INTERNATIONAL STANDARD

ISO 7240-15

First edition
2004-03-01

Fire detection and alarm systems —

Part 15: Multisensor fire detectors

Systèmes de détection et d'alarme d'incendie —

Partie 15: Détecteurs d'incendie multicapteurs

Reference number
ISO 7240-15:2004(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 7240-15 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

ISO 7240 consists of the following parts, under the general title *Fire detection and alarm systems*:

— *Part 1: General and definitions*

— *Part 2: Control and indicating equipment*

— *Part 4: Power supply equipment*

— *Part 5: Point-type heat detectors*

— *Part 6: Carbon monoxide fire detectors*

— *Part 7: Point-type smoke detectors using scattered light, transmitted light or ionisation*

— *Part 11: Manual call points*

— *Part 14: Guidelines for drafting codes of practice for design, installation and use of fire detection and fire alarm systems in and around buildings*

Compatibility assessment of system components will be the subject of the future Part 13.

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.

Fire detection and alarm systems —

Part 15: Multisensor fire detectors

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*

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

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 × ($A_{sr,u}/R$) 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 ± 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).