

Australian Standard[®]

Fire detection and alarm systems

A1

Part 15: Point type fire detectors using scattered light, transmitted light or ionization sensors in combination with a heat sensor (ISO 7240-15:2004, MOD)



This Australian Standard® was prepared by Committee FP-002, Fire Detection, Warning, Control and Intercom Systems. It was approved on behalf of the Council of Standards Australia on 17 March 2004.
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- Audio Engineering Society
 - Australasian Fire Authorities Council
 - Australian Building Codes Board
 - Australian Chamber of Commerce and Industry
 - Australian Electrical and Electronic Manufacturers Association
 - Australian Government Analytical Laboratories, Scientific Services Laboratory
 - Australian Industry Group
 - Australian Institute of Building Surveyors
 - Deafness Forum of Australia
 - Department of Defence (Australia)
 - Fire Protection Association Australia
 - Institute of Security Executives
 - National Electrical and Communications Association
 - Property Council of Australia
-

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STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 7240.15—2004

Fire detection and alarm systems

**Part 15: Point type fire detectors using scattered light, transmitted light or
ionization sensors in combination with a heat sensor (ISO 7240-15:2004, MOD)**

RECONFIRMATION NOTICE

Technical Committee FP-002 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

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NOTES

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PREFACE

This Standard was prepared by the Standards Australia Committee FP-002, Fire Detection, Warning, Control and Intercom Systems.

Amendment No. 1 (March 2007), is identical to ISO 7240-15:2004, Technical Corrigendum 1 and has been bound at the end of this Standard. The amendment relates to the Part Title and Appendix N.

This Standard has been adopted with national modifications and has been reproduced from ISO 7240-15:2004, *Fire detection and fire alarm systems, Part 15: Multisensor fire detectors*. A modification for Australian Condition is the addition of the indicator visibility requirement of AS 2362.25. The variations are set out in Annex ZA.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (b) In the source text ‘this International Standard’ should read ‘this Australian Standard’.
- (c) A full point should be substituted for a comma when referring to a decimal marker.

References to International standards should be replaced by references to Australian Standards as follows:

<i>References to International Standard or other publication</i>		<i>Australian/New Zealand Standard</i>	
ISO		AS	
7240	Fire detection and alarm systems	7240	Fire detection and alarm systems
7240-5	Part 5: Point-type heat detectors	7240.5	Part 5: Point-type heat detectors (ISO 7240-5:2003, MOD)
7240-7	Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization	7240.7	Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization (ISO 7240- 7:2003, MOD)
IEC		AS	
60068	Environmental testing	60068	Environmental testing
60068-1	Part 1: General and guidance	60068.1	General and guidance
60068-2-1	Part 2: Tests, Test A: Cold	60068.2.2	Tests—Test A: Cold
60068-2-6	Part 2: Tests, Test Fc: Vibration (sinusoidal)	60068.2.6	Tests—Test Fc: Vibration (sinusoidal)
60068-2-27	Part 2: Tests, Test Ea and guidance: Shock	60068.2.27	Tests—Tests Ea and guidance: Shock
60068-2-78	Part 2: Tests, Test Cab: Damp heat, steady state	60068.2.78	Tests— Test Cab: Damp heat, steady state

The term ‘normative’ and ‘informative’ are used in this Standard to define the application of the annex to which they apply. A ‘normative’ annex is an integral part of a standard, whereas an ‘informative’ annex is only for information and guidance.

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INTRODUCTION

This part of ISO 7240 for multisensor fire detectors describes requirements for different types of multisensor fire detectors.

This part of ISO 7240 is drafted on the basis of functions which are required to be provided on all multisensor fire detectors covered by this standard, and optional functions with requirements which may be provided. It is intended that the options will be used for specific applications, as recommended in application guidelines.

Each optional function is included as a separate entity, with its own set of associated requirements, in order to permit multisensor fire detectors covered by this standard with different combinations of functions to conform to this standard.

Other functions associated with fire detection and fire alarm may also be provided, even if not specified in this part of ISO 7240, if they do not jeopardize any function required by this document.

AUSTRALIAN STANDARD

Fire detection and alarm systems

Part 15:

Point type fire detectors using scattered light, transmitted light or ionization sensors in combination with a heat sensor
(ISO 7240-15:2004, MOD)

1 Scope

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

The performance of single components within a multisensor fire detector covered by this standard may not be sufficient for conformity to other standards for the single sensor.

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

2 References

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

ISO 209-1, *Wrought aluminium and aluminium alloys — Chemical composition and forms of products — Part 1: Chemical composition*

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

ISO 7240-5, *Fire detection and alarm systems — Part 5: Point-type heat detectors*

ISO 7240-7, *Fire detection and alarm systems — Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization*

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

IEC 60068-2-1, *Environmental testing — Part 2: Tests. Tests A: Cold*

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

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

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

IEC 60068-2-42, *Environmental testing — Part 2-42: Tests. Test Kc: Sulphur dioxide test for contacts and connections*

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

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

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7240-1, ISO 7240-5, ISO 7240-7 and the following apply.

3.1.1

detector response

defined change of the status of a fire detector after actuation of an alarm signal

3.1.2

multisensor fire detector

detector incorporating sensors within one mechanical housing which responds to more than one physical phenomenon of fire, e.g. smoke and heat, smoke and gas or heat and gas

NOTE The mechanism for actuating alarm signals or for operating automatic fire protection equipment may be located with the detector or in another part of the system, for example at the control and indicating equipment.

3.1.3

non-volatile memory

memory elements which do not require the presence of an energy source for the retention of their contents

3.1.4

sensor response

defined change of the output signal of a sensing element

NOTE The output signal may be a response to combustion or may result from environmental influences such as temperature, wind, air pressure, electromagnetic irradiation, etc.

3.1.5

site-specific detector data

alterable data required for the detector to operate in a defined detector configuration

3.1.6

smoke-response value

A_{sr}

aerosol density in the proximity of a test specimen at the moment that it generates a reference signal in a smoke tunnel

3.1.7

temperature-response value

temperature in the proximity of a test specimen at the moment that it generates a reference signal

3.1.8

volatile memory

memory elements which require the presence of an energy source for the retention of their contents

3.2 Abbreviations

3.2.1

c.i.e.

control and indicating equipment

3.2.2

MSFD

multisensor fire detector

4 Functions

4.1 General

The MSFD shall be capable of detecting the mandatory test fires as specified in 6.18.3.1.

The MSFD shall be capable of processing signals from all incorporated sensing elements intended to respond to a fire parameter. At least a common signal shall be produced (either in the MSFD itself or in the c.i.e.) which can be interpreted as a fire alarm signal.

Means shall be provided for the transmission of the fire signal to the c.i.e.

Where the mechanism for actuating alarm signals is located in the c.i.e., means shall be provided for the transmission of all signals which are necessary for the actuation process.

4.2 Optional functions

4.2.1 Requirements for optional functions

Each optional function is included as a separate entity, with its own set of associated requirements, in order to permit multisensor fire detectors covered by this part of ISO 7240 with different combinations of functions to conform to this document.

If an option is taken, all the corresponding requirements shall be met.

The fault of an option shall not jeopardize any function required by this part of ISO 7240.

4.2.2 Types of optional functions

The MSFD may include one or more of the following optional functions:

- a) be capable of detecting one or more of the optional fires specified in 6.18.3.1;
- b) be provided with means for monitoring the integrity of one or more sensing elements;
- c) be provided with means (remote or internal) for changing its response behaviour;

NOTE A change in the response behaviour could be caused by changing a detection algorithm of the MSFD;

- d) be capable of visually indicating conditions other than a fire alarm (e.g. fault or stand-by);
- e) be provided with a means of calibration;
- f) be designed in such a way that the detector head can be detached from its base;
- g) provide for connections to ancillary devices, e.g. remote indicators, control relays, etc;
- h) provide for special sensitivity settings in order to limit its sensitivity (see 6.19).

5 General requirements

5.1 Design considerations

MSFDs should be designed for installation under the same conditions as other fire detectors specified in the other parts of ISO 7240. MSFDs shall be designed so that they are reliable and sufficiently durable for their intended period of use. In particular, MSFDs shall withstand the environmental conditions which may occur in buildings.

MSFDs shall be so designed that the signal(s) from the smoke sensor(s), combined with the signal(s) from the heat sensor(s), produce a fire signal.

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

5.2 Applicability

In order to conform with this standard, the detector shall meet the requirements of Clauses 4 and 5, shall be tested as described in Clause 6 and shall meet the requirements of the tests.

5.3 Individual alarm indication

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

For detachable detectors, the indicator may be integral with the base or the detector head.

The visual indicator shall be visible from a distance of 6 m at an angle of up to 5° from the axis of the detector in any direction, in ambient light intensity up to 500 lx.

5.4 Indication of other conditions

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

5.5 Calibration

Where means of calibration are provided, they shall not be readily adjustable after manufacture.

5.6 Sensitivity adjustment

Where means for field adjustment of the sensitivity of the detector are provided, then

- a) unless the requirements of 5.7 are met, the range of adjustment shall be limited such that the detector meets the requirements of this standard at the highest and lowest sensitivities possible;
- b) the means of adjustment shall not be readily accessible when the detector is installed and ready for operation.

For the purpose of this clause, adjustment of sensitivity includes any adjustment which leads to a change in the response to fire.

5.7 Sensitivity attenuation and signal disablement

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

5.8 Monitoring of detachable detectors

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

5.9 Drift compensation

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

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

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

- a) for any rate of increase in smoke density, R , which is greater than 25 % of the initial uncompensated smoke response value of the detector, $A_{SR,U}$, per hour, the time for the detector to give an alarm, does not exceed $1,6 \times (A_{SR,U}/R)$ by more than 100 s;
- b) the range of total compensation C_t is limited such that $C_t < 0,6 A_{SR,U}$ throughout this range, and that the fully compensated smoke response value, $A_{SR,C}$, of the detector does not exceed its initial value by a factor greater than 1,6 (see Annex O).

5.10 Marking

Each detector shall be clearly marked with the following information:

- a) a reference to this part of ISO 7240 (e.g. ISO 7240-15:2003);
- b) the name or trademark of the manufacturer or supplier;
- c) the model designation (type or number);
- d) the terminal designations;
- e) some mark or code by which the manufacturer can identify, at least, the date or batch of manufacture (e.g. a serial number or batch code).

For detachable detectors, the marking of the detector head shall include items a), b), c) and e) and the base shall be marked with at least items c) and d).

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

The marking shall be visible during installation and shall be accessible during maintenance.

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

For detectors containing radioactive materials, attention is drawn to the marking provisions of the relevant national requirements and OECD recommendations.

5.11 Technical documentation

Detectors shall be supplied with sufficient technical, installation and maintenance documentation to ensure their correct handling, installation and operation. If all of these data are not supplied with each detector, reference to the appropriate data sheet shall be given on, or with, each detector.

For assessment of the detector performance, the documentation shall include a description of the different detector functions and of the options taken.

5.12 Manufacturer's declaration

The manufacturer shall declare the following:

- attestation of conformity with this part of ISO 7240;
- attestation that the detector is so designed that under the tested environmental conditions, each material and each electronic component operates within the limits of its specifications.

5.13 Electrical requirements

5.13.1 Connection of ancillary devices

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

5.13.2 Fault signal

Where means are provided to monitor the sensing elements and a fault is detected, either a common signal or separate signals for each sensing element shall be produced and made available to the c.i.e.

5.14 Protection against ingress of foreign bodies

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

NOTE This requirement is intended to restrict the access of insects into the smoke measuring chamber of the detector. It is known that this requirement is not sufficient to prevent the access of all insects, however it is considered that extreme restrictions on the size of access holes may introduce the danger of clogging by dust, etc. It might therefore be necessary to take other precautions against false alarms due to the entry of small insects.

5.15 Requirements for software-controlled multisensor fire detectors

5.15.1 General requirements

In the case of multisensor detectors which contain elements that are controlled by software in order to fulfil the requirements of this part of ISO 7240, the detectors shall conform to the requirements of 5.15.2, and shall conform to the requirements of 5.15.3 where relevant to the technology used.

5.15.2 Software documentation

5.15.2.1 General documentation

The manufacturer shall prepare documentation which gives an overview of the software design, which shall be submitted to the testing authority together with the multisensor fire detectors. This documentation shall comprise at least a functional description of the main program flow, including the following:

- a brief description of the major modules which are included in the software and the function(s) each performs;
- the ways in which the modules interact;
- a sample of the documentation for one of the modules described above;
- a date or version reference.

The description shall use graphic representations of the system design and the data flows, or an equivalent clear method of software documentation.

5.15.2.2 Detailed documentation

The manufacturer shall prepare detailed design documentation and shall make it available for inspection in a manner which respects the manufacturer's rights of confidentiality.

NOTE This does not necessarily entail submitting such documentation to the testing authority.

This documentation shall comprise at least the following:

- a) description of each module of the program, containing
 - the name of the module,
 - the date or version reference,
 - a description of the tasks performed,
 - a description of the interfaces, including the type of data transfer, the valid data range and the checking for valid data;
- b) full specification of the implementation phase, e.g.
 - source code prior to compiling or assembling,
 - CASE tool listings,
 - listing of graphic development tools for fuzzy logic.

5.15.3 Program monitoring — Optional function

Means may be provided for monitoring the execution of the program. If the monitoring function detects that the program has halted or latched, a signal shall be made available to the c.i.e. within a time limit specified by the manufacturer.

5.16 Storage of programs and data

The program shall be held in non-volatile memory. Each device containing program memory shall be identifiable such that its contents can be uniquely cross-referenced to the software documentation.

For site-specific detector data stored in volatile memory, the data shall be automatically renewed or protected against power loss.

5.17 Monitoring of memory contents — Optional function

Means may be provided for detecting the loss of site-specific data. If such a loss occurs, a signal shall be made available to the c.i.e. within a time limit specified by the manufacturer.

6 Tests

6.1 General

6.1.1 Test classification

6.1.1.1 General

The purpose of the environmental tests is to demonstrate that a detector can operate correctly in its service environment and that it will continue to do so for a reasonable time. The tests are intended to demonstrate failures due to realistic service environments, however, some significant failure mechanisms are brought about by changes which occur slowly under these realistic service conditions. In order to make tests within a practical and economic time-scale, it is sometimes necessary to accelerate these changes by intensifying the conditions (e.g. by increasing the level of an environmental parameter or by increasing the frequency of its application). The tests are divided into two classes: operational and endurance.

6.1.1.2 Operational tests

The test specimen is subjected to test conditions which correspond to the service environment. The object of these tests is to demonstrate the ability of the equipment to withstand and operate correctly in the normal service environment and/or to demonstrate the immunity of the equipment to certain aspects of that environment.

The specimen is, therefore, operational, its condition is monitored and it may be functionally tested during the tests.

6.1.1.3 Endurance tests

The test specimen may be subjected to conditions more severe than the normal service environment in order to accelerate the effects of the normal service environment. The object of these tests is to demonstrate the ability of the equipment to withstand the long-term effects of the service environment. Since the tests are intended to study the residual rather than the immediate effects, the specimens are normally not supplied with power or monitored during the conditioning period. However, if by reason of the design of the specimen, it is necessary for a power supply to be connected, any signal generated during the test shall be ignored.

6.1.2 Assessment of the performance of the sensors

6.1.2.1 General

In order to assess the influence of the environmental tests quantitatively, a suitable detector parameter shall be measured before and after the tests. For each test, the observable changes of the parameter which define clear pass/fail criteria are specified.

The same parameter shall also be used to assess the repeatability (6.2) and the reproducibility (6.4) of the specimen.

Since an MSFD consists of more than one sensor responding to more than one phenomenon associated with combustion, the performance of all incorporated sensors shall be assessed.

6.1.2.2 Performance of the smoke sensor(s)

For the assessment of the performance of a smoke sensor, a smoke tunnel as specified in A.1, the application of a test aerosol as specified in A.3, and aerosol-measuring equipment as specified in A.4 shall be used.

Since the MSFD has to respond to smoke even though the other sensors may not produce a signal, the alarm threshold value for the aerosol can be measured and shall be taken as the assessment parameter.

6.1.2.3 Performance of the heat sensor(s)

For the assessment of the performance of the heat sensor, a heat tunnel as specified in Annex C shall be used.

Since the MSFD need not respond to temperature with an alarm signal, it is the responsibility of the manufacturer to specify a method by which a signal can be derived from the MSFD which can be used as a parameter for the assessment of the performance of the heat sensor.

6.1.2.4 Orientation

The orientation for which the maximum smoke response value or the maximum temperature response value is measured is referred to as the least sensitive orientation for smoke and temperature, respectively. The orientation for which the minimum smoke response value or the minimum temperature response value is measured is referred to as the most sensitive orientation for smoke and temperature, respectively.

6.1.3 Atmospheric conditions for tests

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

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

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

6.1.4 Operating conditions for tests

If a test method requires a specimen to be operational, connect the specimen to suitable supply and indicating equipment in accordance with the manufacturer's instructions. Unless otherwise specified in the test method, set the supply parameters applied to the specimen within the manufacturer's specified range(s) and keep them substantially constant throughout the tests. The value chosen for each parameter shall normally be the nominal value, or the mean of the specified range.

The details of the supply and indicating equipment used are noted in the test report (Clause 7).

6.1.5 Mounting arrangements

Mount the specimen by its normal means of attachment in accordance with the manufacturer's instructions. If these instructions describe more than one method of mounting, choose the method considered to be most unfavourable for each test.

6.1.6 Tolerances

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

6.1.7 Measurement of the smoke response value

Mount the specimen for which the smoke response value is to be measured in a smoke tunnel, as specified in A.1, in its normal operating position, by its normal means of attachment. The orientation of the specimen, relative to the direction of air flow, shall be the least sensitive orientation as determined in the directional dependence test (6.3), unless otherwise specified in the test procedure.

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

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

Unless otherwise specified in the test procedure, the air temperature in the tunnel shall be (23 ± 5) °C and shall not vary by more than 5 K and not faster than 0,2 K/min for all the measurements on a particular detector type.

Connect the specimen to its supply and indicating equipment as described in 6.1.4, and allow it to stabilize for at least 15 min.

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

- for detectors using scattered or transmitted light, in decibels per metre per minute: $0,015 \leq \frac{\Delta m}{\Delta t} \leq 0,1$;
- for detectors using ionization, per minute: $0,05 \leq \frac{\Delta y}{\Delta t} \leq 0,3$.

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

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

Make all aerosol density measurements in the proximity of the specimen.

The smoke response value shall be recorded as m , in decibels per metre, or as y , a dimensionless parameter (see A.4).

6.1.8 Measurement of the temperature response value

Install the specimen for which the temperature response value is to be measured in a heat tunnel, as specified in Annex C, in its normal operating position, by its normal means of attachment. The orientation of the specimen, relative to the direction of air flow, shall be the least sensitive one as determined in the directional dependence test (6.3), unless otherwise specified in the test procedure.

Connect the specimen to its supply and indicating equipment as specified in 6.1.4, and allow it to stabilize for at least 15 min.

Before the test, stabilize the temperature of the air stream and the specimen at $(25 \pm 2) ^\circ\text{C}$. The air flow shall be maintained at a constant mass flow equivalent to a velocity of $(0,8 \pm 0,1) \text{ m/s}$ at $25 ^\circ\text{C}$.

Raise the air temperature until the heat sensor produces a signal (this might be a fire signal), as specified by the manufacturer. The rate of rise of the air temperature and the associated tolerances shall correspond to one of the values, except for 0,2 K/min, 1 K/min and 30 K/min, as specified in ISO 7240-5. Record the temperature at which this signal is produced as reference data.

The choice of the rate within the range of 3 K/min to 20 K/min shall be specified by the manufacturer.

For this purpose, the manufacturer may supply an MSFD with special outputs. However, it is essential that the output signal be routed through the amplification path.

6.1.9 Provision for tests

The data specified in 5.10 and 5.11 plus the following numbers of detectors shall be provided for testing in accordance with this part of ISO 7240:

- for detachable detectors: 20 detector heads and bases;
- for non-detachable detectors: 20 specimens.

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

This implies that the mean smoke response value of the 19 specimens as measured in the reproducibility test (6.4) should also represent the production mean, and that the deviation limits specified for the reproducibility test should also be applicable to the manufacturer's production.

6.1.10 Test schedule

Test the specimens as specified in Table 1. After the reproducibility test (6.4), number the four specimens with the least sensitive smoke response (i.e. those with the highest smoke response value) 17 to 20. Number the others 1 to 16 arbitrarily.

When it is required to determine both the smoke and the temperature response value after an environmental test, determine the smoke response value first.

Table 1 — Test schedule

Test	Subclause	Specimen No(s). to be tested
Repeatability	6.2 ^a	one chosen arbitrarily
Directional dependence	6.3 ^a	one chosen arbitrarily
Reproducibility	6.4 ^a	all specimens
Variation of supply parameters	6.5	1
Air movement	6.6	2
Dazzling ^b	6.7	3
Dry heat (operational)	6.8	4
Cold (operational)	6.9	5
Damp heat, steady state (operational)	6.10	6
Damp heat, steady state (endurance)	6.11 ^a	7
Sulfur dioxide (SO ₂) corrosion (endurance)	6.12 ^a	8
Shock (operational)	6.13 ^a	9
Impact (operational)	6.14 ^a	10
Vibration, sinusoidal (operational)	6.15	11
Vibration, sinusoidal (endurance)	6.16 ^a	11
Electrostatic discharge (operational)	6.17	12 ^c
Radiated electromagnetic fields (operational)	6.17	13 ^c
Conducted disturbances induced by electromagnetic fields (operational)	6.17	14 ^c
Fast transient bursts (operational)	6.17	15 ^c
Slow high energy voltage surge (operational)	6.17	16 ^c
Fire sensitivity	6.18	17, 18, 19, 20
Special requirements on detector sensitivity (optional)	6.19	17, 18, 19, 20

^a The smoke and temperature response shall be measured.

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

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

6.1.11 Test report

The test results shall be reported in accordance with Clause 7.

6.2 Repeatability

6.2.1 Object of test

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

6.2.2 Test procedure

Measure the smoke response value and the temperature response value of the specimen six times as specified in 6.1.7. and 6.1.8.

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

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

Designate the maximum of the measured temperature response values as $T_{\max}$ and the minimum value as $T_{\min}$.

6.2.3 Requirements

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

The ratio of $(T_{\max} - 25) : (T_{\min} - 25)$ shall be not greater than 1,3.

The lower smoke response value $y_{\min}$ shall be not less than 0,2 or $m_{\min}$ shall be not less than 0,05 dB/m.

6.3 Directional dependence

6.3.1 Object of test

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

6.3.2 Test procedure

Measure the smoke response value and the temperature response value of the specimen eight times as specified in 6.1.7 and 6.1.8, the specimen being rotated 45° about its vertical axis between each measurement, so that the measurements are taken at eight different orientations relative to the direction of air flow.

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

Designate the maximum of the measured temperature response values as $T_{\max}$ and the minimum value as $T_{\min}$.

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

6.3.3 Requirements

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

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

The lower smoke response value $y_{\min}$ shall be not less than 0,2 or $m_{\min}$ shall be not less than 0,05 dB/m.

6.4 Reproducibility

6.4.1 Object of test

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

6.4.2 Test procedure

Measure the smoke response value and the temperature response value of each of the test specimens as specified in 6.1.7 and 6.1.8.

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

Calculate the mean value of the temperature response values and designate it as $\bar{T}$.

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

Designate the maximum of the measured temperature response values as $T_{\max}$ and the minimum value as $T_{\min}$.

6.4.3 Requirements

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

The ratio of $(T_{\max} - 25) : (\bar{T} - 25)$ shall be not greater than 1,33 and the ratio of $(\bar{T} - 25) : (T_{\min} - 25)$ shall be not greater than 1,5.

The lower smoke response value $y_{\min}$ shall be not less than 0,2 or $m_{\min}$ shall be not less than 0,05 dB/m.

6.5 Variation in supply parameters (voltage)

6.5.1 Object of test

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

6.5.2 Test procedure

Measure the smoke response value of the specimen to be tested as specified in 6.1.7, under the extremes of the specified supply conditions, e.g. maximum and minimum voltage.

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

6.5.3 Requirements

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

The lower smoke response value $y_{\min}$ shall be not less than 0,2 or $m_{\min}$ shall be not less than 0,05 dB/m.

6.6 Air movement

6.6.1 Object of test

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

6.6.2 Test procedure

Measure the smoke response value of the specimen to be tested as described in 6.1.7 in the most and the least sensitive orientation. Designate these appropriately as $y_{(0,2)\max}$ and $y_{(0,2)\min}$ or $m_{(0,2)\max}$ and $m_{(0,2)\min}$.

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

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

Record any signal that is emitted.

6.6.3 Requirements

One of the following relationships shall apply:

- for detectors using scattered or transmitted light: $0,625 < \frac{m_{(0,2)\max} + m_{(0,2)\min}}{m_{(1,0)\max} + m_{(1,0)\min}} < 1,6$;
- for detectors using ionization: $0,625 < \frac{y_{(0,2)\max} + y_{(0,2)\min}}{y_{(1,0)\max} + y_{(1,0)\min}} < 1,6$.

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

6.7 Dazzling

6.7.1 Object of test

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

6.7.2 Test procedure

Mount the apparatus for the dazzling test (see Annex E) in the smoke tunnel as specified in A.1. Install the specimen in the apparatus in the least sensitive orientation and connect it to its supply and monitoring equipment. Measure the smoke response value as specified in 6.1.7 and then perform the following procedure.

- a) Switch the first lamp ON for 10 s and then OFF for 10 s. Repeat this ten times.
- b) Repeat this sequence for each of the other three lamps in turn.
- c) Connect the four lamps as two pairs of opposite lamps.
- d) Switch the first pair ON for 10 s and then OFF for 10 s. Repeat this ten times.