INTERNATIONAL STANDARD

ISO 7240-18

First edition
2009-11-01

Fire detection and alarm systems —

Part 18: Input/output devices

Systèmes de détection et d'alarme d'incendie—

Partie 18: Dispositifs d'entrée/sortie

Reference number
ISO 7240-18:2009(E)

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 7240-18 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]

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— *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 heat sensor*

— *Part 28: Fire protection control equipment*

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

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Introduction

This part of ISO 7240 is based on a European standard, EN 54-18, prepared by the European Committee for standardization CEN/TC 72 “*Fire detection and fire alarm systems*”.

The term input/output devices, used in this part of ISO 7240, covers a wide range of different types of devices that are intended for different applications and can, therefore, have different functions. This part of ISO 7240 does not, therefore, include detailed functional requirements for the input/output devices but requires that their function is sufficiently specified by the manufacturer and that they function correctly in accordance with the manufacturer’s specification.

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Fire detection and alarm systems —

Part 18: Input/output devices

1 Scope

This part of ISO 7240 specifies requirements, test methods and performance criteria for input/output devices connected to a transmission path of a fire detection and alarm system used to receive and/or transmit signals to or from the transmission path, necessary for the operation of the fire detection and fire alarm system and/or fire protection system.

An input/output device can be a physically separate device or its function can be integrated into another device, in which case this part of ISO 7240 can be used to assess this function.

An input/output device can include signal amplifiers and signal transfer in separate enclosures, in which case the requirements of this part of ISO 7240 shall apply.

Control and indicating equipment and ancillary control and indicating equipment (e.g. repeater panels and fire brigade panels) are not covered by this part of ISO 7240.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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

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

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

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

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

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

IEC 60068-2-75:1997, *Environmental testing — Part 2-75: Tests — Test Eh: Hammer tests*

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

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EN 50130-4:1995, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems (including amendments* EN 50130-4:1995/A1:1998 and EN 50130-4:1995/A2:2003)

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 Terms

3.1.1
conditioning
exposure of a specimen to environmental conditions in order to determine the effect of such conditions on the specimen

3.1.2
input/output device
device connected to a transmission path of a fire detection and fire alarm system, used to receive and/or transmit signals necessary for the operation of the fire detection and fire alarm system

3.1.3
recovery
treatment of a specimen, after conditioning, so that the properties of the specimen may be stabilized before measurement

3.2 Abbreviated terms

c.i.e. control and indicating equipment

EMC electromagnetic compatibility

4 Requirements

4.1 Compliance

In order to comply with this part of ISO 7240, the input/output devices shall meet the requirements of Clause 4, which shall be verified by inspection and engineering assessment, and shall be tested as described in Clause 5 and shall meet the requirements of the tests.

For input/output devices integrated into another device that is already covered by an existing part of ISO 7240, the environmental conditioning shall be performed in accordance with that part of ISO 7240, with the addition of the functional tests before, during and/or after conditioning, as required in this part of ISO 7240. In some detector standards, the dry heat (operational) test is conducted in special test equipment (e.g. in the heat tunnel for heat detectors). The required functional testing of the integrated input/output device before, during and after the dry heat conditioning may be done with this equipment, if this is possible without disrupting the detector measurements. Otherwise, a separate dry heat test, with the same conditioning, shall be conducted. For heat detectors, the test temperature is the maximum application temperature.

4.2 Monitoring of detachable devices

If an input/output device is detachable (i.e. it is attached to a detachable mounting base), then a means shall be provided for a remote monitoring system (e.g. the control and indicating equipment) to detect the removal of the device from the base, in order to give a fault signal.

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4.3 Marking and data

4.3.1 Marking

Each input/output device shall be clearly marked with the following information:

a) the number of this part of ISO 7240 (i.e. ISO 7240-18),

b) the name or trademark of the manufacturer or supplier,

c) the model designation (type or number),

d) the wiring terminal designations,

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

For detachable devices, the head shall be marked with a), b), c) and e), and the base shall be marked with at least c), i.e. its own model designation, and d).

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

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

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

4.3.2 Data

Input/output devices shall be supplied with sufficient technical, installation and maintenance data to ensure their correct installation and operation. These data shall include the parameters necessary to define the input and/or output functions, e.g. output voltage and current ratings, alarm and fault trip levels, logic levels. If all of these data are not supplied with each device, then reference to the appropriate data sheet(s) shall be given on, or with, each device. To enable correct operation of the input/output device, these data shall describe the requirements for the correct processing of the signals from the device. This can be in the form of a full technical specification of these signals, a reference to the appropriate signalling protocol or a reference to suitable types of c.i.e., etc.

4.4 Documentation

The manufacturer shall prepare and provide design documentation (e.g. drawings, parts lists, block diagrams, circuit diagrams). Where appropriate, this shall include documentation of the signal processing principle.

4.5 Requirements for software controlled devices

4.5.1 General

For input/output devices that rely on software control in order to fulfil the requirements of this part of ISO 7240, the requirements of 4.5.2, 4.5.3 and 4.5.4 shall be met.

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4.5.2 Software documentation

4.5.2.1 The manufacturer shall prepare documentation that gives an overview of the software design. This shall be submitted to the testing authority together with the input/output devices. This documentation shall be in sufficient detail so that the design can be inspected for compliance with this part of ISO 7240 and shall include at least the following:

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

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

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

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

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

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

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

   1) the name of the module,

   2) a description of the tasks performed,

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

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

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

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

4.5.3 Software design

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

a) The software shall have a modular structure.

b) The design of the interfaces for manually and automatically generated data shall not permit invalid data to cause error in the program operation.

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

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4.5.4 The storage of programs and data

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

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

5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

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.

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

5.1.2 Operating conditions for tests

If a test method requires that a specimen be operational, then the specimen shall be connected to suitable supply and monitoring equipment with characteristics as required by the manufacturer's data. Unless otherwise specified in the test method, the supply parameters applied to the specimen shall be set within the manufacturer's specified range(s) and shall remain substantially constant throughout the tests. The value chosen for each parameter shall normally be the nominal value or the mean of the specified range.

The details of the supply and monitoring equipment used shall be given in the test report; see Clause 6.

5.1.3 Mounting arrangements

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

5.1.4 Tolerances

Unless otherwise stated, the tolerances for the environmental test parameters shall be as given in the basic reference standards for the test, e.g. the relevant parts of IEC 60068-2.

If a requirement or test procedure does not specify a tolerance or deviation limits, then deviation limits of ± 5 % shall be applied.

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5.1.5 Functional test

Each function of the input/output device shall be activated by a suitable means in accordance with the manufacturer's specification, and appropriate observations or measurements shall be made to confirm the correct operation of the device.

NOTE The variety and the diversity of the equipment within the scope of this part of ISO 7240 make it difficult to define the precise details of this functional test. This functional test is intended to exercise each function of the device in a simple way. A more complete assessment of the performance of these functions, in accordance with the manufacturer's specification, is made in the performance and variation in supply voltage test; see 5.2.

5.1.6 Provision for tests

Twelve specimens are required to conduct the tests as indicated in the test schedule (see 5.1.7). These specimens shall be numbered 1 to 12 arbitrarily.

The number of specimens may be reduced to a minimum of nine if the same specimen is used for more than one EMC test; see Table 1 footnote.

The specimens submitted shall be representative of the manufacturer's normal production with regard to their construction.

5.1.7 Test schedule

The specimens shall be tested according to the test schedule in Table 1.

Table 1 — Test schedule for input/output devices

Test	Subclause	Specimen number
Performance and variation of supply parameters	5.2	1
Dry heat (operational)	5.3	2
Cold (operational)	5.4	2
Damp heat, cyclic (operational)	5.5	3
Damp heat, steady state (endurance)	5.6	4
Sulfur dioxide (SO_2) corrosion (endurance)	5.7	5
Shock (operational)	5.8	6
Impact (operational)	5.9	7
Vibration, sinusoidal (operational)	5.10	8
Vibration, sinusoidal (endurance)	5.11	8
Electromagnetic compatibility (EMC), immunity tests	5.12	9, 10, 11, 12[a]

[a] In the interests of test economy, it is permitted to use the same specimen for more than one EMC test. In that case, intermediate functional test(s) on the specimen(s) used for more than one test may be deleted, and the functional test conducted at the end of the sequence of tests. However it should be noted that in the event of a failure, it might not be possible to identify which test exposure caused the failure; see of EN 50130-4:1995, Clause 4.

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5.2 Performance and variation in supply parameters

5.2.1 Object

To demonstrate the ability of the input/output device to function correctly in accordance with the manufacturer's specifications, at the upper and lower limits of the supply parameters specified by the manufacturer.

5.2.2 Test procedure

Connect the specimen to suitable supply and monitoring equipment, as specified by the manufacturer.

Test the performance of each function of the specimen according to the manufacturer's specification, at the upper and at the lower limits of the supply parameter (e.g. voltage) range(s).

Include tests and measurements in all operating modes with the maximum and minimum parameters and parameter settings specified by the manufacturer for the input and/or output lines; see 4.3.2.

If it is not possible to adjust the input/output device's supply voltage to the upper and lower limits, then test the performance at the worst-case conditions of the supply voltage to the supply and monitoring equipment and of the line impedance allowed by the manufacturer's specifications.

5.2.3 Requirements

The specimen shall function correctly within the manufacturer's specifications.

5.3 Dry heat (operational)

5.3.1 Object

To demonstrate the ability of the specimen to function correctly at high ambient temperatures that can occur for short periods in the service environment.

5.3.2 Test procedure

5.3.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-2, Test Bb, and in 5.3.2.2 to 5.3.2.6.

5.3.2.2 Initial measurements

Before conditioning, conduct the functional test as specified in 5.1.5.

5.3.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 and connect it to supply and monitoring equipment as described in 5.1.2.

5.3.2.4 Conditioning

Apply the following conditioning:

— temperature: (55 ± 2) °C;

— duration: 16 h.

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5.3.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any unwanted or unspecified functioning.

During the last hour of the conditioning period, conduct a functional test as specified in 5.1.5.

5.3.2.6 Final measurements

After a recovery period of at least 1 h at the standard laboratory conditions, conduct the functional test as specified in 5.1.5.

5.3.3 Requirements

No unwanted or unspecified function shall occur during conditioning.

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.4 Cold (operational)

5.4.1 Object

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

5.4.2 Test procedure

5.4.2.1 General

Use the test apparatus and perform the procedure in IEC 60068-2-1, Test Ab, and in 5.4.2.2 to 5.4.2.6.

5.4.2.2 Initial measurements

Before conditioning, conduct the functional test as specified in 5.1.5.

5.4.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 and connect it to supply and monitoring equipment as described in 5.1.2.

5.4.2.4 Conditioning

Apply the following conditioning:

— temperature: (–10 ± 3) °C;

— duration: 16 h.

5.4.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any unwanted or unspecified functioning.

During the last hour of the conditioning period, conduct a functional test as specified in 5.1.5.

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5.4.2.6 Final measurements

After a recovery period of at least 1 h at the standard laboratory conditions, conduct the functional test as specified in 5.1.5.

5.4.3 Requirements

No unwanted or unspecified function shall occur during conditioning.

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.5 Damp heat, cyclic (operational)

5.5.1 Object

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

5.5.2 Test procedure

5.5.2.1 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 5.5.2.2 to 5.5.2.6.

5.5.2.2 Initial measurements

Before conditioning, conduct the functional test as specified in 5.1.5.

5.5.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 and connect it to supply and monitoring equipment as described in 5.1.2.

5.5.2.4 Conditioning

Apply the following conditioning:

— lower temperature: (25 ± 3) °C at > 95% RH;

— upper temperature: (40 ± 2) °C;

— relative humidity at upper temperature: (93 ± 3) %;

— number of cycles: 2.

5.5.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any unwanted or unspecified functioning.

During the last hour of the conditioning period, conduct a functional test as specified in 5.1.5.

5.5.2.6 Final measurements

After the recovery period, conduct the functional test as specified in 5.1.5.

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5.5.3 Requirements

No unwanted or unspecified function shall occur during conditioning.

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.6 Damp heat, steady state (endurance)

5.6.1 Object

To demonstrate the ability of the specimen to withstand the long term effects of humidity in the service environment, e.g. changes in electrical properties of materials, chemical reactions involving moisture and galvanic corrosion.

5.6.2 Test procedure

5.6.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-78, Test Cab, and in 5.6.2.2 to 5.6.2.5.

5.6.2.2 Initial measurements

Before conditioning, conduct the functional test as specified in 5.1.5.

5.6.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 but do not supply it with power during the conditioning.

5.6.2.4 Conditioning

Apply the following conditioning:

— temperature: (40 ± 2) °C;

— relative humidity: (93 ± 3) %;

— duration: 21 d.

5.6.2.5 Final measurements

After a recovery period of at least 1 h at the standard laboratory conditions, conduct the functional test as specified in 5.1.5.

5.6.3 Requirements

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.7 Sulfur dioxide (SO_2) corrosion (endurance)

5.7.1 Object

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

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5.7.2 Test procedure

5.7.2.1 General

Use the test apparatus and procedure as generally specified in IEC 60068-2-42, and in 5.7.2.2 to 5.7.2.5, except for the relative humidity of the test atmosphere, which shall be maintained at (93 ± 3) % instead of (75 ± 5) %.

5.7.2.2 Initial measurements

Before conditioning, conduct the functional test as specified in 5.1.5.

5.7.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3. Do not supply it with power during the conditioning, but equip it with untinned copper wires of the appropriate diameter, connected to a sufficient number of terminals to allow making the final measurement without making further connections to the specimen.

5.7.2.4 Conditioning

Apply the following conditioning:

— temperature: (25 ± 2) °C;

— relative humidity: (93 ± 3) %;

— SO_2 concentration: (25 ± 5) µl/l;

— duration: 21 d.

5.7.2.5 Final measurements

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

After the recovery period, conduct the functional test as specified in 5.1.5.

5.7.3 Requirements

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.8 Shock (operational)

5.8.1 Object

To demonstrate the immunity of the specimen to mechanical shocks that are likely to occur, albeit infrequently, in the anticipated service environment.

5.8.2 Test procedure

5.8.2.1 General

Use the test apparatus and perform the procedure generally as described in IEC 60068-2-27, Test Ea, except that the conditioning shall be as specified in 5.8.2.4, and in 5.8.2.2 to 5.8.2.6.

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5.8.2.2 Initial measurements

Before conditioning, conduct the functional test as specified in 5.1.5.

5.8.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 to a rigid fixture and connect it to supply and monitoring equipment as described in 5.1.2.

5.8.2.4 Conditioning

For specimens with a mass $\leqslant$ 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.

5.8.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period and for a further 2 min to detect any unwanted or unspecified functioning.

5.8.2.6 Final measurements

After the conditioning and the further 2 min, conduct the functional test as specified in 5.1.5.

5.8.3 Requirements

No unwanted or unspecified function shall occur during the conditioning period or the further 2 min.

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.9 Impact (operational)

5.9.1 Object

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

5.9.2 Test procedure

5.9.2.1 General

Use the test apparatus and perform the procedure as described in IEC 60068-2-75 and in 5.9.2.2 to 5.9.2.6.

5.9.2.2 Initial measurements

Before conditioning, conduct the functional test as described in 5.1.5.

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5.9.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 to a rigid structure and connect it to supply and monitoring equipment as described in 5.1.2.

5.9.2.4 Conditioning

Apply the impacts to all accessible surfaces of the specimen. For all such surfaces, apply three blows to any point(s) considered likely to cause damage to or impair the operation of the specimen.

Care shall be taken to ensure that the results from a series of three blows do not influence subsequent series. In case of doubt, the defect shall be disregarded and a further three blows shall be applied to the same position on a new specimen.

Use the following test parameters during the conditioning:

— impact energy: $(0{,}5 \pm 0{,}04)$ J;

— number of impact points: 3.

5.9.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period and for a further 2 min to detect any unwanted or unspecified functioning.

5.9.2.6 Final measurements

After the conditioning and the further 2 min, conduct the functional test as specified in 5.1.5.

5.9.3 Requirements

No unwanted or unspecified function shall occur during the conditioning period or the further 2 min.

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.10 Vibration, sinusoidal (operational)

5.10.1 Object

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

5.10.2 Test procedure

5.10.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-6, Test Fc, and in 5.10.2.2 to 5.10.2.6.

5.10.2.2 Initial measurements

Before conditioning, conduct the functional test as described in 5.1.5.

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5.10.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 on a rigid fixture and connect it to supply and monitoring equipment as described in 5.1.2.

Apply the vibration in each of three mutually perpendicular axes, in turn, and so that one of the three axes is perpendicular to its normal mounting plane.

5.10.2.4 Conditioning

Apply the following conditioning:

— frequency range: (10 to 150) Hz;

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

— number of axes: three;

— sweep rate: 1 octave/min;

— number of sweep cycles: 1.

The vibration (operational) and vibration (endurance) tests may be combined such that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in one axis before changing to the next axis. It is necessary to make only one final measurement.

5.10.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period to detect any unwanted or unspecified functioning.

5.10.2.6 Final measurements

After the conditioning, conduct the functional test as specified in 5.1.5.

5.10.3 Requirements

No unwanted or unspecified function shall occur during conditioning.

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.11 Vibration, sinusoidal (endurance)

5.11.1 Object

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

5.11.2 Test procedure

5.11.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-6, Test Fc, and in 5.11.2.2 to 5.11.2.5.

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5.11.2.2 Initial measurements

Before conditioning, conduct the functional test as specified in 5.1.5.

5.11.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 on a rigid fixture. Apply the vibration in each of three mutually perpendicular axes, in turn, and so that one of the three axes is perpendicular to its normal mounting plane of the specimen.

Do not supply the specimen with power during conditioning.

5.11.2.4 Conditioning

Apply the following conditioning:

— frequency range: (10 to 150) Hz;

— acceleration amplitude: 10 m/s^2 ($\approx$ 1,0 g_n);

— number of axes: three;

— sweep rate: 1 octave/min;

— number of sweep cycles: 20 /axis.

The vibration operational and endurance tests may be combined such that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in one axis before changing to the next axis. It is necessary to make only one final measurement.

5.11.2.5 Final measurements

After the conditioning, conduct the functional test as specified in 5.1.5.

5.11.3 Requirements

In the functional tests, the specimen shall function correctly as specified by the manufacturer.

5.12 Electromagnetic compatibility (EMC) immunity tests

5.12.1 Object

To demonstrate the immunity of the specimen to electromagnetic interference.

5.12.2 Test procedure

5.12.2.1 General

The test apparatus and procedure shall be as described in EN 50130-4 and in 5.12.2.2 to 5.12.2.3.

The functional test, called for in the initial and final measurements, shall be the functional test described in 5.1.5.

5.12.2.2 Initial measurements

Before conditioning, conduct the functional test as described in 5.1.5.

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5.12.2.3 State of the specimen during conditioning

Mount the specimen as described in 5.1.3 on a rigid fixture and connect it to supply and monitoring equipment as described in 5.1.2.

5.12.3 Conditioning

Conduct the following EMC immunity tests, as described in EN 50130-4.

a) if the specimen incorporates a mains supply:

   1) mains supply voltage variations,

   2) mains supply voltage dips and short interruptions;

b) electrostatic discharge;

c) radiated electromagnetic fields;

d) conducted disturbances induced by electromagnetic fields;

e) fast transient bursts;

f) slow high-energy surges.

5.12.4 Requirements

No unwanted or unspecified function shall occur during conditioning.

In the functional tests, the specimen shall function correctly, as specified by the manufacturer.

6 Test report

The test report shall contain as a minimum the following information:

a) identification of the specimen tested;

b) reference to this part of ISO 7240 (i.e. ISO 7240-18:2009);

c) results of the test: the individual response values and the minimum, maximum and arithmetic mean values where appropriate;

d) conditioning period and the conditioning atmosphere;

e) temperature and the relative humidity in the test room throughout the test;

f) details of the supply and monitoring equipment;

g) details of any deviation from this part of ISO 7240 or from the International Standards to which reference is made;

h) details of any operations regarded as optional.

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ICS 13.220.20

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