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Fire detection and alarm systems —

Part 20: Aspirating smoke detectors

Systèmes de détection et d'alarme d'incendie —

Partie 20: Détecteurs de fumée par aspiration

Reference number
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Foreword

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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 7240-20 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 3: Audible alarm devices*

— *Part 4: Power supply equipment*

— *Part 5: Point-type heat detectors*

— *Part 6: Carbon monoxide fire detectors using electro-chemical cells*

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

— *Part 8: Carbon monoxide fire detectors using an electro-chemical cell in combination with a heat sensor*

— *Part 9: Test fires for fire detectors* [Technical Specification]

— *Part 10: Point-type flame detectors*

— *Part 11: Manual call points*

— *Part 12: Line type smoke detectors using a transmitted optical beam*

— *Part 13: Compatibility assessment of system components*

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

— *Part 15: Point type fire detectors using scattered light, transmitted light or ionization sensors in combination with a heat sensor*

— *Part 16: Sound system control and indicating equipment*

— *Part 17: Short-circuit isolators*

— *Part 18: Input/output devices*

— *Part 19: Design, installation, commissioning and service of sound systems for emergency purposes*

— *Part 20: Aspirating smoke detectors*

— *Part 21: Routing equipment*

— *Part 22: Smoke-detection equipment for ducts*

— *Part 24: Sound-system loudspeakers*

— *Part 25: Components using radio transmission paths*

— *Part 27: Point-type fire detectors using a scattered-light, transmitted-light or ionization smoke sensor, an electrochemical-cell carbon-monoxide sensor and a heat sensor*

— *Part 28: Fire protection control equipment*

A part 23, dealing with visual alarm devices, is under preparation.

Introduction

This part of ISO 7240 is based on a European Standard EN 54-20:2006, prepared by the European Committee for Standardization CEN/TC 72 "*Fire detection and fire alarm systems*". It has been reviewed and revised by ISO/TC 21/SC 3/WG 21.

Aspirating smoke detectors differ from point-type smoke detectors (see ISO 7240-7) in that air is drawn into the smoke-sensing chamber, rather than relying on convection.

This part of ISO 7240 is not intended to place any other restriction on the design and construction of such detectors.

Fire detection and alarm systems —

Part 20: Aspirating smoke detectors

WARNING — Certain types of detectors contain radioactive materials. National requirements for radiation protection differ from country to country and they are not, therefore, specified in this part of ISO 7240.

1 Scope

This part of ISO 7240 specifies the requirements, test methods and performance criteria for aspirating smoke detectors for use in fire detection and alarm systems installed in buildings.

Aspirating smoke detectors developed for the protection of specific risks that incorporate special characteristics (including additional features or enhanced functionality for which this part of ISO 7240 does not define a test or assessment method) are also covered by this part of ISO 7240. The performance requirements for any special characteristics are beyond the scope of this part of ISO 7240.

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

ISO 7240-4, *Fire detection and alarm systems — Part 4: Power supply equipment*

ISO 7240-7:2003, *Fire detection and fire alarm systems — Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization*

EN 50130-4:1995 + Amendment 1:1998 + Amendment 2:2003, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

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

IEC 60068-2-2, *Environmental testing — Part 2-2: Tests — Test B: Dry heat*

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

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

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

IEC 60068-2-75, *Environmental testing — Part 2-75: Tests — Test Eh: Hammer tests*

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

IEC 61386-1:2008, *Conduit systems for cable management — Part 1: General requirements*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1
aspirating smoke detector
smoke detector, in which air and aerosols are drawn through a sampling device and carried to one or more smoke-sensing elements by an integral aspirator (e.g. fan or pump)

NOTE Each smoke sensing element may contain more than one sensor exposed to the same smoke sample.

3.1.2
response threshold value
measure of the aerosol concentration in the proximity of the smoke sensing element at the moment that the specimen generates an alarm signal, when it is tested as described in 5.1.5

3.1.3
sampling device
component or series of components or a dedicated device (e.g. a pipe network, dedicated duct, probe or hood) which forms part of the a.s.d. and transfers samples of air to the smoke sensing element(s)

NOTE The sampling device may be supplied separately.

3.1.4
sampling point
any point at which an air sample is drawn into the sampling device

3.1.5
transport time
time for aerosols to transfer from a sampling point to the smoke sensing element

3.2 Abbreviated terms

For the purposes of this document, the following abbreviations apply.

a.s.d. aspirating smoke detector

c.i.e. control and indicating equipment

c.p.c. condensation particle counter

EMC electromagnetic compatibility

MIC measuring ionization chamber

r.t.v. response threshold value

4 Requirements

4.1 Compliance

To comply with this part of ISO 7240, the detector shall meet the requirements of Clause 4, which shall be verified by inspection and engineering assessment, and when tested in accordance with the tests described in Clause 5, shall meet the requirements of the tests.

4.2 Classification

The manufacturer shall clearly state, in accordance with the data presented in 4.13, to which class or classes the aspirating smoke detector is designed. To demonstrate compliance with a specific class, the aspirating smoke detector shall be subjected to the appropriate fire sensitivity test as defined in 5.15.

NOTE Due to the differences and many variations in the design of sampling devices, aspirating smoke detectors are generally intended for use in many varied and often rather specialized applications. Therefore, it might not be practical to conduct type tests that define acceptance criteria for all of these applications. However, in recognition of the diversity of application, three classes are defined to enable system designers and installers to select the most appropriate sensitivity.

Table 1 identifies the classes of detector and the corresponding fire tests used for the classification.

Table 1 — Classification of aspirating smoke detectors

Class	Description	Example application(s)	Test fires
A	Aspirating smoke detector providing very high sensitivity	Very early detection: the detection of very dilute smoke, for example entering air conditioning ducts, to detect the extremely dilute concentrations of smoke that can emanate from equipment in an environmentally controlled area such as a clean room	TF2A, TF3A, TF4 and TF5A
B	Aspirating smoke detector providing enhanced sensitivity	Early detection: for example, special fire detection within or close to particularly valuable, vulnerable or critical items such as computer or electronic equipment cabinets	TF2B, TF3B, TF4 and TF5B
C	Aspirating smoke detector providing normal sensitivity	Standard detection: general fire detection in normal rooms or spaces, giving, for example, at least an equivalent level of detection as a point- or beam-type smoke detection system	TF2, TF3, TF4 and TF5

4.3 Individual visual alarm indication

Each aspirating smoke detector shall be provided with integral red visual indicator(s), visible from outside the aspirating smoke detector, by which the individual smoke-sensing element(s) (see 3.1.1) that released an alarm can be identified until the alarm condition is reset. Where other conditions of the detector can be visually indicated, they shall be clearly distinguishable from the alarm indication.

4.4 Connection of ancillary devices

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

4.5 Manufacturer's adjustments

It shall not be possible to change the manufacturer's settings except by special means (e.g. the use of a special code or tool) or by breaking or removing a seal.

4.6 On-site adjustment of response behaviour

NOTE 1 The effective response behaviour of an aspirating smoke detector is dependent upon both the sensitivity settings of the smoke sensing element and the design of the sampling device. Many types of aspirating smoke detectors, therefore, have facilities to adjust the smoke-sensing element sensitivity to suit the application and sampling device, etc.

If there is provision for field-adjustment of the sensitivity of the smoke sensing element, then

a) access to the means of adjustment shall be limited by the requirement for the use of tools or a special code;

b) it shall be possible to determine what sensitivity settings have been selected and to relate these to documentation that describes the sensitivity settings required for different sampling devices and applications;

NOTE 2 These adjustments may be made at the detector or at the c.i.e.

NOTE 3 Changing sensitivity settings may affect the classification of the installed a.s.d. – see 4.2.

c) if it is possible to configure the detector (including the sampling device and the sensitivity settings) in such a way that the detector does not comply with this part of ISO 7240, it shall be clearly marked on the detector or in the associated data that, if such configurations are used, the detector does not comply with this part of ISO 7240.

4.7 Response to slowly developing fires

The provision of "drift compensation" (e.g. to compensate for sensor drift due to the build-up of dirt in the detector) and/or the provision of algorithms to match a detector to its environment shall not lead to a significant reduction in the sensitivity of the detector to slowly developing fires.

Because it is not practical to carry out 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.

Where such algorithms are used, the detector shall be deemed to meet the requirements of 4.7 if the documentation and assessment shows

a) how and why a sensor drifts;

b) how the compensation technique modifies the detector response to compensate for the drift;

c) that suitable limits to the compensation are in place to prevent the algorithms/means from being applied outside the known limitations of the sensor and to ensure ongoing compliance with the provisions of this part of ISO 7240;

d) for any rate of increase in smoke density, R, that is greater than $A/4$ per hour (where A is the initial uncompensated r.t.v. of the a.s.d.), the time for the detector to give an alarm does not exceed $1{,}6 \times A/R$ by more than 100 s;

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

NOTE Further information about the assessment of requirements d) and e) is given in Annex J.

4.8 Mechanical strength of the pipework

Sampling pipes and fittings shall have adequate mechanical strength and temperature resistance.

Pipes shall either be classified in accordance with IEC 61386-1:2008 to at least class 1131 (for the significance of the digits, see Table 2) or shall be tested in accordance with 5.16.

Table 2 — Mechanical requirements of sampling pipe

Property	Class	Severity
Resistance to compression	1	125 N
Resistance to impact	1	0,5 kg, 100 mm height to fall
Temperature range	31	–15 °C to +60 °C

Where the supplier of the a.s.d. does not supply pipes for the sampling device, the product documentation shall specify that the requirements of this subclause shall be met.

4.9 Hardware components and additional sensing elements in the sampling device

Components, including optional components (box, filter, sensor, valve, etc.), in the sampling device shall be described in the documentation. The a.s.d., including the hardware components listed (i.e. the worst-case combination in accordance with the manufacturer's documentation), shall meet the requirements of this part of ISO 7240.

If the component incorporates a sensing element that participates in the signal output of the a.s.d. (e.g. for localization information), then the performance of the a.s.d., including these sensing elements, shall meet the requirements of this part of ISO 7240.

4.10 Airflow monitoring

4.10.1 The airflow through the aspirating smoke detector shall be monitored to detect leakage or obstruction of the sampling device or sampling point(s).

4.10.2 A fault signal shall be given when the airflow is outside the operational limits as specified by the manufacturer's data.

A fault signal shall be given for the following:

a) when any leakage or obstruction results in an increase or decrease in the volumetric airflow of 20 % and greater through an aspirating smoke detector; or

b) when, for aspirating smoke detectors that incorporate technology that provides for constant (or nearly constant) volumetric flow rate, which is largely independent of the sampling device (e.g. incorporates speed control of the fan or uses a positive displacement pump), there is a loss of 50 % or more of sampling points.

In either case, the fault signal shall be released within not more than 300 s of the fault occurring.

NOTE This time is independent of any delay times between signalling the fault and its indication at the c.i.e. and compensates for spurious, short-term flow variations that would otherwise result in an unwanted fault signal.

4.10.3 Where an a.s.d. has a facility to memorize the “normal” flow rate (present when the detector is installed or serviced) and, thereafter, monitor for deviations from this normal flow, the action of setting the memorized “normal” flow shall be a voluntary action at access level 3 (see ISO 7240-2).

4.10.4 Power cycling of the a.s.d. (turning it off and on) shall not result in a change to the memorized “normal” flow rate.

4.11 Power supply

The power for the aspirating detector shall be supplied by power supply equipment in accordance with ISO 7240-4. This power supply equipment may be common to the c.i.e.

4.12 Marking

Each detector shall be clearly marked with the following information:

a) number of this part of ISO 7240, e.g. “This product conforms to ISO 7240-20”;

b) name or trademark of the manufacturer or supplier;

c) model designation (type or number);

d) wiring terminal designations;

e) some mark(s) or code(s) (e.g. a serial number or batch code) by which the manufacturer can identify at least the date or batch and place of manufacture, and the version number(s) of any software contained within the detector.

Where the sensitivity class (see 4.2) is marked on the detector, additional information shall be provided to clearly indicate the means by which the classification of any used configuration can be determined.

This additional information may be a cross-reference to a separate document or may be a summary of the worst-case configuration tested under each class.

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

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

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

4.13 Data

Either an aspirating smoke detector shall be supplied with sufficient technical, installation and maintenance data to enable its correct installation, sensitivity setting and operation or, if all of these data are not supplied with each a.s.d., reference to the appropriate data sheet(s) shall be given on, or with, each aspirating smoke detector.

The manufacturer shall declare in these data the classification of each sampling device configuration and associated sensitivity settings. If the number of configurations is undetermined, the manufacturer shall provide the necessary means to determine the classification of any configuration used.

These data shall also be available on the commercial datasheets to enable the correct design of an installation prior to delivery of the hardware.

These data shall be referred to in the test report and shall be used to describe and determine the worst-case configuration(s) that are used in the fire tests (see 5.15) and the transport time for the sampling point(s) in the fire test room.

The transport time should not include any processing time and is specifically limited to the time required to transport aerosols from the sampling point (in the fire test room) to the sensing element.

The method used for determining the classification shall be clearly stated. This is likely to take into account the following parameters:

a) sizes and number of sampling points (maximum and minimum) and any limitations on their position along the sampling device;

b) sensitivity settings for the detector and how this parameter should be adjusted;

c) details of permitted sampling device arrangement (e.g. single pipe, branch, “H”-configurations);

d) maximum length of the sampling device (e.g. the maximum pipe length and branch length);

e) aspirator setting (if adjustable).

4.14 Additional requirements for software controlled detectors

4.14.1 General

For detectors that rely on software control to fulfil the requirements of this part of ISO 7240, the requirements of 4.14.2, 4.14.3 and 4.14.4 shall be met.

4.14.2 Software documentation

4.14.2.1 The manufacturer shall submit documentation to the testing authority that gives an overview of the software design. This documentation shall be in sufficient detail to allow inspection of the design for compliance with this part of ISO 7240 and shall include at least the following:

a) functional description of the main program flow (e.g. as a flow diagram or structogram), including

   1) a brief description of the modules and the functions that they perform,

   2) the manner in which the modules interact,

   3) the overall hierarchy of the program,

   4) the manner in which the software interacts with the hardware of the detector,

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

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

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

4.14.2.2 The manufacturer shall prepare and maintain detailed design documentation. This shall be available for inspection in a manner that respects the manufacturer's rights of confidentiality. It shall comprise at least the following:

a) overview of the whole system configuration, including all software and hardware components;

b) description of each module of the program, containing at least

   1) the name of the module,

   2) a description of the tasks performed,

   3) a description of the interfaces, including the type of data transfer, the valid data range and the checking for valid data;

c) full source code listings, as hard copy or in a machine-readable form (e.g. ASCII-code), including global and local variables, constants and labels used, and sufficient comment to recognize the program flow;

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

This detailed design documentation may be reviewed at the manufacturer's premises.