

Secondary lithium cells and batteries for portable applications —

Part 2: Secondary lithium batteries

The European Standard EN 61960-2:2001 has the status of a
British Standard

ICS 29.220.30; 29.220.99

National foreword

This British Standard is the official English language version of EN 61960-2:2001. It is identical with IEC 61960-2:2001, including Corrigendum February 2002.

The UK participation in its preparation was entrusted to Technical Committee PEL/21/1, Secondary cells and batteries containing alkaline and other non-acidic electrolytes, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

This British Standard, having been prepared under the direction of the Electrotechnical Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 15 March 2002

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 31, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments
13848 Corrigendum No.1	17 September 2002	Revision to 6.2.2.1.1

© BSI 17 September 2002

ISBN 0 580 39061 6

EUROPEAN STANDARD

EN 61960-2

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2001

ICS 29.220.30; 29.220.99

English version

**Secondary lithium cells and batteries
for portable applications —
Part 2: Secondary lithium batteries
(IEC 61960-2:2001)**

Eléments et batteries d'accumulateurs
au lithium pour applications portables —
Partie 2: Batteries d'accumulateurs
au lithium
(CEI 61960-2:2001)

Lithium-Sekundärzellen und –batterien
für tragbare Geräte —
Teil 2: Lithium-Sekundärbatterien
(IEC 61960-2:2001)

This European Standard was approved by CENELEC on 2001-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

© 2001 CENELEC - All rights of exploitation in any form and by any means reserved worldwide for CENELEC members.

Ref. No. EN 61960-2:2001 E



Documents
Document Sharing Hub

Foreword

The text of document 21A/328/FDIS, future edition 1 of IEC 61960-2, prepared by SC 21A, Secondary cells and batteries containing alkaline or other non-acid electrolytes, of IEC TC 21, Secondary cells and batteries, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61960-2 on 2001-10-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2002-07-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2004-10-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annex ZA is normative and annex A is informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61960-2:2001 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60086-4	NOTE	Harmonized as EN 60086-4:2000 (not modified).
IEC 60950	NOTE	IEC 60950:1999 + corr. January 2000 is harmonized as EN 60950:2000 (modified).

CONTENTS

INTRODUCTION	5
1 General.....	6
1.1 Scope	6
1.2 Normative references.....	6
1.3 Definitions	7
1.4 Parameter measurement tolerances	9
2 Designation and marking.....	9
2.1 Battery designation	9
2.1.1 Cylindrical secondary lithium batteries	9
2.1.2 Prismatic secondary lithium batteries.....	10
2.2 Marking	11
3 Standard types.....	11
4 Electrical tests	12
4.1 Charging procedure for test purposes.....	12
4.2 Discharge performance	12
4.2.1 Discharge performance at 20 °C (rated capacity).....	12
4.2.2 Discharge performance at -20 °C.....	12
4.2.3 High rate discharge performance at 20 °C	13
4.3 Charge (capacity) retention and recovery	13
4.4 Charge (capacity) recovery after storage	14
4.5 Endurance in cycles	14
4.6 Internal resistance	15
4.6.1 Measurement of the internal a.c. resistance.....	15
4.6.2 Measurement of the internal d.c. resistance.....	15
4.7 Electrostatic discharge (ESD).....	16
4.7.1 Test procedure.....	16
4.7.2 Acceptance criteria	16
5 Mechanical tests	16
5.1 Shock test.....	16
5.2 Vibration test	17
6 Safety evaluation	18
6.1 Intended use simulation tests.....	19
6.1.1 Electrical test	19
6.1.1.1 Continuous charge test.....	19
6.1.1.2 Overdischarge/Overcharge test.....	19
6.1.2 Mechanical tests	20
6.1.2.1 Shock test	20
6.1.2.2 Vibration test	20
6.1.3 Environmental tests.....	20
6.1.3.1 Thermal shock.....	20
6.1.3.2 Altitude simulation (low pressure) test.....	21
6.1.3.3 Mould stress test	21

6.2	Reasonably foreseeable misuse simulation tests	21
6.2.1	Electrical tests	22
6.2.1.1	Short-circuit test	22
6.2.1.2	Overcharge test (simulation of use of an inappropriate charger or charger malfunction)	22
6.2.2	Mechanical tests	22
6.2.2.1	Crush test.....	22
6.2.2.2	Free fall test	23
6.2.3	Environmental tests.....	23
6.2.3.1	Thermal exposure test	23
7	Test protocol and conditions for type approval	24
7.1	Test protocol.....	24
7.2	Conditions for type approval.....	24
7.2.1	Dimensions	24
7.2.2	Electrical tests	24
7.2.3	Intended use simulation tests	24
7.2.4	Reasonably foreseeable misuse simulation tests	24
7.2.5	Conditional type approval	24
8	Transportation tests (non-use)	26
8.1	Transportation tests	27
8.1.1	Mechanical tests	27
8.1.1.1	Shock test	27
8.1.1.2	Vibration test	27
8.1.2	Environmental tests.....	27
8.1.2.1	Thermal shock.....	27
8.1.2.2	Altitude simulation	27
8.1.3	Electrical test	27
8.1.3.1	Short circuit test	27
8.2	Test protocol.....	28
	Annex A (informative) Other transportation requirements	29
	Annex ZA (normative) Normative references to international publications with their corresponding European publications	31
	Bibliography	30

INTRODUCTION

Recent progress in the battery industry has seen secondary lithium cells and batteries evolve from the research environment to a state of regular commercial production and sale. In response to this situation, the IEC has prepared a new standard to cover secondary lithium cells and batteries for portable electronic applications. This part of IEC 61960 covers secondary lithium batteries and must be used in conjunction with IEC 61960-1, which covers secondary lithium cells.

This standard has been prepared so that it covers only those secondary lithium batteries that are:

- commercially available, and
- available from two or more manufacturers.

Traditionally the manufacturers and users of alkaline secondary cells and batteries have expressed the current used to charge and discharge these cells and batteries as a multiple of the capacity. For example, a current of 20 A used to charge a cell with a rated capacity (C Ah) of 100 Ah would be expressed as $C/5$ A or $0,2 C$ A. This method of current designation was originally used in earlier standards relating to alkaline secondary cells and batteries.

Comments have been made, that this method of current designation is dimensionally incorrect in that a multiple of the capacity (ampere hours) will be in ampere hours and not, as required for current, in amperes. As a result of these comments, the method described in IEC 61434 has been used in this standard.

In brief, the method states that the reference test current (I_t) is expressed as:

$$I_t A = C_n \text{ Ah}/1\text{h}$$

where

C_n is the rated capacity declared by the manufacturer in ampere hours (Ah), and
 n is the time base in hours (h) for which the rated capacity is declared.

SECONDARY LITHIUM CELLS AND BATTERIES FOR PORTABLE APPLICATIONS –

Part 2: Secondary lithium batteries

1 General

1.1 Scope

This International Standard specifies performance and safety tests, designations, markings, dimensions and other requirements for secondary lithium batteries.

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

This standard defines a minimum required level of performance and safety, 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 batteries via the declared specification and thus be able to select the battery best suited for their intended application.

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

For the avoidance of doubt, the scope of this standard does not include secondary lithium cells which are covered in IEC 61960-1.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61960. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61960 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(486), *International Electrotechnical Vocabulary (IEV) – Chapter 486: Secondary cells and batteries*

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

IEC 60068-2-6, *Basic environmental testing procedures – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Basic environmental testing procedures – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60068-2-32, *Environmental testing – Part 2: Tests – Test Ed: Free fall*

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

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*. Basic EMC Publication

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

IEC 61960-1, *Secondary lithium cells and batteries for portable applications – Part 1: Secondary lithium cells*

1.3 Definitions

For the purpose of this International Standard, the definitions contained in IEC 60050(486), and the following, apply:

1.3.1

charge (capacity) recovery

percentage of the rated capacity which a cell or battery can deliver after storage, at a specific temperature, for a specific time, when the cell or battery has been subsequently discharged and recharged, using the method declared by the manufacturer

1.3.2

charge (capacity) retention

percentage of the rated capacity which a cell or battery can deliver after storage, at a specific temperature, for a specific time without subsequent recharging

1.3.3

depth of discharge

ratio of the capacity used during a discharge to the rated capacity

1.3.4

end-of-charge current

charge current at which the charge of a cell or battery, at the constant voltage specified by the manufacturer, is terminated

1.3.5

explosion

the bursting of a cell or battery casing resulting in the expulsion of projectiles

1.3.6

final voltage

cut-off voltage

the specified voltage at which a discharge of a cell or battery is considered finished

1.3.7**fire**

the emission of flames from a cell or battery

1.3.8**leakage**

unplanned escape of electrolyte, gas or other material, from a cell or battery: leakage has occurred when a secondary lithium cell or battery loses more than x % (as defined below) of its initial mass due to loss of internal components, for example liquid electrolyte, where x is determined by the mass of the cell. The value of x is:

- 0,5 % for cells weighing not more than 1 g;
- 0,2 % for cells weighing more than 1 g but not more than 5 g;
- 0,1 % for cells weighing more than 5 g.

1.3.9**maximum charge voltage**

value of the charge voltage, recommended by the manufacturer, which shall not be exceeded during charge

1.3.10**new cell**

cell which has never been used and is not older than 30 days from the date of manufacture (for manufacturers testing), or not older than 30 days from the date of receipt (for user's testing)

1.3.11**nominal voltage:**

a suitable approximate value of voltage used to identify the voltage of a cell or battery

NOTE 1 The nominal voltages of secondary lithium cells are given in table 1 of IEC 61960-1.

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.

1.3.12**rated capacity**

quantity of electricity C_5 Ah (ampere hours) declared by the manufacturer, which a single cell or battery can deliver when discharged at +20 °C, at the reference test current of $0,2 I_t$ A to a specified final voltage, after charging, storing and discharging under the conditions specified in clause 4

1.3.13**recommended charge current**

specified current, recommended by the manufacturer, to which a cell can be subjected, during constant current charge for optimum performance and safety

1.3.14**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

1.3.15

secondary lithium cell

secondary single cell whose electrical capacity is derived from the oxidation and the reduction of lithium, but still not ready for consumer use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device

1.3.16

venting

release of gas at increased internal pressure from a cell or battery, in a manner intended by design, to preclude explosion

1.4 Parameter measurement tolerances

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

- a) $\pm 1\%$ for voltage;
- b) $\pm 1\%$ for current;
- c) $\pm 1\%$ for capacity;
- d) $\pm 2\text{ }^{\circ}\text{C}$ for temperature;
- e) $\pm 0,1\%$ for time;
- f) $\pm 0,1\%$ for mass;
- g) $\pm 0,1\%$ 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.

For assistance in selecting instrumentation, see IEC 60051 for analogue instruments and IEC 60485 for digital instruments. The details of the instrumentation used shall be provided in any report of results.

2 Designation and marking

2.1 Battery designation

2.1.1 Cylindrical secondary lithium batteries

Cylindrical secondary lithium batteries shall be designated by a number, followed by three letters, followed by four figures, followed by: "-b".

The first number shall be the number of series connected secondary lithium cells which make up the battery.

The first letter shall indicate the negative electrode system employed by the cells. The letter I defines the Li-ion system which has an intercalation electrode. The letter L defines the lithium metal electrode system or the lithium-alloy electrode system.

The second letter shall indicate the positive electrode system which comprises the largest weight percentage of the electrode active material. The letter C defines a cobalt-based electrode. The letter N defines a nickel-based electrode. The letter M defines a manganese-based electrode. The letter V defines a vanadium-based electrode.