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Fire detection and alarm systems —

Part 4: Power supply equipment

Systèmes de détection et d'alarme d'incendie —

Partie 4: Équipement d'alimentation électrique

Reference number
ISO 7240-4:2003(E)

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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 7240-4 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 4: Power supply equipment*

— *Part 5: Point-type heat detectors*

— *Part 7: Point-type smoke detectors using scattered light transmitted light or ionization*

— *Part 11: Manual call points*

— *Part 14: Guidelines for drafting codes of practice for design, installation and use of fire detection and fire alarm systems in and around buildings*

— *Part 15: Point-type multisensor (light and heat) fire detectors*

Part 6, *Point-type fire detectors for detection of carbon monoxide* and Part 9, *Fire sensitivity tests* are under preparation.

Introduction

This part of ISO 7240 is drafted on the basis of mandatory functions, which are to be provided on all equipment, and optional (each with its own requirements). It is intended that the options be used for specific applications, as recommended in application guidelines.

Each optional function is included as a separate entity, with its own set of associated requirements, in order to permit equipment with many different combinations of functions to comply with this part of ISO 7240.

Other functions associated with fire detection and alarm can also be provided, even if not specified in this part of ISO 7240.

Fire detection and alarm systems —

Part 4
Power supply equipment

1 Scope

This part of ISO 7240 specifies requirements, test methods and performance criteria for power supply equipment (p.s.e.) for use in fire detection and alarm systems installed in buildings.

It is not necessarily applicable to power supply equipment with special characteristics, developed for particular applications, which could require further tests.

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 7240-1:1988, *Fire detection and alarm systems — Part 1: General and definitions*

ISO 7240-2:—[1)], *Fire detection and alarm systems — Part 2: Control and indicating equipment*

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

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

IEC 60068-2-3, *Environmental testing — Part 2: Tests. Test Ca: damp heat, steady state*

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

IEC 60068-2-47, *Environmental testing — Part 2: Test methods — Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests*

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

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721-3-3, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities —Section 3: Stationary use and weather protected locations*

IEC 60950-1, *Information technology equipment — Safety — Part 1: General requirements*

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

1) To be published.

3 Terms, definitions and symbols

For the purposes of this part of ISO 7240, the terms and definitions given in ISO 7240-1 and the following terms, definitions and symbols apply. See also Figure 1 of ISO 7240-1:1988.

3.1 Terms and definitions

3.1.1
float voltage
voltage that when applied to the battery will maintain the battery in a fully charged state

NOTE The float voltage is specified by the battery manufacturer.

3.1.2
final voltage
lowest recommended voltage to which a battery should be discharged

NOTE The final voltage is specified by the battery manufacturer.

3.1.3
integrated p.s.e.
equipment for which it is not possible for the manufacturer to specify its output voltage range(s) or power supply input voltage range(s) and, if in the case of a defective p.s.e., where the repair by replacement of the p.s.e. involves replacement of a part or the whole of the other equipment

3.2 Symbols

3.2.1
$I_{a,\,max}$
rated maximum output current that can be supplied continuously

3.2.2
$I_{b,\,max}$
rated maximum output current that can be supplied for a short duration in which battery charging is not required

3.2.3
I_{min}
⟨integrated p.s.e.⟩ minimum output current specified by the manufacturer

3.2.4
V_n
nominal voltage of the public electricity supply

4 General requirements

4.1 Compliance

In order to comply with this part of ISO 7240, the p.s.e. (Item L in Figure 1 of ISO 7240-1:1988) shall meet the requirements of Clauses 4, 5, 6, 7 and 8, shall be tested in accordance with Clause 9 and shall meet the requirements of the tests.

4.2 Power sources

4.2.1 There shall be at least two power sources for the power supply of a fire detection and alarm system: the main power source and the standby power source.

4.2.2 The main power source shall be designed to operate from the public electricity supply or equivalent system.

4.2.3 Where a battery is used, the p.s.e. shall include charging equipment to charge the battery and maintain it in a fully charged state.

4.2.4 Each power source, on its own, shall be capable of meeting the p.s.e. manufacturer's output specification or, in the case of an integrated p.s.e., shall be capable of operating the equipment in which it is integrated within its specifications.

4.2.5 When the main power source is available, it shall be the exclusive source of power to the fire detection and alarm system, except for currents associated with battery monitoring.

4.2.6 If the main power source fails, then the p.s.e. shall be automatically switched over to a standby power source. When the main power source is restored, the p.s.e. shall be automatically switched back to the main power source.

4.2.7 If the p.s.e. is integrated within other equipment of the fire detection and fire alarm system, then the switching from one power source to the other shall not cause any change in status or indications, other than those relating to the power supply.

4.2.8 If the p.s.e. is separated from other equipment of the fire detection and alarm system and the switching from one power source to the other causes an interruption in supply of power, then the duration of the interruption shall be specified in the manufacturer's data.

4.2.9 Failure of one of the power sources shall not cause the failure of any other power source or the failure of the supply of power to the system.

NOTE The compatibility of the separated p.s.e. with the other equipment, for example the c.i.e. (control and indicating equipment — Item B in Figure 1 of ISO 7240-1:1988), is intended to be dealt with in a future part 13, system requirements.

5 Functions

5.1 Power supply from main power source

When operated from the main power source, the following applies.

a) The p.s.e. shall be capable of operating in accordance with its specification given in the manufacturer's data, irrespective of the condition of the standby power source. This includes any charge condition of the standby power source, or open circuit or short circuit of the connection to the standby power source.

b) The p.s.e. shall be capable of continuously supplying $I_{a,\,max}$ and simultaneously charging a battery discharged to its final voltage.

c) It may allow battery charging to be limited or interrupted when delivering a current greater than $I_{a,\,max}$ (see note to Table 1).

5.2 Power supply from standby power source

5.2.1 When operated from the standby power source, the p.s.e. shall be capable of operating in accordance with the specification given in the manufacturer's data, irrespective of the condition of the main power source.

It is intended that the standby and alarm periods required in any specific application should comply with a future part 14, application guidelines.

5.2.2 When the standby power source consists of a battery it shall

— be rechargeable,

— be suitable to be maintained in a fully charged state,

— be constructed for stationary use,

— be marked with its type designation and code or number identifying the production period, and

— have a safety mechanism to prevent explosion.

5.2.3 If the battery is mounted in a cabinet which houses other fire detection and alarm system equipment, then it shall be of the sealed type and shall be mounted in accordance with the manufacturer's data.

5.2.4 When operating from a battery standby power source and where the battery is subject to damage from over-discharge, the p.s.e. shall have a facility to switch off the p.s.e. output or outputs if the output voltage or voltages, or the voltage of the battery, falls below a value specified by the battery manufacturer.

5.3 Charger

5.3.1 The charger shall be designed and rated so that

— the battery can be charged automatically,

— a battery discharged to its final voltage can be recharged to at least 80 % of its rated capacity within 24 h and to its rated capacity within another 48 h, and

— the charging characteristics are within the battery manufacturer's specification over the ambient temperature range of the battery.

5.3.2 Except for currents associated with battery monitoring, the battery shall not discharge through the charger when the charging voltage is below the battery voltage.

5.4 Faults

The p.s.e. shall be capable of recognizing and signalling the following faults within 100 s of their occurrence:

a) a reduction in the main power source voltage to a level less than the minimum required to maintain the output voltage within the specification;

b) loss of the standby power source;

c) reduction of the battery voltage to less than 0,9 of the final voltage when the primary power source is unavailable;

d) reduction of the charger output to a level of less than 0,9 of the float voltage, except under the conditions specified in 5.1 c).

5.4.1 If the p.s.e. is separately housed from the c.i.e, then at least a fault output common to the above-mentioned faults shall be provided.

5.4.2 If the p.s.e. is housed within the cabinet of the c.i.e., then the above-mentioned faults shall be indicated in accordance with Clause 9 of ISO 7240-2:—[2)] , either on the c.i.e. or on the p.s.e. itself.

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2) To be published.

5.5 Battery function check — Optional

The p.s.e. shall include a facility to check the function of the battery.

6 Materials, design and manufacture

6.1 Manufacturer's declaration

The manufacturer shall declare the following in writing:

a) that the design has been carried out in accordance with a quality management system which incorporates a set of rules for the design of all elements of the p.s.e.;

b) that the components of the p.s.e. have been selected for the intended purpose and are expected to operate within their specification when the environmental conditions outside the cabinet of the p.s.e. comply with Class 3K5 of IEC 60721-3-3.

6.2 Mechanical design

6.2.1 The cabinet of the p.s.e. shall be consistent with the method of installation recommended in the documentation. It shall meet at least classification IP 30 of IEC 60529.

6.2.2 The p.s.e. may be housed either in a separate cabinet or in cabinets associated with other fire detection and alarm system equipment.

6.2.3 If the p.s.e. is housed in the c.i.e., then manual controls, fuses, calibration elements etc. for disconnection and adjustment of the power sources shall be accessible only at Access Level 3 of ISO 7240-2.

6.2.4 If the p.s.e. is not housed in the c.i.e., then manual controls, fuses, calibration elements etc. for disconnection and adjustment of the power sources shall be accessible only by the use of a tool or key.

6.2.5 All manual controls, fuses, calibration elements and cable terminals shall be clearly labelled (e.g. to indicate their function, rating or reference to appropriate drawings).

6.2.6 If mandatory indicators required by ISO 7240-2 are repeated on a separately housed p.s.e., then the indicators shall be in accordance with ISO 7240-2.

6.3 Electrical design

6.3.1 All outputs shall have appropriate power limitations in order to ensure that in case of external short circuits no danger exists because of heat production.

6.3.2 The p.s.e. shall have safety characteristics in accordance with IEC 60950-1 for protection against direct and indirect contact, for the separation of the extra low voltage d.c. circuits from the low voltage a.c. circuits and for earthing of metal parts.

6.4 Power supply interface

Where the p.s.e. is designed to be used with c.i.e. contained in a remote separate cabinet, then an interface shall be provided for at least two transmission paths to the c.i.e., such that a short circuit or interruption in one path does not prevent the supply of power.

7 Documentation

7.1 User documentation

The manufacturer shall prepare installation and user documentation which shall be submitted to the testing authority together with the p.s.e. This shall comprise at least the following:

a) a general description of the p.s.e.;

b) technical specifications of the inputs and outputs of the p.s.e. sufficient to permit an assessment of the mechanical and electrical compatibility with other components of the system (according to ISO 7240-1), including

   1) power requirements for recommended operation,

   2) the maximum and minimum electrical ratings for each input and output,

   3) information on the communication parameters employed by the transmission paths,

   4) fuse ratings,

   5) the types and the maximum and minimum capacities of the batteries suitable for use with the p.s.e., and

   6) the maximum current drawn from the battery by the p.s.e. when the main power source is disconnected;

c) installation information, including

   1) the suitability for use in various environments,

   2) mounting instructions, and

   3) instructions for connecting inputs and outputs;

d) commissioning instructions;

e) operating instructions;

f) maintenance information.

7.2 Design documentation

The manufacturer shall prepare design documentation, which shall be submitted to the testing authority together with the p.s.e. This documentation shall include drawings, parts lists, circuit diagrams, block diagrams and a functional description such that the compliance with the requirements of this part of ISO 7240 can be checked and that a general assessment of the mechanical and electrical design is possible.

8 Marking

The p.s.e. shall be clearly marked with the following information:

a) the number of this part of ISO 7240 (i.e. ISO 7240-4);

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

c) the type number or other designation of the p.s.e.;

d) the code or number identifying the production period of the p.s.e.

If the p.s.e. is housed in its own cabinet, then at least a), b) and c) shall be marked on the outside of this cabinet.

If the p.s.e. is integrated with other fire detection and alarm system equipment in a common cabinet, then at least a) and b) shall be marked on the outside of the common cabinet.

9 Tests

9.1 General

9.1.1 Standard atmospheric conditions for testing

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

Temperature: 15°C to 35°C.

Relative humidity: 25 % to 75 %.

Air pressure: 86 kPa to 106 kPa.

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

9.1.2 Mounting and orientation

Unless otherwise stated in a test procedure, the specimen shall be mounted in its normal orientation by the normal means of mounting indicated by the manufacturer.

9.1.3 Electrical connection

If the test procedure requires the specimen to be operating, then, unless otherwise specified,

— it shall be connected to the main power source and to a standby power source of an appropriate capacity for the test, and

— the output or outputs shall be loaded corresponding to the maximum continuous current ($I_{a,\,max}$).

NOTE For integrated p.s.e., the loading corresponding to $I_{a,\,max}$ is the condition of the equipment with maximum internal power dissipation and output loading that can be expected to occur continuously.

9.2 Functional tests (see Table 1)

9.2.1 General

9.2.1.1 For integrated p.s.e., the loading corresponding to $I_{b,\,max}$ is the condition of the equipment with the maximum internal power dissipation and output loading that can be expected to occur for a short duration in which battery charging is not required.

9.2.1.2 If the equivalent of $I_{b,\,max}$ is not specified by the manufacturer, the condition equivalent to $I_{a,\,max}$ shall be applied.

9.2.1.3 For integrated p.s.e., the loading corresponding to I_{min} is the condition of the equipment with the minimum internal power dissipation and minimum output loading.

9.2.2 Full functional test

9.2.2.1 Procedure for non-integrated p.s.e.

The test consists of all nine tests with voltage combinations and output current, in accordance with Table 1.

During Tests 1 and 2, measure and record the output voltages and the temperatures of the components with high power dissipation (e.g. transformers, rectifiers and voltage regulators).

If $I_{b,\,max}$ is not specified by the manufacturer, $I_{a,\,max}$ shall be applied.

During Tests 3 to 9, measure and record the output voltages.

In addition, during Tests 7 and 8, measure and record the ripple voltage.

The ripple measurement shall include the switching frequency in the case of a switch mode technology p.s.e.

Table 1 — Functional tests

Test	Mains supply voltage	State of battery [a]	Output current load	Purpose of test	Duration of test
1	V_n + 10 %	Discharged [b]	$I_{a,\,max}$	Performance within specification and no overheating	4 h
2	V_n – 15 %	Discharged [b]	$I_{a,\,max}$	Performance within specification and no overheating	4 h
3	V_n – 15 %	Discharged [b]	$I_{b,\,max}$	output voltage within specification	5 min
4	Disconnected	Final voltage [c]	$I_{b,\,max}$		
5	V_n – 15 %	Replaced by short circuit [d]	$I_{b,\,max}$		
6	V_n – 15 %	Replaced by short circuit [e]	$I_{b,\,max}$		
7	V_n + 10 %	Disconnected	$I_{b,\,max}$		
8	V_n – 15 %	Disconnected	$I_{b,\,max}$		
9	V_n + 10 %	Fully charged	I_{min}		

[a] The state of the battery may be simulated by the use of a power supply which provides equivalent performance to a battery. This includes the ability to source and sink current.

[b] A battery of max. specified capacity discharged to its final voltage as described in 9.3.1.1. The battery is allowed to charge during the test.

[c] Supplied by a laboratory power supply capable of supplying the required output current.

[d] Mains shall be applied after having replaced the battery by a short circuit.

[e] Replace the battery by a short circuit after the mains is applied.

9.2.2.2 Requirements for non-integrated p.s.e.

In Tests 1 up to 9, the output voltage shall remain within manufacturer's specification.

In Tests 1 and 2, the surface temperatures shall not exceed the maximum temperature given by the p.s.e. manufacturer [see (6.1)].

In Tests 7 and 8, the ripple on the p.s.e. output voltage shall not exceed the manufacturer's specification.

9.2.2.3 Procedure for integrated p.s.e.

The test shall consist of all nine tests, with the voltage combinations and condition equivalent to $I_{a,\,max}$ as in 9.1.3 and equivalent to $I_{b,\,max}$ as in 9.2.1.1.

Monitor the specimen during the tests to check that the function or functions stay within the manufacturer's specifications.

Measure and record the temperature of the components with high power dissipation.

During Tests 3 to 9, monitor that the function or functions stay within the specification.

9.2.2.4 Requirements for integrated p.s.e.

In Tests 1 to 9, the function or functions shall stay within manufacturer's specification.

In Tests 1 and 2, the surface temperature shall not exceed the maximum temperature given by the p.s.e. manufacturer.

9.2.3 Reduced functional test

9.2.3.1 Procedure for non-integrated p.s.e.

The tests consist of Test 8 and Test 9 in accordance with Table 1. The output voltages and test results shall be measured and recorded, except in Test 8 where the ripple voltage need not to be measured.

9.2.3.2 Requirements for non-integrated p.s.e.

The output voltage or voltages shall remain within the range specified by the p.s.e. manufacturer.

9.2.3.3 Procedure for integrated p.s.e.

The test consists of Tests 8 and 9 in accordance with Table 1. Monitor the specimen during the tests to check that the function or functions stay within specification.

9.2.3.4 Requirement for integrated p.s.e.

The function or functions shall remain within the manufacturer's specification.

9.3 Test of the charger and the standby power source

9.3.1 Test procedure

9.3.1.1 Where applicable, use a battery of maximum capacity and discharge the battery to its final voltage at a discharge rate specified by the p.s.e. manufacturer.

9.3.1.2 Charge the battery for 72 h with the appropriate charger connected to the nominal mains voltage (V_n) while the p.s.e. output is loaded by $I_{a,\,max}$.

This current value should be specified by the p.s.e. manufacturer.

9.3.1.3 Repeat the procedure according to 9.3.1.1 and measure the discharge time (T_1) in hours.

9.3.1.4 Charge the battery again for 24 h at V_n – 15 % while the p.s.e. output is loaded by $I_{a,\,max}$.

This current value should be specified by the p.s.e. manufacturer.

9.3.1.5 Discharge the battery again to its final voltage at a discharge current as in 9.3.1.1 and measure the discharge time (T_2) in hours.

9.3.2 Requirements

The product of the discharge time T_1 and the discharge current specified by the p.s.e. manufacturer shall be not less than the rated capacity of the battery.

The product of the discharge time T_2 and the discharge current specified by the p.s.e. manufacturer shall be not less than 80 % of the rated battery capacity.

9.4 Environmental tests

9.4.1 General

One, two or three specimens may be supplied for environmental testing.

If the p.s.e. is housed within the c.i.e., then the environmental tests described in Clause 16 of ISO 7240-2:—[1)] shall be carried out. However, the functional tests required by 9.4.5 of this part of ISO 7240 shall be carried out in addition to the functional tests required by ISO 7240-2.

If the p.s.e. is housed separately from the c.i.e., then the tests according to Table 2 shall be applied.

Table 2 — Environmental tests

Test	Operational or endurance	Clause number
Cold	Operational	9.5
Damp heat, steady state	Operational	9.6
Impact	Operational	9.7
Vibration, sinusoidal	Operational	9.8
Electromagnetic compatibility (EMC) immunity tests	Operational	9.9
Damp heat, steady state	Endurance	9.10
Vibration, sinusoidal	Endurance	9.11

9.4.2 Tests for one specimen

If a single specimen is supplied for environmental testing, the specimen shall be subjected to all the operational tests, which may be carried out in any order. After the operational tests, the endurance tests shall be carried out on the same specimen in any order.

9.4.3 Tests for two specimens

If two specimens are supplied for environmental testing, then the first test specimen shall be subjected to all the operational tests, which may be carried out in any order, followed by one of the endurance tests. The second specimen shall be subjected to the other endurance test.

9.4.4 Tests for three specimens

If three specimens are supplied for environmental testing, then one test specimen shall be subjected to all the operational tests, which may be carried out in any order. The second specimen shall be subjected to one of the endurance tests and the third specimen to the other.

9.4.5 Selection of functional tests

A functional test shall be carried out before, after and, when required, *during* the conditioning of each environmental test, in accordance with the test procedures. For each specimen, the initial functional test

(before the conditioning of the first environmental test, on that specimen) and the final functional test (after the conditioning of the last environmental test, on that specimen) shall both be the full functional test according to 9.2.2; intermediate functional tests shall be the reduced functional test according to 9.2.3.

The functional test after the conditioning of one environmental test may be taken as the functional test before the conditioning of the next environmental test.

9.4.6 Requirements

When subjected to functional testing, each specimen shall satisfy the requirements of 9.2.1.

The output voltage or voltages measured during conditioning shall comply with the manufacturer's specification.

9.5 Cold (operational)

9.5.1 Object of test

The object of the test is to demonstrate the ability of the equipment to function correctly at low ambient temperatures appropriate to the anticipated service environment.

9.5.2 Test procedure

9.5.2.1 General

Perform the test procedures with gradual changes in temperature according to IEC 60068-2-1. Use test Ad for heat-dissipating specimens (in accordance with IEC 60068-2-1) and test Ab for non-heat-dissipating specimens.

9.5.2.2 Initial examination

Before conditioning, subject the specimen to the functional test in accordance with 9.4.5.

9.5.2.3 State of specimen during conditioning

Mount the specimen in accordance with 9.1.2, connect it in accordance with 9.1.3 and ensure it is operating.

9.5.2.4 Conditioning

Apply the following severity of conditioning.

Temperature: 0 °C ±3 °C or other minimum rated temperature

Duration: 16 h

9.5.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period to check that output voltages are within specification. During the last hour of the conditioning period, subject the specimen to the reduced functional test.

9.5.2.6 Final measurements

After the recovery period, subject the specimen to the functional test according to 9.4.5 and inspect it visually for mechanical damage both externally and internally.

9.6 Damp heat, steady-state (operational)

9.6.1 Object of test

The object of the test is to demonstrate the ability of the equipment to function correctly at the high relative humidities (without condensation) that can occur for short periods in the service environment.

9.6.2 Test procedure

9.6.2.1 General

Perform the test procedure according to IEC 60068-2-3.

9.6.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 9.4.5.

9.6.2.3 State of specimen during conditioning

Mount the specimen in accordance with 9.1.2, connect it in accordance with 9.1.3 and ensure it is operating.

9.6.2.4 Conditioning

Apply the following severity of conditioning.

Temperature: 40 °C ± 2 °C

Relative humidity: $93\ ^{+2}_{-3}$ %

Duration: 4 d

Precondition the specimen at the conditioning temperature (40 °C ± 2 °C) until temperature stability has been reached to prevent the formation of water droplets on the specimen.

9.6.2.5 Measurements during conditioning

Monitor the specimen during the conditioning period to check that output voltages are within the specifications. During the last hour of the conditioning period, subject the specimen to the reduced functional test.

9.6.2.6 Final measurements

After the recovery period, subject the specimen to the functional test according to 9.4.5 and inspect it visually for mechanical damage both externally and internally.

9.7 Impact (operational) — Optional test

9.7.1 Object of test

The object of the test is to demonstrate the immunity of the equipment to the mechanical impacts upon the surface that can be sustained in the normal service environment and which the equipment can reasonably be expected to withstand.

9.7.2 Test procedure

9.7.2.1 General

Use the test apparatus and perform the test procedure in accordance with IEC 60068-2-75.

9.7.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 9.4.5.

9.7.2.3 State of specimen during conditioning

Mount the specimen in accordance with 9.1.2, connect it in accordance with 9.1.3 and ensure it is operating.

9.7.2.4 Conditioning

Apply impacts to all surfaces of the specimen which are accessible without special tools.

For all such surfaces, apply three blows to any point or points considered likely to cause damage to or impair the operation of the specimen.

Care should be taken to ensure that the results from a series of three blows do not influence subsequent series.

Where there is any doubt, disregard the defect and apply a further three blows to the same position on a new specimen.

Apply the following severity of conditioning.

Impact energy: $0{,}5 \pm 0{,}04$ J

Number of impacts per point: 3

9.7.2.5 Measurements during conditioning

Monitor the specimen during the conditioning periods to ensure that output voltages remain within the specifications; ensure that results of three blows do not influence subsequent series.

9.7.2.6 Final measurements

After the recovery period, subject the specimen to the functional test according to 9.4.5 and inspect it visually for mechanical damage both externally and internally.

9.8 Vibration, sinusoidal (operational) — Optional test

9.8.1 Object of test

The object of the test is to demonstrate the immunity of the equipment to vibrations at levels appropriate to the service environment.

9.8.2 Test procedure

9.8.2.1 General

Perform the test procedure according to IEC 60068-2-6.

The vibration operational test may be combined with the vibration endurance test, so that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in each axis.

9.8.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 9.4.5.

9.8.2.3 State of specimen during conditioning

Mount the specimen in accordance with 9.1.2 and IEC 60068-2-47, connect it in accordance with 9.1.3 and ensure it is operating.

9.8.2.4 Conditioning

Subject the specimen to vibration in each of the three mutually perpendicular axes, one of which is perpendicular to the plane of mounting of the specimen, in turn.

Apply the following severity of conditioning.

Frequency range:	10 Hz to 150 Hz
Acceleration amplitude:	0,981 ms^{-2} (0,1 g_n)
Number of axes:	3
Number of sweep cycles per axis:	1 for each functional condition

9.8.2.5 Measurements during conditioning

Monitor the specimen during the conditioning periods to check that output voltages stay within specification.

9.8.2.6 Final measurements

After the recovery period, subject the specimen to the functional test according to 9.4.5 and inspect it visually for mechanical damage both externally and internally.

9.9 Electromagnetic compatibility (EMC), Immunity tests (operational)

9.9.1 The following EMC immunity tests shall be carried out in accordance with EN 50130-4:

a) mains supply voltage variations;

b) mains supply voltage dips and interruptions;

c) electrostatic discharge;

d) radiated electromagnetic fields;

e) conducted disturbances induced by electromagnetic fields;

f) fast transient bursts;

g) slow high energy voltage surges.

9.9.2 For the tests of 9.9.1, the criteria for compliance according to EN 50130-4 and the following shall apply.

a) The functional test, called for in the initial and final measurements, shall be the reduced functional test in accordance with 9.2.3.2 and 9.2.3.4.

b) The required operating condition shall be in accordance with 9.1.3.

c) The connections to the various inputs and outputs shall be made with unscreened cables unless the manufacturer's installation data specifies that only screened cables may be used.

d) In the electrostatic discharge test, the discharges shall be applied to parts of the equipment accessible for manual operations by authorized users.

e) In the fast transient burst test, the transients shall be applied to the a.c. mains lines by the direct injection method, and to the other inputs, signal, data and control lines by the capacitive clamp method.

9.10 Damp heat, steady state (endurance)

9.10.1 Object of test

The object of the test is to demonstrate the ability of the equipment to withstand the long-term effects of humidity in the service environment (changes in electrical properties due to absorption, chemical reactions involving moisture, galvanic corrosion etc.).

9.10.2 Test procedure

9.10.2.1 General

Perform the test procedure according to IEC 60068-2-3.

9.10.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 9.4.5.

9.10.2.3 State of the specimen during conditioning

Mount the specimen in accordance with 9.1.2. Do *not* supply the specimen with power during the conditioning.

9.10.2.4 Conditioning

Apply the following severity of conditioning.

Temperature: 40 °C ± 2 °C

Relative humidity: $93\ ^{+2}_{-3}$ %

Duration: 21 days

Pre-condition the specimen at the conditioning temperature (40 °C ± 2 °C) until temperature stability has been reached, in order to prevent the formation of water droplets on the specimen.

9.10.2.5 Final measurement

After conditioning, subject the specimen to the functional test according to 9.4.5. and inspect it visually for mechanical damage both externally and internally.

9.11 Vibration, sinusoidal (endurance) — Optional test

9.11.1 Object of test

The object of the test is to demonstrate the ability of the equipment to withstand the long-term effects of vibration at levels appropriate to the environment.

9.11.2 Test procedure

9.11.2.1 General

Perform the test procedure according to IEC 60068-2-6.

The vibration endurance test may be combined with the vibration operational test, so that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in each axis in turn.

9.11.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 9.4.5.

9.11.2.3 State of the specimen during conditioning

Mount the specimen in accordance with 9.1.2 and IEC 60068-2-47. Do *not* supply the specimen with power during the conditioning.

9.11.2.4 Conditioning

Subject the specimen to vibration in each of the three mutually perpendicular axes, one of which is perpendicular to the plane of mounting of the specimen, in turn.

Apply the following severity of conditioning.

Frequency range: 10 Hz to 150 Hz

Acceleration amplitude: 4,905 ms^{-2} (0,5 g_n)

Number of axes: 3

Number of sweep cycles: 20 per axis

9.11.2.5 Final measurement

After conditioning, subject the specimen to the functional test according to 9.4.5 and inspect it visually for mechanical damage both externally and internally.

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