the detector shall be conditioned at a temperature of 25 ± 1 °C and relative humidity of $92 \begin{smallmatrix}+3\\-2\end{smallmatrix}$ % for $60 \begin{smallmatrix}+10\\-0\end{smallmatrix}$ min. The insulation resistance shall again be measured as described above.

**Q.2** The climatic test chamber shall be constructed so that at the point where the detector is located, the above mentioned temperature and relative humidity can be maintained within the tolerances specified in **Q.1**. There shall be no misting over or dripping of condensation water on to the detector. An air circulation system is required for this purpose. However, it shall be possible to shield the detector from the air flow so that the flow rate in the vicinity of the detector is not greater than 0,5 m/s.

## Annex R

### Dielectric strength test

The detector shall be subjected to the following climatic conditions for at least 24 h:

Temperature: 25 ± 1 °C

Relative humidity: $50 \begin{smallmatrix} +3 \\ -2 \end{smallmatrix}$ %

The detector shall be mounted in its normal position on a metal plate which is regarded as the earth connection. Using a voltage generator capable of delivering a sinusoidal voltage of between 40 Hz and 60 Hz, with an adjustable amplitude of 0 V to 1500 V r.m.s. (effective value), and a constant short-circuit current of 10 A r.m.s. (effective value), an increasing test voltage shall be applied between the metal plate and the short-circuited connecting wires.

This shall be carried out as follows:

(a) for detectors with nominal supply voltages of below 50 V, the test voltage shall be increased from 0 V to 500 V at a rate of 100 V/s to 500 V/s and maintained at the final magnitude for 60 ± 5 s;

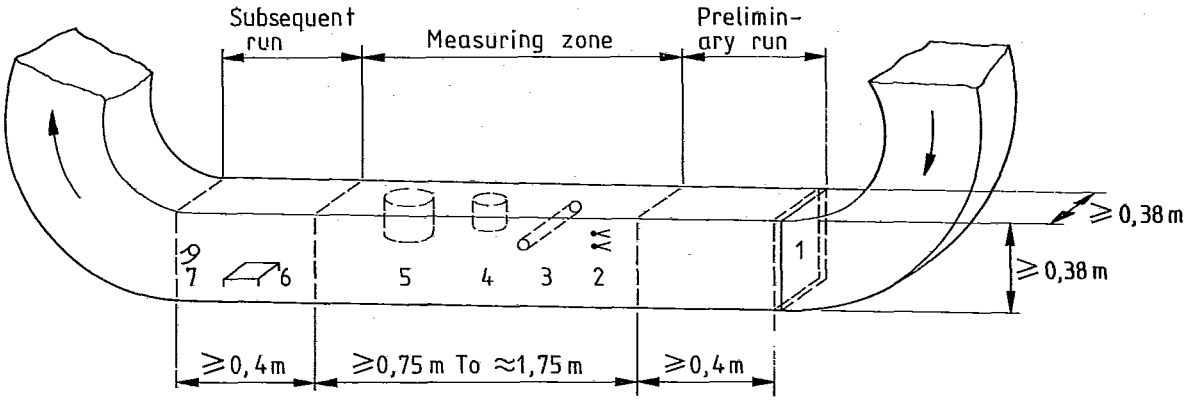
(b) for detectors with nominal supply voltages of more than 50 V and less than 500 V, the test voltage shall be increased from 0 V to 1500 V at a rate of 100 V/s to 500 V/s and maintained at the final magnitude for 60 ± 5 s.

## Annex S

### Low ambient temperature test

The detector shall be connected to its supply and indicating equipment and placed in a chamber at a temperature of between 15 °C and 25 °C for a period of at least 1 h. The air temperature in the chamber shall then be reduced to −20 ± 2 °C at a rate not greater than 0,5 °C/min. The detector shall be left at this ambient temperature for one hour to allow its temperature to stabilize. The conditions in the chamber shall be such that condensation or ice cannot form on the detector.

At the end of the stabilization period, the detector shall be removed from the chamber and kept for a period of 1 h to 2 h at an ambient temperature between 15 °C and 25 °C and at a relative humidity of 70 % or less. The response threshold value shall be measured and recorded according to annex B for the most unfavourable flow direction. Of the two response threshold values measured in the tests in accordance with clauses **8** and **20**, the greater value is given the symbol $y_{max}$ or $m_{max}$, the lesser value is given the symbol $y_{min}$ or $m_{min}$.




(1) Sieve/Net
(2) Measurement of flow rate and temperature
(3) Optical measurement (light transmission method)
(4) Detectors to be tested } mounting on cover plate
(5) Ionization measuring chamber }
(6) Heating element
(7) Aerosol supply

**Figure 1. Arrangement of smoke detector and test apparatus in the wind tunnel**

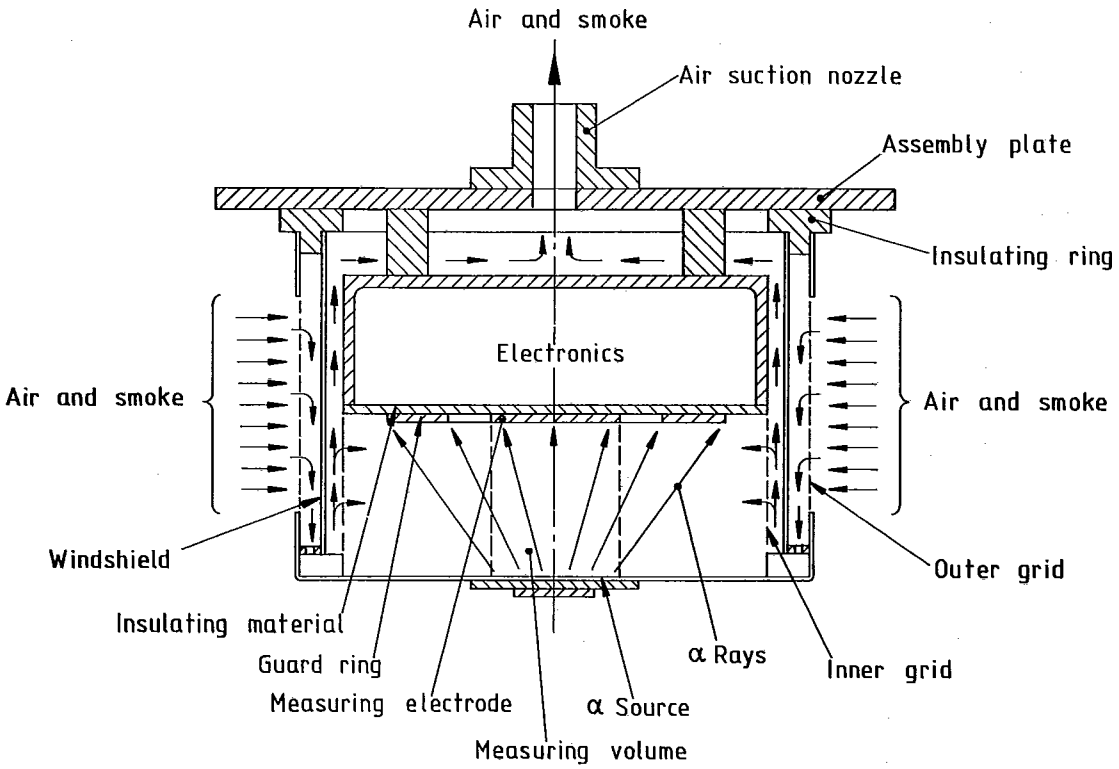
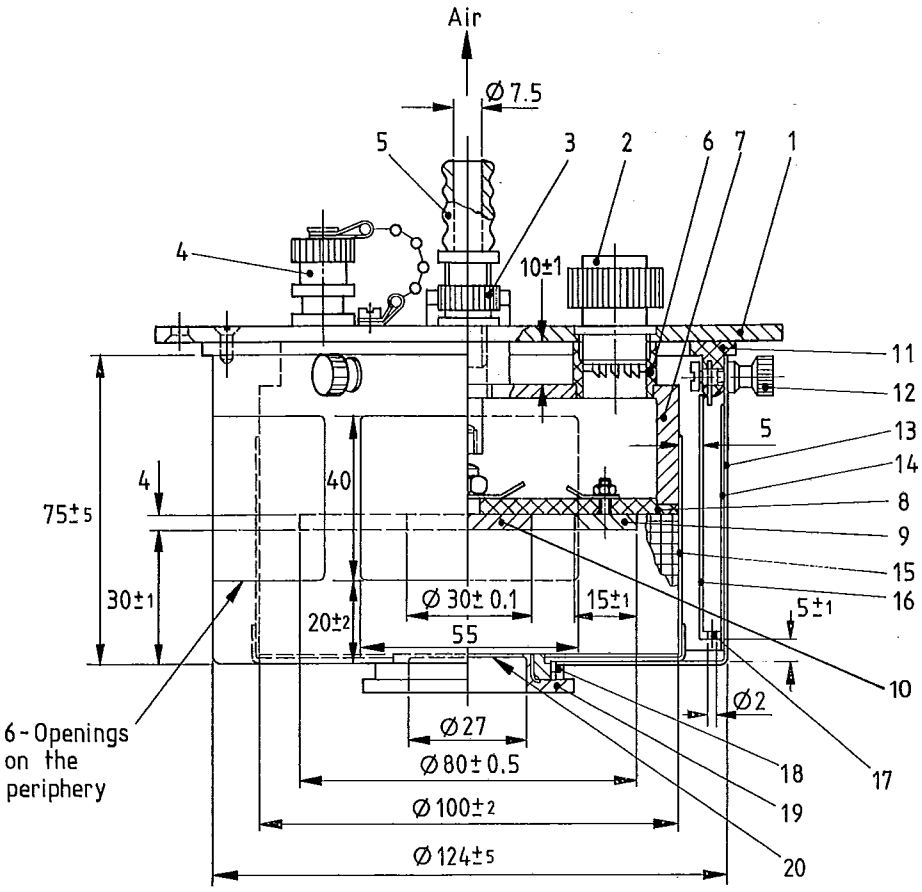



**Figure 2. Ionization measuring chamber; method of operation**




All measurements in mm. Dimensions without tolerance marked are recommended.

**Figure 3. Ionization measuring chamber; construction**

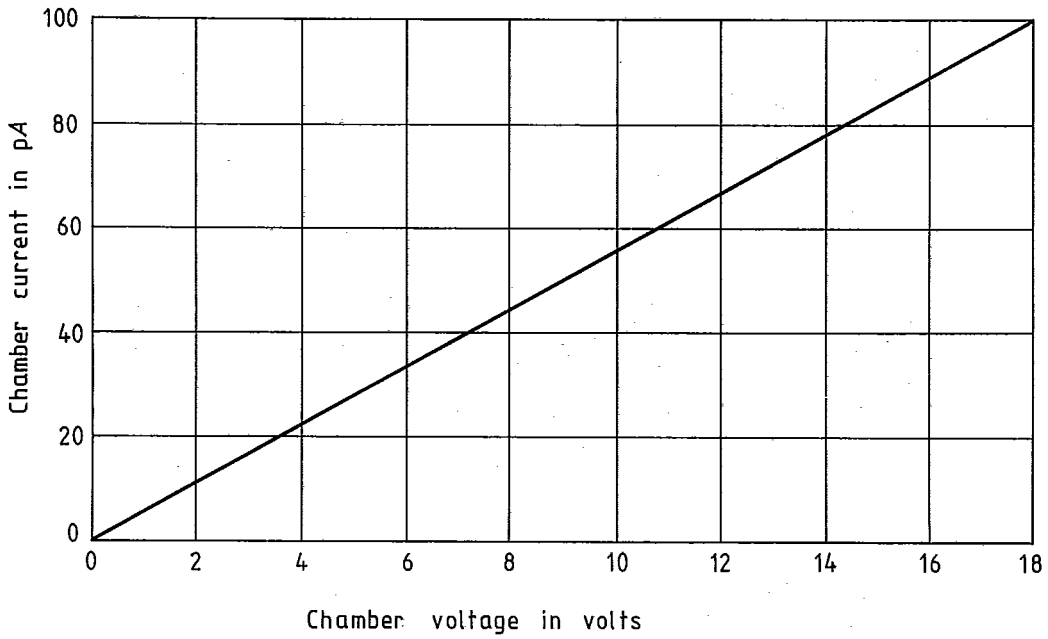



**Figure 4. Ionization measuring chamber; current-voltage characteristic**

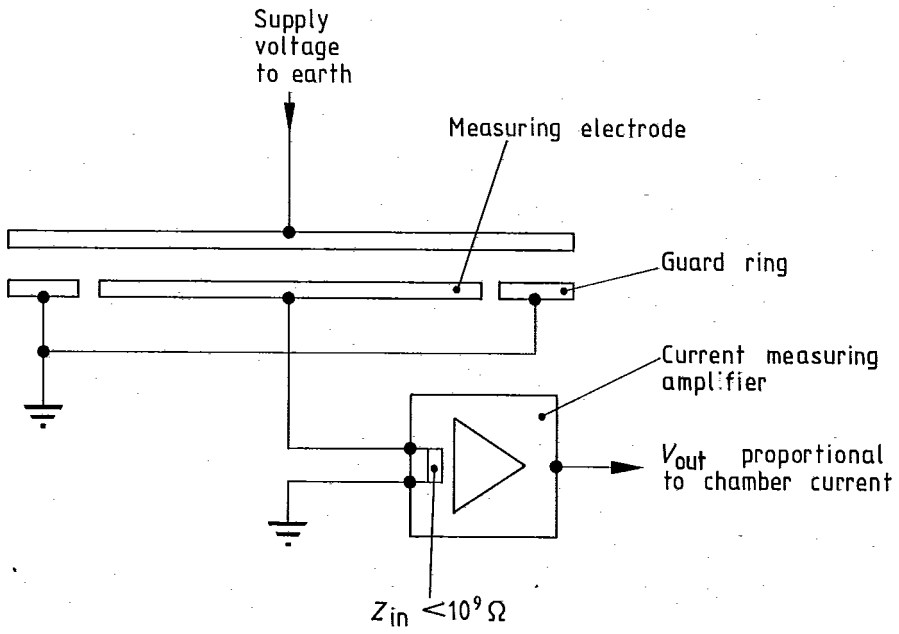



**Figure 5. Operating circuit**

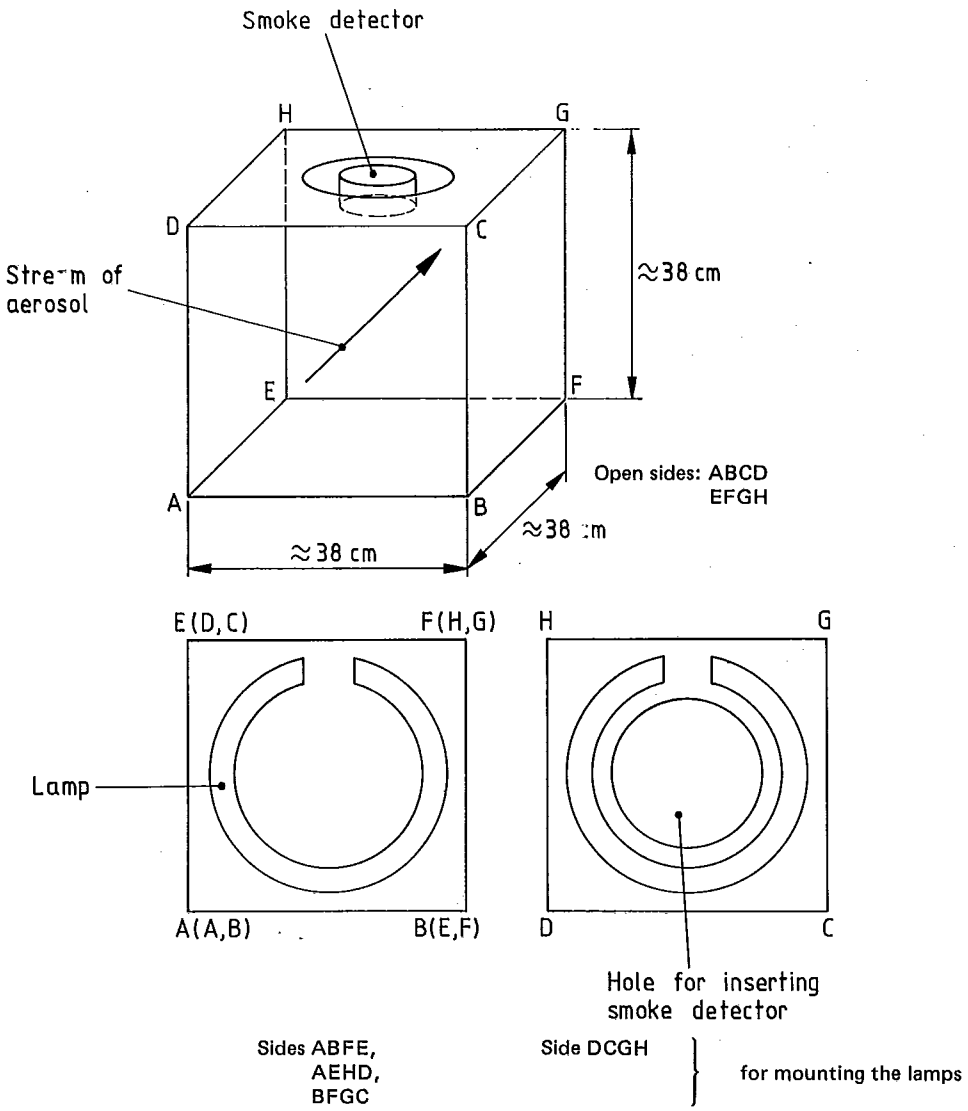
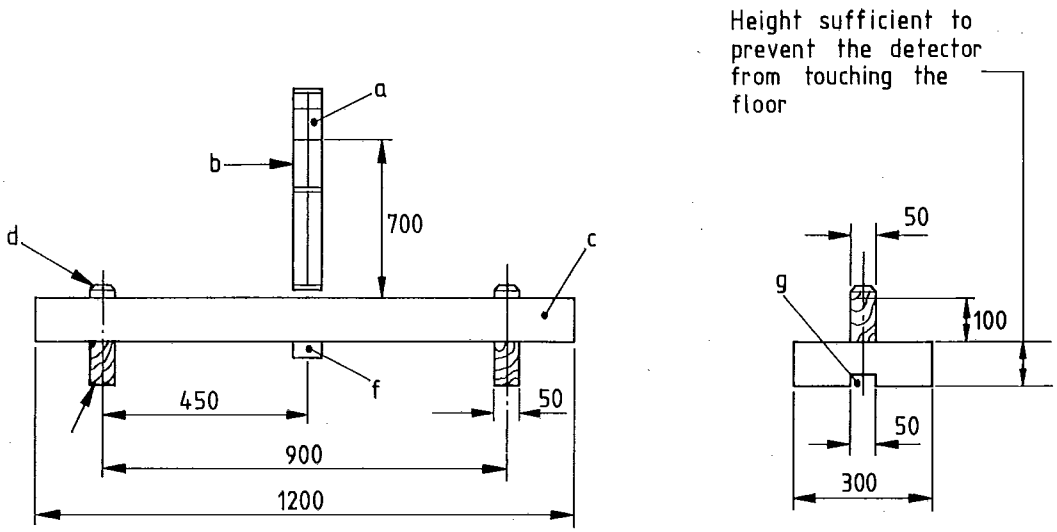



**Figure 6. Dazzling apparatus**

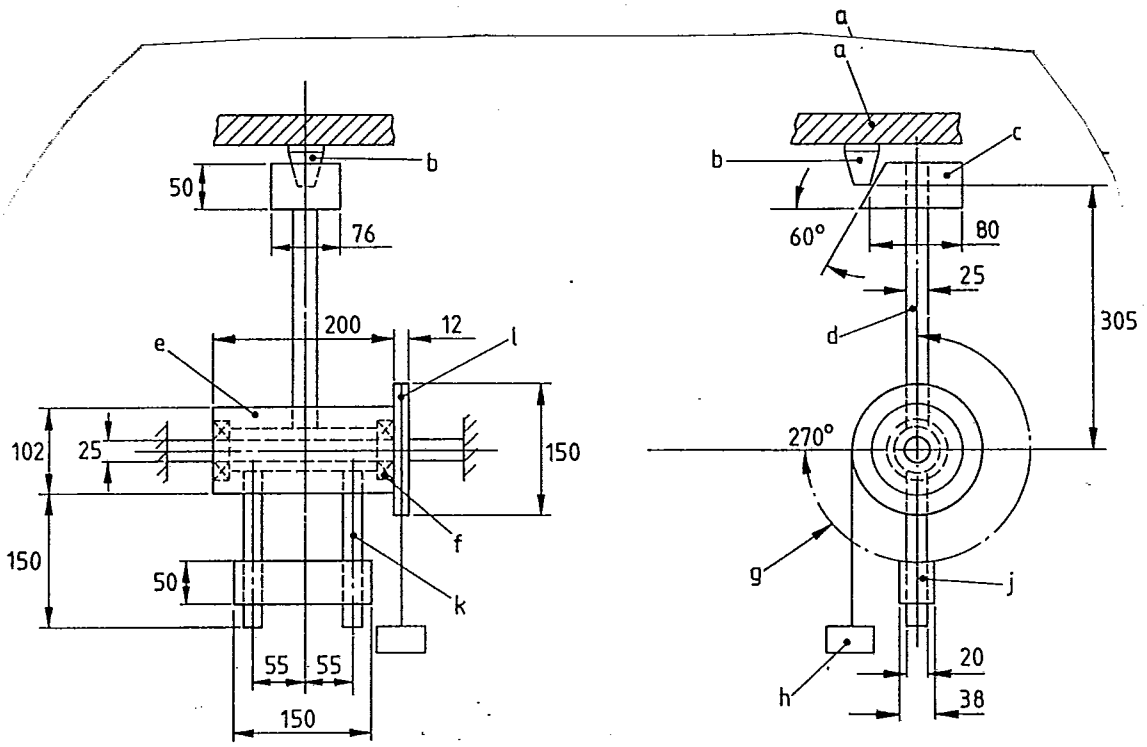



Dimensions in mm

(a) 1 kg steel weight
(b) Guide rods
(c) Oak beam
(d) MS bolt and plate
(e) Oak support
(f) Detector under test
(g) To clear bolt head

NOTE. The sizes given to the dimensions are for guidance only.

**Figure 7. Shock test apparatus**

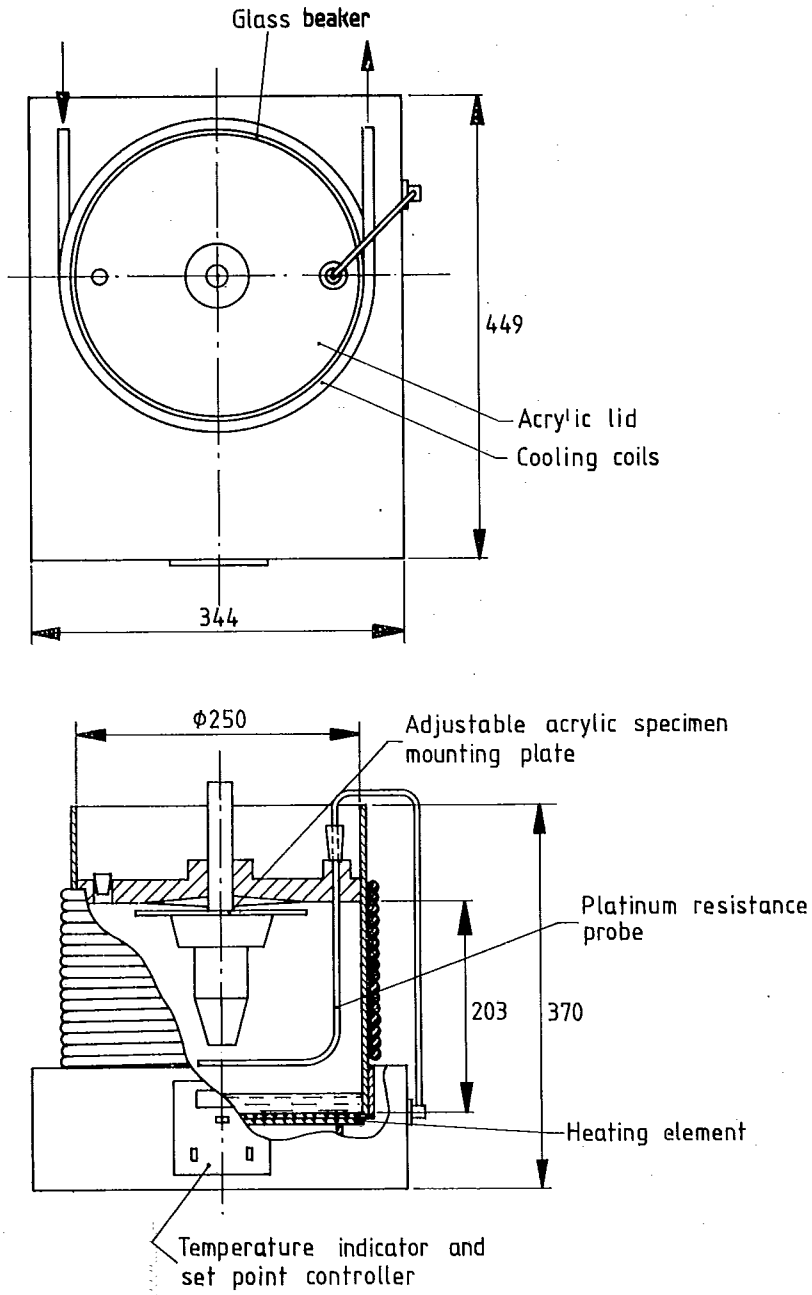



a Mounting board
b Detector
c Striker
d Strikershaft
e Boss
f Ball-bearings
g 270 ° angle of movement
h Operating weight
j Counter balance weight
k Counter balance arms
l Pulley

NOTE. The sizes given to the dimensions are for guidance only.

Dimensions in mm

**Figure 8. Impact apparatus**




Dimensions in millimetres

**Figure 9. Corrosion test apparatus (10 litre)**

## National particularity

**Austria.** With reference to the note of **3.2**(b); in Austria such detectors have to be marked in accordance with § 3(2) of Normengesetz (Standards Act) 1971.

## National appendix Y

### Publications referred to

| | |
|---|---|
| *EN 54 : Part 1 | |
| *published as* | BS 5445 : Part 1 : 1977<br>Components for automatic fire detection systems<br>Part 1 Introduction |
| *EN 54 : Part 5 | |
| *published as* | BS 5445 : Part 5 : 1977<br>Components for automatic fire detection systems<br>Part 5 Heat sensitive detectors — point detectors containing a static element |
| *EN 54 : Part 8 | |
| *published as* | BS 5445 : Part 8 : 1984<br>Components for automatic fire detection systems<br>Part 8 Specification for high temperature heat detectors |
| EN 54 : Part 9 | |
| *published as* | BS 5445 : Part 9 : 1984<br>Components for automatic fire detection systems<br>Part 9 Methods of fire sensitivity test |
| *BS 1470 | Wrought aluminium and aluminium alloys for general engineering purposes — plate, sheet and strip |
| BS 5839 | Fire detection and alarm systems in buildings<br>Part 1 Code of practice for installation and servicing |
| ISO 209 | Composition of wrought products of aluminium and aluminium alloys — Chemical composition (per cent) |

NOTE. As explained in the national foreword, the reference in the text to ISO 209 is to a material that is equivalent to an aluminium alloy in BS 1470 : 1972.

## National appendix Z

### National committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Fire Standard Committee (FSM/—) to Technical Committee FSM/12 upon which the following bodies were represented:

Association of Manufacturers Allied to the Electrical and Electronic Industry (Beama Ltd)
British Fire Protection Systems Association Ltd
British Telecommunications
Chartered Institution of Building Services
Chief and Assistant Chief Fire Officers Association
Department of Health and Social Security
Department of the Environment. Building Research Establishment (Fire Research Station)
Department of the Environment. Property Services Agency
Department of Transport — Marine Directorate
Electrical Contractors Association
Electrical Installation Equipment Manufacturers Association (Beama Ltd)
Fire Insurers Research and Testing Organization (FIRTO)
Fire Offices Committee
Fire Protection Association
Greater London Council
Home Office
Institution of Electrical Engineers
Institution of Fire Engineers
Ministry of Defence
Royal Institute of British Architects
Telecommunication Engineering & Manufacturing Association (TEMA)

The following body was also represented in the drafting of the standard:

Electricity Supply Industry in England and Wales

*Referred to in the national foreword only.

# BS 5445 : Part 7 : 1984
# EN 54 : Part 7

This British Standard, having been prepared under the direction of the Fire Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 May 1984.



ISBN 0 580 13874 7

The following BSI references relate to the work on this standard:
Committee reference FSM/12 Draft for comment 79/10755 DC

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## Cooperating organizations

The European Committee for Standardization, under whose supervision this European Standard was prepared, comprises the national standards organizations of the following Western European countries:

| | |
|---|---|
| Austria | Osterreichisches Normungsinstitut |
| Belgium | Institut Belge de Normalisation |
| Denmark | Dansk Standardiseringsraad |
| Finland | Suomen Standardisoimisliitto, r.y. |
| France | Association Française de Normalisation |
| Germany | Deutsches Institut für Normung E.V. |
| Greece | Hellenic Organization for Standardization |
| Ireland | Institute for Industrial Research and Standards |
| Italy | Ente Nazionale Italiano di Unificazione |
| Netherlands | Nederlands Normalisatie-instituut |
| Norway | Norges Standardiseringsforbund |
| Portugal | Direcçao-Geral de Qualidade |
| Spain | Instituto Espagñol de Normalización |
| Sweden | Standardiseringskommissionen i Sverige |
| Switzerland | Association Suisse de Normalisation |
| United Kingdom | British Standards Institution |

## Amendments issued since publication

| Amd. No. | Date of issue | Text affected |
|---|---|---|
| | | |
| | | |
| | | |
| | | |



BS 5445 : Part 7 : 1984
EN 54 : Part 7

AMD 5763
Amendment No. 1 (E) : 1988 to EN 54 : Part 7

BSI

**Amendment No. 1**
**published and effective from 31 August 1988**
**to BS 5445 : Part 7 : 1984 [EN 54 : Part 7]**

**Components of automatic fire detection systems Part 7. Specification for point-type smoke detectors using scattered light, transmitted light or ionization**

**Revised text**

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**AMD 5763**
**August 1988**

Text of EN 54 : Part 7

Amend the text of the European Standard in accordance with the details given on the attached pages.

EUROPEAN STANDARD
NORME EUROPÉENNE
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EN 54
Part 7
Amendment 1
April 1988

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Key words: fire equipment, fire detection systems, detectors, smoke, automatic control, specifications, tests

Amends EN 54, Part 7, November 1984
English version

# Components of automatic fire detection systems Part 7. Point-type smoke detectors; Detectors using scattered light, transmitted light or ionization

Organes constitutifs des systèmes de détection automatique d'incendie; Partie 7: Détecteurs de fumée; Détecteur fonctionnant suivant le prinzipe de diffusion de la lumière, de la transmission de la lumière et de l'ionisation

Bestandteile automatischer Brandmeldeanalgen; Teil 7: Punktförmige Rauchmelder; Rauchmelder nach dem Streulicht-, Durchlicht- oder Ionisationsprinzip

This Amendment was accepted by CEN on 14 May 1987 in accordance with the conditions given on the title page of the European Standard to which this amendment refers and of which it is an integral part.

The CEN members are bound to abide by the Common CEN/CENELEC Rules which define the conditions for making modifications.

CEN members are the national standards organizations of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Ref. No. EN 54:1984/A1:1988 E

## Brief history

This Amendment 1 to the European Standard EN 54 Part 7 was drawn up by the Technical Committee CEN/TC 72 (the EN has been voted in 1982) 'Automatic fire detection systems', the Secretariat of which is held by BSI. This amendment clarifies the procedures for certain tests.

In accordance with the Common CEN/CENELEC Rules, following countries are bound to implement this Amendment:

Austria, Belgium, Finland, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

## Amendments applicable to all language versions

### 10. Air movement

**10.1 Response behaviour**

Delete the existing text of **10.1** entirely and substitute the following.

'The detector shall be tested in the manner described in annex **H.1**. The detector shall be deemed to comply with the requirements of this clause if:

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

or

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

**10.2 False alarm behaviour**

Insert the following new paragraph between the title and the existing first paragraph.

'This test only applies to smoke detectors using ionization.'

### 12. Ambient light

Insert the following new paragraph between the title and the existing first paragraph.

'This test only applies to smoke detectors using scattered light or transmitted light.'

In paragraph 2, item (b), delete 'or $y_{max} : y_{min}$'.

### Table 1. Test schedule for smoke detectors

In the row titled '12 K Ambient light', in the column titled '4', delete 'x' and substitute '$x^{1)}$'.

At the foot of table 1 insert the following.

'$^{1)}$This test only applies to smoke detectors using scattered light or transmitted light.'

## Annex H. Test for sensitivity to air movement

**H.2 False alarm behaviour**

Insert 'for at least 5 min' between '$v = 5 \pm 0{,}5$ m/s' and 'and then to a gust lasting 2 s'.

## Annex K. Sensitivity to ambient light test

In **K.1**, delete the final paragraph and substitute the following.

'In each directional alignment of the detector, the maximum response threshold value is given the symbol $m_{max}$ and the minimum response threshold value is given the symbol $m_{min}$.'

## Annex M. Humidity test

**M.1 Test method**

Delete:

'The response threshold value of detector no. 6 shall be measured with the most unfavourable flow direction according to annex B within 5 min of removal from the climatic chamber.'

and substitute the following:

'The response threshold value of detector no. 6 shall be measured according to annex B with the most unfavourable flow direction. The measurement shall commence not later than 5 min after removal from the climatic test chamber.'.

## Annex P. Corrosion test

**P.3 Procedure**

In paragraph 2, delete '60 h' and substitute '72 h'.

## Annex Q. Insulation resistance test

In **Q.1**, delete

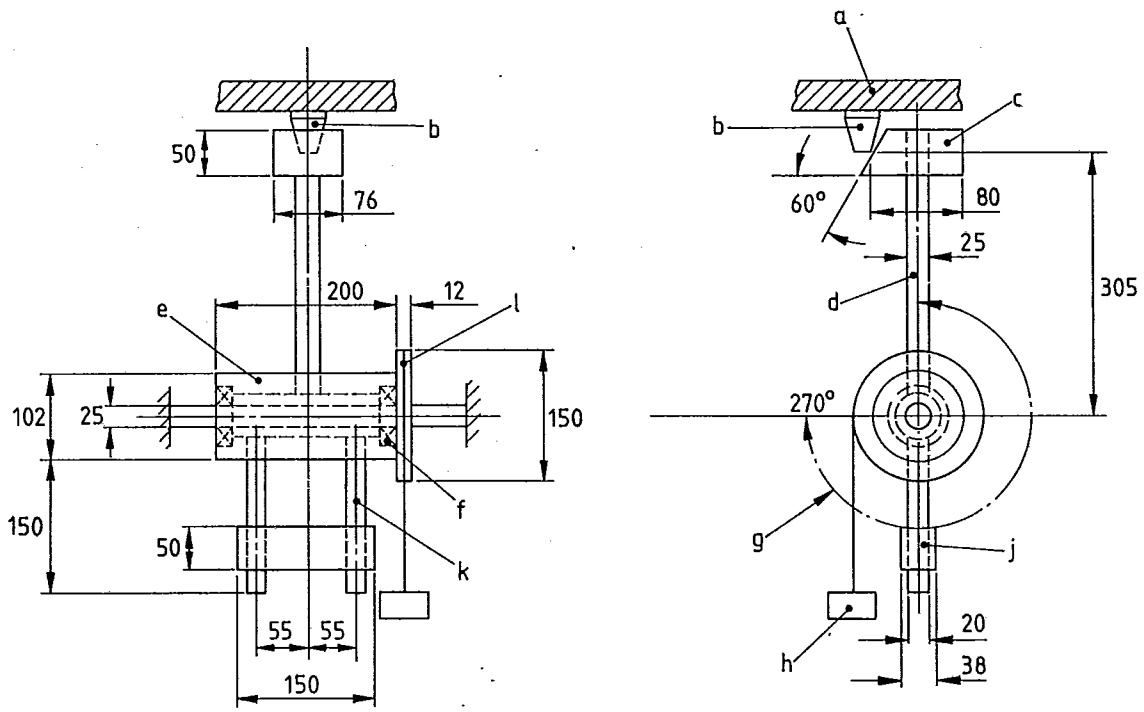
'The detector shall be dried in an oven at a temperature of $40 \pm 5$ °C. Immediately afterwards the detector shall be placed in a climatic chamber, and subjected to the following conditions for 10 days:'

and substitute

'The detector shall then be heated to, and allowed to stabilize at, $40 \pm 5$ °C (to prevent the formation of condensation) before being subjected to the following conditions for 10 days:'.

Figure 8. Impact apparatus

Delete the existing figure, and substitute the following.




a Mounting board
b Detector
c Striker
d Strikershaft
e Boss
f Ball-bearings
g 270 ° angle of movement
h Operating weight
j Counter balance weight
k Counter balance arms
l Pulley

NOTE. The sizes given to the dimensions are for guidance only.

Dimensions in mm

**Figure 8. Impact apparatus**

**Amendment applicable to the French language version only**

## Annex M. Humidity

### M.1 Test method

In the final paragraph delete the first sentence and substitute 'The response threshold of the detector shall then be measured according to annex B in the most unfavourable direction.'.