IEC 62619

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 secondary lithium cells and batteries, for use in industrial applications

Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Exigences de sécurité pour les accumulateurs au lithium pour utilisation dans des applications industrielles

IEC 62619:2017-02(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SAFETY REQUIREMENTS FOR SECONDARY LITHIUM CELLS AND BATTERIES, FOR USE IN INDUSTRIAL APPLICATIONS

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

FDIS	Report on voting
21A/617/FDIS	21A/624/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 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,
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- amended.

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SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SAFETY REQUIREMENTS FOR SECONDARY LITHIUM CELLS AND BATTERIES, FOR USE IN INDUSTRIAL APPLICATIONS

1 Scope

This document specifies requirements and tests for the safe operation of secondary lithium cells and batteries used in industrial applications including stationary applications.

When there exists an IEC standard specifying test conditions and requirements for cells used in special applications and which is in conflict with this document, the former takes precedence (e.g., IEC 62660 series on road vehicles).

The following are some examples of applications that utilize cells and batteries under the scope of this document.

- Stationary applications: telecom, uninterruptible power supplies (UPS), electrical energy storage system, utility switching, emergency power, and similar applications.
- Motive applications: forklift truck, golf cart, auto guided vehicle (AGV), railway, and marine, excluding road vehicles.

Since this document covers batteries for various industrial applications, it includes those requirements, which are common and minimum to the various applications.

Electrical safety is included only as a part of the risk analysis of Clause 8. In regard to details for addressing electrical safety, the end use application standard requirements have to be considered.

This document applies to cells and batteries. If the battery is divided into smaller units, the smaller unit can be tested as the representative of the battery. The manufacturer clearly declares the tested unit. The manufacturer may add functions, which are present in the final battery to the tested unit.

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 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*

IEC 62620:2014, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for use in industrial 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 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
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 lithium cell
cell
secondary cell where electrical energy is derived from the insertion/extraction reactions of lithium ions or oxidation/reduction reaction of lithium between the negative electrode and the positive electrode

Note 1 to entry: The cell typically has an electrolyte that consists of a lithium salt and organic solvent compound in liquid, gel or solid form and has a metal or a laminate film casing. It is not ready for use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device.

3.8
cell block
group of cells connected together in parallel configuration with or without protective devices (e.g. fuse or PTC) and monitoring circuitry

Note 1 to entry: It is not ready for use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device.

3.9
module
group of cells connected together either in a series and/or parallel configuration with or without protective devices (e.g. fuse or PTC) and monitoring circuitry

3.10
battery pack
energy storage device, which is comprised of one or more cells or modules electrically connected

Note 1 to entry: It has a monitoring circuitry which provides information (e.g. cell voltage) to a battery system.

Note 2 to entry: It may incorporate a protective housing and be provided with terminals or other interconnection arrangement.

3.11
battery system
battery
system which comprises one or more cells, modules or battery packs

Note 1 to entry: It has a battery management system to cut off in case of overcharge, overcurrent, overdischarge, and overheating.

Note 2 to entry: Overdischarge cut off is not mandatory if there is an agreement between the cell manufacturer and the customer

Note 3 to entry: The battery system may have cooling or heating units.

3.12
battery management system
BMS
electronic system associated with a battery which has functions to cut off in case of overcharge, overcurrent, overdischarge, and overheating

Note 1 to entry: It monitors and/or manages its state, calculates secondary data, reports that data and/or controls its environment to influence the battery's safety, performance and/or service life.

Note 2 to entry: Overdischarge cut off is not mandatory if there is an agreement between the cell manufacturer and the customer.

Note 3 to entry: The function of the BMS can be assigned to the battery pack or to equipment that uses the battery. (See Figure 5)

Note 4 to entry: The BMS can be divided and it can be found partially in the battery pack and partially on the equipment that uses the battery. (See Figure 5)

Note 5 to entry: The BMS is sometimes also referred to as a BMU (battery management unit)

3.13
leakage
visible escape of liquid electrolyte

3.14
venting
release of excessive internal pressure from a cell, module, battery pack, or battery system in a manner intended by design to preclude rupture or explosion

3.15
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

3.16
explosion
failure that occurs when a cell container or battery case opens violently and solid components are forcibly expelled

Note 1 to entry: Liquid, gas, and smoke are erupted.

3.17
fire
emission of flames from a cell, module, battery pack, or battery system

3.18
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_n Ah (ampere-hours) declared by the manufacturer which a single cell or battery can deliver during an n-hour period when charging, storing and discharging under the conditions specified in IEC 62620:2014, 6.3.1.

[SOURCE: IEC 60050-482:2004, 482-03-15, modified – Addition of Note 1 to entry.]

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

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

3.21
thermal runaway
uncontrolled intensive increase in the temperature of a cell driven by exothermic reaction

3.22
lower limit discharging voltage
the lowest discharging voltage 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) ±0,5 % for voltage;

b) ±1 % for current;

c) ±2 °C for temperature;

d) ±0,1 % for time;

e) ±1 % for mass;

f) ±1 % for dimensions.

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

a) intended use;

b) 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 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.

It is expected that cells or batteries subjected to misuse may fail to function. However, even if such a situation occurs, they shall not present any significant hazards.

Potential hazards which are the subject of this document are:

a) fire,

b) burst/explosion,

c) critical electrical short-circuit due to leakage of cell electrolyte,

d) venting which continuously vents out flammable gases,

e) rupture of the casing of cell, module, battery pack, and battery system with exposure of internal components.

Conformity with 5.1 to 5.6 is checked by the tests of Clauses 6, 7, and 8, and in accordance with the appropriate standard (see Clause 2).

5.2 Insulation and wiring

Wiring and its insulation shall be sufficient to withstand the maximum anticipated voltage, current, temperature, altitude and humidity requirements. The design of wiring shall be such that adequate clearances and creepage distances are maintained between conductors. The mechanical integrity of the whole battery system (cell/module/BMS) and their connections shall be sufficient to accommodate conditions of reasonably foreseeable misuse.

5.3 Venting

The casing of a cell, module, battery pack, and battery system shall incorporate a pressure relief function that will preclude rupture or explosion. 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 system 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. Battery systems shall be designed within voltage, current, and temperature limits specified by the cell manufacturer. Battery systems shall be provided with specifications and charging instructions for equipment manufacturers so that associated chargers are designed to maintain charging within the voltage, current and temperature limits specified.

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

5.5 Terminal contacts of the battery pack and/or battery system

Terminals shall have clear polarity marking(s) on the external surface of the battery pack or battery system.

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.

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, for example to minimize the risk of short-circuits by metal tools.

5.6 Assembly of cells, modules, or battery packs into battery systems

5.6.1 General

The assembly of cells, modules, or battery packs to constitute the battery system shall respect the following rules in order to support adequate mitigation of risks into the battery system:

- Each battery system shall have an independent control and protection method(s).
- The cell manufacturer shall provide recommendations about current, voltage and temperature limits so that the battery system manufacturer/designer may ensure proper design and assembly.
- Batteries that are designed for the selective discharging of a portion of their series connected cells shall incorporate separate circuitry to prevent the cell reversal caused by uneven discharging.
- Protective circuit components should be added as appropriate and consideration given to the end-device application.

5.6.2 Battery system design

The voltage control function of the battery system design shall ensure that the voltage of each cell or cell block shall not exceed the upper limit of the charging voltage specified by the manufacturer of the cells, except in the case where the stationary application devices or motive application devices provide an equivalent voltage control function.

The following should be considered at the battery system level and by the battery manufacturer:

For the battery system which has series-connected plural single cells, modules or battery packs, it is recommended that the voltages of any one of the single cells or cell blocks do not exceed the upper limit of the charging voltage, specified by the cell manufacturer, by monitoring the voltage of every single cell or cell block.

5.7 Operating region of lithium cells and battery systems for safe use

The cell manufacturer shall specify the cell operating region. The battery manufacturer shall design the battery system to comply with the cell operating region. Determination of the cell operating region is explained in Annex A.

5.8 Quality plan

The battery system manufacturer shall prepare and implement a quality plan that defines procedures for the inspection of materials, components, cells, modules, battery packs, and battery systems and which covers the whole process of producing each type of cell, module, battery pack, and battery system (e.g. ISO 9001, etc.). Manufacturers should understand their process capabilities and should institute the necessary process controls as they relate to product safety.

6 Type test conditions

6.1 General

A battery system that is used outside of its operating region may exhibit hazards resulting from the cells or batteries. Such risks have to be taken into consideration in order to prepare a safe test plan.

The test facility should have a sufficient structural integrity and a fire suppression system to sustain the conditions of overpressure and fire that may occur as a result of testing. The facility should have a ventilation system to remove and capture gas which might be produced during the tests. Consideration should be given to high voltage hazards when applicable.

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.**

6.2 Test items

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. Cells or batteries charged by the method specified in 7.1 shall deliver the rated capacity or more when they are discharged at 25 °C ± 5 °C, at a constant current of 0,2 I_t A, down to a specified final voltage. This capacity confirmation may be done in the manufacturer shipping inspection. In the case of a battery, the capacity may be calculated on the basis of the cell capacity measurements during the shipping inspection.

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 cell and battery system safety is reduced after six months

Table 1 – Sample size for type tests

Test items			Test unit	
Category	**Test**		**Cell** (see Note 1)	**Battery system** (see Note 2)
Product safety test (safety of cell and battery system)	7.2.1 External short-circuit test		R	-
	7.2.2 Impact test		R (see Note 3)	-
	7.2.3 Drop test		R	R
	7.2.4 Thermal abuse test		R	-
	7.2.5 Overcharge test		R (see Note 4)	-
	7.2.6 Forced discharge test		R	-
	7.3 Consideration of internal short-circuit (select one from the two options)	7.3.2 Internal short-circuit test	R*	-
		7.3.3 Propagation test	-	R
Functional safety test (safety of battery system)	8.2.2 Overcharge control of voltage		-	R
	8.2.3 Overcharge control of current		-	R
	8.2.4 Overheating control		-	R
"R" = required (minimum of 1) "R*" = required. As for the sample number, refer to IEC 62133:2012, 8.3.9. "-" = unnecessary or not applicable				
NOTE 1 The manufacturer can use "cell block(s)" instead of "cell(s)" at any test that specifies "cell(s)" as the test unit in this document. The manufacturer clearly declares the test unit for each test. NOTE 2 If a battery system is divided into smaller units, the unit can be tested as representative of the battery system. The manufacturer can add functions which are present in the final battery system to the tested unit. The manufacturer clearly declares the tested unit. NOTE 3 Cylindrical cell or cell block: 1 direction, prismatic cell or cell block: 2 directions. NOTE 4 The test is performed with those battery systems that are provided with only a single control or protection for charging voltage control.				

7 Specific requirements and tests

7.1 Charging procedures for test purposes

Prior to charging, the battery shall be discharged in an ambient temperature of 25 °C ± 5 °C, at a constant current of 0,2 I_t A, down to a specified final voltage.

Unless otherwise stated in this document, cells or batteries shall be charged in an ambient temperature of 25 °C ± 5 °C, in using the method specified by the manufacturer.

NOTE 1 Charging and discharging currents for the tests are based on the value of the rated capacity (C_n Ah). These currents are expressed as a multiple of I_t A, where: I_t A = C_n Ah/1 h (see IEC 61434).

NOTE 2 The battery system which cannot be discharged at a constant current of 0,2 I_t A can be discharged at the current specified by manufacturer .

7.2 Reasonably foreseeable misuse

7.2.1 External short-circuit test (cell or cell block)

a) Requirements

Short-circuit between the positive and negative terminals shall not cause a fire or explosion