IEC 61960

Edition 2.0 2011-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications

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

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International Standard IEC 61960 has been prepared by subcommittee 21A: Secondary cells and batteries containing alkaline or other non-acid electrolytes, of IEC technical committee 21: Secondary cells and batteries.

This second edition cancels and replaces the first edition published in 2003. It is a technical revision.

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

- 7.6 Endurance in cycles: addition of an accelerated test procedure.

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

FDIS	Report on voting
21A/486/FDIS	21A/490/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 web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

1 Scope

This International Standard specifies performance tests, designations, markings, dimensions and other requirements for secondary lithium single cells and batteries for portable applications.

The objective of this standard is to provide the purchasers and users of secondary lithium cells and batteries with a set of criteria with which they can judge the performance of secondary lithium cells and batteries offered by various manufacturers.

This standard defines a minimum required level of performance and a standardized methodology by which testing is performed and the results of this testing 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 standard covers secondary lithium cells and batteries with a range of chemistries. Each electrochemical couple has a characteristic voltage range over which it releases its electrical capacity, a characteristic nominal voltage and a characteristic end-of-discharge voltage during discharge. Users of secondary lithium cells and batteries are requested to consult the manufacturer for advice.

2 Normative references

The following referenced documents are indispensable for the application 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 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

3 Terms and definitions

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

3.1
charge recovery
capacity that a cell or battery can deliver after the charge following the charge retention test according to 3.2

3.2
charge retention
capacity retention
capacity that a cell or battery can deliver after storage, at a specific temperature, for a specific time without subsequent recharging as a percentage of the rated capacity

3.3
final voltage
end-of-discharge voltage
specified closed circuit voltage at which a discharge of a cell or battery is terminated

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

NOTE 1 The nominal voltages of secondary lithium cells are given in Table 1.

NOTE 2 The nominal voltage of a battery of *n* series connected cells is equal to *n* times the nominal voltage of a single cell.

3.5
rated capacity
quantity of electricity C_5 Ah (ampere-hours) declared by the manufacturer which a single cell or battery can deliver during a 5-h period, when charged, stored and discharged under the conditions specified in 7.3.1

3.6
secondary lithium battery
unit which incorporates one or more secondary lithium cells and which is ready for use. It incorporates adequate housing and a terminal arrangement and may have electronic control devices

3.7
secondary lithium cell
secondary single cell whose electrical energy is derived from the oxidation and the reduction of lithium. 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

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 % for mass;

g) ± 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 and battery designation

Batteries shall be designated with following form:

$$N_1 A_1 A_2 A_3 N_2 / N_3 / N_4 - N_5$$

Cells shall be designated with following form:

$$A_1\ A_2\ A_3\ N_2\ /\ N_3\ /\ N_4$$

where

N_1 is the number of series connected cells in the battery;

A_1 designates the negative electrode system in which

- I is lithium ion;
- L is lithium metal or lithium alloy;

A_2 designates the positive electrode basis in which

- C is cobalt;
- N is nickel;
- M is manganese;
- V is vanadium;
- T is titanium;

A_3 designates the shape of the cell in which

- R is cylindrical;
- P is prismatic;

N_2 is the maximum diameter (if R) or the maximum thickness (if P) in mm rounded up to the next whole number;

N_3 is the maximum width (if P) in mm rounded up to the next whole number (N_3 not shown if R);

N_4 is the maximum overall height in mm rounded up to the next whole number;

NOTE If any dimension is less than 1 mm, the units used are tenths of millimetres and the single number is written tN.

N_5 is the number of parallel connected cells if 2 or greater (not shown if value is 1).

EXAMPLE 1 ICR19/66 would designate a cylindrical Li-ion secondary cell, with a cobalt-based positive electrode, a maximum diameter between 18 mm and 19 mm, and a maximum overall height between 65 mm and 66 mm.

EXAMPLE 2 ICP9/35/150 would designate a prismatic Li-ion secondary lithium cell, with a cobalt-based positive electrode, a maximum thickness between 8 mm and 9 mm, a maximum width between 34 mm and 35 mm, and a maximum overall height between 149 mm and 150 mm.

EXAMPLE 3 ICPt9/35/48 would designate a prismatic Li-ion secondary lithium cell, with a cobalt-based positive electrode, a maximum thickness between 0,8 mm and 0,9 mm, a maximum width between 34 mm and 35 mm, and a maximum overall height between 47 mm and 48 mm.

EXAMPLE 4 1ICR20/70 would designate a cylindrical Li-ion secondary battery with one single cell, a cobalt-based positive electrode, a maximum diameter between 19 mm and 20 mm, and a maximum overall height between 69 mm and 70 mm.

EXAMPLE 5 2ICP20/34/70 would designate a prismatic Li-ion secondary battery with two series connected cells, a cobalt-based positive electrode, a maximum thickness between 19 mm and 20 mm, a maximum width between 33 mm and 34 mm, and a maximum overall height between 69 mm and 70 mm.

EXAMPLE 6 1ICP20/68/70-2 would designate a prismatic Li-ion secondary battery with two parallel connected cells, a cobalt-based positive electrode, a maximum thickness between 19 mm and 20 mm, a maximum width between 67 mm and 68 mm, and a maximum overall height between 69 mm and 70 mm.

5.2 Cell or battery termination

This standard does not specify cell or battery termination.

5.3 Marking

Each cell or battery shall carry clear and durable markings giving the following information:

- secondary (rechargeable) Li or Li-ion;
- battery or cell designation as specified in 5.1;
- polarity;
- date of manufacture (which may be in code);
- name or identification of manufacturer or supplier.

Battery markings shall provide the following additional information:

- rated capacity;
- nominal voltage.

6 Standard cells

Table 1 lists the secondary lithium cell(s) that are suitable for standardization and used in assembling batteries.

Table 1 – Standard secondary lithium cells

	1	2	3
Secondary lithium cell	ICR19/66	ICP9/35/48	ICR18/68
Height (mm)	64,0/65,2	47,2/48,0	65,9/67,2
Diameter (mm)	17,8/18,5	NA	16,2/17,1
Width (mm)	NA	33,4/34,2	NA
Thickness (mm)	NA	7,6/8,8	NA
Nominal voltage (V)	3,6	3,6	3,6
End-of-discharge voltage (V)	2,50	2,50	2,50
End-of-discharge voltage (V) for endurance (cycle life)	2,75	2,75	2,75

NOTE The end-of-discharge voltage of a battery of *n* series connected cells is equal to *n* times the end-of discharge voltage of a single cell as given in Table 1.

7 Electrical tests

7.1 General

Unless otherwise stated, all tests that are described in this clause shall be performed in still air. Charge and discharge currents for the tests shall be based on the value of the rated capacity (C_5 Ah). These currents are expressed as a multiple of I_t A, where: I_t A = C_n Ah/1 h.

The minimum values required for each electrical test are stated in Table 5. Sample sizes and sequence of tests are described in Table 4.

7.2 Charging procedure for test purposes

Prior to charging, the cell or battery shall be discharged at 20 °C ± 5 °C at a constant current of 0,2 I_t A, down to a specified end-of-discharge voltage.

Unless otherwise stated in this standard, cells or batteries shall be charged, in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer.

7.3 Discharge performance

7.3.1 Discharge performance at 20 °C (rated capacity)

This test verifies the rated capacity of a cell or battery.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

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 of 0,2 I_t A, until its voltage is equal to the specified end-of-discharge voltage.

Step 4 – The capacity (Ah) delivered during step 3 shall be not less than 100 % of the rated capacity declared by the manufacturer. Steps 1 to 4 may be repeated up to four additional times, as necessary to satisfy this requirement.

7.3.2 Discharge performance at –20 °C

This test determines the capacity of the cell or battery at a low temperature.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

Step 2 – The cell or battery shall be stored, in an ambient temperature of −20 °C ± 2 °C, for not less than 16 h and not more than 24 h.

Step 3 – The cell or battery shall be discharged, in an ambient temperature of −20 °C ± 2 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified end-of-discharge voltage.

Step 4 – The capacity (Ah), delivered during step 3, shall be not less than that specified for this characteristic in Table 5.

7.3.3 High rate discharge performance at 20 °C

This test determines the capacity of a cell or battery when discharged at a high rate. This test is not required if the cell or battery is not designed to be used at this rate.

Step 1 –The cell or battery shall be charged in accordance with 7.2.

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 of 1,0 I_t A, until its voltage is equal to the specified end-of-discharge voltage.

Step 4 – The capacity (Ah) delivered during step 3 shall be not less than that specified for this characteristic in Table 5.

7.4 Charge (capacity) retention and recovery

This test determines firstly the capacity which a cell or battery retains after storage for an extended period of time, and secondly the capacity that can be recovered by a subsequent recharge.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

Step 2 – The cell or battery shall be stored in an ambient temperature of 20 °C ± 5 °C, for 28 days.

Step 3 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified end-of-discharge voltage.

Step 4 – The 28-day retained capacity (Ah) delivered, during step 3, shall be not less than that specified for this characteristic in Table 5.

Step 5 – The cell or battery shall then be charged in accordance with 7.2, within 24 h following the discharge of step 3.

Step 6 – 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 7 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified end-of-discharge voltage.

Step 8 – The recovery capacity (Ah) delivered, during step 6, shall be not less than that specified for this characteristic in Table 5.

7.5 Charge (capacity) recovery after long term storage

This test determines the capacity of a cell or battery after extended storage at 50 % state of charge, followed by a subsequent charge.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

Step 2 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, for 2,5 h.

Step 3 – The cell or battery shall be stored in an ambient temperature of 40 °C ± 2 °C, for 90 days.

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 stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 6 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified end-of-discharge voltage.