INTERNATIONAL STANDARD

ISO 7240-8

Second edition
2014-12-15

Fire detection and alarm systems —

Part 8: Point-type fire detectors using a carbon monoxide sensor in combination with a heat sensor

Systèmes de détection et d'alarme d'incendie —

Partie 8: Détecteurs ponctuels utilisant un capteur de monoxide de carbone en combinaison avec un capteur de chaleur

Reference number
ISO 7240-8:2014(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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 21, *Equipment for fire protection and firefighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

This second edition cancels and replaces the first edition (ISO 7240-8:2007), which has been technically revised.

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: Point-type fire detectors using a carbon monoxide sensor 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: Design, installation, commissioning and service of fire detection and fire alarm systems in and around buildings*

— *Part 15: Point-type fire detectors using smoke and heat sensors*

— *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 23: Visual alarm devices*

— *Part 24: Sound-system loudspeakers*

— *Part 25: Components using radio transmission paths*

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

— *Part 28: Fire protection control equipment*

The following parts are under preparation:

— *Part 29: Video fire detectors*

Introduction

This part of ISO 7240 has been prepared by the Subcommittee ISO/TC 21/SC 3 and is based on ISO 7240-8:2007.

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 likely to be met 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.

Test Fires TF2, TF3, TF4, and TF5 from ISO/TS 7240-9 have been included to verify the detection performance of point fire detectors using a combination of carbon monoxide and heat sensors (CO) sensors. TF4 and TF5 specifically demonstrate the influence of the heat sensor(s). For these Test Fires, the CO level and, where applicable, the temperature is used as test validity criteria. 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. Although in the majority of fires, the products of combustion will be transported by convection, the gaseous nature of CO means that it will also diffuse and, particularly in low energy fires, it can move ahead of the smoke plume and, thus, provide earlier detection.

CO fire detectors alone might not react quickly to flaming fires and the addition of a heat sensor as specified in this part of ISO 7240 provides better detection to a broader spectrum of fires.

CO fire detectors based on a combination of a CO sensor and a heat sensor might also be better suited to applications where smoke detectors can produce unwanted alarms due to the presence of dust, steam, or cooking vapours, etc.

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

It is important that the location of CO fire detectors take into account areas where false operation or non-operation is likely. Some typical locations where it is important to carefully evaluate the use of CO fire detectors are as follows:

a) areas where CO gas can be present from exhausts and normal manufacturing processes;

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

b) confined areas where tobacco smoking is likely.

Fire detection and alarm systems —

Part 8: Point-type fire detectors using a carbon monoxide sensor in combination with a heat sensor

1 Scope

This part of ISO 7240 specifies requirements, test methods, and performance criteria for point multi-sensor fire detectors that incorporate at least one carbon monoxide (CO) sensor in combination with one or more heat sensors, for use in fire detection and alarm systems installed in buildings (see ISO 7240-1).

For the testing of other types of CO multi-sensor fire detectors, or CO and heat multi-sensor fire detectors working on different principles, this part of ISO 7240 is only to be used for guidance. CO and heat multi-sensor fire detectors with special characteristics and developed for specific risks are not covered by this part of ISO 7240.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

ISO 7240-5:2012, *Fire detection and alarm systems — Part 5: Point-type heat detectors*

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

IEC 60068-2-1, *Environmental testing Part 2: 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: Tests — Test Fc: Vibration [sinusoidal]*

IEC 60068-2-27, *Basic environmental testing procedures Part 2: 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*

IEC 62599-2, *Alarm systems — Part 2: Electromagnetic compatibility — Immunity requirements for components of fire and security alarm systems*

3 Terms and definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1
CO response value
CO concentration in the proximity of the specimen at the moment that it generates an alarm signal, when tested as described in 5.1.5

Note 1 to entry: The CO response value may depend on signal processing in the detector and in the fire detection control and indicating equipment.

3.1.2
rate-sensitive
behaviour of a detector that depends on the rate of change of CO concentration

3.2 Abbreviated terms

CO carbon-monoxide

EMC electromagnetic compatibility

FDCIE fire detection control and indicating equipment

4 Requirements

4.1 Compliance

In order to comply with this part of ISO 7240, the detector shall meet the following requirements.

a) Clause 4, which shall be verified by visual inspection or engineering assessment, shall be tested as described in Clause 5 and shall meet the requirements of the tests.

b) Clauses 7 and 8, which shall be verified by visual inspection.

4.2 Individual alarm indication

4.2.1 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 might 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 can be integral with the base or the detector head.

4.2.2 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 FDCIE) 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

4.6.1 If there is provision for on-site adjustment of the response behaviour of the detector, then the following should be observed:

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.

4.6.2 Adjustments may be carried out at the detector or at the FDCIE.

4.7 Rate-sensitive response behaviour

4.7.1 The CO response value of the detector might depend on the rate of change of 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.

4.7.2 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.

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

a) for any rate of increase in CO concentration less than 1 µl/l per minute, the detector will signal an alarm condition before the CO concentration reaches 60 µl/l; and

b) the detector does not produce an alarm condition when subjected to a step change in CO concentration of 10 µl/l, superimposed on a background concentration of between 0 µl/l and 5 µl/l.

4.8 Requirements for software-controlled detectors

4.8.1 General

The requirements of 4.8.2 and 4.8.3 shall apply to detectors that rely on software control in order to fulfil the requirements of this part of ISO 7240.

4.8.2 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.

c) The software shall be designed to avoid the occurrence of deadlock of the program flow.

4.8.3 The storage of programs and data

4.8.3.1 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.

4.8.3.2 Site-specific data shall be held in memory that will 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 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

5.1.1.1 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.

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

5.1.2 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.

5.1.3 Operating conditions for tests

5.1.3.1 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 by 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 a specimen to be monitored 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 non-addressable detectors) to allow a fault signal to be recognized.

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

5.1.4 Tolerances

5.1.4.1 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).

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

5.1.5 Measurement of CO response value

5.1.5.1 Install the specimen for which the CO response value is to be measured in a 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 (see 5.3), unless otherwise specified in the test procedure.

5.1.5.2 Purge the gas test chamber to ensure that the carbon monoxide concentration is less than 1 µl/l prior to each test.

5.1.5.3 The air velocity in the proximity of the specimen shall be (0,2 ± 0,04) 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 ± 5) °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 5.1.3, and allow it to stabilize for a period of at least 15 min, unless otherwise specified by the manufacturer.

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

5.1.5.7 Introduce carbon monoxide gas at a rate of between 1 µl/l/min and 6 µl/l/min until the specimen has entered an alarm state. For detectors whose response is rate sensitive, the manufacturer may specify a rate of increase within this range to ensure that the measured response value is representative of the static response value of the detector.

NOTE To avoid unnecessary high levels of CO, the test can be stopped when the CO concentration reaches 100 µl/l.

5.1.5.8 The rate of increase in CO concentration shall be similar for all measurements on a particular detector type.

5.1.5.9 Record the carbon monoxide concentration at the moment the specimen gives an alarm. This shall be taken as the CO response value, *S*.

5.1.6 Measurement of heat sensor response value

5.1.6.1 Where detectors comply with ISO 7240-5, the response times measured in those tests may be used as the heat response values for the purposes of this part of ISO 7240.

5.1.6.2 Install the specimen for which the temperature response value is to be measured in a heat tunnel, as specified in Annex B, in its normal operating position, by its normal means of attachment. The orientation of the specimen, relative to the direction of airflow, shall be the least sensitive one, as determined in the directional dependence test (see 5.4), unless otherwise specified in the test procedure.

5.1.6.3 Connect the specimen to its supply and indicating equipment as specified in 5.1.3, and allow it to stabilize for at least 15 min.

5.1.6.4 Before the test, stabilize the temperature of the air stream and the specimen to (25 ± 2) °C. Maintain the air stream at a constant mass flow equivalent to a velocity of (0,8 ± 0,1) m/s at 25 °C.

5.1.6.5 Raise the air temperature at a rate specified in the test and measure the heat response value as specified in ISO 7240-5:2012, 5.1.5 until the signal specified by the manufacturer is produced by the heat sensor.

NOTE If the detector is not capable of giving an alarm signal from heat alone, it will be necessary for the manufacturer to provide special means by which the heat response value can be measured. For example, it may be acceptable to provide a supplementary output that varies with temperature, or specially modified software to indicate when the air temperature has caused an internal temperature threshold to be reached. In such cases, the special means should preferably be chosen such that the nominal heat response value corresponds to a response time between the minimum and maximum times given in ISO 7240-5:2012, Table 4 for a class A2 detector. It is essential that the output signal be routed through the amplification path.

5.1.6.6 Assess the heat response value as follows:

a) the time taken from the start of the temperature increase to the point at which the heat signal reaches a level specified by the manufacturer, or the detector gives an alarm signal, or

b) the change in signal level produced in a certain time.

NOTE A shorter time will represent a higher sensitivity while a larger change will represent a higher sensitivity.

5.1.6.7 Record the measured heat response value as *T*.

5.1.7 Provision for tests

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

— for detachable detectors: 25 detector heads and bases;

NOTE Detachable detectors comprise 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.

— for non-detachable detectors: 25 specimens;

— the data required in Clause 8;

— means to enable a quantitative measurement of the heat response value of the temperature sensing element(s) of the detector according to 5.1.6.

5.1.7.2 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 value of the specimens found in the reproducibility test (see 5.6 and 5.7), should also represent the production mean, and that the limits specified in the reproducibility test should also be applicable to the manufacturer's production.

5.1.8 Test schedule

The specimens shall be tested according to the following test schedule (see Table 1). After the reproducibility test, number the four least sensitive specimens (i.e. those with the highest CO response value) as 22 to 25, and number the remaining as 1 to 21 arbitrarily.

5.1.9 Test report

The test results shall be reported in accordance with Clause 6.

5.2 Repeatability of CO response

5.2.1 Object of the test

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

5.2.2 Test procedure

5.2.2.1 Measure the CO response value of the specimen to be tested six times as specified in 5.1.5. The orientation of the specimen, relative to the direction of airflow is arbitrary, but it shall be the same for all six measurements.

5.2.2.2 Designate the maximum response value as S_{max}; the minimum value as S_{min}.

5.2.3 Requirements

5.2.3.1 The lower response value S_{min} shall be not less than 25 µl/l.

5.2.3.2 The ratio of the response values $S_{max} : S_{min}$ shall be not greater than 1,6.

Table 1 — Test schedule

Test	Clause	Specimen No(s)
Repeatability of CO response	5.2	one chosen arbitrarily
Directional dependence of CO response	5.3	one chosen arbitrarily
Directional dependence of heat response	5.4	one chosen arbitrarily
Lower limit of heat sensitivity	5.5	1
Reproducibility of CO response	5.6	all specimens
Reproducibility of heat sensitivity	5.7	all specimens

[a] 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 may 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 might not be possible to identify which test exposure caused the failure.