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Fire detection and alarm systems —

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

Systèmes de détection d'incendie et d'alarme —

Partie 12: Détecteurs linéaires de fumée utilisant une transmission par faisceaux lumineux

Reference number
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Foreword

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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. www.iso.org/directives

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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 fire fighting*, Subcommittee SC 3, *Fire detection and fire alarm systems*.

This second edition cancels and replaces the first edition (ISO 7240-12:2006), 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: 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: Design, installation, commissioning and service of fire detection and fire alarm systems in and around buildings*

— *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 23: Visual alarm devices*

— *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 29 dealing with video fire detectors is under preparation.

Introduction

This part of ISO 7240 has been prepared by ISO/TC 21/SC 3, the secretariat of which is held by SA and is based on ISO 7240-12:2006.

A fire detection and alarm system is required to function satisfactorily not only in the event of fire, but also during and after exposure to conditions likely to be met in practice, including corrosion, vibration, direct impact, indirect shock and electromagnetic interference. Specific tests are intended to assess the performance of the smoke detectors under such conditions.

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

Fire detection and alarm systems —

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

1 Scope

1.1 This part of ISO 7240 specifies requirements, test methods and performance criteria for line-type smoke detectors for use in fire detection systems installed in buildings. The detectors consist of at least a transmitter and a receiver and can include reflector(s), for the detection of smoke by the attenuation and/or changes in attenuation of an optical beam.

1.2 This part of ISO 7240 does not cover

— line-type smoke detectors designed to operate with separations between opposed components of less than 1 m;

— line-type smoke detectors whose optical path length is defined or adjusted by an integral mechanical connection;

— line-type smoke detectors with special characteristics, which cannot be assessed by the test methods in this part of ISO 7240.

NOTE The term "optical" is used to describe that part of the electromagnetic spectrum produced by the transmitter to which the receiver is responsive; this is not restricted to visible wavelengths.

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*

IEC 60064, *Tungsten filament lamps for domestic and similar general lighting purposes — Performance requirements*

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

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

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

IEC 60081, *Double-capped fluorescent lamps — Performance specifications*

EN 50130-4:2011, *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 and definitions given in ISO 7240-1 and the following apply.

3.1
attenuation
A
reduction in intensity of the optical beam at the receiver, defined by the equation

$$A = 10\log_{10}\left(\frac{I_0}{I}\right)$$

where

I_0 is the received intensity without reduction in intensity;

I is the received intensity after reduction in intensity

Note 1 to entry: The attenuation is expressed in units of decibels (dB).

3.2
opposed component
component [transmitter and receiver or transmitter-receiver and reflector(s)] of the detector whose position determines the optical path

3.3
optical path length
total distance traversed by the optical beam between the transmitter and the receiver

3.4
receiver
component that receives the optical beam

3.5
response threshold value
C
value of attenuation at the moment an alarm signal is generated

$$C = F \times \left(\frac{n_f}{n_v}\right)$$

where

F is the value of attenuation resulting from a beam passing once through a filter, and given by the formula $10\log_{10}\left(\frac{I_0}{I}\right)$;

I_0 is the received intensity of the optical beam without reduction through an attenuating filter;

I is the received intensity of the optical beam after passing once through an attenuating filter;

n_f is the number of times the beam passes through the filter;

n_v is the number of times the beam passes through the measured volume

Note 1 to entry: The attenuation is expressed in units of decibels (dB).

Note 2 to entry: The inclusion of $\left(\frac{n_f}{n_v}\right)$ means that the value of C recorded for a multi–pass arrangement tested by obscuring the beam only once (at the receiver, as recommended in B.1.2) is consistent with a single pass (end-to-end) arrangement.

3.6
sensitivity adjustment
any adjustment during or after commissioning which leads to a change in the response to fire

3.7
separation
physical distance between the opposed components

3.8
transmitter
component from which the optical beam emanates

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 in accordance with 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 releasing 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.

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 up to

a) 5° from the vertical axis of the detector when viewed from beneath the detector in any direction and

b) 45° from the vertical axis of the detector when viewed from beneath the detector in at least one direction.

4.3 Connection of ancillary devices

The detector may provide for connections to ancillary devices (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 and connections

4.4.1 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.

4.4.2 If there are cables connecting separate parts of the detector, then a means shall be provided for a remote monitoring system (e.g. the fire detection control and indicating equipment) to detect a short or open circuit on those cables, in order to give a fault signal.

4.4.3 If more than one detector can be connected to the transmission path of a remote monitoring system (e.g. control and indicating equipment), the removal of a head from the base shall not prevent an alarm signal from another detector connected to the same transmission path.

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 threshold value

4.6.1 If there is provision for on-site adjustment of the response threshold value of the detector then

a) for all of the settings at which the manufacturer claims compliance, 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 or settings 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 or settings are used, the detector does not comply with this part of ISO 7240.

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

4.7 Protection of optical components

The detector shall be so designed that a sphere of diameter greater than (1,3 ± 0,05) mm cannot pass into any enclosure containing optical components when the detector is in the operational condition.

NOTE This requirement is intended to restrict the access of insects into the sensitive parts of the detector. It is known that this requirement is not sufficient to prevent the access of all insects, therefore, it may be necessary to take other precautions against unwanted alarms due to the entry of small insects.

4.8 Limit of compensation

4.8.1 Compensation may be used to mitigate changes in sensitivity due to the build-up of dust and other contaminants on the optical surfaces (see Annex A).

4.8.2 The detector shall emit either a fault or alarm signal at the limit of compensation for the effect of a slowly changing signal response.

4.8.3 Since it is practically impossible to perform tests with very slight increases in attenuation, an evaluation of the detectors conformity shall be made by analysing the circuits/software and/or by physical tests and simulations.

4.9 Fault signalling

A fire alarm signal shall not be cancelled by a fault resulting from a rapid change in obscuration (in accordance with 5.6) or by a result of the limit of compensation being reached (in accordance with 4.8).

4.10 Software-controlled detectors

4.10.1 General

The requirements of 4.10.2, 4.10.3 and 4.10.4 shall be met for 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 prepare documentation that gives an overview of the software design. This documentation shall be in sufficient detail for the design to 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 structogram), including:

   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 those areas of memory 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 comprise at least the following.

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

b) A 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 (CASE-Tools, compilers, etc.).

NOTE This detailed design documentation may 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 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.

4.10.4 Storage of programs and data

4.10.4.1 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.

4.10.4.2 Site-specific data shall be held in memory which 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 Test methods

5.1 General

5.1.1 Atmospheric conditions for tests

5.1.1.1 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.

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

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

5.1.3 Operating conditions for tests

5.1.3.1 If a test method requires a specimen to be operational, then connect the specimen to suitable supply and monitoring equipment having the characteristics required by the manufacturer's data. Unless otherwise specified in the test method, set the supply parameters applied to the specimen within the manufacturer's specified range(s) and maintain 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. If a test procedure requires a specimen to be monitored to detect any alarm or fault signals, then connect the specimen 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 (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 tolerance of ± 5 % shall be applied.

5.1.5 Measurement of response threshold value

5.1.5.1 General

5.1.5.1.1 Install the specimen, for which the response threshold value is to be measured, on the measuring bench, conforming to Annex B, in its normal operating position, by its normal means of attachment in accordance with 5.1.2.

5.1.5.1.2 Connect the specimen to its supply and monitoring equipment in accordance with 5.1.3, and allow it to stabilize for at least 15 min.

5.1.5.2 Operating conditions

5.1.5.2.1 Assemble the receiver on a rigid support at a longitudinal distance of at least 500 mm from the transmitter or the transmitter-receiver at the same distance from the reflector (see Figure B.1).

5.1.5.2.2 In the case of opposed components with a separate transmitter and receiver, place a filter holder as close as possible to the front of the receiver.

5.1.5.2.3 Adjust the filter holder so that the whole beam passes through the filter. Use the filter holder to mount the filters used during the measurement of response threshold value.

5.1.5.2.4 The height, *h*, separating the axis of the optical beam above the support shall be 10 times the diameter (or the vertical dimension) of the optical system of the receiver.