UL 62133-1

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 1: Nickel 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 1: Nickel Systems, UL 62133-1

First Edition, Dated January 10, 2020

Summary of Topics

This reaffirmation of ANSI/UL 62133-1 dated January 28, 2025 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

UL 62133-1 is an adoption of IEC 62133-1, 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 62133-1.

As noted in the Commitment for Amendments statement located on the back side of the title page, ULSE and CSA are committed to updating this harmonized standard jointly. However, the revision pages dated January 28, 2025 will not be jointly issued by ULSE and CSA as these revision pages only address UL ANSI approval dates.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated November 15, 2024.

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CSA Group
CSA C22.2 No. 62133-1:20
First Edition
(IEC 62133-1:2017, MOD)

ULSE Inc.
UL 62133-1
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 1: Nickel Systems

January 10, 2020

(Title Page Reprinted: January 28, 2025)

This national standard is based on publication IEC 62133-1, First Edition (2017).

ANSI/UL 62133-1-2020 (R2025)

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as "CSA Group") and ULSE Inc. (ULSE). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or ULSE at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and ULSE. CSA Group and ULSE will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. The technical content of IEC and ISO publications is kept under constant review by IEC and ISO. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

To purchase CSA Group Standards and related publications, visit CSA Group's Online Store at ?>www.csagroup.org/store/ or call toll-free 1-800-463-6727 or 416-747-4044.

This ANSI/UL Standard for Safety consists of the First Edition including revisions through January 28, 2025.

The most recent designation of ANSI/UL 62133-1 as a Reaffirmed American National Standard (ANS) occurred on January 28, 2025. 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.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

For information on ULSE Standards, visit https://www.shopulstandards.com, call toll free 1-888-853-3503 or email us at ClientService@shopULStandards.com.

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Preface

This is the harmonized CSA Group and ULSE 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 1: Nickel Systems. It is the first edition of CSA C22.2 No. 62133-1, and the first edition of UL 62133-1. This edition of CSA C22.2 No. 62133-1 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 62133-1 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 is based on IEC Publication 62133-1: 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 1: Nickel Systems, issued February 2017. IEC 62133-1 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.

IEC Copyright

For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication 62133-1, 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 1: Nickel Systems, copyright 2017, 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.

NATIONAL DIFFERENCES

In the CSA Group and UL publications of this standard, National Differences from the text of International Electrotechnical Commission (IEC) Publication 62133-1, 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 1: Nickel Systems, copyright 2017, 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.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

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 1: Nickel 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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6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

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.

International Standard IEC 62133-1 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 lithium systems into a separate Part 2;

– inclusion of button cell requirements.

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

FDIS	Report on voting
21A/619/FDIS	21A/627/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.

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

• 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 1: Nickel systems

1 Scope

This part of IEC 62133 specifies requirements and tests for the safe operation of portable sealed secondary nickel cells and batteries containing alkaline 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 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*

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 2054, ***Household and Commercial 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.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

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
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 – In the definition, "battery" has been replaced with "cell or battery". Note 1 to entry has been added.]

3.17
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

3.18
button cell
coin cell
cell with a cylindrical shape in which the overall height is less than the diameter, e.g. in the shape of a button or a coin

Note 1 to entry: In practice, the term coin is used exclusively for non-aqueous lithium cells.

[SOURCE: IEC 60050-482:2004, 482-02-40]

3.19
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]

3.20
prismatic cell
cell having the shape of a parallelepiped whose faces are rectangular

[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".]

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 button cells is checked by inspection, by the tests of Clauses 7, and in accordance with the appropriate standard (see Clause 2 and Table 1).

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 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.

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

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 circuits.

5.6 Assembly of cells into batteries

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. The battery shall have some type of safety device or feature for charging.

Manufacturers of cells shall specify 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 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. When testing a battery, the manufacturer of the battery should provide a test report confirming the compliance according to this document.

5.6DV.1 D1 *Modification to add the following to Clause 5.6:*

For products where no end-product standard requirements exist, printed wiring boards and outer moulded battery cases shall be flammability rated a minimum of V-1 in accordance with CAN/CSA-C22.2 No. 0.17 or UL 94.

5.6DV.2 DC *Modification to add the following to Clause 5.6 (US only):*

Batteries shall be constructed of:

a) Cells meeting the requirements of this standard; or

b) Cells in compliance with the requirements of UL 2054.

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.

5.8DV DC *Addition of Clause 5.8DV.1 for component standards:*

5.8DV.1 Battery safety components

5.8DV.1.1 See Annex DVA.

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. 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

Test	Cell [a]	Battery
7.2.1 Low rate charging	5	–
7.2.2 Vibration	5	5
7.2.3 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 per temperature	5 per 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	–

[a] – not applicable to button cells

7 Specific requirements and tests

7.1 Charging procedure for test purposes

Unless otherwise stated in this document, 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 2. 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.

Table 2
Conditions for vibration test

Step	Axes of vibration	Frequency Hz	Vibration time min	Rest time h	Visual examination
1	–	–	–	–	Pre-test
2	X	10 to 55	90 ± 5	–	–

Table 2 Continued on Next Page

Table 2 Continued

Step	Axes of vibration	Frequency Hz	Vibration time min	Rest time h	Visual examination
3	Y	10 to 55	90 ± 5	–	–
4	Z	10 to 55	90 ± 5	–	–
5	–	–	–	1	Post-test
NOTE The sequence of Step 2 through Step 4 can be interchanged.					

Step 1: Verify that the measured voltage is typical of the charged product being tested.
Steps 2 to 4: Apply the vibration as specified in Table 2.

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

c) Acceptance criteria

No fire, no explosion, no leakage.

7.2.3 Case stress at high ambient temperature (batteries)

a) Requirement

Internal components of batteries shall not be exposed during use at high temperature. This requirement only applies to batteries with a moulded case.

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 protective components and cells.

7.2.4 Temperature cycling

a) Requirements

Repeated exposure to high and low temperatures shall not cause leakage, 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. Transition from Step 4 to Step 1 within 30 min.

Step 6: After the fifth cycle, store the cells or batteries and conduct a visual 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.

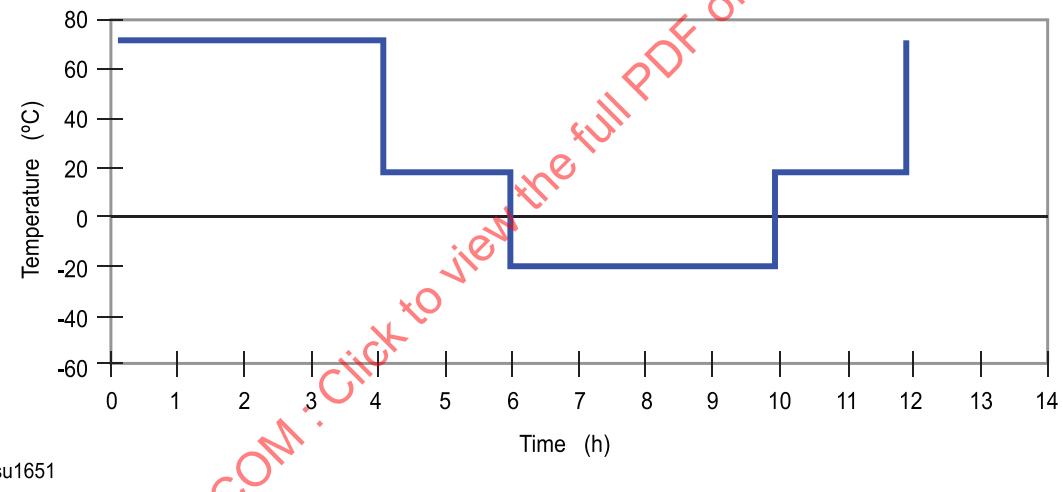


Figure 1

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

Fully charged cells are evaluated under conditions in which one of the cells is incorrectly installed. Four fully charged single cells of the same brand, type, size and age are connected in series with one of the four cells reversed. The resultant assembly is connected across a resistor of 1 Ω until

the vent opens or until the temperature of the reversed cell returns to ambient temperature. Alternatively, a stabilized DC power supply can be used to simulate the conditions imposed on the reversed cell.

c) Acceptance criteria

No fire, no explosion.

7.3.2 External short circuit

a) Requirements

Short-circuiting of the positive and negative terminals shall not cause fire or explosion.

b) Test

Two sets of fully charged cells or batteries are stored in an ambient temperature of 20 °C ± 5 °C and 55 °C ± 5 °C, respectively, when the samples reach temperature balance with the ambient temperature. The cell or battery is then short-circuited by connecting the positive and negative terminals with a total external resistance of 80 mΩ ± 20 mΩ. The cells or batteries remain on test for 24 h or until the case temperature declines by 20 % of the maximum temperature rise, whichever is the sooner.

c) Acceptance criteria

No fire, no explosion.

7.3.3 Free fall

a) Requirements

Dropping a cell or battery (for example, from a bench top) shall not cause fire or explosion.

b) Test

Each fully charged cell or battery is dropped three times from a height of 1,0 m onto a concrete floor. The cells or batteries are dropped so as to obtain impacts in random orientations. After the test, the sample shall be put on rest for a minimum of 1 h and then a visual inspection shall be performed.

c) Acceptance criteria

No fire, no explosion.

7.3.4 Mechanical shock (crash hazard)

a) Requirements

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

b) Test

The fully charged cell or battery is secured to the testing machine by means of a rigid mount which will support all mounting surfaces of the cell or battery. The cell or battery is subjected to a total of three shocks of equal magnitude. The shocks are applied in each of three mutually perpendicular directions. At least one of them shall be perpendicular to a flat face.

For each shock the cell or battery is accelerated in such a manner that during the initial 3 ms the minimum average acceleration is 735 m/s^2 (75 g_n). The peak acceleration shall be between 1 226 m/s^2 (125 g_n) and 1 716 m/s^2 (175 g_n). Cells or batteries are tested in an ambient temperature of 20 °C ± 5 °C. After the test, the sample shall be put on rest for a minimum of 1 h and then a visual inspection shall be performed.

c) Acceptance criteria

No fire, no explosion, no leakage.

7.3.5 Thermal abuse (cells)

a) Requirements

An extremely high temperature shall not cause fire or explosion.

b) Test

Each fully charged cell, stabilized in an ambient temperature of 20 °C ± 5 °C, is placed in a gravity or circulating air-convection oven. The oven temperature is raised at a rate of 5 °C/min ± 2 °C/min to a temperature of 130 °C ± 2 °C. The cell remains at this temperature for 30 min before the test is terminated.

c) Acceptance criteria

No fire, no explosion.

7.3.6 Crushing of cells

a) Requirements

Severe crushing of a cell (for example, during disposal in a waste compactor) shall not cause fire or explosion.

b) Test

Each fully charged cell is crushed between two flat surfaces. The force for the crushing is applied by a device exerting a force of 13 kN ± 0,78 kN. The crushing is performed in a manner that will cause the most adverse result. Once the maximum force has been applied, or an abrupt voltage drop of one-third of the original voltage has been obtained, the force is released.

A cylindrical or prismatic cell is crushed with its longitudinal axis parallel to the flat surfaces of the crushing apparatus. To test both wide and narrow sides of prismatic cells, a second set of cells is tested, rotated 90° around their longitudinal axes compared to the first set.

c) Acceptance criteria

No fire, no explosion.

7.3.7 Low pressure (cells)

Low pressure testing of cells

a) Requirements

Low pressure (for example, during transportation in an aircraft cargo hold) shall not cause fire or explosion.

b) Test

Each fully charged cell is placed in a vacuum chamber, in an ambient temperature of 20 °C ± 5 °C. Once the chamber has been sealed, its internal pressure is gradually reduced to a pressure equal to or less than 11,6 kPa (this simulates an altitude of 15 240 m) and held at that value for 6 h.

c) Acceptance criteria

No fire, no explosion, no leakage.

7.3.8 Overcharge

a) Requirements

Charging for longer periods and at a higher rate than specified by the manufacturer shall not cause fire or explosion.

b) Test

A discharged cell or battery is subjected to a high-rate charge of 2,5 times the recommended charging current for a time that produces a 250 % charge input (250 % of rated capacity).

c) Acceptance criteria

No fire, no explosion.

7.3.9 Forced discharge (cells)

a) Requirements

A cell in a multi-cell application shall withstand polarity reversal without causing fire or explosion.

b) Test

A discharged cell is subjected to a reverse charge at 1 I_t A for 90 min.

c) Acceptance criteria

No fire, no explosion.

8 Information for safety

8.1 General

The use, and particularly abuse, of portable sealed secondary cells and batteries containing alkaline or other non-acid electrolyte may result in the creation of hazards and may cause harm. Manufacturers of secondary cells shall ensure that information is provided about current, voltage and temperature limits of their products. Manufacturers of batteries shall ensure that equipment manufacturers and, in the case of direct sales, end-users are provided with information to minimize and mitigate hazards.

It is the equipment manufacturer's responsibility to inform end-users of the potential hazards arising from the use of equipment containing secondary cells and batteries. Systems analyses should be performed by device manufacturers to ensure that a particular battery design prevents hazards from occurring during use of a product. As appropriate, any information relating to hazard avoidance resulting from a system analysis should be provided to the end user.

Guidance is provided in IEC TR 62188 on the design and manufacture of portable batteries, and non-exhaustive lists of good advice are provided for information in Annex A and Annex B.

Conformity can be checked by examination of manufacturer's documentation.

8.2 Small cell and battery safety information

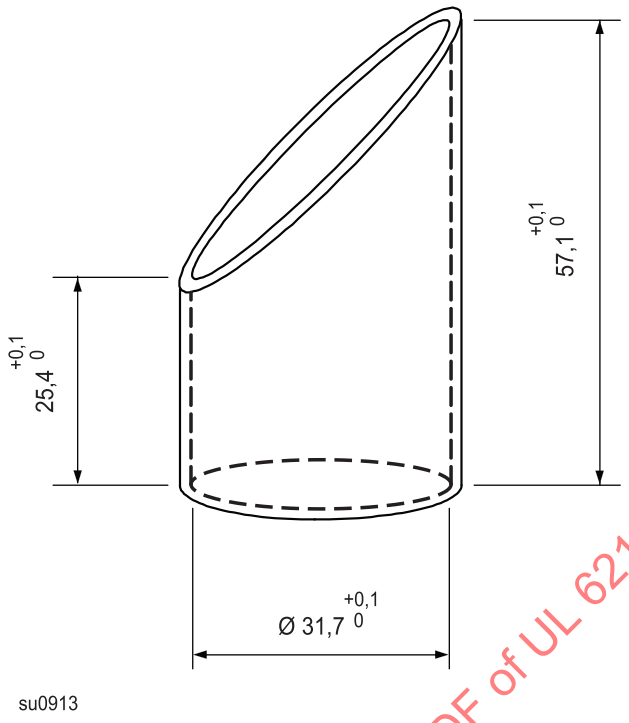
Small cells and batteries and equipment using small cells and batteries are to be provided with information regarding ingestion hazards. Small cells and batteries that may pose an ingestion hazard are those that can fit within the limits of the ingestion gauge shown in Figure 2.

The following warning language is to be provided with the information packaged with the small cells and batteries or equipment using them:

• Keep small cells and batteries which are considered swallowable out of the reach of children.

• Swallowing may lead to burns, perforation of soft tissue, and death. Severe burns can occur within 2 h of ingestion.

• In case of ingestion of a cell or battery, seek medical assistance promptly.



NOTE This gauge defines a swallowable component and is defined in ISO 8124-1.

Figure 2

Ingestion gauge

9 Marking

9.1 Cell marking

Cells shall be marked as specified in the following applicable cell standards: IEC 61951-1 or IEC 61951-2.

By agreement between the cell manufacturer and the battery and/or end product manufacturer, component cells used in the manufacture of a battery need not be marked. However, the cell marking can be indicated with the battery, the instructions and/or the specifications.

Conformity is checked by inspection.

9.2 Battery marking

Batteries shall be marked as specified in IEC 61951-1 or IEC 61951-2. Batteries shall also be marked with an appropriate caution statement.

Terminals shall have clear polarity marking on the external surface of the battery.

Batteries 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.

Conformity is checked by inspection.