IEC 62133-2

Edition 1.0 2017-02

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 –
Part 2: Lithium systems

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 –
Partie 2: Systèmes au lithium

IEC 62133-2:2017-02(en-fr)

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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 –

Part 2: Lithium systems

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International Standard IEC 62133-2 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 first edition cancels and replaces the second edition of IEC 62133 published in 2012. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 62133:2012:

– separation of nickel systems into a separate Part 1;
– inclusion of coin cell requirements;

– update of assembly of cells into batteries (5.6);
– mechanical tests [vibration, shock] (7.3.8.1, 7.3.8.2);
– insertion of IEC TR 62914 within the Bibliography.

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

FDIS	Report on voting
21A/620/FDIS	21A/628/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 different practices of a less permanent nature exist in the countries indicated below.

7.3.9: Design evaluation – Forced internal short-circuit test only applies to Korea, Japan, Switzerland and France.

A list of all parts of the IEC 62133 series, published under the general title *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*, can be found on the IEC website.

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

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- withdrawn,
- replaced by a revised edition, or
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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 –

Part 2: Lithium systems

1 Scope

This part of IEC 62133 specifies requirements and tests for the safe operation of portable sealed secondary lithium cells and batteries containing non-acid electrolyte, under intended use and reasonably foreseeable misuse.

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.

IEC 60050-482:2004, *International Electrotechnical Vocabulary – Part 482: Primary and secondary cells and batteries* (available at http://www.electropedia.org)

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, ISO/IEC Guide 51 and the following apply.

3.1
safety
freedom from unacceptable risk

3.2
risk
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) which may include associated safety and control circuits and case, ready for use as a source of electrical energy characterized by its voltage, size, terminal arrangement, capacity and rate capability

Note 1 to entry: Includes single cell batteries.

3.9
leakage
unplanned, visible escape of liquid electrolyte

3.10
venting
release of excessive internal pressure from a cell or 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
emission of flames from a cell or battery

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

3.15
portable cell
cell intended for assembly in a portable battery

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

3.17
rated capacity
capacity value of a cell or battery determined under specified conditions and declared by the manufacturer

Note 1 to entry: The rated capacity is the 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.

[SOURCE: IEC 60050-482:2004, 482-03-15, modified – Note 1 to entry has been added.]

3.18
reference test current
I_t
charge or discharge current expressed as a multiple of I_t A, where I_t A = C_5 Ah/1 h, as defined in IEC 61434, and based on the rated capacity (C_5 Ah) of the cell or battery

3.19
upper limit charging voltage
highest charging voltage in the cell operating region, which is specified by the cell manufacturer

3.20
maximum charging current
maximum charging current in the cell operating region, which is specified by the cell manufacturer

3.21
coin cell
button cell
coin battery
small round cell or battery in which the overall height is less than the diameter

Note 1 to entry: In English, the term “coin cell” or “coin battery” is used for lithium batteries only while the term “button cell” or “button battery” is only used for non-lithium batteries. In languages other than English, the terms “coin” and “button” are often used interchangeably, regardless of the electrochemical system.

[SOURCE: IEC 60050-482:2004 482-02-40, modified — The term “coin battery” has been added, and the NOTE “In practice terms, the term coin is used exclusively for non-aqueous lithium cells.” has been replaced with Note 1 to entry.)]

3.22
cylindrical cell
cell with a cylindrical shape in which the overall height is equal to or greater than the diameter

[SOURCE: IEC 60050-482:2004, 482-02-39]

3.23
prismatic cell
cell having the shape of a parallelepiped whose faces are rectangular

Note 1 to entry: Prismatic cells may be provided with either a rigid metal case or flexible laminate film case.

[SOURCE: IEC 60050-482:2004, 482-02-38, modified – The source term is "prismatic" (adj.). In the definition, "qualifies a cell or a battery" has been replaced with "cell". Note 1 to entry has been added.]

3.24
cell block
parallel connection
arrangement of cells or batteries wherein all the positive terminals and all the negative terminals, respectively, are connected together

[SOURCE: IEC 60050-482:2004, 482-03-39, modified — The term "cell block" has been added.]

3.25
functional safety
part of the overall safety that depends on functional and physical units operating correctly in response to their inputs

[SOURCE: IEC 60050-351:2013, 351-57-06]

3.26
end-of-discharge voltage
final voltage
specified voltage of a battery at which the battery discharge is terminated

[SOURCE: IEC 60050-482:2004, 482-03-30, modified — The terms "cut-off voltage" and "end-point voltage" have been deleted.]

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.

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:

1) intended use;

2) 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 document are:

- fire,
- burst/explosion,
- leakage of cell electrolyte,
- venting,
- burns from excessively high external temperatures,
- rupture of battery case with exposure of internal components.

Conformity with 5.2 to 5.7 for cells and batteries other than coin cells, with an internal resistance greater than 3 Ω, is checked by inspection, by the tests of Clauses 7, and in accordance with the appropriate standard (see Clause 2 and Table 1). The internal resistance is to be measured in accordance with Annex D.

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 DC when measured 60 s after applying the voltage.

Internal wiring and insulation should be sufficient to withstand the maximum anticipated current, voltage and temperature requirements. The orientation of wiring should be such that adequate clearances and creepage distances are maintained between conductors. The mechanical integrity of internal connections should be sufficient to accommodate conditions of reasonably foreseeable misuse (i.e. solder alone is not considered a reliable means of connection.).

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 and 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 as specified by the cell manufacturer. Batteries shall be provided with specifications and charging instructions for equipment manufacturers so that specified chargers are designed to maintain charging within the temperature, voltage and current limits specified.

5.5 Terminal contacts

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-circuit.

5.6 Assembly of cells into batteries

5.6.1 General

Each battery should have an independent control and protection for current, voltage, temperature and any other parameter required for safety and to maintain the cells within their operating region. However this protection may be provided external to the battery such as within the charger or the end devices. If protection is external to the battery, the manufacturer of the battery shall provide this safety relevant information to the external device manufacturer for implementation.

If there is more than one battery housed in a single battery case, each battery should have protective circuitry that can maintain the cells within their operating regions.

Manufacturers of cells shall specify current, voltage and temperature limits so that the battery manufacturer/designer may ensure proper design and assembly (see Annex A).

Batteries that are designed for the selective discharge of a portion of their series connected cells shall incorporate circuitry to prevent operation of cells outside the limits specified by the cell manufacturer.

Protective circuit components should be added as appropriate and consideration given to the end-device application. The manufacturer of the battery should provide a safety analysis of the battery safety circuitry with a test report including a fault analysis of the protection circuit under both charging and discharging conditions confirming the compliance.

5.6.2 Design recommendation

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 2, excepting the case where the portable electronic devices or similar devices have the equivalent function.

The following should be considered at the battery 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 2;
- 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 2, 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.
- For batteries consisting of series-connected cells or cell blocks, nominal charge voltage shall not be counted as an overcharge protection.
- For batteries consisting of series-connected cells or cell blocks, cells should have closely matched capacities, be of the same design, be of the same chemistry and be from the same manufacturer.
- It is recommended that the cells and cell blocks should not be discharged beyond the cell manufacturer’s specified final voltage.
- For batteries consisting of series-connected cells or cell blocks, cell balancing circuitry should be incorporated into the battery management system.

5.6.3 Mechanical protection for cells and components of batteries

Mechanical protection for cells, cell connections and control circuits within the battery should be provided to prevent damage as a result of intended use and reasonably foreseeable misuse. The mechanical protection can be provided by the battery case or it can be provided by the end product enclosure for those batteries intended for building into an end product.

The battery case and compartments housing cells should be designed to accommodate cell dimensional tolerances during charging and discharging as recommended by the cell manufacturer.

For batteries intended for building into a portable end product, testing with the battery installed within the end product should be considered when conducting mechanical tests.

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.

5.8 Battery safety components

See Annex F.

6 Type test and sample size

Tests are made with the number of cells or batteries specified in Table 1 using cells or batteries that are not more than six months old. The internal resistance of coin cells shall be measured in accordance with Annex D. Coin cells with internal resistance less than or equal to 3 Ω shall be tested in accordance with Table 1. 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.