IEC 61960-4

Edition 2.0 2024-07
COMMENTED VERSION

INTERNATIONAL STANDARD

colour inside

Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 4: Coin secondary lithium cells, and batteries made from them

IEC 61960-4:2024-07 CMV(en)

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CONTENTS

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SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SECONDARY LITHIUM CELLS AND BATTERIES FOR PORTABLE APPLICATIONS –

Part 4: Coin secondary lithium cells, and batteries made from them

FOREWORD

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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This commented version (CMV) of the official standard IEC 61960-4:2024 edition 2.0 allows the user to identify the changes made to the previous IEC 61960-4:2020 edition 1.0. Furthermore, comments from IEC SC 21A experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 61960-4 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, in cooperation with ISO technical committee 114: Horology. It is an International Standard.

This second edition cancels and replaces the first edition published in 2020. This edition constitutes a technical revision.

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

a) added an annex to standardize requirements for secondary lithium watch batteries;
b) added new chemistries;
c) added a table to standardize dimensions and size codes for secondary lithium watch batteries;
d) modified marking requirements.

The text of this International Standard is based on the following documents:

Draft	Report on voting
21A/880/FDIS	21A/892/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61960 series, published under the general title *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn, or
- revised.

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

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SECONDARY LITHIUM CELLS AND BATTERIES FOR PORTABLE APPLICATIONS –

Part 4: Coin secondary lithium cells, and batteries made from them

1 Scope

This part of IEC 61960 specifies performance tests, designations, markings, dimensions and other requirements for coin secondary lithium cells and batteries for portable applications, watches, and backup power supply such as memory backup applications. In particular, watch-specific requirements are specified in Annex A. 1

This document provides purchasers and users of coin secondary lithium cells and batteries with a set of criteria with which they can assess the performance of coin secondary lithium cells and batteries offered by various manufacturers.

This document defines a minimum required level of performance and a standardized methodology by which testing is performed and the results of this testing are reported to the user. Hence, users will be able to establish the viability of commercially available cells and batteries via the declared specification and thus be able to select the cell or battery best suited for their intended application.

This document covers coin secondary lithium cells and batteries with a range of chemistries. Each electrochemical couple has a characteristic voltage range over which, during discharge, it releases its electrical capacity, a characteristic nominal voltage and a characteristic end-of-discharge voltage. Users of coin secondary lithium cells and batteries are requested to consult the manufacturer for advice.

This document also provides guidelines for designers of equipment using lithium batteries (see Annex B).

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 (IEV) – Part 482: Primary and secondary cells and batteries*

IEC 60086-4:2019, *Primary batteries – Part 4: Safety of lithium batteries*

IEC 62133-2:2017, *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*
IEC 62133-2:2017/AMD1:2021

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-482 and the following apply.

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

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

3.1 2
coin cell
coin battery
lithium button cell
lithium button battery
small round cell or battery where the overall height is less than the diameter, containing non-aqueous electrolyte

[SOURCE: IEC 60086-4:2019, 3.3, modified – Note to entry omitted.]

3.2
secondary lithium cell
secondary cell whose electrical energy is derived from oxidation and the reduction of lithium

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

3.3
secondary lithium battery
unit which incorporates one or more secondary lithium cells and which is ready for use

Note 1 to entry: This unit incorporates adequate housing and a terminal arrangement and may have electronic control devices.

3.4
nominal voltage
suitable approximate value of voltage used to designate or identify a cell, or a battery

Note 1 to entry: The nominal voltages of coin secondary lithium cells are shown in Table 1.

[SOURCE: IEC 60050-482:2004, 482-03-31, modified – "electrochemical system" has been omitted from the definition and the note has been added.]

3.5
rated capacity
quantity of electricity mAh (milliampere-hours) that a single cell or battery can deliver, when charged, stored and discharged under specified conditions and declared by the manufacturer

3.6
end-of-charge voltage
voltage attained at the end of a charging step, at a specified constant current or a specified constant resistance

Note 1 to entry: The end-of-charge voltage may be used to initiate the termination of the charge process.

[SOURCE: IEC 60050-482:2004, 482-05-55, modified – "or a specified constant resistance" has been added to the definition.]

3.7
end-of-discharge voltage
specified closed circuit voltage at which a discharge of a cell or battery is terminated

[SOURCE: IEC 60050-482:2004, 482-03-30, modified – The synonyms "final voltage", "cut-off voltage", and "end-point voltage" have been omitted and the words "closed circuit" and "cell" have been added to the definition.]

3.8
charge recovery
capacity recovery
capacity that a cell or battery can deliver with subsequent recharge, after storage at a specific temperature, for a specific time, as a percentage of the rated capacity

4 Parameter measurement tolerances

The overall accuracy of controlled or measured values, relative to the specified or actual values, shall be within the following tolerances:

a) ±1 % for voltage;
b) ±1 % for current;
c) ±1 % for capacity;
d) ±2 °C for temperature;
e) ±0,1 % for time;
f) ±0,1 mm 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 Cell designation and marking

5.1 Cell designation

Cells shall be designated with the following form:

$$A_1A_2DDHH$$

where

A_1 designates the positive electrode system in which:

C or U is lithium cobalt oxide;
FP is lithium iron phosphate;
M is lithium manganese oxide;
N is lithium nickel oxide;
NB is niobium oxide;
V is vanadium oxide;
T is lithium titanium oxide.

A_2 designates the negative electrode system in which:

C is carbon;

L is lithium aluminium alloy;

S is lithium silicon oxide/alloy;

T or TL is lithium titanium oxide;

DD designates the diameter in mm;

HH designates the height in 1/10 of mm.

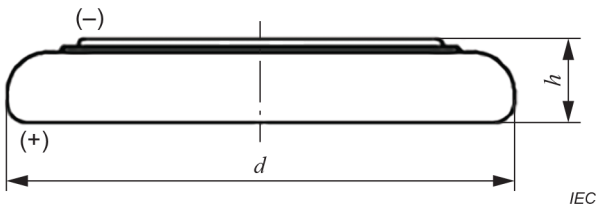
The requirements concerning code letters on electrochemical systems are given in Table 1.

Table 1 – Electrochemical systems in current practical use

Positive electrode	Electrolyte	Negative electrode	Nominal voltage (V)	Code letters
Lithium transition metal (cobalt, manganese, nickel) oxide	Non-aqueous solution with lithium salt	Carbon	~~3,7~~ 3,6 to 3,9	UC or MC or NC[a] 3
Lithium iron phosphate		Carbon	3,2	FPC 4
Lithium cobalt oxide		Lithium titanium oxide	~~3,0~~ 2,4 5	UT
Vanadium oxide		Lithium aluminium alloy	3,0	VL
Lithium manganese oxide		Lithium aluminium alloy	3,0	ML
Lithium manganese oxide		Lithium silicon oxide/alloy	3,0	MS
Lithium cobalt oxide		Lithium titanium oxide	2,3	CTL
Niobium oxide		Lithium aluminium alloy	2,0	NBL
Lithium manganese oxide		Lithium titanium oxide	1,5	MT
Lithium titanium oxide		Lithium-carbon compound	1,5	TC
Lithium titanium oxide		Lithium aluminium alloy	1,5	TL
Lithium titanium oxide		Lithium silicon oxide	1,5	TS

The above code letters are given as examples. Each positive electrode and negative electrode shall be designated with one or two letters. Any code letter can be decided on by agreement between the manufacturer and user when there is a same chemistry which has different nominal voltages.

[a] For lithium transition metal oxide positive electrodes, the symbols for the highest element composition of cobalt, manganese or nickel shall be used. (For example, the symbol for a lithium transition metal oxide with a composition of $LiNi_{0,6}Mn_{0,2}Co_{0,2}O_2$ is N.) 6



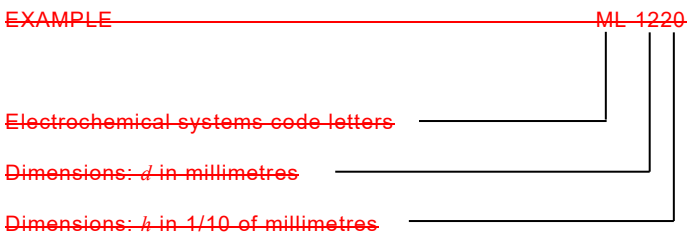
Key

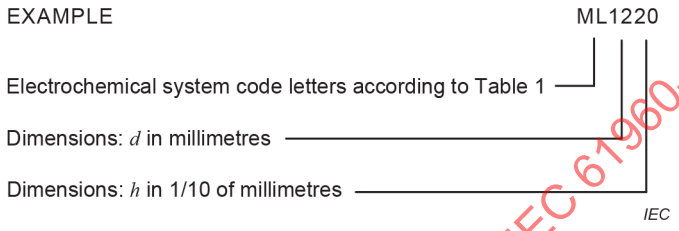
h overall height of the cell

d diameter of the cell

Figure 1 – Dimensional characteristics

Coin secondary lithium cells complying with this document shall be designated by the following system consisting of code letters and numbers. For the electrochemical systems, the code letters shall be expressed using two letters (a maximum of three letters), followed by diameter and height expressed in that order. See Figure 1.





NOTE Notwithstanding the above specification, other designations can be used according to an agreement between manufacturer and user.

5.2 Marking

5.2.1 General

With the exception of small swallowable cells or batteries (see 5.2.2), each cell or battery of the following pieces of information shall be marked with the following information (details on the location of the marking are given after the following list):

a) cell designation, IEC or common designation;
b) the year and month or week of manufacture (may be given in code);
c) polarity of the positive (+) terminal;
d) nominal voltage;
e) rated capacity;
f) name or trademark of the manufacturer or supplier;
g) cautionary advice;
g) caution for ingestion of swallowable cells and batteries (see IEC 60086-4);
h) combination of "secondary (rechargeable)" and "Li", or "secondary (rechargeable)" and "Li-ion".

The designation a) and the polarity c) shall be marked on the cell or battery.

For cells or batteries with an internal AC resistance less than or equal to 3 Ω, intended to be user replaceable or not contained in the equipment, the additional marking of h) shall be marked on the cell or battery.

Other information shall be either marked on the cell or battery, provided in the specification sheet or instruction manual, or marked on the immediate package.

5.2.2 ~~Small~~ Swallowable cells or batteries

For cells or batteries that fit entirely within the ingestion gauge (Figure 3 in IEC 62133-2:2017), the designation specified in 5.2.1 a) and the polarity specified in 5.2.1 c) shall be marked on the cell or battery.

For cells or batteries that have a diameter of 16 mm or more intended to be user replaceable or not contained in the equipment, the safety sign KEEP OUT OF REACH OF CHILDREN shall be marked on the cell or battery in accordance with Annex F of IEC 60086-4:2019. **7**

For cells or batteries with an internal AC resistance less than or equal to 3 Ω, intended to be user replaceable or not contained in the equipment, the additional marking of 5.2.1 h) shall be marked on the cell or battery.

All other information shown in 5.2.1 and caution for ingestion of swallowable cells and batteries (see IEC 62133-2:2017, 9.3) should be given in the specification sheet, or in the instruction manual or on the immediate package instead of on the cell or battery.

6 Electrical tests

6.1 General

Only cell or battery samples which are less than two months (60 days) old from the date of manufacture shall be used for the tests specified in this document.

Unless otherwise stated in this document, the following tests shall be carried out in an ambient temperature of 20 °C ± 5 °C.

Tested cells or batteries should not exceed the upper limit charge voltage or end-of-discharge voltage limit during the test.

Coin secondary lithium cells or batteries have different characteristics and features in terms of voltage, discharge performance, capacity recovery after storage, and cycling depending on their chemistries. Therefore, conditions specified by the manufacturer shall be used in order to make the most of cell or battery characteristics.

The sample sizes and the sequence of the tests are described in Figure 2.

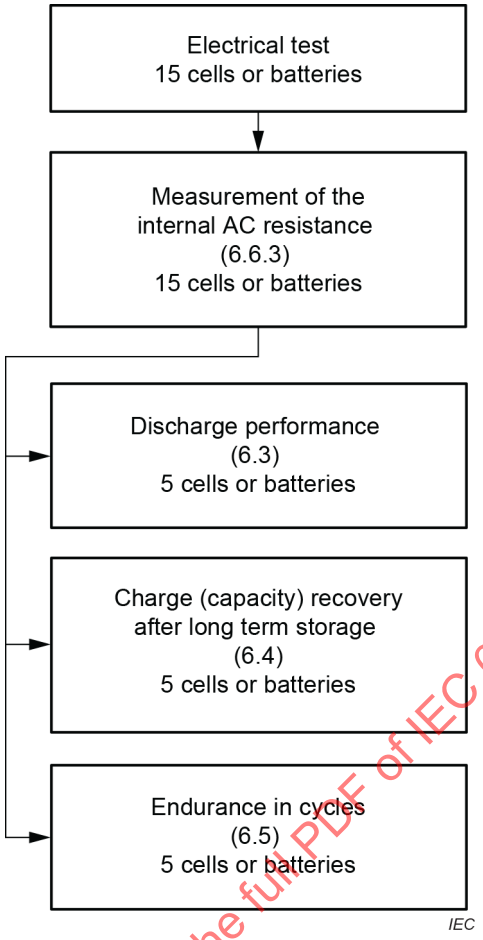


Figure 2 – Sample sizes and sequence of tests

6.2 Charging procedure for test purposes

There are two different charging methods for the coin secondary lithium cells or batteries: constant voltage charge and constant current charge. The charge method and conditions specified by the manufacturer shall be used. ~~When such information is not available, the charge voltage shall be in accordance with Table 2.~~ The charge voltages in Table 2 are generally used upper limits, and some manufacturers allow higher values. Contact each manufacturer for details.

Table 2 – Examples of ~~recommended~~ generally used upper limit charge voltage

Code letters	~~Recommended~~ Generally used upper limit charge voltage
UC or MC or NC	4,25 V
FPC	3,6 V
UT	3,2 V
VL	3,55 V
ML	3,2 V
MS	3,3 V
CTL	2,7 V
NBL	2,5 V
MT	2,6 V
TC	3,15 V
TL	1,7 V
TS	3,0 V

6.3 Discharge performance

This test verifies the rated capacity of a cell or battery at 20 °C.

Step 1: The cell or battery shall be charged in accordance with 6.2.

Step 2: The cell or battery shall be stored in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 3: The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current or constant resistance to the end-of-discharge voltage ~~specified by the manufacturer. When such information is not available, the recommended end-of-discharge voltage limits are shown in Table 3.~~ The discharge method and condition specified by the manufacturer shall be used. The end-of-discharge voltages in Table 3 are generally lower limits, and some manufacturers allow lower values. Contact each manufacturer for details.

Step 4: The capacity (mAh) delivered during step 3 shall be not less than the rated capacity declared by the manufacturer.

Table 3 – ~~Recommended end-of-discharge voltage limit~~ Example of generally used lower limit of end-of-discharge voltage

Code letters	~~Recommended end-of-discharge voltage limit~~ Generally used lower limit of end-of-discharge voltage
UC or MC or NC	2,5 V
FPC	2,5 V
UT	2,0 V
VL	2,5 V
ML	2,0 V
MS	2,0 V
CTL	2,0 V
NBL	1,0 V
MT	1,0 V
TC	0,5 V
TL	0,8 V
TS	1,0 V

6.4 Charge (capacity) recovery after long-term storage

This test verifies the capacity of a cell or battery after extended storage at 100 % state of charge, followed by a subsequent charge.

Step 1: The cell or battery shall be charged in accordance with the specific conditions specified by the manufacturer.

Step 2: The cell or battery shall be stored at 60 °C for 20 days.

Step 3: The cell or battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 4: The cell or battery shall be charged, in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer. **8**

Step 5: The cell or battery shall be discharged in an ambient temperature of 20 °C ± 5 °C, at the discharge conditions specified by the manufacturer, until its voltage is equal to the manufacturer's specified end-of-discharge voltage. ~~The cell or battery shall be charged before discharge by the specific condition by the manufacturer.~~

Step 6: The capacity (mAh) delivered during step 5 shall be more than 50 % of its rated capacity.

6.5 Endurance in cycles

This test verifies the ability of the charge-discharge cycle.

Step 1: The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer.

Step 2: The cell or battery shall be continuously charged and discharged, in an ambient temperature of 20 °C ± 5 °C.

The cell or battery shall be charged until its voltage is equal to the specified end-of-charge voltage, or it shall be charged for the specified amount of time after its voltage is equal to the specified end-of-charge voltage, using the method and conditions declared by the manufacturer.

The cell or battery shall be discharged in an ambient temperature of 20 °C ± 5 °C, until its voltage is equal to the specified end-of-discharge voltage, or it shall be discharged for the specified amount of time, using the method declared by the manufacturer.

The test shall be terminated when the discharge capacity reaches 50 % of its first cycle. The result shall satisfy the minimum number of cycles in Table 4.

Table 4 – Minimum number of cycles

Code letters	Minimum number of cycles
UC or MC or NC	100
FPC	100
UT	100
VL	5
ML	5
MS	50
CTL	100
NBL	5
MT	100
TC	100
TL	5
TS	50
The test procedure in 6.5 is a representative and unified accelerated method to cover various electrochemical systems, and actual charge-discharge conditions may be different depending on each application. The above minimum numbers of cycles are values tested according to the procedure in 6.5. This accelerated test method ~~might~~ can result in a fewer number of cycles than in actual use.	

6.6 Cell or battery internal resistance (AC resistance)

6.6.1 General

Internal AC resistance measurement is necessary to evaluate cell performance. ~~When internal AC resistance is smaller than 3 Ω, the safety standard of IEC 62133-2:2017, Annex D is applicable.~~ Cells with internal AC resistance less than or equal to 3 Ω shall be tested in accordance with Table 1 of IEC 62133-2:2017.

6.6.2 Test – General

This test verifies the internal resistance of a secondary lithium cell or battery by the alternating current (AC) method.

The internal resistance shall be measured at conditions (e.g. voltage, temperature) specified by the manufacturer.

6.6.3 Measurement

The alternating RMS voltage, U_a, shall be measured while applying an alternating RMS current, I_a, at the frequency of 1,0 kHz ± 0,1 kHz, to the cell or battery, for a period of 1 s to 5 s.

All voltage measurements shall be made at the terminals of the cell or battery independently of the contacts used to carry current.

The internal AC resistance, R_{ac}, is given by:

~~$$R_{ac} = \frac{U_a}{I_a} (\Omega)$$~~

$$R_{ac} = \frac{U_a}{I_a}$$

where

U_a is the alternating RMS voltage in V;

I_a is the alternating RMS current in A.

The alternating current should be selected so that the peak voltage stays below 20 mV.

NOTE This method will in fact measure the impedance which, at the frequency specified, is approximately equal to the resistance.

6.6.4 Acceptance criterion

The internal AC resistance of the cell or battery shall be not greater than the value of R_{ac}, declared by the manufacturer.

7 Differentiation

Technical consideration shall be taken to prevent coin secondary lithium cells and batteries from being confused with primary lithium cells and batteries which are similar in appearance and size. ~~(For example, construction of an attached terminal in such a way that the terminal cannot be replaced, affixing a note of caution, etc.)~~ Attention shall be paid to the designation because the voltage is also different between the secondary batteries.

The required information shall be marked on coin secondary lithium cells or batteries in accordance with 5.2.

Annex A
(normative)

Requirements for secondary lithium watch batteries

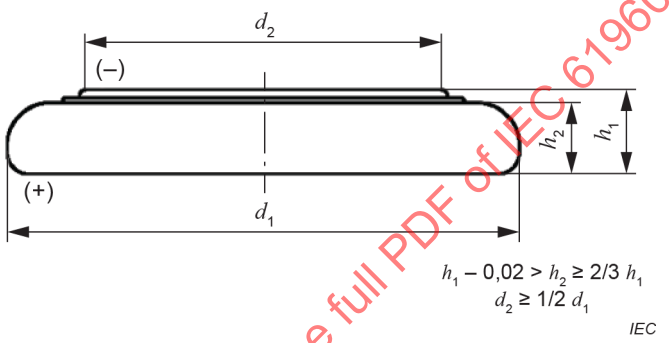
A.1 General

This annex specifies dimensions, test methods and requirements for secondary lithium batteries for watches.

A.2 Physical requirements

A.2.1 Symbols and shape of cell

The symbols used to denote the various dimensions in Figure A.1 are as follows.



Key

h_1 overall height of the cell

h_2 height of the side

d_1 diameter of the cell

d_2 diameter of the negative contact

Figure A.1 – Dimensional drawing

Except for cells with terminals, the shape of cells shall meet the following requirements: **9**

- The height of the side is greater than or equal to two thirds of the overall height of the cell.
- The height of the side is smaller than the overall height minus 0,02 mm.
- The negative contact is the highest point of the battery.
- The diameter of the negative contact is greater than or equal to a half of the diameter of the cell.

A.2.2 Dimensions and size codes

Dimensions and size codes of secondary lithium watch batteries shall be in accordance with Figure A.1 and Table A.1.

None of the tolerances of Table A.1 shall be exceeded during the charge and discharge conditions in accordance with 6.2, 6.3 and 6.5.

For batteries placed on the market prior to and within 2 years from the publication date of this second edition of IEC 61960-4, other dimensions and size codes may be used according to the agreement between the manufacturer and the user. **10**

Table A.1 – Dimensions and size codes for watch batteries 11

Dimensions in millimetres									
Diameter				**Height h_1**					
Code	d_1	Tolerance		Code					
			16	20	21	27	30	32	37
				Tolerance					
			+0,15 −0,20	+0,20 −0,20	+0,20 −0,20	+0,20 −0,20	+0,20 −0,20	+0,20 −0,20	+0,20 −0,20
4	4,8	0 −0,15	1,60						
5	5,8	0 −0,15	1,60						
6	6,8	0 −0,15	1,60		2,10				
9	9,5	0 −0,15		2,00		2,70			3,70
16	16	0 −0,25	1,60	2,00					
20	20	0 −0,25	1,60	2,00				3,20	
24	24,5	0 −0,25					3,00		
30	30	0 −0,25						3,20	

A.3 Test methods for determining the resistance to leakage 12

A.3.1 Preconditioning and initial visual examination

Before carrying out the tests specified in A.3.2 and A.3.3, the batteries shall be submitted to a visual examination according to the requirements stated in Clause A.4.

For tests in A.3.2, batteries shall be pre-stored at the specified temperature (45 °C) for 2 h. Batteries shall be moved from the preconditioning (alternative pre-stored) chamber (or oven) into the high temperature and humidity test chamber within minutes in order to avoid cooling of the battery and the risk of condensation at elevated humidity.

A.3.2 High temperature and humidity test

The cell or battery shall be charged according to the charging method and conditions specified by the manufacturer (see 6.2). The battery shall be stored under the conditions specified in Table A.2.

Table A.2 – Storage conditions

Temperature °C	Relative humidity %
45 ± 2	90 to 95

The storage duration should be agreed between the manufacturer and the user.

The temperature tolerance of ±2 °C is for the temperature maintenance period and a brief overshoot in temperature is allowed during the transition period.

A.3.3 Test by temperature cycle

The cell or battery shall be charged according to the charging method and conditions specified by the manufacturer (see 6.2). The battery shall be submitted to temperature cycles according to the schedule in Figure A.2. The number of cycles should be agreed between the manufacturer and the user.

The temperature tolerance of ±2 °C is for the temperature maintenance period and a brief overshoot in temperature is allowed during the transition period.

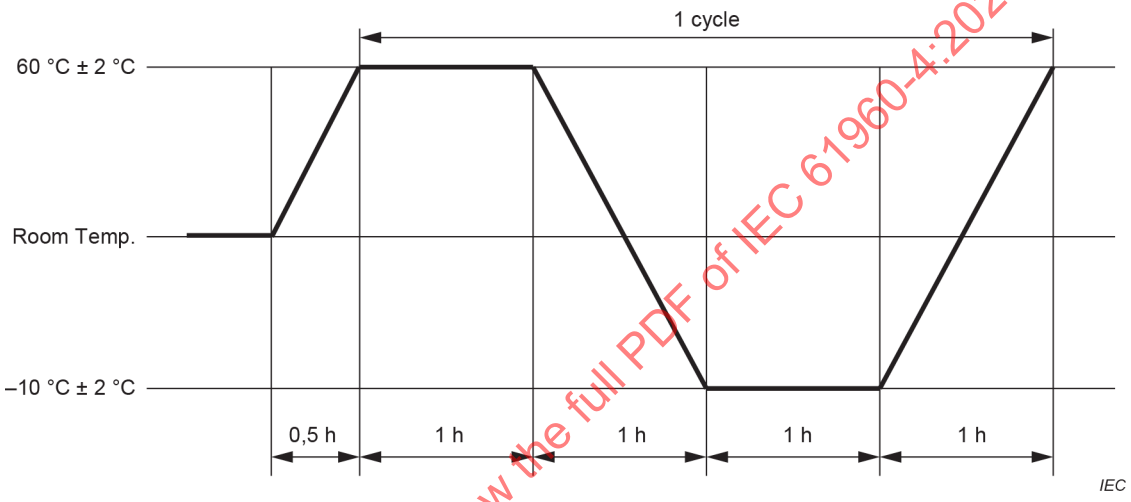


Figure A.2 – Test by temperature cycles

A.4 Visual examination and acceptance criteria

A.4.1 Preconditioning

Before carrying out the initial visual examination or after the tests specified in A.3.2 and A.3.3, the batteries shall be stored for at least 24 h at room temperature and at a relative humidity of 55 % ± 20 %.

The leakage should be observed after crystallisation of the electrolyte. The time of the storage of 24 h may be prolonged if necessary. This examination may be applied to new or used batteries, or to batteries which have been submitted to different tests.

A.4.2 Magnification

The visual examination shall be carried out at a magnification of x15.

A.4.3 Leakage levels and classification

The visual examination shall be carried out under a diffuse white light of 900 lx to 1 100 lx at the surface of the battery to be inspected (see IEC 60086-3:2021, Table 10). 13

A.4.4 Acceptance conditions

The acceptable levels of leakage, as well as the proportion of defective pieces, shall be agreed between the manufacturer and the user.

~~Annex A~~Annex B
(informative)

Guidelines for designers of equipment using lithium batteries

Equipment design guidelines are given in Table B.1.

Table B.1 – Equipment design guidelines

Item	Sub-item	Recommendations	Possible consequences if the recommendations are not observed
(1) Battery holder and battery compartment		a) Battery compartments should be designed so that if a battery is reversed, open circuit is achieved. Battery compartments should be clearly and permanently marked to show the correct orientation of batteries	Unless protection is provided against battery reversal, damage to equipment can occur from resultant electrolyte leakage, overheating, rupture, explosion or fire
		b) Battery compartments should be designed so that batteries of sizes other than those specified cannot be inserted and make contact	Equipment ~~might~~ can be damaged or ~~might~~ can not operate
		c) Battery compartments should be designed to allow generated gases to escape	Battery compartments ~~might~~ can be damaged when internal pressure of the battery becomes too high due to gas generation
		d) Battery compartments should be designed to be waterproof	
		e) Battery compartments should be designed to be explosion-proof when tightly sealed	
		f) Battery compartments should be isolated from heat generated by the equipment	Battery ~~might~~ can be deformed and leak electrolyte due to excessive heat
		g) Battery compartments should be designed so that they cannot easily be opened by children	Children ~~might~~ can remove batteries from the compartment and swallow them
(2) Contacts and terminals		a) Material and shape of contacts and terminals should be selected so that effective electric contact is maintained	Heat ~~might generate~~ can be generated at the contact due to insufficient connection
		b) Auxiliary circuit should be designed to prevent reverse installation of batteries	Equipment ~~might~~ can be damaged or ~~might~~ can not operate
		c) Contacts and terminals should be designed to prevent reverse installation of batteries	Equipment ~~might~~ can be damaged. Battery ~~might~~ can cause electrolyte leakage, overheating, rupture, explosion or fire
		d) Direct soldering or welding to a battery should be avoided	Battery ~~might~~ can leak, overheat, rupture, explode or catch fire

Bibliography

IEC 60051 (all parts), *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60086-1, *Primary batteries – Part 1: General*

IEC 60086-2, *Primary batteries – Part 2: Physical and electrical specifications*

IEC 60086-3:2021, *Primary batteries – Part 3: Watch batteries*

~~IEC 60086-4:2019, *Primary batteries – Part 4: Safety of lithium batteries*~~

IEC 60485, *Digital electronic d.c. voltmeters and d.c. electronic analogue-to-digital converters*[1]

IEC 61434, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Guide to designation of current in alkaline secondary cell and battery standards*

IEC 61959, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Mechanical tests for sealed portable secondary cells and batteries*

IEC 61960-3, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 3 – Prismatic and cylindrical lithium secondary cells, and batteries made from them*

~~IEC 62133 (all parts), *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 62281, *Safety of primary and secondary lithium cells and batteries during transport*

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

1 Withdrawn publication

List of comments

1 Annex A is added as required by ISO/TC 114/WG 1 - Requirements for watch batteries.

2 "lithium button cell" and "lithium button battery" are added for languages such as French that do not have a word equivalent to the English word "coin". Refer to IEC 60050-482, 482-02-40.

3 New electrochemical systems available on the market are added to the table.

4 New electrochemical system available on the market is added to the table.

5 This is a correction of a typo of the 1st edition.

6 An example is provided for selecting symbols for electrode systems consisting of multi-element active materials.

7 This paragraph is added to clarify the range and contents of measures to prevent accidental ingestion by infants.

8 The step is divided to clarify the test procedure.

9 These requirements are for putting a battery into a watch compartment.

10 This paragraph clarifies exceptions for batteries that are available on the market or under development.

11 The battery models listed in Table A.1 are already available in the watch battery market.

12 The test methods are developed based on IEC 60086-3:2021 with modifications for secondary lithium watch batteries.

13 Table 10 in IEC 60086-3:2021 is for reference only, and the criteria for leakage levels may be defined between cell manufacturers and watch manufacturers.

IEC 61960-4

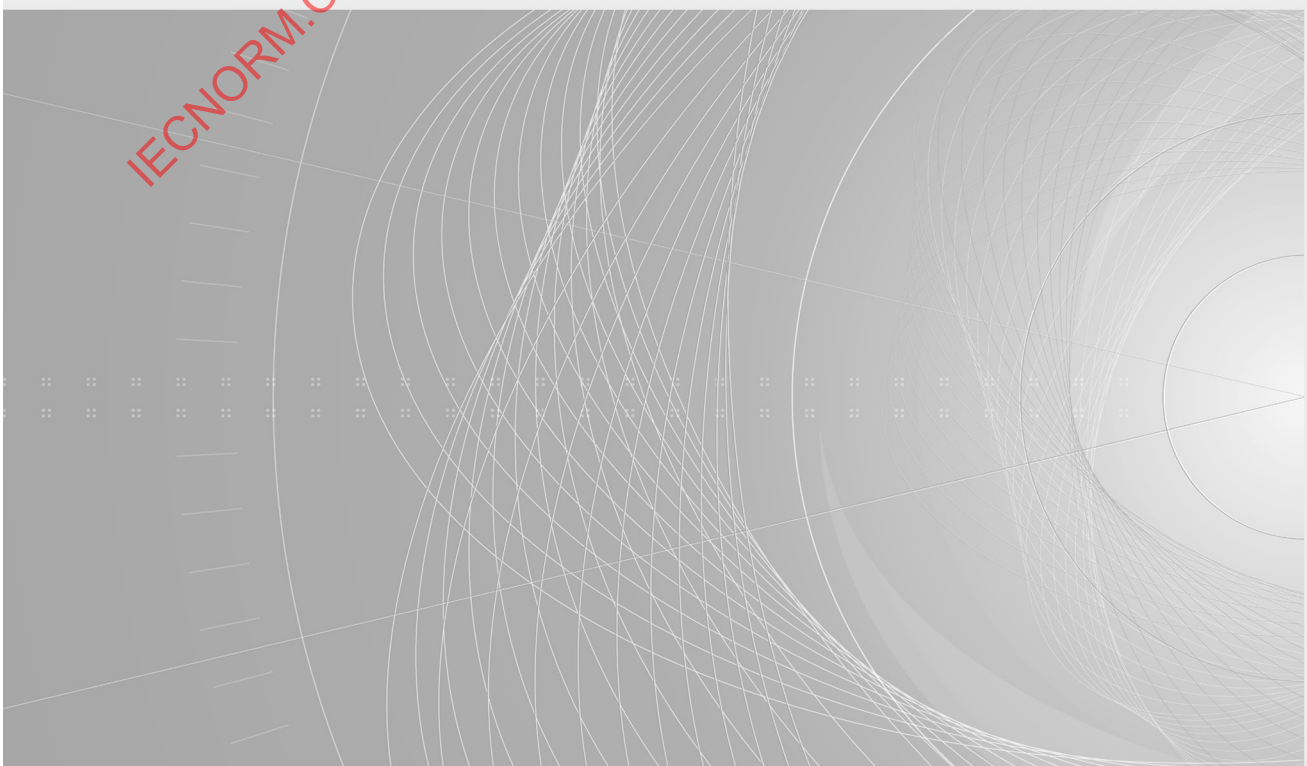
Edition 2.0 2024-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 4: Coin secondary lithium cells, and batteries made from them

Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Accumulateurs au lithium pour applications portables – Partie 4: Éléments et batteries d'accumulateurs boutons au lithium



IEC 61960-4:2024-07(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SECONDARY LITHIUM CELLS AND BATTERIES FOR PORTABLE APPLICATIONS –

Part 4: Coin secondary lithium cells, and batteries made from them

FOREWORD

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IEC 61960-4 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, in cooperation with ISO technical committee 114: Horology. It is an International Standard.

This second edition cancels and replaces the first edition published in 2020. This edition constitutes a technical revision.

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

a) added an annex to standardize requirements for secondary lithium watch batteries;
b) added new chemistries;

c) added a table to standardize dimensions and size codes for secondary lithium watch batteries;

d) modified marking requirements.

The text of this International Standard is based on the following documents:

Draft	Report on voting
21A/880/FDIS	21A/892/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61960 series, published under the general title *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn, or
- revised.

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SECONDARY LITHIUM CELLS AND BATTERIES FOR PORTABLE APPLICATIONS –

Part 4: Coin secondary lithium cells, and batteries made from them

1 Scope

This part of IEC 61960 specifies performance tests, designations, markings, dimensions and other requirements for coin secondary lithium cells and batteries for portable applications, watches, and backup power supply such as memory backup applications. In particular, watch-specific requirements are specified in Annex A.

This document provides purchasers and users of coin secondary lithium cells and batteries with a set of criteria with which they can assess the performance of coin secondary lithium cells and batteries offered by various manufacturers.

This document defines a minimum required level of performance and a standardized methodology by which testing is performed and the results of this testing are reported to the user. Hence, users will be able to establish the viability of commercially available cells and batteries via the declared specification and thus be able to select the cell or battery best suited for their intended application.

This document covers coin secondary lithium cells and batteries with a range of chemistries. Each electrochemical couple has a characteristic voltage range over which, during discharge, it releases its electrical capacity, a characteristic nominal voltage and a characteristic end-of-discharge voltage. Users of coin secondary lithium cells and batteries are requested to consult the manufacturer for advice.

This document also provides guidelines for designers of equipment using lithium batteries (see Annex B).

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, *International Electrotechnical Vocabulary (IEV) – Part 482: Primary and secondary cells and batteries*

IEC 60086-4:2019, *Primary batteries – Part 4: Safety of lithium batteries*

IEC 62133-2:2017, *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*
IEC 62133-2:2017/AMD1:2021

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-482 and the following apply.

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

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

3.1
coin cell
coin battery
lithium button cell
lithium button battery
small round cell or battery where the overall height is less than the diameter, containing non-aqueous electrolyte

[SOURCE: IEC 60086-4:2019, 3.3, modified – Note to entry omitted.]

3.2
secondary lithium cell
secondary cell whose electrical energy is derived from oxidation and the reduction of lithium

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

3.3
secondary lithium battery
unit which incorporates one or more secondary lithium cells and which is ready for use

Note 1 to entry: This unit incorporates adequate housing and a terminal arrangement and may have electronic control devices.

3.4
nominal voltage
suitable approximate value of voltage used to designate or identify a cell, or a battery

Note 1 to entry: The nominal voltages of coin secondary lithium cells are shown in Table 1.

[SOURCE: IEC 60050-482:2004, 482-03-31, modified – "electrochemical system" has been omitted from the definition and the note has been added.]

3.5
rated capacity
quantity of electricity mAh (milliampere-hours) that a single cell or battery can deliver, when charged, stored and discharged under specified conditions and declared by the manufacturer

3.6
end-of-charge voltage
voltage attained at the end of a charging step, at a specified constant current or a specified constant resistance

Note 1 to entry: The end-of-charge voltage may be used to initiate the termination of the charge process.

[SOURCE: IEC 60050-482:2004, 482-05-55, modified – "or a specified constant resistance" has been added to the definition.]

3.7
end-of-discharge voltage
specified closed circuit voltage at which a discharge of a cell or battery is terminated

[SOURCE: IEC 60050-482:2004, 482-03-30, modified – The synonyms "final voltage", "cut-off voltage", and "end-point voltage" have been omitted and the words "closed circuit" and "cell" have been added to the definition.]

3.8
charge recovery
capacity recovery
capacity that a cell or battery can deliver with subsequent recharge, after storage at a specific temperature, for a specific time, as a percentage of the rated capacity

4 Parameter measurement tolerances

The overall accuracy of controlled or measured values, relative to the specified or actual values, shall be within the following tolerances:

a) ±1 % for voltage;
b) ±1 % for current;
c) ±1 % for capacity;
d) ±2 °C for temperature;
e) ±0,1 % for time;
f) ±0,1 mm 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 Cell designation and marking

5.1 Cell designation

Cells shall be designated with the following form:

$$A_1A_2DDHH$$

where

A_1 designates the positive electrode system in which:

C or U is lithium cobalt oxide;
FP is lithium iron phosphate;
M is lithium manganese oxide;
N is lithium nickel oxide;
NB is niobium oxide;
V is vanadium oxide;
T is lithium titanium oxide.

A_2 designates the negative electrode system in which:

C is carbon;

L is lithium aluminium alloy;

S is lithium silicon oxide/alloy;

T or TL is lithium titanium oxide;

DD designates the diameter in mm;

HH designates the height in 1/10 of mm.

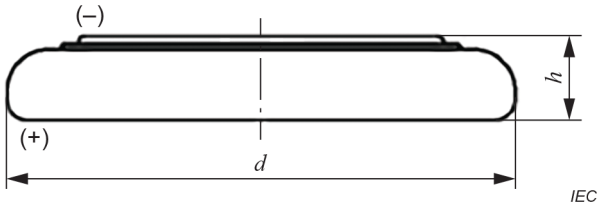
The requirements concerning code letters on electrochemical systems are given in Table 1.

Table 1 – Electrochemical systems in current practical use

Positive electrode	Electrolyte	Negative electrode	Nominal voltage (V)	Code letters
Lithium transition metal (cobalt, manganese, nickel) oxide	Non-aqueous solution with lithium salt	Carbon	3,6 to 3,9	UC or MC or NC[a]
Lithium iron phosphate		Carbon	3,2	FPC
Lithium cobalt oxide		Lithium titanium oxide	2,4	UT
Vanadium oxide		Lithium aluminium alloy	3,0	VL
Lithium manganese oxide		Lithium aluminium alloy	3,0	ML
Lithium manganese oxide		Lithium silicon oxide/alloy	3,0	MS
Lithium cobalt oxide		Lithium titanium oxide	2,3	CTL
Niobium oxide		Lithium aluminium alloy	2,0	NBL
Lithium manganese oxide		Lithium titanium oxide	1,5	MT
Lithium titanium oxide		Lithium-carbon compound	1,5	TC
Lithium titanium oxide		Lithium aluminium alloy	1,5	TL
Lithium titanium oxide		Lithium silicon oxide	1,5	TS

The above code letters are given as examples. Each positive electrode and negative electrode shall be designated with one or two letters. Any code letter can be decided on by agreement between the manufacturer and user when there is a same chemistry which has different nominal voltages.

[a] For lithium transition metal oxide positive electrodes, the symbols for the highest element composition of cobalt, manganese or nickel shall be used. (For example, the symbol for a lithium transition metal oxide with a composition of $LiNi_{0,6}Mn_{0,2}Co_{0,2}O_2$ is N.)



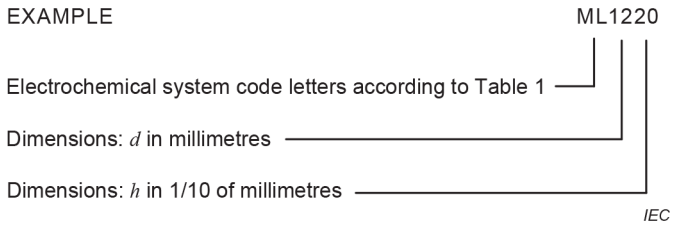
Key

h overall height of the cell

d diameter of the cell

Figure 1 – Dimensional characteristics

Coin secondary lithium cells complying with this document shall be designated by the following system consisting of code letters and numbers. For the electrochemical systems, the code letters shall be expressed using two letters (a maximum of three letters), followed by diameter and height expressed in that order. See Figure 1.



Notwithstanding the above specification, other designations can be used according to an agreement between manufacturer and user.

5.2 Marking

5.2.1 General

With the exception of swallowable cells or batteries (see 5.2.2), each of the following pieces of information shall be marked (details on the location of the marking are given after the following list):

a) cell designation, IEC or common designation;

b) the year and month or week of manufacture (may be given in code);

c) polarity of the positive (+) terminal;

d) nominal voltage;

e) rated capacity;

f) name or trademark of the manufacturer or supplier;

g) cautionary advice;

h) combination of "secondary (rechargeable)" and "Li", or "secondary (rechargeable)" and "Li-ion".

The designation a) and the polarity c) shall be marked on the cell or battery.

For cells or batteries with an internal AC resistance less than or equal to 3 Ω, intended to be user replaceable or not contained in the equipment, the additional marking of h) shall be marked on the cell or battery.

Other information shall be either marked on the cell or battery, provided in the specification sheet or instruction manual, or marked on the immediate package.

5.2.2 Swallowable cells or batteries

For cells or batteries that fit entirely within the ingestion gauge (Figure 3 in IEC 62133-2:2017), the designation specified in 5.2.1 a) and the polarity specified in 5.2.1 c) shall be marked on the cell or battery.

For cells or batteries that have a diameter of 16 mm or more intended to be user replaceable or not contained in the equipment, the safety sign KEEP OUT OF REACH OF CHILDREN shall be marked on the cell or battery in accordance with Annex F of IEC 60086-4:2019.

For cells or batteries with an internal AC resistance less than or equal to 3 Ω, intended to be user replaceable or not contained in the equipment, the additional marking of 5.2.1 h) shall be marked on the cell or battery.

All other information shown in 5.2.1 and caution for ingestion of swallowable cells and batteries (see IEC 62133-2:2017, 9.3) should be given in the specification sheet, or in the instruction manual or on the immediate package instead of on the cell or battery.

6 Electrical tests

6.1 General

Only cell or battery samples which are less than two months (60 days) old from the date of manufacture shall be used for the tests specified in this document.

Unless otherwise stated in this document, the following tests shall be carried out in an ambient temperature of 20 °C ± 5 °C.

Tested cells or batteries should not exceed the upper limit charge voltage or end-of-discharge voltage limit during the test.

Coin secondary lithium cells or batteries have different characteristics and features in terms of voltage, discharge performance, capacity recovery after storage, and cycling depending on their chemistries. Therefore, conditions specified by the manufacturer shall be used in order to make the most of cell or battery characteristics.

The sample sizes and the sequence of the tests are described in Figure 2.

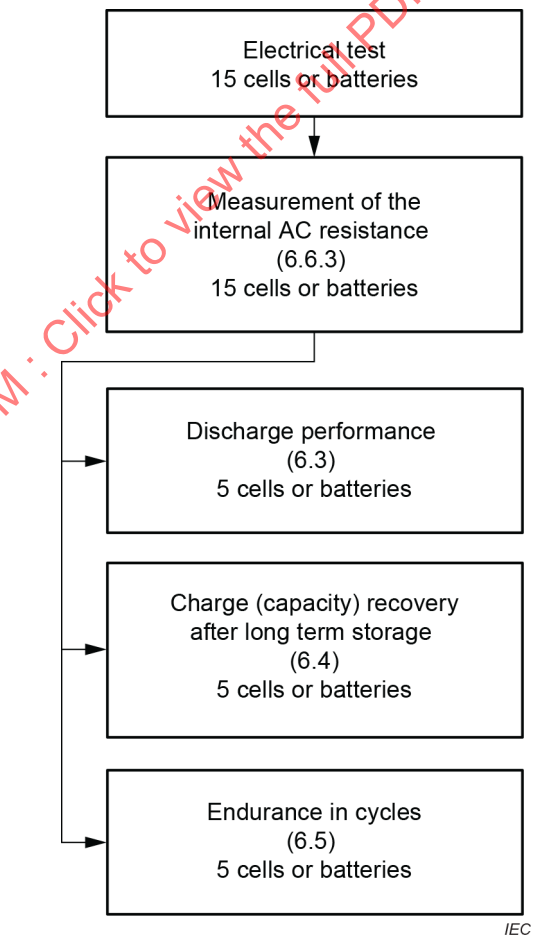


Figure 2 – Sample sizes and sequence of tests

6.2 Charging procedure for test purposes

There are two different charging methods for the coin secondary lithium cells or batteries: constant voltage charge and constant current charge. The charge method and conditions specified by the manufacturer shall be used. The charge voltages in Table 2 are generally used upper limits, and some manufacturers allow higher values. Contact each manufacturer for details.

Table 2 – Examples of generally used upper limit charge voltage

Code letters	Generally used upper limit charge voltage
UC or MC or NC	4,25 V
FPC	3,6 V
UT	3,2 V
VL	3,55 V
ML	3,2 V
MS	3,3 V
CTL	2,7 V
NBL	2,5 V
MT	2,6 V
TC	3,15 V
TL	1,7 V
TS	3,0 V

6.3 Discharge performance

This test verifies the rated capacity of a cell or battery at 20 °C.

Step 1: The cell or battery shall be charged in accordance with 6.2.

Step 2: The cell or battery shall be stored in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 3: The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current or constant resistance to the end-of-discharge voltage. The discharge method and condition specified by the manufacturer shall be used. The end-of-discharge voltages in Table 3 are generally lower limits, and some manufacturers allow lower values. Contact each manufacturer for details.

Step 4: The capacity (mAh) delivered during step 3 shall be not less than the rated capacity declared by the manufacturer.

Table 3 – Example of generally used lower limit of end-of-discharge voltage

Code letters	Generally used lower limit of end-of-discharge voltage
UC or MC or NC	2,5 V
FPC	2,5 V
UT	2,0 V
VL	2,5 V
ML	2,0 V
MS	2,0 V
CTL	2,0 V
NBL	1,0 V
MT	1,0 V
TC	0,5 V
TL	0,8 V
TS	1,0 V

6.4 Charge (capacity) recovery after long-term storage

This test verifies the capacity of a cell or battery after extended storage at 100 % state of charge, followed by a subsequent charge.

Step 1: The cell or battery shall be charged in accordance with the specific conditions specified by the manufacturer.

Step 2: The cell or battery shall be stored at 60 °C for 20 days.

Step 3: The cell or battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 4: The cell or battery shall be charged, in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer.

Step 5: The cell or battery shall be discharged in an ambient temperature of 20 °C ± 5 °C, at the discharge conditions specified by the manufacturer, until its voltage is equal to the manufacturer's specified end-of-discharge voltage.

Step 6: The capacity (mAh) delivered during step 5 shall be more than 50 % of its rated capacity.

6.5 Endurance in cycles

This test verifies the ability of the charge-discharge cycle.

Step 1: The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer.

Step 2: The cell or battery shall be continuously charged and discharged, in an ambient temperature of 20 °C ± 5 °C.

The cell or battery shall be charged until its voltage is equal to the specified end-of-charge voltage, or it shall be charged for the specified amount of time after its voltage is equal to the specified end-of-charge voltage, using the method and conditions declared by the manufacturer.

The cell or battery shall be discharged in an ambient temperature of 20 °C ± 5 °C, until its voltage is equal to the specified end-of-discharge voltage, or it shall be discharged for the specified amount of time, using the method declared by the manufacturer.

The test shall be terminated when the discharge capacity reaches 50 % of its first cycle. The result shall satisfy the minimum number of cycles in Table 4.

Table 4 – Minimum number of cycles

Code letters	Minimum number of cycles
UC or MC or NC	100
FPC	100
UT	100
VL	5
ML	5
MS	50
CTL	100
NBL	5
MT	100
TC	100
TL	5
TS	50
The test procedure in 6.5 is a representative and unified accelerated method to cover various electrochemical systems, and actual charge-discharge conditions may be different depending on each application. The above minimum numbers of cycles are values tested according to the procedure in 6.5. This accelerated test method can result in a fewer number of cycles than in actual use.	

6.6 Cell or battery internal resistance (AC resistance)

6.6.1 General

Internal AC resistance measurement is necessary to evaluate cell performance. Cells with internal AC resistance less than or equal to 3 Ω shall be tested in accordance with Table 1 of IEC 62133-2:2017.

6.6.2 Test – General

This test verifies the internal resistance of a secondary lithium cell or battery by the alternating current (AC) method.

The internal resistance shall be measured at conditions (e.g. voltage, temperature) specified by the manufacturer.

6.6.3 Measurement

The alternating RMS voltage, U_a, shall be measured while applying an alternating RMS current, I_a, at the frequency of 1,0 kHz ± 0,1 kHz, to the cell or battery, for a period of 1 s to 5 s.

All voltage measurements shall be made at the terminals of the cell or battery independently of the contacts used to carry current.

The internal AC resistance, R_{ac}, is given by:

$$R_{ac} = \frac{U_a}{I_a}$$

where

U_a is the alternating RMS voltage in V;

I_a is the alternating RMS current in A.

The alternating current should be selected so that the peak voltage stays below 20 mV.

NOTE This method will in fact measure the impedance which, at the frequency specified, is approximately equal to the resistance.

6.6.4 Acceptance criterion

The internal AC resistance of the cell or battery shall be not greater than the value of R_{ac}, declared by the manufacturer.

7 Differentiation

Technical consideration shall be taken to prevent coin secondary lithium cells and batteries from being confused with primary lithium cells and batteries which are similar in appearance and size. Attention shall be paid to the designation because the voltage is also different between the secondary batteries.

The required information shall be marked on coin secondary lithium cells or batteries in accordance with 5.2.

Annex A
(normative)

Requirements for secondary lithium watch batteries

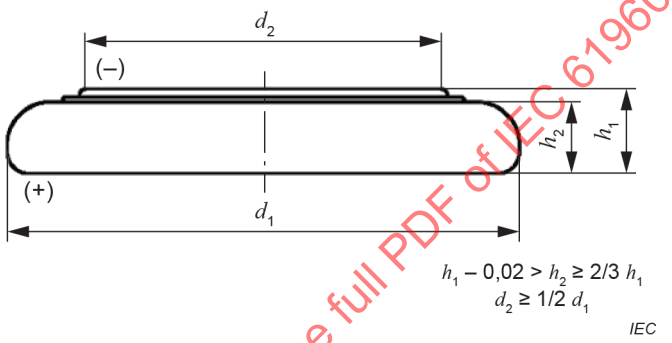
A.1 General

This annex specifies dimensions, test methods and requirements for secondary lithium batteries for watches.

A.2 Physical requirements

A.2.1 Symbols and shape of cell

The symbols used to denote the various dimensions in Figure A.1 are as follows.



Key

h_1 overall height of the cell

h_2 height of the side

d_1 diameter of the cell

d_2 diameter of the negative contact

Figure A.1 – Dimensional drawing

Except for cells with terminals, the shape of cells shall meet the following requirements:

- The height of the side is greater than or equal to two thirds of the overall height of the cell.
- The height of the side is smaller than the overall height minus 0,02 mm.
- The negative contact is the highest point of the battery.
- The diameter of the negative contact is greater than or equal to a half of the diameter of the cell.

A.2.2 Dimensions and size codes

Dimensions and size codes of secondary lithium watch batteries shall be in accordance with Figure A.1 and Table A.1.

None of the tolerances of Table A.1 shall be exceeded during the charge and discharge conditions in accordance with 6.2, 6.3 and 6.5.

For batteries placed on the market prior to and within 2 years from the publication date of this second edition of IEC 61960-4, other dimensions and size codes may be used according to the agreement between the manufacturer and the user.

Table A.1 – Dimensions and size codes for watch batteries

Dimensions in millimetres									
Diameter				**Height h_1**					
Code	d_1	Tolerance		Code					
			16	20	21	27	30	32	37
				Tolerance					
			+0,15 −0,20	+0,20 −0,20	+0,20 −0,20	+0,20 −0,20	+0,20 −0,20	+0,20 −0,20	+0,20 −0,20
4	4,8	0 −0,15	1,60						
5	5,8	0 −0,15	1,60						
6	6,8	0 −0,15	1,60		2,10				
9	9,5	0 −0,15		2,00		2,70			3,70
16	16	0 −0,25	1,60	2,00					
20	20	0 −0,25	1,60	2,00				3,20	
24	24,5	0 −0,25					3,00		
30	30	0 −0,25						3,20	

A.3 Test methods for determining the resistance to leakage

A.3.1 Preconditioning and initial visual examination

Before carrying out the tests specified in A.3.2 and A.3.3, the batteries shall be submitted to a visual examination according to the requirements stated in Clause A.4.

For tests in A.3.2, batteries shall be pre-stored at the specified temperature (45 °C) for 2 h. Batteries shall be moved from the preconditioning (alternative pre-stored) chamber (or oven) into the high temperature and humidity test chamber within minutes in order to avoid cooling of the battery and the risk of condensation at elevated humidity.

A.3.2 High temperature and humidity test

The cell or battery shall be charged according to the charging method and conditions specified by the manufacturer (see 6.2). The battery shall be stored under the conditions specified in Table A.2.

Table A.2 – Storage conditions

Temperature °C	**Relative humidity** %
45 ± 2	90 to 95

The storage duration should be agreed between the manufacturer and the user.

The temperature tolerance of ±2 °C is for the temperature maintenance period and a brief overshoot in temperature is allowed during the transition period.

A.3.3 Test by temperature cycle

The cell or battery shall be charged according to the charging method and conditions specified by the manufacturer (see 6.2). The battery shall be submitted to temperature cycles according to the schedule in Figure A.2. The number of cycles should be agreed between the manufacturer and the user.

The temperature tolerance of ±2 °C is for the temperature maintenance period and a brief overshoot in temperature is allowed during the transition period.

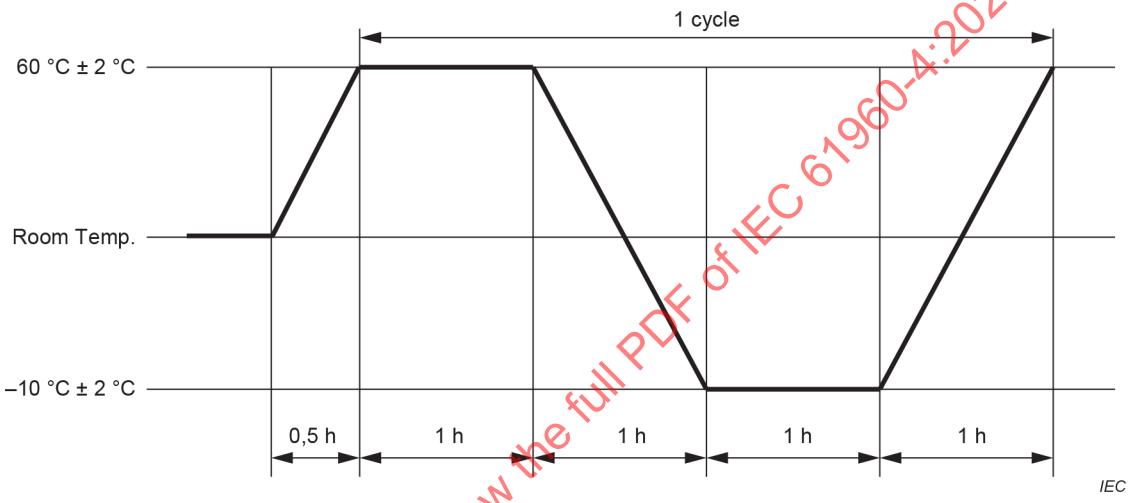


Figure A.2 – Test by temperature cycles

A.4 Visual examination and acceptance criteria

A.4.1 Preconditioning

Before carrying out the initial visual examination or after the tests specified in A.3.2 and A.3.3, the batteries shall be stored for at least 24 h at room temperature and at a relative humidity of 55 % ± 20 %.

The leakage should be observed after crystallisation of the electrolyte. The time of the storage of 24 h may be prolonged if necessary. This examination may be applied to new or used batteries, or to batteries which have been submitted to different tests.

A.4.2 Magnification

The visual examination shall be carried out at a magnification of x15.

A.4.3 Leakage levels and classification

The visual examination shall be carried out under a diffuse white light of 900 lx to 1 100 lx at the surface of the battery to be inspected (see IEC 60086-3:2021, Table 10).

A.4.4 Acceptance conditions

The acceptable levels of leakage, as well as the proportion of defective pieces, shall be agreed between the manufacturer and the user.

Annex B
(informative)

Guidelines for designers of equipment using lithium batteries

Equipment design guidelines are given in Table B.1.

Table B.1 – Equipment design guidelines

Item	Sub-item	Recommendations	Possible consequences if the recommendations are not observed
(1) Battery holder and battery compartment		a) Battery compartments should be designed so that if a battery is reversed, open circuit is achieved. Battery compartments should be clearly and permanently marked to show the correct orientation of batteries	Unless protection is provided against battery reversal, damage to equipment can occur from resultant electrolyte leakage, overheating, rupture, explosion or fire
		b) Battery compartments should be designed so that batteries of sizes other than those specified cannot be inserted and make contact	Equipment can be damaged or can not operate
		c) Battery compartments should be designed to allow generated gases to escape	Battery compartments can be damaged when internal pressure of the battery becomes too high due to gas generation
		d) Battery compartments should be designed to be waterproof	
		e) Battery compartments should be designed to be explosion-proof when tightly sealed	
		f) Battery compartments should be isolated from heat generated by the equipment	Battery can be deformed and leak electrolyte due to excessive heat
		g) Battery compartments should be designed so that they cannot easily be opened by children	Children can remove batteries from the compartment and swallow them
(2) Contacts and terminals		a) Material and shape of contacts and terminals should be selected so that effective electric contact is maintained	Heat can be generated at the contact due to insufficient connection
		b) Auxiliary circuit should be designed to prevent reverse installation of batteries	Equipment can be damaged or can not operate
		c) Contacts and terminals should be designed to prevent reverse installation of batteries	Equipment can be damaged. Battery can cause electrolyte leakage, overheating, rupture, explosion or fire
		d) Direct soldering or welding to a battery should be avoided	Battery can leak, overheat, rupture, explode or catch fire

Bibliography

IEC 60051 (all parts), *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60086-1, *Primary batteries – Part 1: General*

IEC 60086-2, *Primary batteries – Part 2: Physical and electrical specifications*

IEC 60086-3:2021, *Primary batteries – Part 3: Watch batteries*

IEC 60485, *Digital electronic d.c. voltmeters and d.c. electronic analogue-to-digital converters*[1]

IEC 61434, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Guide to designation of current in alkaline secondary cell and battery standards*

IEC 61959, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Mechanical tests for sealed portable secondary cells and batteries*

IEC 61960-3, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 3 – Prismatic and cylindrical lithium secondary cells, and batteries made from them*

IEC 62281, *Safety of primary and secondary lithium cells and batteries during transport*

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

[1] Withdrawn publication

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ACCUMULATEURS ALCALINS ET AUTRES ACCUMULATEURS À ÉLECTROLYTE NON ACIDE – ACCUMULATEURS AU LITHIUM POUR APPLICATIONS PORTABLES –

Partie 4: Éléments et batteries d'accumulateurs boutons au lithium

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L'IEC 61960-4 a été établie par le sous-comité 21A: Accumulateurs alcalins et autres accumulateurs à électrolyte non acide, du comité d'études 21 de l'IEC: Accumulateurs, en coopération avec le comité d'études 114 de l'ISO: Horlogerie. Il s'agit d'une norme internationale.

Cette deuxième édition annule et remplace la première édition parue en 2020. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) ajout d'une annexe pour normaliser les exigences des batteries d'accumulateurs au lithium pour montres;
b) ajout de nouvelles compositions chimiques;
c) ajout d'un tableau pour normaliser les dimensions et le codage de la taille des batteries d'accumulateurs au lithium pour montres;
d) modification des exigences de marquage.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
21A/880/FDIS	21A/892/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 61960, publiées sous le titre général *Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Accumulateurs au lithium pour applications portables*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

ACCUMULATEURS ALCALINS ET AUTRES ACCUMULATEURS À ÉLECTROLYTE NON ACIDE – ACCUMULATEURS AU LITHIUM POUR APPLICATIONS PORTABLES –

Partie 4: Éléments et batteries d'accumulateurs boutons au lithium

1 Domaine d'application

La présente partie de l'IEC 61960 spécifie les essais de performance, les désignations, les marquages, les dimensions et autres exigences pour les éléments et batteries d'accumulateurs boutons au lithium destinés aux montres, aux applications portables et d'alimentation de secours telles que les applications de sauvegarde de mémoire. Les exigences propres aux montres, en particulier, sont spécifiées dans l'Annexe A.

Le présent document fournit aux acheteurs et aux utilisateurs d'éléments et batteries d'accumulateurs boutons au lithium un ensemble de critères au moyen desquels ils peuvent évaluer les performances des différents accumulateurs de ce type proposés par différents fabricants.

Le présent document définit un niveau d'exigence minimale de performance et une méthodologie normalisée par laquelle sont réalisés les essais dont les résultats sont mis à la disposition de l'utilisateur. Les utilisateurs sont alors en mesure d'apprécier par eux-mêmes la viabilité des accumulateurs disponibles dans le commerce au moyen de la spécification déclarée et donc de sélectionner l'élément ou la batterie le ou la mieux adaptée à l'application prévue.

Le présent document couvre les éléments et batteries d'accumulateurs boutons au lithium dans une large gamme de compositions chimiques. Chaque couple électrochimique possède une plage de tension caractéristique dans laquelle il restitue, en décharge, sa capacité emmagasinée, une tension nominale caractéristique et une tension de fin de décharge caractéristique. Il est demandé aux utilisateurs d'éléments et batteries d'accumulateurs boutons au lithium de prendre conseil auprès du fabricant.

Le présent document fournit également des lignes directrices pour les concepteurs d'équipements utilisant des batteries au lithium (voir l'Annexe B).

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-482, *Vocabulaire Électrotechnique International (IEV) – Partie 482: Piles et accumulateurs électriques*

IEC 60086-4:2019, *Piles électriques – Partie 4: Sécurité des piles au lithium*

IEC 62133-2:2017, *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/AMD1:2021

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 60050-482, ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse https://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse https://www.iso.org/obp

3.1
élément bouton
batterie bouton
élément bouton au lithium
batterie bouton au lithium
petit élément rond ou petite batterie ronde d'une hauteur totale inférieure à son diamètre, contenant un électrolyte non aqueux

[SOURCE: IEC 60086-4:2019, 3.3, modifié – Note à l'article supprimée]

3.2
élément d'accumulateur au lithium
élément d'accumulateur dont l'énergie électrique résulte de l'oxydation et de la réduction du lithium

Note 1 à l'article: Cet élément est impropre à l'utilisation dans une application, car il n'est pas encore équipé de son habillage final, ni de ses bornes, ni de son dispositif de contrôle électronique.

3.3
batterie d'accumulateurs au lithium
ensemble, constitué d'un ou plusieurs éléments d'accumulateurs au lithium, prêt à l'emploi

Note 1 à l'article: Cet ensemble incorpore un habillage adéquat, une disposition des bornes de sortie et peut être équipé de dispositifs de contrôle électroniques.

3.4
tension nominale
valeur approchée appropriée d'une tension, utilisée pour désigner ou identifier un élément ou une batterie

Note 1 à l'article: Les tensions nominales des éléments d'accumulateurs boutons au lithium sont présentées dans le Tableau 1.

[SOURCE: IEC 60050-482:2004, 482-03-31, modifié – "système électrochimique" a été supprimé de la définition et une note a été ajoutée.]

3.5
capacité assignée
quantité d'électricité en mAh (milliampères-heures) qu'un élément ou une batterie individuel(le) est capable de restituer, après charge, repos et décharge, dans des conditions spécifiées et déclarées par le fabricant.

3.6
tension de fin de charge
tension atteinte à la fin d'une charge à un courant constant spécifié ou à une résistance constante spécifiée

Note 1 à l'article: La tension de fin de charge peut être utilisée pour déclencher l'arrêt du processus de charge.

[SOURCE: IEC 60050-482:2004, 482-05-55, modifié – "ou à une résistance constante modifiée" a été ajouté à la définition.]

3.7
tension de fin de décharge
tension en circuit fermé spécifiée pour laquelle la décharge de l'élément ou de la batterie est terminée

[SOURCE: IEC 60050-482:2004, 482-03-30, modifié – Les synonymes "tension de coupure" et "tension finale" ont été omis et les mots "circuit fermé" et "élément" ont été ajoutés à la définition.]

3.8
récupération de charge
récupération de capacité
capacité qu'un élément ou une batterie peut restituer, après repos à une température spécifique, pendant une durée spécifique, avec une recharge ultérieure, exprimée en pourcentage de la capacité assignée

4 Tolérances de mesure relatives aux paramètres

L'exactitude globale des valeurs contrôlées ou mesurées, par rapport aux valeurs spécifiées ou réelles, doit respecter les tolérances suivantes:

a) ±1 % pour la tension;
b) ±1 % pour le courant;
c) ±1 % pour la capacité;
d) ±2 °C pour la température;
e) ±0,1 % pour le temps;
f) ±0,1 mm pour les dimensions.

Ces tolérances comprennent l'exactitude combinée des appareils de mesure, des techniques de mesure utilisées et de toutes les autres sources d'erreur liées à la méthode d'essai.

Les caractéristiques des appareils utilisés doivent être fournies dans chaque rapport de résultats.

5 Désignation et marquage des éléments

5.1 Désignation des éléments

Les éléments doivent être désignés sous la forme suivante:

$$A_1A_2DDHH$$

où

A_1 désigne le système d'électrodes positives dans lequel:

C ou U est l'oxyde de cobalt et lithium;

FP est le phosphate de fer et lithium;

M est l'oxyde de manganèse et lithium;

N est l'oxyde de nickel et lithium;

NB est l'oxyde de niobium;

V est l'oxyde de vanadium;

T est l'oxyde de titane et lithium.

A_2 désigne le système d'électrodes négatives dans lequel:

C est le carbone;

L est l'alliage de lithium-aluminium;

S est l'oxyde/alliage silico-lithium;

T ou TL est l'oxyde de titane et lithium;

DD désigne le diamètre en mm;

HH désigne la hauteur en 1/10 de mm.

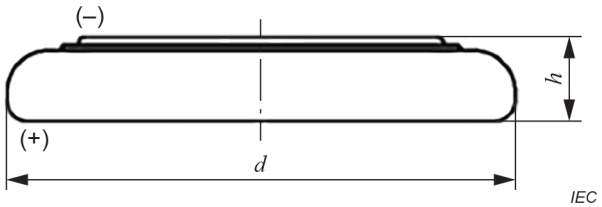
Les exigences relatives aux lettres du code des systèmes électrochimiques sont données dans le Tableau 1.

Tableau 1 – Systèmes électrochimiques en utilisation pratique courante

Électrode positive	Électrolyte	Électrode négative	Tension nominale (V)	Lettres du code
Oxyde de métal de transition lithium (cobalt, manganèse, nickel)	Solution non aqueuse avec du sel de lithium	Carbone	3,6 à 3,9	UC ou MC ou NC[a]
Phosphate de fer et lithium		Carbone	3,2	FPC
Oxyde de cobalt et lithium		Oxyde de titane et lithium	2,4	UT
Oxyde de vanadium		Alliage de lithium-aluminium	3,0	VL
Oxyde de manganèse et lithium		Alliage de lithium-aluminium	3,0	ML
Oxyde de manganèse et lithium		Oxyde/alliage silico-lithium	3,0	MS
Oxyde de cobalt et lithium		Oxyde de titane et lithium	2,3	CTL
Oxyde de niobium		Alliage de lithium-aluminium	2,0	NBL
Oxyde de manganèse et lithium		Oxyde de titane et lithium	1,5	MT
Oxyde de titane et lithium		Composé de lithium-carbone	1,5	TC
Oxyde de titane et lithium		Alliage de lithium-aluminium	1,5	TL
Oxyde de titane et lithium		Oxyde silico-lithium	1,5	TS

Les lettres du code ci-dessus sont données à titre d'exemple. Chaque électrode positive et chaque électrode négative doivent être désignées par une ou deux lettres. Toute lettre du code peut être définie par accord entre le fabricant et l'utilisateur lorsqu'une même composition chimique ayant des tensions nominales différentes existe.

[a] Pour les électrodes positives en oxyde de métal de transition lithium, les symboles de l'élément cobalt, manganèse ou nickel dont la teneur est la plus élevée dans la composition doivent être utilisés. (Par exemple, le symbole d'un oxyde de métal de transition lithium de composition $LiNi_{0,6}Mn_{0,2}Co_{0,2}O_2$ est N.)



Légende

h hauteur totale de l'élément

d diamètre de l'élément

Figure 1 – Caractéristiques dimensionnelles

Les éléments d'accumulateurs boutons au lithium conformes au présent document doivent être désignés par le système suivant, composé de lettres et chiffres qui constituent un code. Pour les systèmes électrochimiques, le code doit être constitué de deux lettres (trois lettres au maximum), suivies du diamètre et de la hauteur exprimés dans cet ordre. Voir Figure 1.