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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

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Foreword

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

This second edition cancels and replaces the first edition (ISO 7240-4:2003), which has been technically revised.

The main changes compared to the previous edition are as follows:

— this document has been reformatted and modified to comply with the current ISO structure for standards;

— a reference has been made to power ratings in place of current ratings as this is better with custom and practice of product specifications; however, it is expected that these new values can be derived from previous test results quoted in voltage and current;

— the time limits for notification of some PSU faults have been added;

— an optional dry heat, (operational) test has been added.

A list of all the parts in the ISO 7240 series can be found on the ISO website.

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Introduction

This document is based on ISO 7240-4:2003.

The power supply function (see ISO 7240-1:2014, Figure 1, item L), within a fire detection and alarm system (FDAS) installed in and around buildings, is provided by power supply equipment (PSE). The PSE provides power to all parts of the FDAS, either by direct connection or through one function to another function.

This document is drafted on the basis of mandatory functions, which are to be provided on all the PSE and optional functions (with requirements) which may be provided. It is intended that the options be used for specific applications and to meet the fire detection and alarm system design objectives. Each optional function is included as a separate entity, with its own set of associated requirements, in order to permit the PSE with different combinations of functions to comply with this document. Other functions associated with fire detection and fire alarm may also be provided, even if not specified in this document.

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Fire detection and alarm systems —

Part 4:
Power supply equipment

1 Scope

This document specifies requirements, test methods and performance criteria for power supply equipment (PSE) for use in fire detection and alarm systems installed in buildings.

For the testing of other types of the PSE, this document is intended to be used only for guidance. The PSE with special characteristics, developed for specific risks, are not covered in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 7240-1:2014, *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: Tests. Tests A: cold*

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

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

IEC 60721-3-3:1994, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities —Section 3: Stationary use and weatherprotected locations*

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

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

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4 Symbols and abbreviated terms

4.1 Symbols

$P_{a,\,max}$ rated maximum output power that can be supplied continuously

$P_{b,\,max}$ rated maximum output power higher than $P_{a,\,max}$ that can be supplied while battery charging is not required

$P_{c,\,max}$ rated maximum output power higher which can be supplied by the standby power source

P_{min} minimum output power specified by the manufacturer

V_n nominal mains voltage of the public electricity supply

4.2 Abbreviated terms

FDAS fire detection and alarm system

FDCIE fire detection control and indicating equipment

PSE power supply equipment

5 Requirements

5.1 General

5.1.1 The PSE 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 DC circuits from the low voltage AC circuits and for earthing of metal parts.

5.1.2 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.

5.2 Compliance

5.2.1 In order to comply with this document, the PSE shall meet the following requirements.

a) Clause 5, which shall be verified by visual inspection or engineering assessment, shall be tested in accordance with Clause 6 and shall meet the requirements of the tests.

b) Clauses 8 and 9, shall be verified by visual inspection.

5.2.2 If an optional function with requirements is included in the PSE, then all the corresponding requirements shall be met.

5.2.3 If functions other than those specified in this document are provided, they shall not jeopardize compliance with any requirement of this document.

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5.3 Power sources

5.3.1 General

5.3.1.1 There shall be at least two power sources for the power supply of the FDAS: the main power source and the standby power source.

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

5.3.1.3 Switching from one power source to the other shall not cause any change in status or indications within other equipment of the FDAS, other than those relating to the power supply.

5.3.1.4 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 FDAS.

NOTE The compatibility of the separated PSE with the other equipment, for example, FDCIE, is dealt with in ISO 7240-13.

5.3.2 Main power source

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

5.3.2.2 When the main power source is available, it shall be the exclusive source of power to the FDAS, except for currents associated with battery monitoring.

5.3.2.3 If the main power source fails, then the PSE shall automatically switch over to a standby power source. When the main power source is restored, the PSE shall automatically switch back to the main power source.

5.3.2.4 When operated from the main power source, the following shall apply.

a) The PSE 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 PSE shall be capable of continuously supplying $P_{a,\,max}$ and simultaneously charging a battery discharged to its final voltage.

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

5.3.3 Standby power source

5.3.3.1 At least one standby power source shall be a rechargeable battery.

5.3.3.2 When operated from the standby power source, the PSE shall be capable of operating in accordance with the specification given in the manufacturer's data. The PSE shall be capable of supplying $P_{c,\,max}$, irrespective of the condition of the main power source, and with an internal resistance of the battery and its associated circuitry, e.g. connections, fuses (see 6.4) equal to $R_{i,\,max}$.

NOTE Standby periods and alarm periods for specific applications are specified in ISO 7240-14 and ISO 7240-19, or other national design and installation standards where they take precedence.

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5.3.3.3 The battery 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.

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

5.3.3.5 When operating from a standby power source, the PSE shall have a facility to switch off the PSE output if the output voltages or the voltage of the battery falls below a value specified by the PSE manufacturer.

5.4 Charger

5.4.1 The PSE shall include charging equipment to charge the battery and maintain it in a fully charged state.

5.4.2 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 thereafter be maintained at its float voltage at least after another 48 h, and

— the charging characteristics are within the battery manufacturer's specification for the range of battery temperatures reached with the ambient temperature (i.e. outside the standby power source enclosure) from –5 °C to +40 °C.

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

5.5 Faults

5.5.1 The PSE shall be capable of recognizing and signalling the following faults:

a) a loss of the main power source within 90 min of the occurrence;

b) loss of the standby power source within 1 min of the occurrence;

c) if batteries can be damaged by deep charge, the PSE shall have a facility to protect the batteries against deep charge. In this case, reduction of the battery voltage to less than the final voltage when the main power source is unavailable shall signal a fault. Manufacturers may signal a fault at a higher voltage, depending on the battery requirements or other factors (such as maximizing life expectancy);

d) loss of the battery charging voltage within 90 min of the occurrence, except where the charger is switched off or limited as under 5.3.2.4 c);

e) the battery impedance shall be monitored as described in 6.4 and a fault warning signal given within 4 h of the occurrence of a high battery impedance.

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5.5.2 If the PSE is separately housed from other functions of the FDAS (ISO 7240-1:2014, Figure 1), then at least a fault output common to the faults listed in 5.5.1 shall be provided. This output shall also be given if the PSE is de-energized.

5.5.3 If the PSE is housed within the cabinet of other equipment within the FDAS (e.g. FDCIE), then the faults listed in 5.5.1 shall be indicated in accordance with the requirements of the other equipment, either on the equipment or on the PSE itself.

5.6 Mechanical

5.6.1 The cabinet of the PSE shall be of robust construction, consistent with the method of installation recommended in the documentation. It shall meet at least the classification IP 30 of IEC 60529.

5.6.2 The PSE may be housed either in a separate cabinet or in cabinets associated with other FDAS equipment.

5.6.3 If the PSE is housed in the cabinet of other equipment within the FDAS (e.g. FDCIE), then manual controls, fuses, calibration elements, etc. for disconnection and adjustment of the power sources shall be accessible only by persons who are trained and authorized to maintain or repair the PSE in accordance with the manufacturer's published instructions and data.

NOTE This corresponds to Access Level 3 or 4 as defined in ISO 7240-2 and ISO 7240-16.

5.6.4 If the PSE is not housed in the cabinet of other equipment within the FDAS (e.g. FDCIE), 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.

5.6.5 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).

5.6.6 If mandatory indicators required by other equipment within the FDAS (e.g. FDCIE) are repeated on a separately housed the PSE, then the indicators shall be in accordance with the requirements of the relevant equipment.

5.7 Power supply interface

Where the PSE directly supplies power to functions of the FDAS and is not housed in the same cabinet as the other equipment, then an interface shall be provided for at least two transmission paths to the other equipment, such that a short circuit or interruption in one path does not prevent the supply of power.

5.8 Software

5.8.1 General

The PSE may contain elements which are controlled by software in order to fulfil requirements of this document. In this case, the PSE shall comply with the requirements of 5.8 where relevant to the technology used.

5.8.2 Program monitoring

5.8.2.1 The execution of the program shall be monitored to prevent the occurrence of a deadlock in the system. The monitoring device shall signal a system fault if routines associated with the main functions of the program are not executed within a time limit of 100 s.

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5.8.2.2 The functioning of the monitoring device and the signalling of a fault warning shall not be prevented by a failure in the execution of the program of the monitored system.

5.8.2.3 If an execution failure as in 5.8.2.1 is detected, the PSE shall enter a safe state within 100 s. This safe state shall be defined by the manufacturer.

The safe state should be defined by the manufacturer and should not give a false impression to a user that the PSE remains operational if it is not. In practice, it may be acceptable either to stop or automatically restart the program execution. If there is a possibility that the memory may have been corrupted, the restart procedure should check the contents of this memory and, if necessary, re-initialize the running data to ensure that the PSE enters a safe operating state. Even if program execution is successfully restarted, it is important that the user be made aware of the incident. For this reason, it could be advantageous for the PSE to be capable of automatically recording details of the restart event.

5.8.2.4 The monitoring device shall use the highest priority feature provided to enter the safe state of 5.8.2.3 (e.g. the highest priority non-maskable interrupt).

5.8.3 Storage of programs and data

5.8.3.1 All executable code and data necessary to comply with this document shall be held in memory which is capable of continuous, unmaintained, reliable operation for a period of at least 10 years.

NOTE In the existing state of the art, memory with moving mechanical parts is not believed to be sufficiently reliable. The use of tapes, or magnetic or optical data discs, for the storage of programs and data is therefore not considered to be acceptable at the time of publication.

5.8.3.2 The program shall be held in non-volatile memory. Each memory device shall be identifiable such that its contents can be uniquely cross-referenced to the software documentation.

5.8.4 Monitoring of memory contents

The contents of the memories containing the program shall be automatically checked at intervals not exceeding 1 h. The checking device shall signal a system fault if a corruption of the memory contents is detected.

6 Tests

6.1 General

6.1.1 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:

a) temperature: 15 °C to 35 °C;

b) relative humidity: 25 % to 75 %;

c) 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.

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6.1.2 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.

6.1.3 Electrical connection

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

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

b) the output or outputs shall be loaded corresponding to the maximum continuous power ($P_{a,\,max}$), and

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

c) all inputs and outputs shall be connected to cables, equipment and/or dummy loads as specified by the manufacturer.

6.2 Functional tests

6.2.1 The object of test

The object of the functional test is to demonstrate the operation of the equipment before, during and/or after the environmental conditioning.

6.2.2 Test schedule

6.2.2.1 The functional tests are shown in Table 1.

Table 1 — Functional tests

Test	Mains supply voltage	Condition of battery	Loading condition	Purpose of test	Duration of test
1	V_n[a] + 10 %	Discharged[b]	$P_{a,\,max}$	Performance within specification, no overheating	4 h
2	V_n − 15 %	Discharged[b]	$P_{a,\,max}$	Performance within specification, no overheating	4 h
3	V_n − 15 %	Discharged[b]	$P_{b,\,max}$[c]	Output voltage at manufacturers specification	within 5 min
4	Disconnected	Discharging[d]	$P_{b,\,max}$[c]	—	—

a V_n is nominal voltage of the public electricity supply or equivalent.

b A battery of max. specified capacity discharged to its final voltage as described in 6.3.1.1. The battery is allowed to charge during the test.

c For integrated PSE, the loading corresponding to $P_{b,\,max}$ is the condition of the equipment with the maximum internal power dissipation and output loading that can be expected to occur while battery charging is not required. If the equivalent of $P_{b,\,max}$ is not specified by the manufacturer, the condition equivalent to $P_{a,\,max}$ shall be applied.

d In this test, the battery may be replaced with a laboratory power supply capable of supplying the required output current. The output voltage of the power supply shall be gradually reduced from the fully charged voltage of the battery to the voltage at which the PSE outputs switch off as described in 5.3.3.5.

e Mains shall be applied after having replaced the battery by a short circuit.

f Replace the battery by a short circuit after the mains is applied.

g A battery charged to its fully charged voltage.

h For integrated PSE, the loading corresponding to P_{min} is the condition of the equipment with the minimum internal power dissipation and minimum output loading.

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Table 1 *(continued)*

Test	Mains supply voltage	Condition of battery	Loading condition	Purpose of test	Duration of test
5	V_n − 15 %	Replaced by short circuit[e]	$P_{a, max}$	—	—
6	V_n − 15 %	Replaced by short circuit[f]	$P_{a, max}$	—	—
7	V_n + 10 %	Disconnected	$P_{b, max}$[c]	—	—
8	V_n − 15 %	Disconnected	$P_{b, max}$[c]	—	—
9	V_n + 10 %	Fully charged[g]	P_{min}[h]	—	—

[a] V_n is nominal voltage of the public electricity supply or equivalent.

[b] A battery of max. specified capacity discharged to its final voltage as described in 6.3.1.1. The battery is allowed to charge during the test.

[c] For integrated PSE, the loading corresponding to $P_{b, max}$ is the condition of the equipment with the maximum internal power dissipation and output loading that can be expected to occur while battery charging is not required. If the equivalent of $P_{b, max}$ is not specified by the manufacturer, the condition equivalent to $P_{a, max}$ shall be applied.

[d] In this test, the battery may be replaced with a laboratory power supply capable of supplying the required output current. The output voltage of the power supply shall be gradually reduced from the fully charged voltage of the battery to the voltage at which the PSE outputs switch off as described in 5.3.3.5.

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

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

[g] A battery charged to its fully charged voltage.

[h] For integrated PSE, the loading corresponding to P_{min} is the condition of the equipment with the minimum internal power dissipation and minimum output loading.

6.2.3 Full functional test

6.2.3.1 Object of the test

The object of the full functional test is to demonstrate that the PSE complies with the requirements in 5.3, 5.4 and 5.7.

6.2.3.2 Procedure for non-integrated PSE

6.2.3.2.1 Conduct all nine tests with voltage combinations and output current, in accordance with Table 1.

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

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

6.2.3.2.4 During tests 7 and 8, measure and record the ripple voltage, including the switching frequency in the case of a switch mode technology PSE.

6.2.3.3 Requirements for non-integrated PSE

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

6.2.3.3.2 In tests 1 and 2, the surface temperatures of the components shall not exceed the maximum temperature given by the PSE manufacturer [see 9.1 b)].

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6.2.3.3.3 In tests 7 and 8, the ripple on the PSE output voltage shall not exceed the manufacturer's specification.

6.2.3.4 Procedure for integrated PSE

6.2.3.4.1 Conduct all nine tests in accordance with Table 1, with the voltage combinations and condition equivalent to $P_{a,\,max}$ as in 6.1.3 b) and equivalent to $P_{b,\,max}$.

6.2.3.4.2 Monitor the specimen during the tests to check that the functions of the equipment within which the PSE is integrated stay within the manufacturer's specifications.

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

6.2.3.4.4 During tests 3 to 9, monitor that the functions of the equipment within which the PSE is integrated stay within the specification.

6.2.3.5 Requirements for integrated PSE

6.2.3.5.1 In tests 1 to 9, the functions of the equipment within which the PSE is integrated shall stay within the manufacturer's specification.

6.2.3.5.2 In tests 1 and 2, the surface temperature of the components shall not exceed the maximum temperature given by the PSE manufacturer.

6.2.4 Reduced functional test

6.2.4.1 Object of the test

The object of the reduced functional test is to demonstrate that the PSE operates correctly before, after or during (if specified) each of the tests specified in 6.5.

6.2.4.2 Procedure for non-integrated PSE

For non-integrated PSE, the test consists of tests 8 and 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 be measured.

6.2.4.3 Requirements for non-integrated PSE

For non-integrated PSE, the output voltages shall remain within the range specified by the PSE manufacturer.

6.2.4.4 Procedure for integrated PSE

For integrated PSE, the test consists of tests 8 and 9 in accordance with Table 1. Monitor the specimen during the tests to check that the functions of the equipment within which the PSE is integrated stay within specification.

6.2.4.5 Requirement for integrated PSE

For integrated PSE, the functions of the equipment within which the PSE is integrated shall remain within the manufacturer's specification.

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6.3 Charger and the standby power source test

6.3.1 Test procedure

6.3.1.1 Use a battery of maximum capacity. Discharge the battery to its final voltage at a discharge current of $I_d = C/20$ amperes for lead acid type batteries, or $I_d = C/10$ amperes for nickel cadmium type batteries, where C is the rated ampere hour capacity of the battery given by the battery manufacturer. For other battery types, the discharge current shall be that for which the battery manufacturer specifies the rated capacity.

6.3.1.2 Charge the battery for 72 h with the appropriate charger connected to the nominal mains voltage, V_n, while the PSE output is loaded by $P_{a,\,max}$.

6.3.1.3 Repeat the procedure according to 6.3.1.1 and measure the discharge time, T_1, in hours.

6.3.1.4 Charge the battery again for 24 h at V_n – 15 % while the PSE output is loaded by $P_{a,\,max}$.

6.3.1.5 Discharge the battery again to its final voltage at a discharge current as in 6.3.1.1 and measure the discharge time, T_2, in hours.

6.3.2 Requirements

6.3.2.1 The product of the discharge time, T_1, and the discharge current, I_d, shall be not less than the rated capacity of the battery, C.

6.3.2.2 The product of the discharge time, T_2, and the discharge current, I_d, shall be not less than 80 % of the rated battery capacity, C.

6.4 High battery impedance test

6.4.1 Object of test

The object of the test is to demonstrate the ability of the equipment to detect and provide a fault warning in the event of battery high internal impedance.

6.4.2 General

Conduct the test procedure according 6.4.3 for non-integrated PSE and 6.4.5 for integrated PSE.

6.4.3 Test procedure for non-integrated PSE

6.4.3.1 Mount the specimen in accordance with 6.1.2.

6.4.3.2 Connect the PSE as shown in Figure 1 with

— a fully charged battery of maximum capacity,

— mains power input of nominal voltage, V_n,

— R_i set to 0 ohm, and

— R_L adjusted to give $P_1 = P_{min}$.

6.4.3.3 Adjust R_L to the specified $R_{i\,Max}$.

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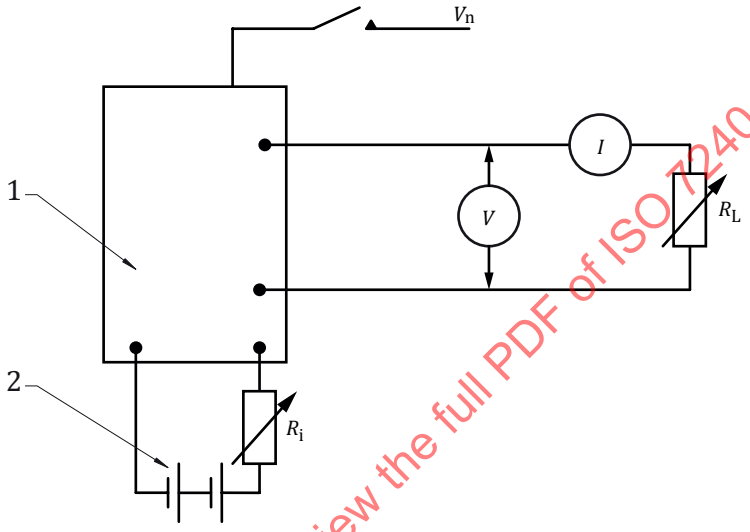
NOTE $R_{i\ Max}$ is specified by the PSE manufacturer for the purpose of the test. It is intended to simulate the maximum internal resistance of the battery and its associated circuitry, e.g. connections, fuses.

6.4.3.4 Monitor the PSE for up to 4 h to detect a fault signal.

6.4.3.5 Disconnect the mains supply.

6.4.3.6 Adjust R_L to give $P = P_{c,\ max}$.

6.4.3.7 Measure the output voltages, V, for 2 min.



Key

1 PSE

2 battery

Figure 1 — Circuit arrangement for non-integrated PSE

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6.4.4 Requirements for integrated PSE

6.4.4.1 For 6.4.3.4, a fault warning shall be indicated within 4 h.

6.4.4.2 For 6.4.3.7, the output voltages shall remain within the specifications.

6.4.5 Test procedure for integrated PSE

6.4.5.1 Mount the specimen in accordance with 6.1.2.

6.4.5.2 Connect the PSU as shown in Figure 2 with

— a fully charged battery of maximum capacity,

— mains power input of nominal voltage, V_n,

— R_i set to 0 ohm, and

— the equipment in the condition with minimum internal power dissipation and minimal output load.

6.4.5.3 Adjust R_i to the specified $R_{i\ max}$.

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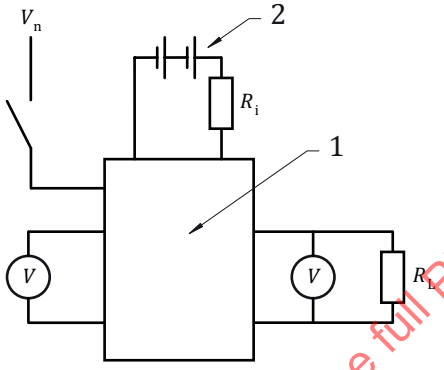
6.4.5.4 Monitor the equipment for up to 4 h to detect a fault signal.

6.4.5.5 Disconnect the mains supply.

6.4.5.6 Place the equipment in the condition with the maximum internal power dissipation and maximum output load (equivalent to $P_{c,\,max}$).

NOTE $R_{i\,max}$ is specified by the PSE manufacturer for the purpose of the test. It is intended to simulate the maximum internal resistance of the battery and its associated circuitry, e.g. connections and fuses, and to check that the fault warning is given with an internal resistance of the battery chosen by the manufacturer where the battery is still in the condition to operate the system.

6.4.5.7 Measure the output voltages for 2 min.



Key

1 PSE integrated with FDCIE

2 battery

Figure 2 — Circuit arrangement for integrated PSE

6.4.6 Requirements for integrated PSE

6.4.6.1 For 6.4.5.4, a fault warning shall be indicated within 4 h.

6.4.6.2 For 6.4.5.7, the output voltages shall remain within the specifications.

6.5 Environmental tests

6.5.1 General

65.1.1 One or more specimens may be supplied for environmental testing.

6.5.1.2 If the PSE is housed within the cabinet of other equipment forming the FDAS (e.g. ISO 7240-2 for the FDCIE), then the environmental tests of the relevant equipment standard shall be conducted. However, the functional test required by 6.2.3 and 6.2.4 of this document shall be conducted in addition to the functional test of the other relevant standards.

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6.5.1.3 If the PSE is housed separately from other equipment or housed within equipment for which there is no standard, then the tests according to Table 2 shall be applied.

Table 2 — Environmental tests

Test	Operational or endurance	Subclause number
Cold	Operational	6.6
Damp heat, steady state	Operational	6.7
Impact — Optional test	Operational	6.8
Vibration, sinusoidal — Optional test	Operational	6.9
Electromagnetic compatibility (EMC) immunity tests	Operational	6.10
Damp heat, steady state	Endurance	6.11
Vibration, sinusoidal — Optional test	Endurance	6.12
Dry heat — Optional test	Endurance	6.13

6.5.2 Tests for one specimen

6.5.2.1 If a single specimen is supplied for environmental testing, subject the specimen to all of the tests, which may be carried out in any order. Conduct the full functional test (see 6.2.3) before and after the series of environmental tests. Conduct the reduced functional test (see 6.2.4) before, during (if specified) and after each environmental test.

6.5.2.2 The reduced functional test after one environmental test may be taken as the reduced functional test before the next environmental test.

6.5.3 Tests for more than one specimen

6.5.3.1 If more than one specimen is supplied for environmental testing, divide the tests between the specimens and conduct the tests in any order. Conduct the full functional test (see 6.2.3) on one specimen before the series of environmental tests, and on each of the specimens after the last environmental test on that specimen.

6.5.3.2 Conduct the reduced functional test (see 6.2.4) before, during, (if specified) and after each environmental test.

6.5.3.3 For each specimen, the reduced functional test after one environmental test may be taken as the reduced functional test before the next environmental test.

6.5.4 Requirements

6.5.4.1 When subjected to the functional test, each specimen shall satisfy the relevant requirements in 6.2.3 or 6.2.4.

6.5.4.2 Any mechanical damage to the specimen observed following tests 6.6 to 6.12 shall not jeopardize any mandatory function of this document.

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6.6 Cold (operational)

6.6.1 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.

6.6.2 Test procedure

6.6.2.1 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, and 6.6.2.2 to 6.6.2.6.

6.6.2.2 Initial examination

Before conditioning, subject the specimen to the functional test in accordance with 6.2.4.

6.6.2.3 State of specimen during conditioning

Mount the specimen in accordance with 6.1.2, connect it in accordance with 6.1.3 and ensure it is operating.

6.6.2.4 Conditioning

Apply the following severity of conditioning:

a) temperature: −5 °C ± 3 °C; or other lower temperature as specified by the manufacturer;

b) duration: 16 h.

6.6.2.5 Measurements during conditioning

6.6.2.5.1 Monitor the specimen during the conditioning period to check that output voltages are within specification.

6.6.2.5.2 During the last hour of the conditioning period, subject the specimen to the reduced functional test.

6.6.2.6 Final measurements

After the recovery period, subject the specimen to the functional test according to 6.2.4 and inspect it visually for mechanical damage both externally and internally.

6.6.3 Requirements

6.6.3.1 All mandatory functions and optional functions claimed by the manufacturer shall operate according to the requirements of this document.

6.6.3.2 No mechanical damage shall be apparent on the specimen.

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6.7 Damp heat, steady-state (operational)

6.7.1 Object of test

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

6.7.2 Test procedure

6.7.2.1 General

Conduct the test procedure according to IEC 60068-2-78 and 6.7.2.2 to 6.7.2.6.

6.7.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 6.2.4.

6.7.2.3 State of specimen during conditioning

Mount the specimen in accordance with 6.1.2, connect it in accordance with 6.1.3 and ensure it is operating.

6.7.2.4 Conditioning

6.7.2.4.1 Apply the following severity of conditioning:

a) temperature: 40 °C ± 2 °C;

b) relative humidity: 93^{+2}_{-3} %;

c) duration: 4 d.

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

6.7.2.5 Measurements during conditioning

6.7.2.5.1 Monitor the specimen during the conditioning period to check that output voltages are within the specifications.

6.7.2.5.2 During the last hour of the conditioning period, subject the specimen to the reduced functional test.

6.7.2.6 Final measurements

After the recovery period, subject the specimen to the functional test according to 6.2.4 and inspect it visually for mechanical damage both externally and internally.

6.7.3 Requirements

6.7.3.1 All mandatory functions and optional functions claimed by the manufacturer shall operate according to the requirements of this document.

6.7.3.2 No mechanical damage shall be apparent on the specimen.

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6.8 Impact (operational) — Optional test

6.8.1 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.

6.8.2 Test procedure

6.8.2.1 General

Use the test apparatus and perform the test procedure in accordance with IEC 60068-2-75 and 6.8.2.2 to 6.8.2.6.

6.8.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 6.2.4.

6.8.2.3 State of specimen during conditioning

Mount the specimen in accordance with 6.1.2, connect it in accordance with 6.1.3 and ensure it is operating.

6.8.2.4 Conditioning

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

6.8.2.4.2 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.

6.8.2.4.3 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 further three blows to the same position on a new specimen.

6.8.2.4.4 Apply the following severity of conditioning:

a) impact energy: 0,5 ± 0,04 J;

b) number of impacts per point: 3.

6.8.2.5 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.

6.8.2.6 Final measurements

After the recovery period, subject the specimen to the functional test according to 6.2.4 and inspect it visually for mechanical damage both externally and internally.

6.8.3 Requirements

6.8.3.1 All mandatory functions and optional functions claimed by the manufacturer shall operate according to the requirements of this document.

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6.8.3.2 No mechanical damage shall be apparent on the specimen.

6.9 Vibration, sinusoidal (operational) — Optional test

6.9.1 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.

6.9.2 Test procedure

6.9.2.1 General

6.9.2.1.1 Conduct the test procedure according to IEC 60068-2-6 and 6.9.2.2 to 6.9.2.6.

6.9.2.1.2 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.

6.9.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 6.2.4.

6.9.2.3 State of specimen during conditioning

Mount the specimen in accordance with 6.1.2 and IEC 60068-2-47, connect it in accordance with 6.1.3 and ensure it is operating.

6.9.2.4 Conditioning

6.9.2.4.1 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.

If the PSE consists of modules that are designed to be installed in a floor mounting rack, the test may be carried out on the individual modules separately.

6.9.2.4.2 Apply the following severity of conditioning:

a) frequency range: 10 Hz to 150 Hz;

b) acceleration amplitude: 0,981 m/s^2 (0,1 g_n);

c) number of axes: 3;

d) number of sweep cycles per axis: 1 for each functional condition.

6.9.2.5 Measurements during conditioning

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

6.9.2.6 Final measurements

After the recovery period, subject the specimen to the functional test according to 6.2.4 and inspect it visually for mechanical damage both externally and internally.

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6.9.3 Requirements

6.9.3.1 All mandatory functions and optional functions claimed by the manufacturer shall operate according to the requirements of this document.

6.9.3.2 No mechanical damage shall be apparent on the specimen.

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

6.10.1 Conduct the following EMC immunity tests in accordance with IEC 62599-2:

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, with a repetition rate of 100 kHz;

g) slow high energy voltage surges.

6.10.2 For the tests of 6.10.1, the criteria for compliance according to IEC 62599-2 and the following shall apply.

a) The functional test, called for in the initial and final measurements, shall be as required in 6.2.4.

b) The required operating condition shall be in accordance with 6.1.3.

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.

6.11 Damp heat, steady state (endurance)

6.11.1 Object of test

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

6.11.2 Test procedure

6.11.2.1 General

Conduct the test procedure according to IEC 60068-2-78 and 6.11.2.2 to 6.11.2.5.

6.11.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 6.2.4.

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6.11.2.3 State of the specimen during conditioning

Mount the specimen in accordance with 6.1.2 and connects loads and meters as required in 6.1.3. Do not supply the specimen with power during the conditioning.

6.11.2.4 Conditioning

6.11.2.4.1 Apply the following severity of conditioning:

a) temperature: 40 °C ± 2 °C;

b) relative humidity: 93^{+2}_{-3} %;

c) duration: 21 days.

6.11.2.4.2 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.

6.11.2.5 Final measurement

After conditioning, subject the specimen to the functional test according to 6.2.4 and inspect it visually for mechanical damage both externally and internally.

6.11.3 Requirements

6.11.3.1 All mandatory functions and optional functions claimed by the manufacturer shall operate according to the requirements of this document.

6.11.3.2 No mechanical damage shall be apparent on the specimen.

6.12 Vibration, sinusoidal (endurance) — Optional test

6.12.1 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.

6.12.2 Test procedure

6.12.2.1 General

6.12.2.1.1 Perform the test procedure according to IEC 60068-2-6 and 6.12.2.2 to 6.12.2.5.

6.12.2.1.2 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.

6.12.2.2 Initial examination

Before conditioning, subject the specimen to the functional test according to 6.2.4.

6.12.2.3 State of the specimen during conditioning

Mount the specimen in accordance with 6.1.2 and IEC 60068-2-47. Do not supply the specimen with power during the conditioning.

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