



UL 62133-2

STANDARD FOR SAFETY

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

UL Standard for Safety for 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, UL 62133-2

First Edition, Dated January 10, 2020

Summary of Topics

This revision of ANSI/UL 62133-2 dated May 31, 2024 includes the adoption of IEC 62133-2 Amendment 1, issued by the IEC July 2021: [7.1.2](#), [Table 2](#), [7.3.5](#), [7.3.6](#), [Table 5](#) and [Table F.1](#).

This revision also includes an update to Clause [DVF](#) and [Table DVF.1](#)

The first edition of UL 62133-2 reflects the latest approval date as an American National Standard and is an adoption of IEC 62133-2, First Edition, issued by the IEC February 2017. Please note that the National Difference document incorporates all of the U.S. national differences for UL 62133-2.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated December 15, 2023.

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CSA C22.2 No. 62133-2:20
First Edition
(IEC 62133-2:2017, MOD)



ULSE Inc.
UL 62133-2
First Edition

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

January 10, 2020

(Title Page Reprinted: May 31, 2024)

This national standard is based on publication IEC 62133-2, First Edition (February 2017) and IEC Amendment 1 (July 2021).



ANSI/UL 62133-2-2024



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This ANSI/UL Standard for Safety consists of the First Edition including revisions through May 31, 2024.

The most recent designation of ANSI/UL 62133-2 as an American National Standard (ANSI) occurred on May 31, 2024. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

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Preface

This is the harmonized CSA Group and UL standard for 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. It is the first edition of CSA C22.2 No. 62133-2, and the first edition of UL 62133-2. This edition of CSA C22.2 No. 62133-2 replaces CAN/CSA-C22.2 No. 62133:17 (adopted IEC 62133:2012), 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. This edition of UL 62133-2 replaces the second edition UL 62133, 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, published September 5, 2017. This harmonized standard has been jointly revised on May 31, 2024. For this purpose, CSA Group and ULSE are issuing revision pages dated May 31, 2024.

This harmonized standard is based on IEC Publication 62133-2+AMD1:2021, Edition 1.1 (Edition 1:2017 consolidated with Amendment 1:2021), 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, issued July 2021. IEC 62133-2 is copyrighted by the IEC.

This harmonized standard was prepared by CSA Group and ULSE. The efforts and support of the International Harmonization Committee for 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 are gratefully acknowledged.

This Standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This Standard was reviewed by the CSA Subcommittee on Batteries and Battery Systems, under the jurisdiction of the CSA Technical Committee on General Requirements, CE Code, Part II and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of Harmonization

This Standard adopts the IEC text with national differences.

This Standard is published as an identical standard for CSA Group and ULSE.

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

All national differences from the IEC text are included in the CSA Group and ULSE versions of the standard. While the technical content is the same in each organization's version, the format and presentation may differ.

Reasons for Differences From IEC

National differences from the IEC are being added in order to address editorial, component, safety and regulatory situations present in the US and Canada.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

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For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication 62133-2, 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, copyright 2021, are used in this Standard with the consent of the International Electrotechnical Commission. The IEC Foreword is not a part of the requirements of this standard but is included for information purposes only.

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NATIONAL DIFFERENCES

In the CSA Group and ULSE publications of this Standard, National Differences from the text of International Electrotechnical Commission (IEC) Publication 62133-2, 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, copyright 2021, are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

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Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 62133-2 edition 1.1 contains the first edition (2017-02) [documents 21A/620/FDIS and 21A/628/RVD] and its amendment 1 (2021-07) [documents 21A/760/FDIS and 21A/729B/RVD].

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 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.

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 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.

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.

DV.1 DE Modification to add the following to the IEC Foreword:

The numbering system in the standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

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.

1DV.1 D1 *Modification to add the following paragraph and note to Clause 1:*

This standard is not, by itself, generally suitable for the evaluation of the safety of end-products, as it lacks specific requirements regarding charging, the effect of normal loads, abnormal conditions that should be considered, and the physical and electromagnetic stresses encountered in the anticipated environment of the end-product.

NOTE Battery packs with additional features or circuitry, including integral circuitry that facilitates charging, are considered to be end-products.

1DV.2 DR *Modification to add the following paragraph to Clause 1 (Canada only):*

This standard deals with the covered components used in accordance with CAN/CSA-C22.2 No. 0.

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*

2DV.1 DR *Modification to add the following to Clause 2 (Canada only):*

CAN/CSA-C22.2 No. 0, *General Requirements – Canadian Electrical Code, Part II*

2DV.2 D1 Modification to add the following to Clause 2:

CAN/CSA-C22.2 No. 0.17, Evaluation of Properties of Polymeric Materials

UL 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

2DV.3 DC Modification to add the following to Clause 2 (US only):

UL 1642, Lithium Batteries

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_L 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) $\pm 1\%$ for voltage;
- b) $\pm 1\%$ for current;
- c) $\pm 2\text{ }^{\circ}\text{C}$ for temperature;
- d) $\pm 0,1\%$ for time;
- e) $\pm 1\%$ for dimension;
- f) $\pm 1\%$ 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 M Ω 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.