IEC 62133

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

**Secondary cells and batteries containing alkaline or other non-acid electrolytes –
Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications**

Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Exigences de sécurité pour les accumulateurs portables étanches, et pour les batteries qui en sont constituées, destinés à l'utilisation dans des applications portables

IEC 62133:2012

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SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES –

SAFETY REQUIREMENTS FOR PORTABLE SEALED SECONDARY CELLS, AND FOR BATTERIES MADE FROM THEM, FOR USE IN PORTABLE APPLICATIONS

FOREWORD

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International Standard IEC 62133 has been prepared by subcommittee 21A: Secondary cells and batteries containing alkaline or other non-acid electrolytes, of IEC technical committee 21: Secondary cells and batteries.

This second edition cancels and replaces the first edition published in 2002. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

– update of assembly of cells into batteries (5.5);
– addition of design recommendations for lithium system only (5.6.2);
– separation of nickel systems and lithium systems (Clause 6);

– addition of specific requirements and tests for lithium systems (Clause 8);
– addition of charging of secondary lithium-ion cells for safe use (Annex A).

The text of this standard is based on the following documents:

FDIS	Report on voting
21A/503/FDIS	21A/509/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The following difference exists in the countries indicated below:

Subclause 8.3.9: Design evaluation – Forced internal short circuit only applies to Korea, Japan, Switzerland and France.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The contents of the corrigendum of June 2013 have been included in this copy.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES –

SAFETY REQUIREMENTS FOR PORTABLE SEALED SECONDARY CELLS, AND FOR BATTERIES MADE FROM THEM, FOR USE IN PORTABLE APPLICATIONS

1 Scope

This International Standard specifies requirements and tests for the safe operation of portable sealed secondary cells and batteries (other than button) containing alkaline or other non-acid electrolyte, under intended use and reasonably foreseeable misuse.

2 Normative references

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

IEC 60050-482, *International Electrotechnical Vocabulary – Part 482: Primary and secondary cells and batteries*

IEC 61951-1, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Portable sealed rechargeable single cells – Part 1: Nickel-cadmium*

IEC 61951-2, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Portable sealed rechargeable single cells – Part 2: Nickel-metal hydride*

IEC 61960, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-482 and ISO/IEC Guide 51, as well as the following apply.

3.1
safety
freedom from unacceptable risk

3.2
risk
a combination of the probability of occurrence of harm and the severity of that harm

3.3
harm
physical injury or damage to the health of people or damage to property or to the environment

3.4
hazard
potential source of harm

3.5
intended use
use of a product, process or service in accordance with specifications, instructions and information provided by the supplier

3.6
reasonably foreseeable misuse
use of a product, process or service in a way which is not intended by the supplier, but which may result from readily predictable human behaviour

3.7
secondary cell
basic manufactured unit providing a source of electrical energy by direct conversion of chemical energy, that consists of electrodes, separators, electrolyte, container and terminals, and that is designed to be charged electrically

3.8
secondary battery
assembly of secondary cell(s) ready for use as a source of electrical energy characterized by its voltage, size, terminal arrangement, capacity and rate capability

3.9
leakage
visible escape of liquid electrolyte

3.10
venting
release of excessive internal pressure from a cell/battery in a manner intended by design to preclude rupture or explosion

3.11
rupture
mechanical failure of a cell container or battery case induced by an internal or external cause, resulting in exposure or spillage but not ejection of materials

3.12
explosion
failure that occurs when a cell container or battery case opens violently and major components are forcibly expelled

3.13
fire
the emission of flames from a cell or battery

3.14
portable battery
a battery for use in a device or appliance which is conveniently hand carried

3.15
portable cell
a cell intended for assembly in a portable battery

3.16
polymer cell
cell using gel polymer electrolyte or solid polymer electrolyte, not liquid electrolyte

3.17
rated capacity
quantity of electricity C_5 Ah (ampere-hours) declared by the manufacturer which a single cell can deliver when discharged at the reference test current of 0,2 I_t A to a specified final voltage, after charging, storing and discharging under specified conditions

3.18
upper limit charging voltage
the highest charging voltage in the cell operating region specified by the cell manufacturer

3.19
maximum charging current
the maximum charging current in the cell operating region which is specified by the cell manufacturer

4 Parameter measurement tolerances

The overall accuracy of controlled or measured values, relative to the specified or actual parameters, shall be within these tolerances.

a) ± 1 % for voltage;

b) ± 1 % for current;

c) ± 2 °C for temperature;

d) ± 0,1 % for time;

e) ± 1 % for dimension;

f) ± 1 % for capacity.

These tolerances comprise the combined accuracy of the measuring instruments, the measurement techniques used, and all other sources of error in the test procedure.

For assistance in selecting instrumentation see IEC 60051 series for analogue instruments and IEC 60485 for digital instruments. The details of the instrumentation used shall be provided in any report of results.

5 General safety considerations

5.1 General

The safety of secondary cells and batteries requires the consideration of two sets of applied conditions:

- intended use;
- reasonably foreseeable misuse.

Cells and batteries shall be so designed and constructed that they are safe under conditions of both intended use and reasonably foreseeable misuse. It is expected that cells or batteries subjected to misuse may fail to function following such experience. They shall not however present significant hazards. It may also be expected that cells and batteries subjected to intended use shall not only be safe but shall continue to be functional in all respects.

Potential hazards which are the subject of this standard are:

a) fire,

b) burst/explosion,

c) leakage of cell electrolyte,

d) venting,

e) burns from excessively high external temperatures,

f) rupture of battery case with exposure of internal components.

Conformity with 5.2 to 5.7 is checked by inspection, by the tests of Clauses 7 and 8, and in accordance with the appropriate standard (see Clause 2).

5.2 Insulation and wiring

The insulation resistance between the positive terminal and externally exposed metal surfaces of the battery excluding electrical contact surfaces shall be not less than 5 MΩ at 500 V d. c. when measured 60 s after applying the voltage.

Internal wiring and its insulation shall be sufficient to withstand the maximum anticipated current, voltage and temperature requirements. The orientation of wiring shall be such that adequate clearances and creepage distances are maintained between connectors. The mechanical integrity of internal connections shall be sufficient to accommodate conditions of reasonably foreseeable misuse.

5.3 Venting

Battery cases and cells shall incorporate a pressure relief mechanism or shall be so constructed that they will relieve excessive internal pressure at a value and rate that will preclude rupture, explosion and self-ignition. If encapsulation is used to support cells within an outer case, the type of encapsulant and the method of encapsulation shall neither cause the battery to overheat during normal operation nor inhibit pressure relief.

5.4 Temperature/voltage/current management

The design of batteries shall be such that abnormal temperature-rise conditions are prevented. Batteries shall be designed to be within temperature, voltage and current limits specified by the cell manufacturer. Batteries shall be provided with specifications and charging instructions for equipment manufacturers so that associated chargers are designed to maintain charging within the temperature, voltage and current limits specified.

NOTE Where necessary, means can be provided to limit current to safe levels during charge and discharge.

5.5 Terminal contacts

Terminals shall have clear polarity marking on the external surface of the battery. The size and shape of the terminal contacts shall ensure that they can carry the maximum anticipated current. External terminal contact surfaces shall be formed from conductive materials with good mechanical strength and corrosion resistance. Terminal contacts shall be arranged so as to minimize the risk of short circuits.

NOTE Exception: Battery packs with keyed external connectors designed for connection to specific end products need not be marked with polarity markings if the design of the external connector prevents reverse polarity connections.

5.6 Assembly of cells into batteries

5.6.1 General

If there is more than one battery housed in a single battery case, cells used in the assembly of each battery shall have closely matched capacities, be of the same design, be of the same

chemistry and be from the same manufacturer. Each battery shall have an independent control and protection. Manufacturers of cells shall make recommendations about current, voltage and temperature limits so that the battery manufacturer/designer may ensure proper design and assembly. Batteries that are designed for the selective discharge of a portion of their series connected cells shall incorporate separate circuitry to prevent the cell reversal caused by uneven discharges. Protective circuit components should be added as appropriate and consideration given to the end-device application. When testing a battery, the manufacturer of the battery shall provide a test report confirming the compliance according to this standard. Conformity shall be checked by inspection.

5.6.2 Design recommendation for lithium systems only

The voltage of each cell, or each cellblock consisting of parallel-connected plural cells, should not exceed the upper limit of the charging voltage specified in Table 4, excepting the case where the portable electronic devices or the likes have the equivalent function.

The following should be considered at the battery pack level and by the device designer:

- for the battery consisting of a single cell or a single cellblock, it is recommended that the charging voltage of the cell does not exceed the upper limit of the charging voltage specified in Table 4;
- for the battery consisting of series-connected plural single cells or series-connected plural cellblocks, it is recommended that the voltages of any one of the single cells or single cellblocks does not exceed the upper limit of the charging voltage, specified in Table 4, by monitoring the voltage of every single cell or the single cellblocks;
- for the battery consisting of series-connected plural single cells or series-connected plural cellblocks, it is recommended that charging is stopped when the upper limit of the charging voltage is exceeded for any one of the single cells or single cellblocks by measuring the voltage of every single cell or the single cellblocks.

5.7 Quality plan

The manufacturer shall prepare and implement a quality plan that defines procedures for the inspection of materials, components, cells and batteries and which covers the whole process of producing each type of cell or battery. Manufacturers should understand their process capabilities and should institute the necessary process controls as they relate to product safety.

6 Type test conditions

Tests are made with the number of cells or batteries specified in Table 1 for nickel-cadmium and nickel-metal hydride systems and Table 2 for lithium systems, using cells or batteries that are not more than six months old. Unless otherwise specified, tests are carried out in an ambient temperature of 20 °C ± 5 °C.

NOTE Test conditions are for type tests only and do not imply that intended use includes operation under these conditions. Similarly, the limit of six months is introduced for consistency and does not imply that battery safety is reduced after six months.

Table 1 – Sample size for type tests (nickel systems)

Test	Cell	Battery
7.2.1 Low rate charging	5	–
7.2.2 Vibration	5	5
7.2.3 Moulded case stress	–	3
7.2.4 Temperature cycling	5	5
7.3.1 Incorrect Installation	5 sets of 4	–
7.3.2 External short circuit	5 /Temperature	5 /Temperature
7.3.3 Free fall	3	3
7.3.4 Mechanical shock	5	5
7.3.5 Thermal abuse	5	–
7.3.6 Crush	5 (10 for prismatic)	–
7.3.7 Low pressure	3	–
7.3.8 Overcharge	5	5
7.3.9 Forced discharge	5	–

Table 2 – Sample size for type tests (lithium systems)

Test	Cell	Battery
8.1.2 Charge (Procedure 2)	5/Temp/Condition	5/Temp/Condition
8.2.1 Continuous charge	5	-
8.2.2 Moulded case stress	-	3
8.3.1 External short circuit	5/Temp	-
8.3.2 External short circuit	–	5/Temp
8.3.3 Free fall	3	3
8.3.4 Thermal abuse	5/Temp	-
8.3.5 Crush	5/Temp	-
8.3.6 Overcharge	-	5
8.3.7 Forced Discharge	5	-
8.3.8 Transport	(20)	-
8.3.9 Forced Internal Short [a]	10	-
[a] Country specific test : only required for listed countries.		

7 Specific requirements and tests (nickel systems)

7.1 Charging procedure for test purposes

Unless otherwise stated in this standard, the charging procedure for test purposes is carried out in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer.

Prior to charging, the battery shall have been discharged at 20 °C ± 5 °C at a constant current of 0,2 I_t A down to a specified final voltage.

Warning: THESE TESTS USE PROCEDURES WHICH MAY RESULT IN HARM IF ADEQUATE PRECAUTIONS ARE NOT TAKEN. TESTS SHOULD ONLY BE PERFORMED BY QUALIFIED AND EXPERIENCED TECHNICIANS USING ADEQUATE PROTECTION. TO PREVENT BURNS, CAUTION SHOULD BE TAKEN FOR THOSE CELLS OR BATTERIES WHOSE CASINGS MAY EXCEED 75 °C AS A RESULT OF TESTING.

7.2 Intended use

7.2.1 Continuous low-rate charging (cells)

a) Requirement

A continuous low-rate charge shall not cause fire or explosion.

b) Test

Fully charged cells are subjected for 28 days to a charge as specified by the manufacturer.

c) Acceptance criteria

No fire, no explosion.

7.2.2 Vibration

a) Requirements

Vibration encountered during transportation shall not cause leakage, fire or explosion.

b) Test

Fully charged cells or batteries are vibration-tested under the following test conditions and the sequence in Table 3. A simple harmonic motion is applied to the cells or batteries with an amplitude of 0,76 mm, and a total maximum excursion of 1,52 mm. The frequency is varied at the rate of 1 Hz/min between the limits of 10 Hz and 55 Hz. The entire range of frequencies (10 Hz to 55 Hz) and return (55 Hz to 10 Hz) is traversed in 90 min ± 5 min for each mounting position (direction of vibration). The vibration is applied in each of three mutually perpendicular directions, in the sequence specified below.

Step 1: Verify that the measured voltage is typical of the charged product being tested.

Steps 2-4: Apply the vibration as specified in Table 3.

Step 5: Rest cell for 1 h, and then make a visual inspection.

c) Acceptance criteria

No fire, no explosion, no leakage.

Table 3 – Conditions for vibration test

Step	Rest time h	Vibration time min	Visual examination
1	–	–	Pre-test
2	–	90 ± 5	–
3	–	90 ± 5	–
4	–	90 ± 5	–
5	1	–	Post-test

7.2.3 Moulded case stress at high ambient temperature (batteries)

a) Requirement

Internal components of batteries shall not be exposed during use at high temperature.

b) Test

Fully charged batteries are exposed to a moderately high temperature to evaluate case integrity. The battery is placed in an air circulating oven at a temperature of 70 °C ± 2 °C. The batteries remain in the oven for 7 h, after which they are removed and allowed to return to room temperature.

c) Acceptance criteria

No physical distortion of the battery case resulting in exposure of internal components.

7.2.4 Temperature cycling

a) Requirements

Repeated exposure to high and low temperatures shall not cause fire or explosion.

b) Test according to the following procedure and the profile shown in Figure 1.

Fully charged cells or batteries are subjected to temperature cycling (–20 °C, +75 °C), in forced draught chambers, according to the following procedure.

Step 1: Place the cells or batteries in an ambient temperature of 75 °C ± 2 °C for 4 h.

Step 2: Change the ambient temperature to 20 °C ± 5 °C within 30 min and maintain at this temperature for a minimum of 2 h.

Step 3: Change the ambient temperature to –20 °C ± 2 °C within 30 min and maintain at this temperature for 4 h.

Step 4: Change the ambient temperature to 20 °C ± 5 °C within 30 min and maintain at this temperature for a minimum of 2 h.

Step 5: Repeat steps 1 to 4 for a further four cycles.

Step 6: After the fifth cycle, store the cells or batteries and check after a rest period of at least 24 h.

NOTE This test can be performed in a single chamber whose temperature is changed or in three separate chambers at three different test temperatures.

c) Acceptance criteria

No fire, no explosion, no leakage.

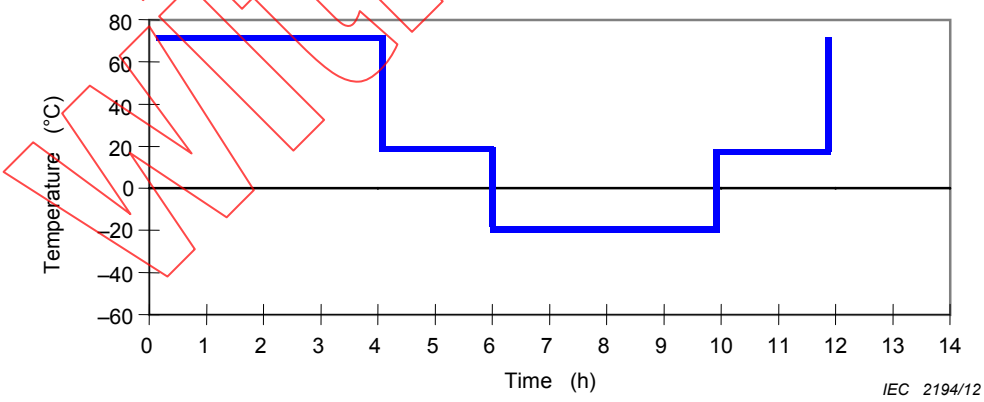

Figure 1 – Temperature profile for 7.2.4 – Temperature cycling test

7.3 Reasonably foreseeable misuse

7.3.1 Incorrect installation (cells)

a) Requirements

The incorrect installation of a single cell in a multi-cell application shall not cause fire or explosion.

b) Test