INTERNATIONAL STANDARD

ISO 7240-25

First edition
2010-06-01

Fire detection and fire alarm systems —

Part 25: **Components using radio transmission paths**

Systèmes de détection et d'alarme d'incendie —

Partie 25: Composants utilisant des voies de transmission radio

Reference number
ISO 7240-25:2010(E)

Contents

Page

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 7240-25 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 indicators, is under development.

Introduction

This part of ISO 7240 is based on European Standard EN 54-25, prepared by the European Committee for Standardization, CEN/TC 72, *Fire detection and fire alarm systems*.

This part of ISO 7240 defines requirements and tests in addition to those in other parts of ISO 7240 that allow components of a fire detection and alarm system using radio transmission paths to operate with an integrity and stability similar to those of wire transmission paths.

This part of ISO 7240 includes both equipment and system requirements because of the integral relationship between equipment that forms the system.

Limitations to the use of radio components, such as capacity, can be specified in national rules or guidelines.

Technical aspects of the assessment of frequencies, bands and channels should be considered.

Fire detection and fire alarm systems —

Part 25: Components using radio transmission paths

1 Scope

This part of ISO 7240 specifies requirements, test methods and performance criteria for components used in fire detection and alarm systems, installed in and around buildings, which use radio-frequency (r.f.) transmission paths. It specifies requirements for the assessment of conformance of the components to the requirements of this part of ISO 7240.

Where components work together and this requires knowledge of the system design, this part of ISO 7240 also specifies requirements for the system.

When the fire detection and alarm system uses wired and r.f. transmission paths, the relevant parts of ISO 7240 apply together with this part of ISO 7240. Requirements relevant to wire transmission paths are superseded or modified by those included in this part of ISO 7240.

This part of ISO 7240 does not restrict

— the intended use of radio spectrum, e.g. frequency, power output of devices;

— the allowed maximum number of the components using r.f. transmission paths within the fire detection and alarm system or one wire transmission path and/or r.f. transmission path;

— the allowed maximum number of the components affected by loss of one wire transmission path and/or r.f. transmission path.

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 7240-2, *Fire detection and alarm systems — Part 2: Control and indicating equipment*

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

ISO 7240-5:2003, *Fire detection and alarm systems — Part 5: Point-type heat detectors*

ISO 7240-11, *Fire detection and alarm systems — Part 11: Manual call points*

ISO 7240-18, *Fire detection and alarm systems — Part 18: Input/output devices*

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*

IEC 61620:1998, *Insulating liquids — Determination of the dielectric dissipation factor by measurement of the conductance and capacitance — Test method*

IEC 61672-1:2002, *Electroacoustics — Sound level meters — Part 1: Specifications*

ITU-T O.153, *Basic parameters for the measurement of error performance at bit rates below the primary rate*

EN 50130-4, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

3 Definitions and abbreviations

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

3.1 Definitions

3.1.1
adjacent channel selectivity
measure of the capability of the receiver to operate satisfactorily in the presence of an unwanted signal that differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended

3.1.2
antenna
element of a radio component of the fire detection and alarm system that allows coupling between the component and the media where r.f. waves are propagated

3.1.3
assigned band
frequency band within which the equipment is authorized to operate

3.1.4
autonomous power source
p.s.e. without any link to the public power supply or an equivalent system not rechargeable during operation and able by itself to power the supplied component

EXAMPLE A primary battery.

3.1.5
base station
transceiver in the system that communicates with a certain number of components

3.1.6
blocking or desensitization
measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels or bands

3.1.7
collision
simultaneous transmissions, from two or more transmitters belonging to the same system, of sufficient signal strength to cause, by mutual interaction, corruption or obliteration of the information carried by the r.f. transmission path

3.1.8
compatibility
capacity of a component of the system to operate with another component of this system

— within the limits specified by each component,

— within the specified limits given by the relevant parts of ISO 7240 if available or given by the manufacturer if not available,

— within specified configurations of the system

3.1.9
fire detection and alarm system
group of components including a c.i.e. that, when arranged in (a) specified configuration(s), is capable of detecting and indicating a fire, and giving signals for appropriate action

3.1.10
identification code
part of a message used to identify a transmitting r.f. communication device belonging to the system

3.1.11
intermediate element
device connected to a transmission path of a fire detection and alarm system, used to receive and/or transmit signals necessary for the operation of the fire detection and alarm system

NOTE An intermediate element meets the requirements of an input/output device in accordance with ISO 7240-18 but it is not restricted to electrical signals.

3.1.12
limited frequency range
frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver plus or minus the sum of the intermediate frequencies (f_{I1},... f_{In}) and half of the switching range, r_{sw}, of the receiver, as defined by the expression in Equation (1):

$$f_{LO} - \sum_{j=1}^{n} f_{Ij} - \frac{r_{sw}}{2} \leqslant f_{I} \leqslant f_{LO} + \sum_{j=1}^{n} f_{Ij} - \frac{r_{sw}}{2} \quad (1)$$

3.1.13
manufacturer
natural or legal person who places the equipment on the market under his own name

NOTE Normally, the manufacturer designs and manufactures the product himself. A manufacturer can also design, manufacture, assemble, pack, process or label the product as subcontractor or he assembles, packs, processes, or labels products as ready-made products.

3.1.14
r.f. transmission path
means of communication between at least two points, using r.f. wave propagation

3.1.15
radio part
component or part of the component incorporating the receiver and/or transmitter

NOTE The radio part can include a power supply, e.g. an autonomous power source.

3.1.16
receiver
device that receives the r.f. energy corresponding to an r.f. transmission path

NOTE The receiver can be incorporated in a component of the fire detection and alarm system.

3.1.17
r.f. interference
r.f. transmission from a source other than a component of the fire detection and alarm system that can cause corruption or obliteration of wanted signals and that does not conform to the definition of collision or message substitution

3.1.18
service life
period of useful life of an autonomous power source under specified conditions

3.1.19
site attenuation
degradation of the r.f. signal due to either transmission path loss or a change in the environment of the fire detection and alarm system after its installation

NOTE Site attenuation can be changed for example by installation or relocation of reflection or absorption materials.

3.1.20
special tool
device not normally carried by the public (e.g. a key), normally provided by the manufacturer and that is used for opening the enclosure of the component to detach the antenna

NOTE It is intended to deter unauthorized access to the antenna, while being available on site either at a defined location or from a "responsible person" familiar with and having knowledge of the system.

3.1.21
spurious response rejection
measure of the capability of the receiver to receive a wanted, modulated signal without exceeding a given degradation due to the presence of an unwanted, modulated signal at any other frequency at which a response is obtained

3.1.22
switching range
r_{sw}
maximum frequency range over which the receiver or the transmitter can be operated within the alignment range without reprogramming or realignment

3.1.23
transmitter
device which generates the r.f. energy necessary for an r.f. transmission path

NOTE The transmitter can be incorporated in a component of the fire detection and alarm system.

3.2 Abbreviated terms

c.i.e. control and indicating equipment

p.s.e. power supply equipment

r.f. radio frequency

RMS root mean square

4 System requirements

4.1 General

The requirements of this part of ISO 7240 shall be applied, together with requirements of the relevant part of ISO 7240, where the r.f. transmission path component has the same function as the component covered by that part and when not otherwise specified in this part of ISO 7240.

For example, a component with a r.f. transmission path, having the function of a heat detector shall comply with ISO 7240-5 and a component having the function of a manual call point shall comply with ISO 7240-11.

4.2 Radio frequency transmission paths

4.2.1 Immunity to site attenuation

The manufacturer shall provide means either in the component itself or by the system configuration to ensure that a site attenuation, which can be caused by influences for different reasons on site, shall not affect the r.f. transmission path adversely in a way that communication between components is not possible.

The immunity to site attenuation shall be specified as follows:

a) for r.f. operating frequencies up to 10 MHz: at least 10 dB;

b) for r.f. operating frequencies higher than 10 MHz: as calculated in Annex B.

The manufacturer shall provide the necessary documentation and/or means of evaluation that permits an assessment of the full functionality of the component. If these means are a part of the component, the user shall not be able to interfere with these means (see 8.2.2).

4.2.2 Alarm signal integrity

The components of the system shall use a transmission protocol on the transmission path to ensure that no alarm message is lost (see 8.2.3).

4.2.3 Identification of components

4.2.3.1 Each component using an r.f. transmission path shall be identified by an individual identification code as belonging to one specific fire detection and alarm system.

4.2.3.2 The manufacturer shall provide means to ensure that a component using an r.f. transmission path shall not be accepted by other fire detection and alarm systems (see 8.2.4).

4.2.4 Receiver performance

Unless otherwise specified in mandatory national regulations, the receiver shall meet the requirements given in Table 1.

Table 1 — Minimum receiver performance characteristics

Characteristic	Limit dB	Working frequency offset MHz	Notes
Adjacent channel selectivity	⩾ 36	—	For all bandwidths and modulation schemes
Blocking or desensitization	⩾ 40	± 1	In direct sequence spread spectrum systems (DSSS) the working frequency is the centre frequency
	⩾ 45	± 2	
	⩾ 60	± 5	
	⩾ 65	± 10	
Spurious response rejection	⩾ 40	—	—

The manufacturer of the receiver shall provide a test report by a test laboratory to demonstrate that the requirements of this subclause are fulfilled. If the manufacturer cannot provide this evidence, the tests described in 8.2.5 shall be conducted. The manufacturer shall provide the means to carry out the test, e.g. stop frequency hopping.

4.2.5 Immunity to interference

4.2.5.1 General

4.2.5.1.1 Tests shall be conducted to determine the level of immunity to the following sources:

— radio influences from the fire detection and alarm system;

— radio influences from other users of the spectrum.

4.2.5.1.2 The following influences are not covered:

— random influences as a result of electromagnetic effects;

NOTE 1 These are covered by EMC guidelines (see EN 50130-4).

— deliberate electromagnetic attack on the r.f. transmission path.

NOTE 2 No special sabotage resistance is required for fire detection and alarm systems in ISO 7240.

4.2.5.1.3 Unless otherwise specified in mandatory national regulations, the requirements of 4.2.5 shall apply.

4.2.5.2 Availability of r.f. transmission path in two or more technically similar systems from the same manufacturer

For two or more technically similar systems from the same manufacturer operating within the same radio range the r.f. transmission paths shall not mutually impede one another.

The manufacturer shall specify the means for assessment, which shall be suitable to ensure the availability of all parts of the system in all expected system configurations (see 8.2.6).

4.2.5.3 Availability of the r.f. transmission path in the presence of other band users

Where equipment from other users is operating at the maximum permitted limits (e.g. power, bandwidth and duty cycle) in the same r.f. band or sub-band, r.f. interference shall not prevent signal transmission (see 8.2.7).

NOTE The definition in EN 300220-1 applies for establishing the duty cycle.

4.2.5.4 Integrity of the r.f. transmission path

The application of one of the r.f. interference signals specified in 8.2.7 to one of the fire detection and alarm system receivers shall not cause an alarm condition or a fault warning condition at the c.i.e.

4.2.6 Loss of communication

The loss of the ability of the system to transmit a message of any component with an r.f. transmission path to the c.i.e. within periods specified in ISO 7240-2 shall be recognized in less than 300 s and shall be indicated in less than 100 s (see 8.2.8).

4.2.7 Antenna

The antenna or its cable shall be detachable only by opening the enclosure of the component or by using special tools provided by the manufacturer (see 8.2.9).

5 Components requirements

5.1 Compliance

In order to comply with this part of ISO 7240, the components shall meet the requirements of this Clause 5, which shall be verified by visual inspection or engineering assessment, shall be tested in accordance with Clause 8 and shall meet the requirements of the tests.

5.2 General

5.2.1 All components shall meet the requirements of the relevant part of ISO 7240 and the additional specific requirements in 5.3 and 5.4, including the transmission paths.

5.2.2 The component shall be designed such that the removal from its base and/or point of installation are detected and indicated as a fault.

5.2.3 Components that rely on software control in order to fulfil the requirements of this part of ISO 7240 shall comply with the relevant part of ISO 7240.

5.3 Power supply equipment

5.3.1 The components shall be powered by

a) an autonomous power source, e.g. a primary battery; or

b) a p.s.e. in accordance with ISO 7240-4.

5.3.2 All components powered by an autonomous power source shall be within the enclosure of the component.

The manufacturer shall declare the type of the autonomous power source and its service life for the component in normal operation. The service life shall be demonstrated by a statement of calculation. This calculation shall take into account the mean consumption and voltage under quiescent and at standard atmospheric conditions. The product of the specified discharge time and the mean discharge current shall not be greater than 85 % of the rated capacity of the power source.

NOTE The remaining 15 % of the rated capacity takes into account self-discharge of the power source.

The mean consumption shall be calculated based on the electronic element of the circuit.

Where calculation is not practical, the mean consumption shall be measured at nominal voltage for at least 1 h under quiescent operation after the stabilization period specified by the manufacturer. The verification of this calculation shall be made as defined in 8.3.3. Annex C gives an example for the calculation of the service life of the autonomous power source.

5.3.3 All components powered by an autonomous power source shall be able to transmit a fault signal (low power) before the power source fails. The following conditions shall be taken into account (see 8.3.4).

a) The component shall be capable of generating and transmitting a fault signal within 60 min after replacing a good or new autonomous power source by a preconditioned power source representing a discharged power source at the end of its service life.

b) The component shall be capable of operating as intended when it is activated using the preconditioned power source representing a discharged power source at the end of its service life.

c) The component shall keep the fire alarm condition and/or another activated condition for at least 30 min (where alarm condition is not applicable).

5.3.4 The loss of the power source shall be indicated as a fault signal from point in accordance with ISO 7240-2. Where several power sources are used for different functions within one component, the fault signal shall be given for each power source (see 5.3.3).

5.3.5 Either the component shall be designed to make polarity reversal impossible or, if not, the polarity of the connections for the power source shall be identifiable and the polarity reversal shall not damage the component (see 8.3.5).

5.4 Environmental

5.4.1 General

Components shall be tested to the environmental tests defined in the relevant part of ISO 7240. The functional tests of the radio part of the component before and after the environmental treatment shall be conducted in accordance with 8.3.

The type and severity of the environmental tests are separately specified for the following main categories of equipment containing a transmitter/receiver:

— c.i.e.;

— other components (e.g. detectors, manual call points, input/output devices).

5.4.2 General test procedure

Unless otherwise stated, the components of the fire detection and alarm system containing the transmitter and the receiver, respectively, shall be mounted in the radio-frequency-shielded test equipment in accordance with Annex A.

The component transmitting the alarm signal shall be tested together with a typical component receiving the alarm signal and *vice versa*.

The measurements of the attenuation values, A, shall be conducted with the component mounted in the test equipment and with the fixtures closed correctly. However, during some of the environmental exposures the fixtures shall be opened or the equipment under test shall be taken out of the fixture.

5.4.3 Provision for testing

The manufacturer shall provide a sufficient number of specimens for testing. The required number of specimens in Table 2 is dependent on the type of component being tested.

Table 2 — Provisions for testing

Components	Number of specimens
C.i.e.	At least 1 (in accordance with ISO 7240-2)
Other components (e.g. detectors, manual call points, input/output devices)	At least 16 (in accordance with the relevant part of ISO 7240)

The specimens submitted shall be deemed representative of the manufacturer's normal production with regard to their construction and calibration. Where specimens are comprised of at least two parts — a base (socket) and a head (body) — and the radio part and the power supply are located only in one of these parts, only this part shall be tested in accordance with this part of ISO 7240. The other part is used to trigger the radio part.

6 Marking

6.1 The marking shall be in accordance with the marking requirements of the relevant part of ISO 7240.

6.2 The element containing the radio part shall be additionally clearly marked with

a) the number of this part of ISO 7240 (i.e. ISO 7240-25);

b) the marking required by national regulations.

6.3 The element containing an autonomous power source shall be additionally clearly marked with

a) the type and the reference of the power source(s) recommended by the manufacturer, which indications shall be visible during its replacement;

b) the service life of the autonomous power source.

7 Data

7.1 General

The manufacturer shall prepare the documentation to evaluate the compatibility in the configuration(s) specified by the manufacturer. This documentation shall include at least the following:

a) list of the relevant components of the fire detection and alarm system, which shall define for each component the functions (a part of this definition shall include a description of the software and of the hardware) and the technical information for each component to facilitate proof of the compatibility of each sub-system within the global network system;

b) test reports relative to the conformity of the components, with indication of the relevant part of ISO 7240;

c) characteristics of the r.f. transmission path between each component and the c.i.e.;

d) how the requirements of 4.2.3 are satisfied;

e) utilization limits and functional limits of the system, e.g. configuration, the number of components that are able to communicate with one base station.

7.2 Input/output devices

The documentation of the input/output devices shall comply with the requirements of 7.1.

The input/output devices shall be delivered with technical instructions and sufficient installation and maintenance information to enable their setting and their operation, or, if all of this information is not provided with each input/output device, the reference to the appropriate documents shall be indicated on each device or given with it.

For an efficient operation of the input/output device, this documentation shall detail the requirements for the correct processing of the signals of the input/output device. This may be a detailed technical specification, a reference to an adequate processing protocol or by a reference to the list of c.i.e. that can be connected, etc.

NOTE Additional information can be required by the certification body for the assessment of the input/output device according to this part of ISO 7240.

8 Tests

8.1 General requirements

8.1.1 General

Tests in accordance with this part of ISO 7240 may be combined with tests required in other parts of ISO 7240.

NOTE If the specimens are detachable elements, i.e. comprising of at least two parts — a base (socket) and a head (body) — then at least the two parts together are regarded as a complete component.

8.1.2 Standard atmospheric conditions for testing

Unless otherwise stated in the test procedures, the conditions defined in the relevant part of ISO 7240 shall apply.

8.1.3 Operating conditions for tests

If a test method requires that a specimen be operational, then the specimen shall be powered as required by the manufacturer and shall be connected to suitable 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.

The details of the powered and of the monitoring equipment, as well as the alarm criteria used, shall be given in the test report.

8.1.4 Mounting and orientation

The mounting and orientation requirements defined in the relevant part of ISO 7240 shall apply.

8.1.5 Tolerances

The requirements for tolerances defined in the relevant part of ISO 7240 shall apply.

8.2 System tests

8.2.1 Test schedule for system tests

The test order and the number of samples are given in Table 3.

Table 3 — Test schedule for system tests

System tests	Reference subclause	Number of device(s)/component(s)	
		C.i.e.	Other components
Immunity to site attenuation	8.2.2	documentation only	documentation only
Alarm signal integrity	8.2.3	1	10 or maximum number of acceptable samples by the system, if less than 10
Identification of components with an r.f. transmission path	8.2.4	documentation only	documentation only
Receiver performance	8.2.5	see Table 1	see Table 1
Mutual disturbance between systems of the same manufacturer	8.2.6	at least 2	10 or maximum number of acceptable samples by the system, if less than 10
Compatibility with other band users	8.2.7	at least 1	at least 1
Detection of a loss of communication on an r.f. transmission path	8.2.8	at least 1	as specified by the manufacturer
Antenna	8.2.9	1	1

8.2.2 Immunity to site attenuation

8.2.2.1 Object

To demonstrate that the appropriate r.f. transmission path complies with the requirements of 4.2.1 in a medium free from interference and in the relevant frequency band.

8.2.2.2 Test procedure

In accordance with the manufacturer's documentation, verify by engineering assessment the requirements of 4.2.1.

NOTE The assessment takes into account the difference of the technical approaches of different manufacturers to avoid communication loss by site attenuation.

8.2.2.3 Requirements

The assessment shall indicate that the requirements of 4.2.1 are fulfilled.

8.2.3 Alarm signal integrity

8.2.3.1 Object

To demonstrate that an alarm message to or from a component is not lost due to collisions and/or r.f. transmission path occupation and that the system complies with the requirements defined in 4.2.2.

8.2.3.2 Test procedure

Activate input signals to 10 components simultaneously to transmit or receive alarm messages by means provided by the manufacturer. If the system capacity is less than 10 components, trigger the maximum number of components.

8.2.3.3 Requirements

The first alarm message shall be indicated within 10 s and the last alarm message within 100 s. No alarm message shall be lost.

NOTE The value of 100 s is not intended to show the compliance with the alarm response time or with the fault response time of ISO 7240-2.

8.2.4 Identification of components with r.f. transmission path

8.2.4.1 Object

To demonstrate that the component complies with the requirements of 4.2.3.

8.2.4.2 Test procedure

Verify that the documentation provided by the manufacturer fulfils the requirements of 4.2.3.1 and 4.2.3.2.

8.2.4.3 Requirements

The manufacturer shall show that the identification of a component with an r.f. transmission path complies with the requirements of 4.2.3.

The probability that component with an r.f. transmission path is identified and accepted as belonging to another system from the same system manufacturer not intended to receive shall be less than 1:1 000 000.

8.2.5 Receiver performance

8.2.5.1 Adjacent channel selectivity

8.2.5.1.1 Object

To demonstrate that the adjacent channel selectivity of the receiver complies with the requirements of 4.2.4.

8.2.5.1.2 Test procedure

Cary out the test procedure as follows.

a) Undertake the measurement under normal conditions.

   Connect two signal generators, A (e.g. a detector) and B, to the receiver (e.g. c.i.e.) via a combining network to the receiver antenna or test antenna. Signal generator B is initially switched off.

b) Set signal generator A as follows:

   — to the nominal frequency of the receiver;

   — with normal modulation of the wanted signal;

   — at a signal level that gives sufficient response at the receiver.

Increase the signal level of signal generator A by 3 dB.

Set signal generator B as follows:

— to the channel frequency immediately above the wanted signal;

— with an unmodulated signal;

— at an increasing signal level until the wanted criteria (e.g. interconnection protocol) are exceeded.

Repeat the measurement with signal generator B set to the channel frequency immediately below the wanted signal.

8.2.5.1.3 Measurements

Record the settings of signal generator A and signal generator B.

Record the upper and lower adjacent channel selectivity as the ratio of the level of the unwanted signal to the level of the wanted signal, with the signals expressed in decibels.

8.2.5.1.4 Requirements

The adjacent channel selectivity shall be not less than the unwanted signal as stated in Table 1.

8.2.5.2 Blocking or desensitization

8.2.5.2.1 Object

To demonstrate that the blocking or desensitization robustness of the receiver complies with the requirements of 4.2.4.

8.2.5.2.2 Test procedure

Cary out the test procedure as follows.

a) Undertake the measurement under normal conditions.

b) Connect two signal generators, A (e.g. a detector) and B, to the receiver (e.g. c.i.e.) via a combining network to the receiver antenna or test antenna. Signal generator B is initially switched off.

c) Set signal generator A as follows:

   — to the nominal frequency of the receiver;

   — with normal modulation of the wanted signal;

   — at a signal level that gives sufficient response at the receiver.

d) Increase the signal level of signal generator A by 3 dB.

e) Set signal generator B as follows:

   — to a frequency 1 MHz above the upper edge of the nominal band;

   — with an unmodulated signal;

   — at an increasing signal level until the wanted criteria (e.g. interconnection protocol) are exceeded.

f) Repeat the measurement with signal generator B set to 2 MHz, then 5 MHz, then 10 MHz above the upper edge of the nominal band.

g) Repeat the measurement with signal generator B set to 1 MHz, then 2 MHz, then 5 MHz, then 10 MHz below the lower edge of the nominal band.

8.2.5.2.3 Measurements

Record the settings of signal generator A and signal generator B.

Record the level of signal generator B, as the ratio of the lowest level of the unwanted signal to the level of the wanted signal, with the signals expressed in decibels, at which the signal from signal generator A is blocked.

8.2.5.2.4 Requirements

The blocking or desensitization robustness shall be in accordance with Table 1.

8.2.5.3 Spurious response rejection

8.2.5.3.1 Object

To demonstrate the spurious response rejection of the receiver complies with the requirements of 4.2.4.

8.2.5.3.2 Preliminary calculations

Calculate the following:

a) limited frequency range;

b) frequencies outside the limited frequency range, at which spurious responses can occur outside the limited frequency range for the remainder of the frequency range of interest, as appropriate (see 8.2.5.3.6 and 8.2.5.3.7).

NOTE The frequencies outside the limited frequency range are equal to the harmonics of the frequency, f_{LO}, of the local oscillator signal applied to the first mixer of the receiver plus or minus the first intermediate frequency, f_{I1}, of the receiver. Hence, the frequencies of these spurious responses are $nf_{LO} \pm f_{I1}$, where n is an integer not less than 2.

For the calculations in a) and b), the manufacturer shall state the frequency of the receiver, the frequency of the local oscillator signal, f_{LO}, applied to the first mixer of the receiver, the intermediate frequencies (f_{I1}, f_{I2} etc.), and the switching range, r_{sw}, of the receiver.

Measure the first image response of the receiver to verify the calculation of spurious response frequencies.

8.2.5.3.3 Arrangements for test signals

Sources of test signals for application to the receiver input shall be connected in such a way that the source impedance presented to the receiver input is 50 Ω (non-reactive impedance).

This requirement shall be met irrespective of whether one or more signals using a combining network are applied to the receiver simultaneously.

The levels of the test signals at the receiver input terminals (RF socket) shall be expressed in terms of electromagnetic force.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

8.2.5.3.4 Test procedure — Method of search over the limited frequency range

Cary out the test procedure as follows.

a) Connect two signal generators, A (e.g. a detector) and B, to the receiver (e.g. c.i.e.) via a combining network (see Figure 1). Signal generator B is initially switched off, maintaining the output impedance.

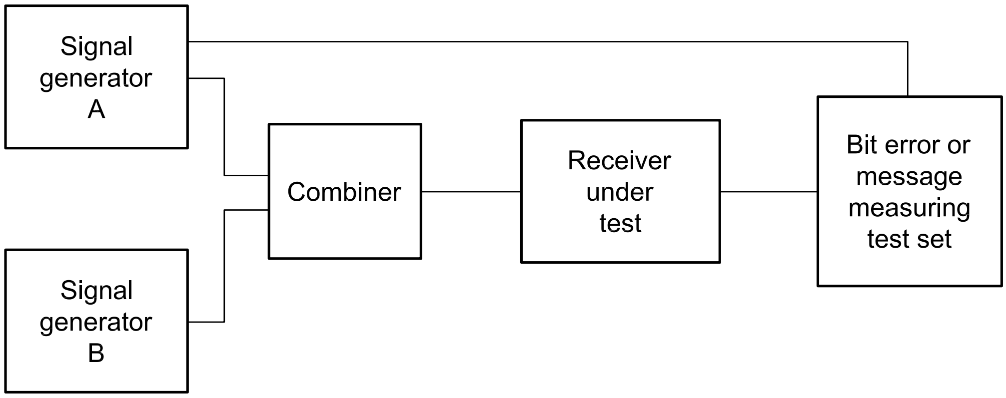


Figure 1 — Measurement arrangement

b) Set signal generator A as follows:

— to the nominal frequency of the receiver;

— with normal modulation of the wanted signal;

— at a signal level that gives sufficient response at the receiver.

NOTE Signalling and modulation are identical to the target radio link.

c) Adjust the level of the wanted signal from generator A to 3 dB above the level of the limit of the maximum usable sensitivity at the receiver input terminals (i.e. 6 dB above 1 µV electromagnetic force under normal test conditions).

d) Set signal generator B as follows:

— to the nominal frequency of the receiver;

— modulated with signal A-M3, consisting of an r.f. signal, modulated by an audio frequency signal of 400 Hz with a deviation of 12 % of the channel separation;

— at a signal level of 86 dBµV at the receiver input terminals.

e) Vary the frequency of the unwanted signal generator B in increments of 5 kHz over the limited frequency range [8.2.5.3.2 a)] and over the frequencies in accordance with the calculations outside of this frequency range [8.2.5.3.2 b)].

8.2.5.3.5 Measurements

Record the frequency of any spurious response detected (e.g. by an increase in the bit error ratio), for use in the measurements in accordance with 8.2.5.3.6 and 8.2.5.3.7.

In the case where operation using a continuous bit stream is not possible, a similar method shall be used, such as a degradation of the successful message ratio.

8.2.5.3.6 Test procedure — Method of measurement with continuous bit streams

Carry out the test procedure as follows.

a) Connect two signal generators, A (e.g. a detector) and B, to the receiver (e.g. c.i.e.) via a combining network (see Figure 1). Signal generator B is initially switched off, maintaining the output impedance.

b) Set signal generator A as follows:

— to the nominal frequency of the receiver;

— with normal modulation of the wanted signal D-M2 or D-M5, where D-M2 consists of a pseudo-random bit sequence of at least 511 bits in accordance with ITU-T O.153.

NOTE Signalling and modulation are identical to the target radio link.

c) Adjust the level of the wanted signal from generator A to 3 dB above the level of the limit of the maximum usable sensitivity at the receiver input terminals (i.e. 6 dB above 1 μV electromagnetic force under normal test conditions).

d) Set signal generator B as follows:

— to the nominal frequency of the receiver;

— modulated with signal A-M3, consisting of an r.f. signal, modulated by an audio frequency signal of 400 Hz with a deviation of 12 % of the channel separation.

e) Increase the signal level of the unwanted signal generator B until a bit error ratio of 10^{-1} or worse is obtained.

f) Decrease the level of the unwanted signal generator B in steps of 1 dB until a bit error ratio of 10^{-2} or better is obtained.

g) Repeat the measurements at all spurious response frequencies found during the search over the limited frequency range [see 8.2.5.3.2 a)].

h) Repeat the measurements at frequencies calculated for the remainder of the spurious response frequencies [see 8.2.5.3.2 b)] in the frequency range from $f_{Rx}/3,2$ or 30 MHz, whichever is higher, to $3,2 \times f_{Rx}$, where f_{Rx} is the nominal frequency of the receiver.

8.2.5.3.7 Measurements

Record the signal level, expressed as the ratio of the level of the unwanted signal to the level of the wanted signal at the receiver input, with the signals expressed in decibels, at which the bit error ratio of 10^{-2} or better is obtained.

The spurious response rejection of the equipment under test shall be expressed as the lowest value recorded.

8.2.5.3.8 Test procedure — Method of measurement with messages

Carry out the test procedure as follows.

a) Connect two signal generators, A (e.g. a detector) and B, to the receiver (e.g. c.i.e.) via a combining network (see Figure 1). Signal generator B is initially switched off, maintaining the output impedance.

b) Set signal generator A as follows:

— to the nominal frequency of the receiver;

— with normal modulation of the wanted signal.

NOTE Signalling and modulation are identical to the target radio link.

c) Adjust the level of the wanted signal from generator A to 3 dB above the level of the limit of the maximum usable sensitivity at the receiver input terminals (i.e. 6 dB above 1 μV electromagnetic force under normal test conditions).

d) Set signal generator B as follows:

— to the nominal frequency of the receiver;

— modulated with signal A-M3, consisting of an r.f. signal, modulated by an audio frequency signal of 400 Hz with a deviation of 12 % of the channel separation.

e) Adjust the signal level of the unwanted signal generator B until a successful message ratio of less than 10 % is obtained.

f) Transmit the normal test signal repeatedly, whilst observing in each case whether or not a message is successfully received.

g) Reduce the level of the unwanted signal by 2 dB for each occasion that a message is not successfully received. Continue to reduce the level until three consecutive messages are successfully received.

h) Increase the level of the unwanted signal by 1 dB.

i) Transmit the normal test signal 20 times. In each case, if a message is not successfully received, reduce the level of the unwanted signal by 1 dB.

j) If a message is successfully received, do not change the level of the unwanted signal until three consecutive messages have been successfully received. Then increase the unwanted signal by 1 dB.

k) No level of the unwanted signal shall be recorded unless preceded by a change in level.

l) Calculate the average of the values of the unwanted signal during both tests to successfully receive three consecutive messages, which provides the level corresponding to the successful message ratio of 80 %.

m) Repeat the measurement at all spurious response frequencies found during the search over the limited frequency range [see 8.2.5.3.2 a)] and at frequencies calculated for the remainder of the spurious response frequencies [see 8.2.5.3.2 b)] in the frequency range from $f_{Rx}/3,2$ or 30 MHz, whichever is higher, to $3,2 \times f_{Rx}$, where f_{Rx} is the nominal frequency of the receiver.

8.2.5.3.9 Measurements

For each frequency, record the signal levels, expressed as the ratio of the level of the unwanted signal to the level of the wanted signal at the receiver input, with the signals expressed in decibels.

Record the unwanted signal level at which three consecutive messages are successfully received.

Record the unwanted signal level after the 1 dB increase.

Record the unwanted signal level during the transmission of 20 wanted signal messages.

Record the unwanted signal level after the 1 dB increase.

Record the average value of the unwanted signal.

The spurious response rejection of the equipment under test shall be expressed as the lowest ratio recorded.

8.2.5.4 Requirements

The requirements in accordance with the test procedures as given in Table 1 shall be fulfilled.

8.2.6 Mutual disturbance between systems of the same manufacturer

8.2.6.1 Object

To demonstrate that the component complies with the requirements of 4.2.5.2 and to demonstrate the ability of an r.f. transmission path to convey signals even when many radio components within systems of the same manufacturer and the same system type work in a limited area. The test shall verify the basic function of the component.

8.2.6.2 Test procedure

8.2.6.2.1 General

Check the documentation that shows that the interaction between the r.f. transmission paths does not negatively impact the transmission time and fault detection time during normal operation as set out in this part of ISO 7240.

8.2.6.2.2 System configuration

Configure two independent base stations, each with five components set up at the minimum distance between all the components permitted by the manufacturer and commissioned in accordance with the manufacturer's specifications. If the maximum number of components per system is less than five, configure the maximum number of components.

The manufacturer shall provide means to ensure the simultaneous triggering of the devices.

8.2.6.2.3 Measurements

Monitor the operation of the systems for 48 h.

Conduct the following procedure.

a) Trigger two fire alarm messages from two separate components in one of the two systems at an interval within 2 s.

b) Simultaneously trigger fire alarm messages from five separate components in each system (or the maximum number of acceptable fire alarm messages if less than five).

c) Decommission one component in a system.

The test for alarm signal integrity may be combined with this test.

8.2.6.3 Requirements

The systems shall operate without fault messages and the following shall be met.

a) After triggering two fire alarm messages, each message shall be received and/or indicated correctly within 10 s after each activation.

b) After simultaneously triggering five fire alarm messages (or the maximum number of acceptable alarm messages if fewer than five), the first message shall be received and/or indicated correctly at the appropriate c.i.e. within 10 s and the following messages triggered shall be received and indicated correctly at the appropriate c.i.e. within 100 s.

c) After decommissioning one component in a system, the fault shall be displayed correctly on the c.i.e. in accordance with 4.2.6.

The fault or alarm messages shall be correctly addressed within the assigned system without producing a fault or an alarm signal on the non-assigned system.

8.2.7 Compatibility with other band users

8.2.7.1 Object

To demonstrate that the component complies with the requirements of 4.2.5.3.

8.2.7.2 Test procedure

8.2.7.2.1 General

The manufacturer shall provide suitable test equipment and sufficient information about the measures to ensure the availability of the transmission path in the presence of other band users in accordance with the national regulations where the tested system is used.

CAUTION — The allowable use of bands, sub-bands, channels and frequencies depends on national regulations.

The attenuation between the components under test shall be within a mean range.

NOTE The formulation “The signal level shall fall within a mean range” was chosen because the absolute level is not relevant for this measurement. In practice, a level between –80 dBm and –70 dBm is typical.

8.2.7.2.2 System configuration

Configure an r.f. transmission path with two components (i.e. c.i.e. and component) such that the signal level at the point where the messages are received is within a mean range.

If more than one component is being tested, install all components in the test equipment.

If a transmission uses more than one intermediate equipment, apply an interfering signal to one receiver at any one time. Repeat the test for each receiver.

8.2.7.2.3 Multi-channel components

Apply an unmodulated interfering signal sufficient to block the transmission to the message recipient (e.g. c.i.e.).

NOTE It is generally sufficient if the interfering level on the message recipient is > 10 dB above the current signal level of the transmission in its bandwidth.

Conduct the test on all of the frequencies used by the component under test.

Block each frequency for at least 1 s in turn. The time of frequency change shall not exceed 1 s.

Repeat the procedure continuously for the duration of the function test.

After the start of the blocking procedure, trigger five separate non-contiguous alarm messages at the transmitting component.

8.2.7.2.4 Single-channel components

Generate an unmodulated interfering signal to mimic other users on the wanted channel, sufficient to block the transmission to the message recipient (e.g. c.i.e.), with an "ON" time and "OFF" time for the interfering signal in accordance with Table 4.

Table 4 — Duty cycle categories

Transmitting time/full cycle %	"ON" time s	"OFF" time s	Remarks
< 0,1	0,72	0,72	e.g. 5 transmissions of 0,72 s within 1 h
< 1	3,6	1,8	e.g. 10 transmissions of 3,6 s within 1 h
< 10	36	3,6	e.g. 10 transmissions of 36 s within 1 h
< 100	—	—	Typically continuous transmissions, but also those with a duty cycle > 10 %

WARNING — Single-channel systems using frequencies where the "on" time is longer than 10 s are likely to fail.

8.2.7.3 Requirements

The r.f. transmission paths shall operate appropriately, as intended, and

a) no unintentional fault or alarm message shall be indicated at the c.i.e. when the interfering signal occurs; and

b) all intended messages, e.g. alarm messages, shall be processed correctly.

8.2.8 Detection of a loss of communication on an r.f. transmission path

8.2.8.1 Object of the test

To demonstrate the ability of the receiving equipment to detect the loss of the communication with a transmitter in the system.

8.2.8.2 Test procedure

8.2.8.2.1 General

The manufacturer shall provide a suitable test equipment and sufficient information about the measures to ensure that the r.f. transmission path operates appropriately and as intended.

During the test, the maximum number of components as specified by the manufacturer shall be connected to the base station.

The attenuation between the component being tested and its partners shall not influence the communication paths. If there are a number of components being checked, install all the components.

8.2.8.2.2 Measurements

Verify that monitoring signals are correctly received by the receiving equipment in accordance with the specification provided by the manufacturer.

Prevent the transmission of the monitoring signals from a randomly selected component for at least 300 s, e.g. by disconnecting the power supply to the transmitting equipment.

NOTE Depending on the system design, it is possible that the maximum number of components assigned to the c.i.e. is greater than the number of components directly connected to the base station.

Repeat the test twice.

8.2.8.3 Requirements

The c.i.e. shall enter the fault warning condition within the times specified in 4.2.6.

8.2.9 Antenna

8.2.9.1 Object of the test

To demonstrate that an antenna or its cable cannot easily be detached.

8.2.9.2 Test procedure

The requirement of 4.2.7 shall be verified by engineering assessment.

The manufacturer shall provide the components for the assessment.

8.2.9.3 Requirements

The antenna or its cable shall be detachable only by opening the enclosure of the component or by using special tools provided by the manufacturer.

8.3 Components tests

8.3.1 General

All environmental tests shall be carried out as defined in the relevant parts of ISO 7240. For components powered by autonomous power source(s), the tests shall be conducted with fully charged autonomous power source(s), with the exception of the endurance tests [i.e. vibration with the power source in the original position but not connected, damp heat (steady state) and sulfur dioxide (SO_2) corrosion tests].

The test "supply voltage variation" defined in the appropriate parts of ISO 7240 shall be conducted with the minimum and maximum power supply values. The minimum value for consideration is the value leading to the fault signal defined in 5.3.3.

In addition to the tests defined in the relevant part of ISO 7240 with which the component shall comply, the tests defined in 8.3.3 to 8.3.20 shall apply.

8.3.2 Test schedule for components tests

The test order is given in Table 5. The manufacturer may provide more than one c.i.e. for the environmental tests.

Where applicable, the test order can be changed in the interest of test economy.

Table 5 — Components test schedule

Tests	Reference subclause	Number of device(s)/component(s)		Remarks
		C.i.e.	Other components	
Verification of service life of power sources	8.3.3	Documentation only		Only applicable for the components powered by an autonomous power source
Low-power condition fault signal	8.3.4	no test	1	
Polarity reversal	8.3.5	no test	1	
Repeatability test	8.3.6	1	1	—
Reproducibility test	8.3.7	1	1 to 16	If more than one c.i.e. is provided, these shall be included in the test
Variation of supply parameters	8.3.8	1	[a]	—
Dry heat (operational)	8.3.9	no test	[a]	For heat detectors, temperatures in accordance with ISO 7240-5
Dry heat (endurance)	8.3.10	no test	[a]	For heat detectors, temperatures in accordance with ISO 7240-5:2003, classes C to G
Cold (operational)	8.3.11	1	[a]	—
Damp heat, cyclic (operational)	8.3.12	no test	[a]	Not applicable for smoke detectors
Damp heat, steady state (operational)	8.3.13	1	[a]	Only applicable for smoke detectors and c.i.e.
Damp heat, steady state (endurance)	8.3.14	1	[a]	—
SO_2 corrosion test (endurance)	8.3.15	no test	[a]	—
Shock (operational)	8.3.16	no test	[a]	—
Impact (operational)	8.3.17	1	[a]	—
Vibration, sinusoidal (operational)	8.3.18	1	[a]	—
Vibration, sinusoidal (endurance)	8.3.19	1	[a]	—
Electrostatic discharge	8.3.20.3 a)	1	11[b]	—
Radiated electromagnetic fields	8.3.20.3 b)	1	12[b]	—
Fast transient disturbances/bursts	8.3.20.3 d)	1	13[b]	Only applicable if cables are connected to the component
Slow high-energy surges	8.3.20.3 e)	1	14[b]	
Conducted disturbances induced by electromagnetic fields	8.3.20.3 c)	1	15[b]	
Mains supply voltage variations	8.3.20.3 f)	1	16[b]	Only applicable for mains supplied components
Mains supply voltage dips and short interruptions	8.3.20.3 g)	1	16[b]	only applicable for mains supplied components

[a] For environmental testing, the numbering of other components being tested shall be adapted to the assigned part of ISO 7240.

[b] 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 functional test conducted at the end of the sequence of tests. However, in the event of a failure, it might not be possible to identify which test exposure caused the failure (see EN 50130-4).

8.3.3 Verification of the service life of the autonomous power source(s)

8.3.3.1 Object of the verification

To demonstrate, by analysis and calculation, that the power source functions during the required time.

8.3.3.2 Verification procedure

The manufacturer shall provide the electric current consumption of the component powered in quiescent conditions.

8.3.3.3 Requirements

The service life calculation shall be provided by the manufacturer and shall be verified by the test authority. The requirements of 5.3.2 shall be fulfilled.

8.3.4 Low-power condition fault signal

8.3.4.1 Object of the test

To demonstrate, if the component is powered by an autonomous power source, that a low-power fault signal is transmitted by the powered component in time before the component is unable to operate as intended due to the failure of the autonomous power source.

8.3.4.2 Test procedure

8.3.4.2.1 Preconditioning

For test purposes, precondition the autonomous power source as follows.

a) Connect an autonomous power source recommended by the manufacturer to the component.

b) In order to shorten the time until the low-power condition threshold is reached, connect an additional current sink (e.g. a resistor or a constant-current sink) to the autonomous power source. In order not to excessively change the behaviour of the battery, calculate the current to reach the low-power threshold within a reasonable time, e.g. 30 days to 90 days. Details shall be agreed between the test laboratory and the manufacturer and shall be documented in the test report.

   The manufacturer can provide an autonomous power source that has been preconditioned and which can be used by the test laboratory. In this case, an additional current sink agreed between the test laboratory and the manufacturer should still be connected to the autonomous power source.

c) Monitor the fault signal at the c.i.e. through the real transmission path.

d) After the occurrence of the fault signal, maintain the connection of the current sink for an additional period of 10 % of the days needed for the discharge.

e) Disconnect the current sink from the autonomous power source and label the power source as “preconditioned”, in conjunction with the component in which it was discharged.

8.3.4.2.2 Measurements

To minimize the recovery effect of the preconditioned autonomous power source, immediately conduct the following tests.

a) Connect the preconditioned autonomous power source to the component.

b) Connect the component to the monitoring equipment.

c) After a period of at least 60 min, trigger the component into the alarm condition.

d) If the component under test is an intermediate element, perform a functional test in accordance with the manufacturer's requirements.

e) Activate all possible inputs/outputs such that the power consumption of the intermediate element is at the maximum level.

8.3.4.3 Requirements

After reconnecting the preconditioned autonomous power source, the component shall generate and transmit a fault signal within 60 min.

After the occurrence of the fault signal and the subsequent triggering, the component shall recognize and indicate the alarm condition, e.g. sound output. The component shall maintain the alarm condition for at least 30 min.

If the component under test is an intermediate element, the functional test shall be within the manufacturer's specifications.

The activated inputs/outputs shall not change their preset conditions for at least 30 min.

8.3.5 Polarity reversal

8.3.5.1 Object of the test

To demonstrate that, if the component is powered by an autonomous power source and if a mechanical polarity reversal is possible, this polarity reversal does not damage the powered component.

8.3.5.2 Test procedure

8.3.5.2.1 General

If the manufacturer can demonstrate to the test laboratory that the polarity reversal cannot adversely affect the performance of the component, it is not necessary to conduct the tests of 8.3.5.2.2 and 8.3.5.2.3.

8.3.5.2.2 Functional part

Measure the response or conduct the functional test of the powered component specified in the relevant part of ISO 7240 to which the component under test shall comply.

If mechanically possible, reverse the polarity and maintain the polarity reversal for 2 h, unless a fault signal is transmitted by the component under test.

After the polarity reversal, connect power to the component in its normal condition and measure the response of the component.

If the component under test is an intermediate element, do not measure each response, but conduct a functional test performed in accordance with the manufacturer's requirements.

8.3.5.2.3 Radio part

Determine the transmission threshold value in accordance with Annex A before and after the polarity reversal test.

Record the threshold values A_{before} and A_{after} for each measurement.

8.3.5.3 Requirements

8.3.5.3.1 Functional part

The response values (qualitative or quantitative) shall comply with the test requirements as defined in the relevant part of ISO 7240 to which the component under test shall comply.

If the component under test is an intermediate element, it shall comply with the manufacturer's specifications when the function tests are conducted.

8.3.5.3.2 Radio part

The difference $|A_{\text{before}} - A_{\text{after}}|$ shall be less than 6 dB.

8.3.6 Repeatability

8.3.6.1 Object of the test

To demonstrate that the transmission behaviour is stable.

8.3.6.2 Test procedure

Determine the transmission threshold six times in sequence in accordance with Annex A.

Record the threshold value A for each measurement.

Designate the maximum attenuation as A_{max} and the minimum attenuation as A_{min}.

8.3.6.3 Requirements

The difference $|A_{\text{max}} - A_{\text{min}}|$ shall be less than 6 dB.

8.3.7 Reproducibility

8.3.7.1 Object of the test

To demonstrate that the transmission behaviour does not vary unduly from specimen to specimen and to establish threshold value data for comparison with the threshold values measured after the environmental tests.

8.3.7.2 Test procedure

Determine the transmission threshold of each of the specimen in accordance with Annex A.

Record the threshold values A for each measurement.

Designate the maximum attenuation as A_{max} and the minimum attenuation as A_{min}.

8.3.7.3 Requirements

The difference $|A_{\text{max}} - A_{\text{min}}|$ shall be less than 6 dB.

8.3.8 Variation of supply parameters

8.3.8.1 Object of the test

To demonstrate that within the specified range(s) of the supply parameters (e.g. voltage), the transmission behaviour is not unduly dependent on these parameters.

8.3.8.2 Test procedure

Determine the transmission threshold of the specimen in accordance with Annex A, using a bench-top power supply. The upper and lower limits of the supply parameter range(s) shall be specified by the manufacturer.

Record the threshold values A for each measurement.

Designate the maximum attenuation as A_{max} and the minimum attenuation as A_{min}.

8.3.8.3 Requirements

The difference $|A_{max} - A_{min}|$ shall be less than 6 dB.

8.3.9 Dry heat (operational)

8.3.9.1 Object of the test

To demonstrate the ability of the specimen to function correctly at high ambient temperatures appropriate to the anticipated service environment.

8.3.9.2 Test procedure

8.3.9.3 General

Use the test apparatus and perform the test procedure as specified in IEC 60068-2-2, Test Bb, and in 8.3.9.4 to 8.3.9.6.

8.3.9.4 Conditioning

8.3.9.4.1 Unless otherwise stated in the relevant parts of ISO 7240, apply the following conditioning for heat detectors:

- temperature: maximum ambient temperature in accordance with the appropriate class of ISO 7240-5;
- duration: 2 h.

8.3.9.4.2 Unless otherwise stated in the relevant parts of ISO 7240, apply the following conditioning, except for heat detectors:

- temperature: (55 ± 2) °C for indoor use or (70 ± 2) °C for outdoor use;
- duration: 16 h.

8.3.9.5 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any alarm or fault signal.

During the last 0,5 h of the conditioning period, determine the transmission threshold of the specimen in accordance with Annex A. Record the threshold value A_{during}.

8.3.9.6 Final measurements

After a recovery period of at least 1 h under standard laboratory conditions, measure the transmission threshold of the specimen in accordance with Annex A. Record the threshold value A_{after}.

8.3.9.7 Requirements

No alarm or fault signal shall be given during the conditioning.

The difference $|A_{during} - A|$ shall be less than 10 dB, where A is measured in the reproducibility test.

The difference $|A_{after} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.10 Dry heat (endurance)

8.3.10.1 Object

To demonstrate the ability of the component to withstand a high ambient temperature.

8.3.10.2 Test procedure

8.3.10.3 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-2, Test Ba or Bb, and by 8.3.10.4 to 8.3.10.5.

8.3.10.4 Conditioning

8.3.10.4.1 Unless otherwise stated in the relevant parts of ISO 7240, apply the following conditioning for heat detectors:

— temperature: maximum ambient temperature in accordance with ISO 7240-5:2003, classes C to G;

— duration: 21 d.

8.3.10.4.2 Unless otherwise stated in the relevant parts of ISO 7240, apply the following conditioning, except for heat detectors:

— temperature: (70 ± 2) °C;

— duration: 21 d.

8.3.10.5 Final measurements

After a recovery period of at least 1 h under standard laboratory conditions, measure the transmission threshold of the specimen in accordance with Annex A. Record the threshold value A_{after}.

8.3.10.6 Requirements

No fault signal, attributable to the endurance conditioning, shall be given on reconnection of the specimen.

The difference $|A_{after} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.11 Cold (operational)

8.3.11.1 Object of the test

To demonstrate the ability of the specimen to function correctly at low ambient temperatures appropriate to the anticipated service environment.

8.3.11.2 Test procedure

8.3.11.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-1, Test Ab, and in 8.3.11.2.2 to 8.3.11.2.4.

8.3.11.2.2 Conditioning

Apply the following conditioning, unless otherwise stated in the relevant parts of ISO 7240:

— temperature: (–5 ± 3) °C for c.i.e. and (–10 ± 3) °C for indoor use specimens or (–25 ± 3) °C for outdoor use specimens;

— duration: 16 h.

For countries with very cold outside temperatures, a test temperature of (–40 ± 3) °C should be employed for outdoor-use specimens.

8.3.11.2.3 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any alarm or fault signal.

Measure the transmission threshold as specified in Annex A during the last 0,5 h of the conditioning period.

Record the threshold value A_{during}.

8.3.11.2.4 Final measurements

After a recovery period of at least 1 h in standard laboratory conditions, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.11.3 Requirements

No alarm or fault signal shall be given during the conditioning.

The difference $|A_{\text{during}} - A|$ shall be less than 10 dB, where A is measured in the reproducibility test.

The difference $|A_{\text{after}} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.12 Damp heat, cyclic (operational)

8.3.12.1 Object of the test

To demonstrate the ability of the specimen to function correctly at a high relative humidity (with condensation), which can occur for short periods in the anticipated service environment.

8.3.12.2 Test procedure

8.3.12.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-30, Test Db, using the Variant 1 test cycle and controlled recovery conditions, and in 8.3.12.2.2 to 8.3.12.2.4.

8.3.12.2.2 Conditioning

Apply the following conditioning, unless otherwise stated in the relevant parts of ISO 7240:

- lower temperature: (25 ± 3) °C at > 95% RH;
- upper temperature: (40 ± 5) °C for indoor use specimens or (55 ± 2) °C for outdoor use specimens;
- relative humidity at upper temperature: (93 ± 3) %;
- number of cycles: 2.

8.3.12.2.3 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any alarm or fault signal.

Measure the transmission threshold as specified in Annex A during the last 0,5 h of the conditioning period.

Record the threshold value A_{during}.

8.3.12.2.4 Final measurements

After a recovery period of at least 1 h in standard laboratory conditions, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.12.3 Requirements

No alarm or fault signal shall be given during the conditioning.

The difference $|A_{\text{during}} - A|$ shall be less than 10 dB, where A is measured in the reproducibility test.

The difference $|A_{\text{after}} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.13 Damp heat, steady state (operational)

8.3.13.1 Object of the test

To demonstrate the ability of the specimen to function correctly at a high relative humidity (without condensation), which can occur for short periods in the anticipated service environment.

8.3.13.2 Test procedure

8.3.13.2.1 General

For the c.i.e. use the test procedure as specified in IEC 60068-2-78; for other components, use the test apparatus and procedure as specified in IEC 60068-2-78, Test Cab, and in 8.3.13.2.2 to 8.3.13.2.4.

8.3.13.2.2 Conditioning

Apply the following conditioning to the c.i.e. and to other components:

— temperature: (40 ± 2) °C;

— relative humidity: (93 ± 3) %;

— duration: 4 d.

8.3.13.2.3 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any alarm or fault signal.

Measure the transmission threshold as specified in Annex A during the last 0,5 h of the conditioning period.

Record the threshold value A_{during}.

8.3.13.2.4 Final measurements

After a recovery period of at least 1 h in standard laboratory conditions, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.13.3 Requirements

No alarm or fault signal shall be given during the conditioning.

The difference $|A_{\text{during}} - A|$ shall be less than 10 dB, where A is measured in the reproducibility test.

The difference $|A_{\text{after}} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.14 Damp heat, steady state (endurance)

8.3.14.1 Object of the test

To demonstrate the ability of the specimen to withstand long-term effects of humidity in the service environment.

8.3.14.2 Test procedure

8.3.14.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-78, Test Cab, and in 8.3.14.2.2 to 8.3.14.2.4.

8.3.14.2.2 State of the specimen during conditioning

Do not supply the specimen with power during the conditioning.

8.3.14.2.3 Conditioning

Apply the following conditioning to the c.i.e. and to other components:

— temperature: (40 ± 2) °C;

— relative humidity: (93 ± 3) %;

— duration: 21 d.

8.3.14.2.4 Final measurements

After a recovery period of at least 1 h under standard laboratory conditions, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.14.3 Requirements

No alarm or fault signal, attributable to the endurance conditioning, shall be given on reconnection of the specimen.

The difference $|A_{after} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.15 SO_2 corrosion (endurance)

8.3.15.1 Object of the test

To demonstrate the ability of the specimen to withstand the corrosive effects of sulfur dioxide as an atmospheric pollutant.

8.3.15.2 Test procedure

8.3.15.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-42, Test Kc, but carry out the conditioning as specified in 8.3.15.2.3.

8.3.15.2.2 State of the specimen during conditioning

Do not supply the specimen with power during the conditioning.

8.3.15.2.3 Conditioning

Apply the following conditioning:

— temperature: (25 ± 2) °C;

— relative humidity: (93 ± 3) %;

— SO_2 concentration: (25 ± 5) µl/l;

— duration: 21 d.

8.3.15.2.4 Final measurements

Immediately after the conditioning subject the specimen to a drying period of 16 h at (40 ± 2) °C and < 50 % RH, followed by a recovery period of at least 1 h at the standard atmospheric conditions.

After the recovery period, measure the transmission threshold of the specimen as specified in Annex A.

Record the threshold value A_{after}.

8.3.15.3 Requirements

No alarm or fault signal, attributable to the endurance conditioning, shall be given on reconnection of the specimen.

The difference $|A_{after} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.16 Shock (operational)

8.3.16.1 Object of the test

To demonstrate the immunity of the specimen to mechanical shocks which are likely to occur in the anticipated service environment.

8.3.16.2 Test procedure

8.3.16.2.1 General

Use the test apparatus and perform the procedure generally as specified in IEC 60068-2-27, Test Ea, but carry out the conditioning as specified in 8.3.16.2.2.

8.3.16.2.2 Conditioning

For specimens with a mass < 4,75 kg, apply the following conditioning:

- shock pulse type: half sine;
- pulse duration: 6 ms;
- peak acceleration: $10(100 - 20M)$ m/s^2 (where M is the mass of the specimen in kilograms);
- number of directions: six;
- pulses per direction: three.

Do not test specimens with a mass > 4,75 kg.

8.3.16.2.3 Measurements during conditioning

Monitor the specimen during the conditioning period and for a further 2 min to detect any alarm or fault signal.

After the conditioning, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.16.3 Requirements

No alarm or fault signal shall be given during the conditioning.

The difference $|A_{after} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.17 Impact (operational)

8.3.17.1 Object of the test

To demonstrate the immunity of the specimen to mechanical impacts upon its surface which it can sustain in the normal service environment and which it can reasonably be expected to withstand.

8.3.17.2 Test procedure

8.3.17.2.1 Conditioning

8.3.17.2.1.1 Apply the conditioning in accordance with the relevant part of ISO 7240.

8.3.17.2.1.2 For components conditioned with a spring hammer (e.g. c.i.e.), apply the following conditioning:

— impact energy: (0,5 ± 0,04) J;

— number of impacts: 3.

8.3.17.2.1.3 For components conditioned with a swinging hammer, apply the following conditioning:

— impact energy: (1,9 ± 0,1) J;

— hammer velocity: (1,5 ± 0,13) m/s

— number of impacts: 1.

8.3.17.2.2 Measurement during conditioning

Monitor the specimen during the conditioning period and for a further 2 min to detect any alarm or fault signal.

8.3.17.2.3 Final measurements

After the conditioning, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.17.3 Requirements

No alarm or fault signal shall be given during the conditioning.

The difference $|A_{after} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.18 Vibration, sinusoidal (operational)

8.3.18.1 Object of the test

To demonstrate the immunity of the specimen to vibration at levels considered appropriate to the normal service environment.

8.3.18.2 Test procedure

8.3.18.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-6, Test Fc, and in 8.3.18.2.2 to 8.3.18.2.4.

8.3.18.2.2 Conditioning

8.3.18.2.2.1 For c.i.e., apply the following conditioning:

— frequency range: (10 to 150) Hz;

— acceleration amplitude: 0,981 m/s^2 (≈ 0,5 g_n);

— number of axes: three;

— sweep rate: 1 octave/min;

— number of sweep cycles: 1 /axis.

8.3.18.2.2.2 For other components, apply the following conditioning:

— frequency range: (10 to 150) Hz;

— acceleration amplitude: 5 m/s^2 (≈ 0,5 g_n);

— number of axes: three;

— sweep rate: 1 octave/min;

— number of sweep cycles: 1 /axis.

8.3.18.2.3 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any alarm or fault signal.

8.3.18.2.4 Final measurements

After the conditioning, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.18.3 Requirements

No alarm or fault signal shall be given during the conditioning.

The difference $|A_{after} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.19 Vibration, sinusoidal (endurance)

8.3.19.1 Object of the test

To demonstrate the ability of the specimen to withstand the long-term effects of vibration at levels appropriate to the service environment.

8.3.19.2 Test procedure

8.3.19.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-6, Test Fc, and in 8.3.19.2.2 to 8.3.19.2.4.

8.3.19.2.2 State of the specimen during conditioning

Do not supply the specimen with power during the conditioning.

8.3.19.2.3 Conditioning

8.3.19.2.3.1 For c.i.e., apply the following conditioning:

- frequency range: (10 to 150) Hz;
- acceleration amplitude: 5 m/s^2 (≈ 0,5 g_n);
- number of axes: three;
- sweep rate: 1 octave/min;
- number of sweep cycles: 20.

8.3.19.2.3.2 For other components, apply the following conditioning:

- frequency range: (10 to 150) Hz;
- acceleration amplitude: 10 m/s^2 (≈ 0,5 g_n);
- number of axes: three;
- sweep rate: 1 octave/min;
- number of sweep cycles: 20 /axis.

8.3.19.2.4 Final measurements

After the conditioning, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.19.3 Requirements

No alarm or fault signal, attributable to the endurance conditioning, shall be given on reconnection of the specimen.

The difference $|A_{after} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

8.3.20 Electromagnetic compatibility (EMC), immunity tests (operational)

8.3.20.1 Object of the test

To demonstrate the immunity to electromagnetic disturbances that can occur in the normal service environment.

8.3.20.2 Test procedure

8.3.20.3 General

Conduct the following EMC immunity tests as specified in EN 50130-4:

a) electrostatic discharge;

b) radiated electromagnetic fields;

c) conducted disturbances induced by electromagnetic fields;

d) fast transient bursts;

e) slow high-energy voltage surges;

f) mains supply voltage variations;

g) mains supply voltage dips and short interruptions.

8.3.20.3.1 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any alarm or fault signal.

8.3.20.3.2 Final measurements

After the conditioning, measure the transmission threshold of the specimen in accordance with Annex A.

Record the threshold value A_{after}.

8.3.20.4 Requirements

For these tests, the criteria for compliance specified in EN 50130-4, in the appropriate part of ISO 7240 and the following shall apply.

The difference $|A_{\text{after}} - A|$ shall be less than 6 dB, where A is measured in the reproducibility test.

Annex A
(normative)

Test configuration by using radio-frequency-shielded test equipment

A.1 Radio-frequency-shielded test equipment for the component or the radio part of the component transmitting the alarm signal

The component or the radio part of the component transmitting the alarm signal shall be mounted in a test equipment as shown in Figure A.1 which complies with the following.

a) The test equipment shall be a radio-frequency-shielded metal casing, which provides sufficient attenuation of the radio-frequency-free field from the transmitter in order to avoid any possible free-field-transmitted signal activation of the corresponding receiver.

b) The cavity resonances shall be reduced by covering the inside of the casing with a radio-frequency-absorbing material (e.g. by ferrite tiles) or by other means.

c) The mechanical positioning of the component or the radio part of the component transmitting the alarm signal shall be reproducible to the extent that the output level from the equipment does not change more than ± 1 dB after removal and remounting.

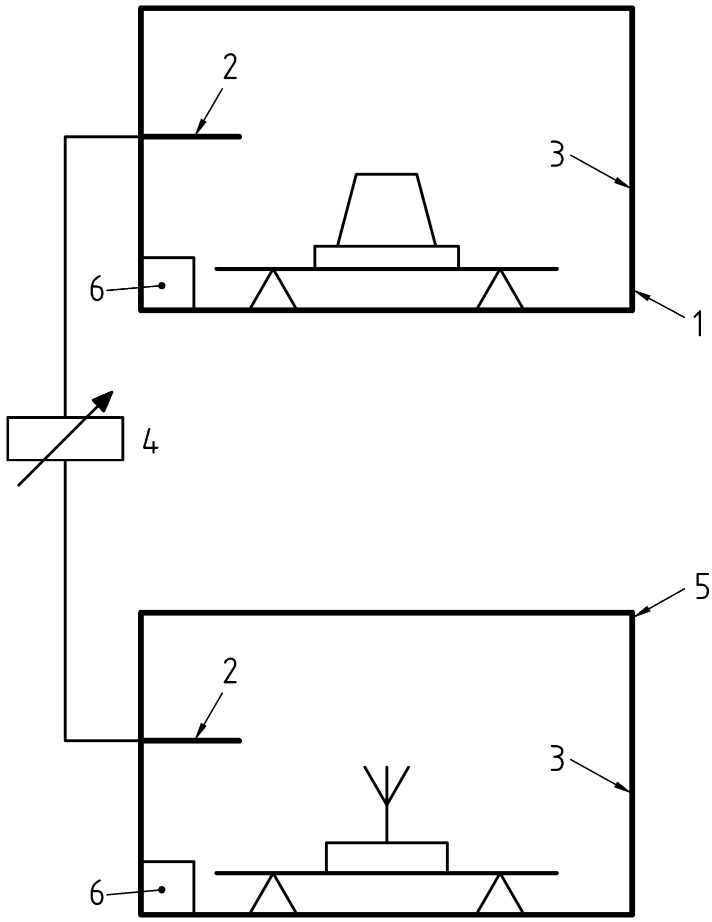
d) A honeycomb shall be mounted at each side of the r.f.-shielded box and filtered-through connections shall be available at the side of the box to enable carrying out functional testing. Through the honeycombs, it is possible, for instance, to activate an inside-mounted smoke detector by applying a test smoke or to activate an inside-mounted heat detector by applying heat from, for instance, a hair dryer. Also filtered-through connections shall be available at the side of the r.f.-shielded box to allow feeding mains or low-voltage AC/DC signals into the box for powering the component or the radio part of the component transmitting the alarm signal or to enable powering of appliances for activation of its different types.

e) The small holes in the honeycombs can be used for external manual activation of the component or the radio part of the component transmitting the alarm signal by means of some non-conducting activation rod, e.g. when using push-button types of manual call points.

f) The equipment shall not be affected by the different environmental test exposures with respect to the output level by more than ± 1 dB; i.e. avoid the use of dielectric materials that change the relative dielectric constant under different temperature and humidity conditions.

g) The antenna of the component or the radio part of the component transmitting the alarm signal shall be fixed in the same position during all the environmental tests in accordance with the specification given by the manufacturer.

NOTE The purpose of working with test equipment is to convert the free-field transmission into a cable-signal transmission situation, where the test reproducibility is high and the immunity to the interfering surroundings negligible.



Key

1 radio-frequency-shielded box for the fire detection and alarm system part with a component transmitting the alarm signal

2 antenna

3 radio-frequency-absorbing material

4 r.f. attenuator (A_T = 0 dB to 100 dB)

5 radio-frequency-shielded box for the fire detection and alarm system part with a component receiving the alarm signal

6 inputs/outputs, e.g. mains, DC or signalling

Figure A.1 — Radio-frequency-shielded test equipment and interconnections

A.2 Radio-frequency-shielded test equipment for the component or the radio part of the component receiving the alarm signal

The component or the radio part of the component receiving the alarm signal shall be mounted in a test equipment as shown in Figure A.1 which complies with the following.

a) The test equipment shall be a radio-frequency-shielded metal casing which provides a very high attenuation of the radio-frequency free-field signal from the corresponding transmitter in order to avoid any possible free-field transmitted signal activation of the receiver.

b) The cavity resonance shall be reduced by covering the inside of the casing with a radio-frequency-absorbing material (e.g. by ferrite tiles) or by other means.

c) The mechanical positioning of the component or the radio part of the component receiving the alarm signal shall be reproducible to the extent where the attenuation level for 80 % of successful transmission trials, as measured by the r.f. attenuator connected between the two pieces of test equipment, does not change more than ± 1 dB after its removal and remounting.

d) The equipment shall not be affected by the different environmental test exposures with respect to the measured attenuation level for 80 % of successful transmission trials, as measured by the r.f. attenuator connected between the two pieces of test equipment, with more than ± 1 dB; i.e. avoid the use of dielectric materials that change the relative dielectric constant under different temperature and humidity conditions.

e) The antenna of the component or the radio part of the component receiving the alarm signal shall be fixed in the same position during all the environmental tests in accordance with the specification given by the manufacturer.

NOTE The purpose of working with test equipment is to convert the free-field transmission into a cable-signal transmission situation, where the test reproducibility is high and the immunity to the interfering surroundings negligible. For the test equipment used for the component or the radio part of the component receiving the alarm signal, it is, in general, more difficult to achieve a high degree of screening, since mains power and/or input/output cables are led through the screened casing.

A.3 Cable connection between test equipment with component transmitting the alarm signal and test equipment with component receiving the alarm signal

The equipment as described in A.1 and A.2 is interconnected by shielded cables with the radio-frequency attenuator connected in series with the signalling lead as shown in Figure A.1.

The complete test set-up shall provide sufficient attenuation to avoid direct coupling between the components under test.

A.4 Determination of the transmission threshold, A

The transmission threshold, A, is the highest value of attenuation where a minimum of 80 % of the alarm transmission trials are successful. This value is found by affecting the component or the radio part of the component to change from its normal condition to alarm condition, for example by applying smoke, heat, light or by mechanical movements of rods.

In most cases, the highest A value, where 80 % of the alarm transmission trials are successful, can be found as the A value, where four out of five transmission trials are successful.

Some components or radio parts of the component are polled at certain time intervals by the control and indicating equipment or its related repeater/gateway and some just transmit a message confirming that it is alive. If the time intervals between these status transmissions are known and sufficiently short, and if the transmitted power from the component or radio parts of the component is the same as when transmitting alarm signals, the transmissions of status signals can be used to verify the highest A value instead. The attenuator is simply increased until a fault indication due to no communication with the component or radio parts of the component is given on the control and indicating equipment. Having identified what seems to be the highest A value, the A value is finally verified by performing alarm transmission trials as described above starting at the same A value.

The alarm condition of the component or radio parts of the component is achieved by many different methods depending on the type of device. Therefore, the method of generating alarms shall be suitable for the type of component or radio parts of the component under test.

For fire detectors such as smoke, heat or flame detectors, the test smoke, heat generator or flickering light test source can be applied to the detector through the honeycombs, which are installed at both sides of the r.f.-test equipment in accordance with A.1.

For manual call points, the alarm-triggering element or service facility can be affected to change it to alarm condition by pressing or pushing on it by a rod made of a non-conducting material and led through the honeycomb cells. It shall be ensured before the test starts that the test object is securely fixed at the mounting plate inside the test equipment.

During the conditioning period of the operational climatic tests, it shall be ensured that the components under test are exposed to the climatic conditions. This can be achieved, for example, by opening the box, except for the measurement of the attenuation.

In general, it is very important that all cables as well as the equipment under test are properly fixed to the mounting plate in the same position during each A measurement. If this is not the case, deviations in the A values due to the positioning can influence the test result.

Annex B
(normative)

Immunity to site attenuation (path loss)

NOTE See 4.2.1.

Experience shows that in practice the occurrence of site attenuation fluctuations can be managed by adherence to the following requirement.

The attenuation reserve, as required in 4.2.1 b), shall be calculated as given in Equation (B.1):

$$A_{\text{reserve}} \geqslant 10 \log f \tag{B.1}$$

where f is frequency, expressed in megahertz.

By using one of the methods of Table B.1, the attenuation reserve can be reduced, but shall not be less than 10 dB.

Table B.1 — Methods for the reduction of the attenuation reserve

Method	Minimum attenuation reserve
Standard transmission path	$A_{\text{reserve}}/1$
Automatic alteration of the directional characteristics of the transmitter or receiver aerial Gain difference at least 5 dB (e.g. aerial diversity)	$A_{\text{reserve}}/1{,}5$
Automatic change in carrier frequency by at least 1 MHz	$A_{\text{reserve}}/2$
Automatic space diversity Distance between two antennas at least two times the wavelength	$A_{\text{reserve}}/3$
The destination of the alarm signal (c.i.e.) can be reached automatically via multiple routes (repeaters)	$A_{\text{reserve}}/3$

Annex C
(informative)

Data and calculation of the service life of the autonomous power source(s)

NOTE See 5.3.2.

The manufacturer should declare the type of the autonomous power source and its service life for the component in normal operation. The service life can be attested by a statement of calculation. This calculation should take into account the mean consumption and voltage under quiescent and at standard atmospheric conditions.

Table C.1 shows an example of data required from the manufacturer to calculate the service life.

Table C.1 — Data required for the calculation of the service life

Parameters	Variables and calculations	Example values
COMPONENT PARAMETERS		
General circuit		
Processor current consumption	I_{PR}	10,86 μA
Tantalum capacitor leakage current	I_{CL}	3,7 μA
Voltage detector leakage current	I_{DL}	2,4 μA
Voltage regulator leakage current	I_{VL}	0,8 μA
Subtotal quiescent current consumption	$I_Q = I_{PR} + I_{CL} + I_{DL} + I_{VL}$	17,76 μA
Receiver		
Receiver current consumption	I_R	3,4 mA
Receiver on time (no message)	t_{Ron}	32,8 ms
Period of wakeups	T_W	1,35 s
Number of receiver wakeups per hour	N_{RW} = 3 600 s/h/T_W	2 666,67
Transmitter		
Transmitter current consumption	I_T	32,1 mA
Transmitter on time (periodic communications)	t_{Ton}	352 ms
Period of periodic communications	T_{PC}	6 min
Number of periodic communications per hour	N_{PC} = 60 min/h/T_{PC}	10
Sounder		
Current consumption	I_S	50 mA
PARAMETERS FOR FREQUENT FUNCTION TEST		
Sounder		
Sounder current consumption	I_S	50 mA
Sounder on time	t_{test}	8,36 min
Number of tests per week	$N_{Soundtest}$	1
LED		
LED current consumption	I_{LED}	8 mA
LED on time	t_{LEDon}	5 min
Number of tests per year	$N_{LEDtest}$	1
Number of tests per week	$N_{LEDtest}$/52	1/52
POWER SUPPLY PARAMETERS		
Battery data		
Theoretical available battery capacity for battery No. 1	C_{batt1}	7,75 Ah
Theoretical available battery capacity for battery No. 2	C_{batt2}	2,70 Ah
Total battery capacity theoretical available	$C_{batt} = C_{batt1} + C_{batt2}$	10,45 Ah

Bibliography

[1] EN 300220-1, *Electromagnetic compatibility and radio spectrum matters (ERM) — Short range devices — Radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW — Part 1: Technical characteristics and test methods*

[2] ISO 7240-13, *Fire detection and alarm systems — Part 13: Compatibility assessment of system components*

[3] ISO 9001, *Quality management systems — Requirements*

ICS 13.220.20

Price based on 44 pages