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**Fire detection and alarm systems —**  
**Part 6:**  
**Carbon monoxide fire detectors using**  
**electro-chemical cells**

*Systèmes de détection et d'alarme d'incendie —*

*Partie 6: Détecteurs de monoxyde de carbone pour la détection  
d'incendie utilisant des cellules électro-chimiques*

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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 7240-6 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

This second edition cancels and replaces the first edition (ISO 7240-6:2004), which has been technically revised.

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

- *Part 1: General and definitions* <https://standards.iteh.ai/catalog/standards/sist/bfd84a34-0ab4-4ea1-bc72-fac0d04b864d/iso-7240-6-2011>
- *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*

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- *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 and a part 29 dealing with video fire detectors are under development.

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## Introduction

This part of ISO 7240 has been drawn up by ISO/TC 21/SC 3 and is based on a standard prepared by Standards Australia International Technical Committee FP-002 “*Fire detection, warning, control and intercom systems*”.

A fire detection and fire alarm system is required to function satisfactorily not only in the event of a fire, but also during and after exposure to conditions that the system is likely to meet in practice, such as corrosion, vibration, direct impact, indirect shock and electromagnetic interference. Some tests specified are intended to assess the performance of the fire detectors under such conditions.

The performance of fire detectors is assessed from results obtained in specific tests; this part of ISO 7240 is not intended to place any other restrictions on the design and construction of such detectors.

Carbon monoxide (CO) fire detectors can react promptly to slow, smouldering fires involving carbonaceous materials because CO does not depend solely on convection, but also moves by diffusion, and CO fire detectors can be better suited to applications where other fire detection techniques are prone to false alarms, i.e. due to dust, steam and cooking vapours.

Whilst CO gas has greater mobility than smoke, it can be diluted by ventilation systems and can be affected by convection currents. Hence, it is necessary to take into account the same considerations as for point smoke detectors. Recirculating systems confined to a single room have little effect on dilution, as this is similar to the natural diffusion of the CO gas.

CO fire detectors can be less affected by stratification than other types of fire detectors.

It is important that the location of CO fire detectors take into account areas where false operation or non-operation is likely. CO fire detectors might not be suitable for detecting fires involving

- clean-burning liquids,
- PVC-insulated cables,
- combustible metals,
- certain self-oxidizing chemicals,
- non-carbonaceous materials.

Some typical locations where it is important to carefully evaluate the use of CO fire detectors are areas where CO gas can be present from exhausts and normal manufacturing processes.

EXAMPLES     Car parks, car-park return air plenums, loading docks.

Generally, cigarette smoke does not contain sufficient CO to cause alarms, even though smoke can be clearly visible. However, in heavy smoking or incense-burning areas, it is important to measure the CO concentration before installing CO fire detectors.

This part of ISO 7240 includes a number of Electromagnetic Compatibility (EMC) immunity requirements. The details for these requirements have been taken from EN 50130-4.

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# Fire detection and alarm systems —

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

### 1 Scope

This part of ISO 7240 specifies requirements, test methods and performance criteria for point fire detectors using electro-chemical cells that operate using carbon-monoxide detection principles for use in fire detection and alarm systems installed in buildings (see ISO 7240-1).

For the testing of other types of CO fire detectors working on different principles, this part of ISO 7240 can be used only for guidance. Fire detectors with special characteristics and developed for specific risks are not covered by 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 209, *Aluminium and aluminium alloys — Chemical composition*

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

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

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 60068-2-30, *Environmental testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

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 and definitions

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

**3.1 response threshold value**  
CO concentration in the proximity of the specimen at the moment that it enters an alarm state when tested as specified in 5.1.5

NOTE The response threshold value can depend on signal processing in the detector and in the control and indicating equipment.

### 4 Requirements

#### 4.1 Compliance

In order to comply with this part of ISO 7240, the detector shall meet the requirements of this clause, which shall be verified by visual inspection or engineering assessment, shall be tested as specified in Clause 5 and shall meet the requirements of the tests.

#### 4.2 Individual alarm indication

Each detector shall be provided with an integral red visual indicator, by which the individual detector that released an alarm can be identified, until the alarm condition is reset. Where other conditions of the detector can be visually indicated, these shall be clearly distinguishable from the alarm indication, 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.

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The visual indicator shall be visible from a distance of 6 m in an ambient light intensity up to 500 lx at an angle of up to

- a) 5° from the axis of the detector in any direction, and
- b) 45° from the axis of the detector in at least one direction.

#### 4.3 Connection of ancillary devices

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

#### 4.4 Monitoring of detachable detectors

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

#### 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

If there is provision for on-site adjustment of the response behaviour of the detector, then

- a) for all of the settings at which the manufacturer claims compliance with this part of ISO 7240, the detector shall comply with the requirements of this part of ISO 7240 and access to the adjustment means shall be possible only by the use of a code or special tool, or by removing the detector from its base or mounting;
- b) any setting(s) at which the manufacturer does not claim compliance with this part of ISO 7240 shall be accessible only by the use of a code or special tool, and it shall be clearly marked on the detector or in the associated data that, if these setting(s) are used, the detector does not comply with this part of ISO 7240.

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

#### 4.7 Rate-sensitive response behaviour

The response threshold value of the detector can depend on the rate of change of the CO concentration in the vicinity of the detector. Such behaviour may be incorporated in the detector design to improve the discrimination between ambient CO concentrations and those generated by a fire. If such rate-sensitive behaviour is included, then it shall not lead to a significant reduction in the sensitivity of the detector to fires, nor shall it lead to a significant increase in the probability of unwanted alarms.

Since it is not practical to make tests with all possible rates of increase in CO concentration, an assessment of the rate sensitivity of the detector 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 clause if this assessment shows that

- a) for any rate of increase in CO concentration less than 1  $\mu\text{l/l}/\text{min}$ , the detector signals an alarm condition before the CO concentration reaches 60  $\mu\text{l/l}$ , and
- b) the detector does not produce an alarm condition when subjected to a step change in CO concentration of 10  $\mu\text{l/l}$ , superimposed on a background concentration of between 0  $\mu\text{l/l}$  and 5  $\mu\text{l/l}$ .

#### 4.8 Marking

Each detector shall be clearly marked with the following information:

- a) number of this part of ISO 7240 (i.e. ISO 7240-6);
- 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. 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;
- f) life-expectancy of the electro-chemical cell under normal operating conditions.

For detachable detectors, the detector head shall be marked with items a), b), c), e) and f), and the base shall be marked with at least item c), i.e. its own model designation, 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 markings shall be visible during installation of the detector and shall be accessible during maintenance.

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

#### 4.9 Data

Detectors shall either be supplied with sufficient technical, installation and maintenance data to enable their correct installation and operation or, 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.

To enable correct operation of the detectors, these data should describe the requirements for the correct processing of the signals from the detector. This may be in the form of a full technical specification of these signals, a reference to the appropriate signalling protocol or a reference to suitable types of control and indicating equipment, etc.

Installation and maintenance data shall include reference to an *in situ* test method to ensure that detectors operate correctly when installed.

NOTE Additional information can be required by organizations certifying that detectors produced by a manufacturer conform to the requirements of this part of ISO 7240.

#### 4.10 Requirements for software controlled detectors

##### 4.10.1 General

The requirements of 4.10.2, 4.10.3 and 4.10.4 shall apply to detectors that rely on software control in order to fulfil the requirements of this part of ISO 7240.

##### 4.10.2 Software documentation

4.10.2.1 The manufacturer shall submit documentation that gives an overview of the software design. This documentation shall be in sufficient detail that the design can be inspected 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 schema), including the following:
  - 1) a brief description of the modules and the functions that they perform;
  - 2) the way in which the modules interact;
  - 3) the overall hierarchy of the program;
  - 4) the way in which the software interacts with the hardware of the detector;
  - 5) the way in which the modules are called, including any interrupt processing;
- b) 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.

**4.10.2.2** The manufacturer shall prepare and maintain detailed design documentation. This shall be available for inspection in a manner that respects the manufacturers' rights for confidentiality. It shall be comprised of 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 machine-readable form (e.g. ASCII-code), including all global and local variables, constants and labels used, and sufficient comment for the program flow to be recognized;
- d) details of any software tools used in the design and implementation phase (e.g. CASE-Tools, Compilers, etc.).

NOTE This detailed design documentation can be reviewed at the manufacturers' premises.

### 4.10.3 Software design

In order to ensure the reliability of the detector, the following requirements for software design shall apply.

- a) The software shall have a modular structure.
- b) The design of the interfaces for manually and automatically generated data shall not permit invalid data to cause error in the program operation. [ISO 7240-6:2011](https://standards.iteh.ai/catalog/standards/sist/bf184a34-0ab4-4ea1-be72-fac0d04b864d/iso-7240-6-2011)
- c) The software shall be designed to avoid the occurrence of deadlock of the program flow. <https://standards.iteh.ai/catalog/standards/sist/bf184a34-0ab4-4ea1-be72-fac0d04b864d/iso-7240-6-2011>

### 4.10.4 Storage of programs and data

The program necessary to comply with this part of ISO 7240 and any preset data, such as manufacturer's settings, shall be held in non-volatile memory. Writing to areas of memory containing this program and data shall be possible only by the use of some special tool or code and shall not be possible during normal operation of the detector.

Site-specific data shall be held in memory that can retain data for at least two weeks without external power to the detector, unless provision is made for the automatic renewal of such data, following loss of power, within 1 h of power being restored.

## 5 Test methods

### 5.1 General

#### 5.1.1 Atmospheric conditions for tests

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

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

The temperature and humidity shall be substantially constant for each environmental test where the standard atmospheric conditions are applied.

### 5.1.2 Operating conditions for tests

If a test method requires a specimen to be operational, then the specimen shall be connected to suitable supply and monitoring equipment with characteristics as required according to the manufacturer's data. Unless otherwise specified in the test method, the supply parameters applied to the specimen shall be set within the manufacturer's specified range(s) and shall remain substantially constant throughout the tests. The value chosen for each parameter shall normally be the nominal value, or the mean of the specified range. If a test procedure requires monitoring a specimen to detect any alarm or fault signals, then connections shall be made to any necessary ancillary devices (e.g. through wiring to an end-of-line device for conventional detectors) to allow a fault signal to be recognized.

The details of the supply and monitoring equipment and the alarm criteria used shall be given in the test report (Clause 6).

### 5.1.3 Mounting arrangements

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

### 5.1.4 Tolerances

Unless otherwise stated, the tolerances for the environmental test parameters shall be as given in the basic reference standards for the test (e.g. the relevant part of IEC 60068).

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

### 5.1.5 Measurement of response threshold value

**5.1.5.1** Install the specimen for which the response threshold value is being measured in the gas test chamber, as specified in Annex A, in its normal operating position, by its normal means of attachment. The orientation of the specimen, relative to the direction of gas flow, shall be the least sensitive orientation as determined in the directional dependence test, unless otherwise specified in the test procedure.

**5.1.5.2** Before commencing each measurement, the gas test chamber shall be purged to ensure that the carbon monoxide concentration is less than  $1 \mu\text{l/l}$  prior to each test.

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

**5.1.5.4** Unless otherwise specified in the test procedure, the air temperature in the gas test chamber shall be  $(23 \pm 5) ^\circ\text{C}$  and shall not vary by more than 5 K for all the measurements on a particular detector type.

**5.1.5.5** Connect the specimen to its supply and monitoring equipment as specified in 5.1.2, and allow it to stabilize for a period of at least 15 min, unless otherwise specified by the manufacturer.

**5.1.5.6** Introduce carbon monoxide gas into the chamber such that the rate of increase of gas concentration is between  $1 \mu\text{l/l/min}$  and  $6 \mu\text{l/l/min}$  to a concentration of  $18 \mu\text{l/l}$ .

**5.1.5.7** For detectors whose response is rate-sensitive, the manufacturer may specify a rate of increase within this range to ensure that the measured response threshold value is representative of the static response threshold value of the detector. The rate of increase in CO concentration shall be similar for all measurements on a particular detector type.

**5.1.5.8** Allow the detector to stabilize at a concentration of 18 µl/l for a period of 10 min. The detector shall not respond with an alarm to this concentration. Report the results.

**5.1.5.9** Increase the carbon monoxide gas concentration at a rate of between 1 µl/l/min and 6 µl/l/min until either the specimen has entered an alarm state or the concentration has reached 100 µl/l. Record the time and carbon monoxide concentration at the moment the specimen gives an alarm. This shall be taken as the response threshold value, *S*.

#### **5.1.6 Provision for tests**

The following shall be provided for testing compliance with this part of ISO 7240:

- a) for detachable detectors, 20 detector heads and bases; for non-detachable detectors, 20 specimens;
- b) data required in 4.10.

**NOTE** Detachable detectors are comprised of at least two parts: a base (socket) and a head (body). If the specimens are detachable detectors, then the two or more parts together are regarded as a complete detector.

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 response threshold value of the 16 specimens found in the reproducibility test (5.4) should also represent the production mean, and that the limits specified in the reproducibility test should also be applicable to the manufacturer's production.

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