

Safety of primary and secondary lithium cells and batteries during transport

The European Standard EN 62281:2004 has the status of a British Standard

ICS 29.220.10

National foreword

This British Standard is the official English language version of EN 62281:2004. It is identical with IEC 62281:2004.

The UK participation in its preparation was entrusted to Technical Committee CPL/35, Primary cells and batteries, 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 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 its correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 24, an inside back cover and a back cover.

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

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2006

© BSI

EUROPEAN STANDARD

EN 62281

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2004

ICS 29.220.10

English version

**Safety of primary and secondary lithium cells
and batteries during transport
(IEC 62281:2004)**

Sécurité des piles et des accumulateurs
au lithium pendant le transport
(CEI 62281:2004)

Sicherheit von Primär- und Sekundär-
Lithiumbatterien beim Transport
(IEC 62281:2004)

This European Standard was approved by CENELEC on 2004-06-01. 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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, 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

© 2004 CENELEC - All rights of exploitation in any form and by any means reserved worldwide for CENELEC members.

Foreword

The text of document 35/1202/FDIS, future edition 1 of IEC 62281, prepared by IEC TC 35, Primary cells and batteries, and 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 62281 on 2004-06-01.

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) 2005-03-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2007-06-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62281:2004 was approved by CENELEC as a European Standard without any modification.

CONTENTS

INTRODUCTION.....	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	6
4 Requirements for safety.....	9
4.1 General considerations	9
4.2 Packaging	9
5 Type testing, sampling and re-testing.....	9
5.1 Type testing	9
5.2 Assembly of batteries	10
5.3 Sampling	10
5.4 Re-testing	12
6 Test methods and requirements	12
6.1 General.....	12
6.1.1 Safety notice.....	12
6.1.2 Ambient temperature.....	12
6.1.3 Parameter measurement tolerances	12
6.1.4 Pre-discharge and pre-cycling	12
6.2 Evaluation of test criteria	13
6.2.1 Shifting	13
6.2.2 Distortion.....	13
6.2.3 Short-circuit	13
6.2.4 Excessive temperature rise	13
6.2.5 Leakage.....	13
6.2.6 Mass loss	13
6.2.7 Venting	14
6.2.8 Fire.....	14
6.2.9 Rupture	14
6.2.10 Explosion.....	14
6.3 Tests and requirements – overview	14
6.4 Transport tests	15
6.4.1 Test T-1: Altitude	15
6.4.2 Test T-2: Thermal cycling	15
6.4.3 Test T-3: Vibration	15
6.4.4 Test T-4: Shock	16
6.4.5 Test T-5: External short-circuit	17
6.4.6 Test T-6: Impact.....	17
6.5 Mis-use tests.....	18
6.5.1 Test T-7: Overcharge	18
6.5.2 Test T-8: Forced discharge	18
6.6 Packaging test.....	18
6.6.1 Test P-1: Drop test.....	18
6.6.2 Void.....	19
6.7 Information to be given in the relevant specification.....	19
6.8 Evaluation and report.....	19

7	Information for safety.....	20
7.1	Packaging	20
7.2	Handling of battery cartons	20
7.3	Transport	20
7.3.1	General	20
7.3.2	Air transport.....	20
7.3.3	Sea transport.....	20
7.3.4	Land transport	20
7.4	Display and storage	21
8	Instructions for packaging and handling during transport	21
8.1	Quarantine	21
9	Marking.....	21
9.1	Marking of primary and secondary (rechargeable) cells and batteries.....	21
9.2	Marking of the packaging and shipping documents	21
	Bibliography.....	23
	Annex ZA (normative) Normative references to international publications with their corresponding European publications.....	24
	Figure 1 – Example for the marking of packages with primary or secondary (rechargeable) lithium cells or batteries	22
	Table 1 – Number of test cells and batteries for type testing	11
	Table 2 – Maximum mass loss	13
	Table 3 – Transport and packaging tests and requirements.....	14
	Table 4 – Vibration profile (sinusoidal)	16
	Table 5 – Shock parameters	16

INTRODUCTION

Primary lithium cells and batteries were first introduced in military applications in the 1970s. At that time, little commercial interest and no industrial standards existed. Consequently, the United Nations (UN) Committee of Experts on the Transport of Dangerous Goods, although usually referring to industrial standards for testing and criteria, introduced a sub-section in the Manual of tests and criteria, dealing with safety tests relevant to transport of primary lithium cells and batteries. Meanwhile, commercial interest in primary and secondary (rechargeable) lithium cells and batteries has grown and several industrial standards exist. However, the existing IEC standards are manifold, not completely harmonized, and not necessarily relevant to transport. They are not suitable to be used as a source of reference in the UN Model Regulations. Therefore, a new group safety standard has been prepared to harmonize the tests and requirements relevant to transport.

This International Standard applies to primary and secondary (rechargeable) lithium cells and batteries containing lithium in any chemical form: lithium metal, lithium alloy or lithium-ion. Lithium-metal and lithium alloy primary electrochemical systems use metallic lithium and lithium alloy, respectively, as the negative electrode. Lithium-ion secondary electrochemical systems use intercalation compounds (intercalated lithium exists in an ionic or quasi-atomic form within the lattice of the electrode material) in the positive and in the negative electrodes.

This International Standard also applies to lithium polymer cells and batteries, which are considered either as primary lithium-metal cells and batteries or as secondary lithium-ion cells and batteries, depending on the nature of the material used in the negative electrode.

The history of transporting primary and secondary lithium cells and batteries is worth noting. Since the 1970s, over ten billion primary lithium cells and batteries have been transported, and since the early 1990s, over one billion secondary (rechargeable) lithium cells and batteries utilizing a lithium-ion system have been transported. As the number of primary and secondary lithium cells and batteries to be transported is increasing, it is appropriate to also include in this standard the safety testing of packaging used for the transportation of these products.

This International Standard specifically addresses the safety of primary and secondary lithium cells and batteries during transport and also the safety of the packaging used. Other International Standards dealing with the safety of primary and secondary lithium cells and batteries are referenced in Clause 2 and in the bibliography of this standard. They include the safety of primary and secondary lithium cells and batteries during handling, use and disposal and also address particular aspects of primary lithium batteries (IEC 60086-4) and secondary lithium cells and batteries (IEC 62133). They also contain some test methods and acceptance criteria that are relevant to transport. Consideration may, in the future, be given to the harmonization of these standards with this standard.

SAFETY OF PRIMARY AND SECONDARY LITHIUM CELLS AND BATTERIES DURING TRANSPORT

1 Scope

This International Standard specifies test methods and requirements for primary and secondary (rechargeable) lithium cells and batteries to ensure their safety during transport other than for recycling or disposal. Requirements specified in this standard do not apply in those cases where special provisions given in the relevant regulations, listed in 7.3, provide exemptions.

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

IEC 61960, *Secondary cells and batteries containing alkaline or other non-acid electrolyte – Secondary lithium cells and batteries for portable applications*

IEC Guide 104:1997, *The preparation of safety publications and the use of basic safety publications and group safety publications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

aggregate lithium content

total lithium content or lithium equivalent content of the cells comprising a battery

3.2

battery

one or more cells electrically connected by permanent means, fitted in a case, with terminals, markings and protective devices, etc., as necessary for use

3.3

button cell

coin cell

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

NOTE In practice, the term coin is used exclusively for non-aqueous lithium cells.

3.4

cell

basic functional unit, consisting of an assembly of electrodes, electrolyte, container, terminals and, usually, separators that is a source of electric energy obtained by direct conversion of chemical energy

3.5

component cell

cell contained in a battery

3.6

cycle (of a secondary (rechargeable) cell or battery)

set of operations that is carried out on a secondary (rechargeable) cell or battery and is repeated regularly in the same sequence

NOTE These operations may consist of a sequence of a discharge followed by a charge or a charge followed by a discharge under specified conditions. This sequence may include rest periods.

3.7

cylindrical cell

cell with a cylindrical shape in which the overall height is equal to or greater than the diameter

3.8

depth of discharge

DOD

percentage of rated capacity discharged from a battery

3.9 first cycle

initial cycle of a secondary (rechargeable) cell or battery following completion of all manufacturing, formation and quality control processes

3.10

fully charged

state of charge of a secondary (rechargeable) cell or battery corresponding to 0 % depth of discharge

3.11

fully discharged

state of charge of a cell or battery corresponding to 100 % depth of discharge

3.12

large battery

battery in which the aggregate lithium content is more than 500 g

3.13

large cell

cell in which the lithium content or lithium equivalent content is more than 12 g

3.14

lithium cell (primary or secondary (rechargeable))

cell containing a non-aqueous electrolyte and a negative electrode of lithium or containing lithium

NOTE Depending on the design features chosen, a lithium cell may be primary or secondary (rechargeable).

3.15

lithium content

mass of lithium in the negative electrode of a lithium metal or lithium alloy cell or battery in the undischarged or fully charged state