UL 60086-4

STANDARD FOR SAFETY

Primary Batteries – Part 4: Safety of Lithium Batteries

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UL Standard for Safety for Primary Batteries – Part 4: Safety of Lithium Batteries, UL 60086-4

First Edition, Dated May 22, 2015

Summary of Topics

The adoption of IEC 60086-4, the Standard for Primary Batteries – Part 4: Safety of Lithium Batteries (fourth edition, issued by the IEC September 2014) as a new IEC-based UL standard, UL 60086-4.

The effective date for UL LLC will be announced through Industry File Review – Announcement Letter.

The new requirements are substantially in accordance with Proposal(s) on this subject dated February 13, 2015.

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Standard For Safety For Primary Batteries – Part 4: Safety Of Lithium Batteries

First Edition

May 22, 2015

This UL Standard for Safety consists of the First Edition.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at http://csds.ul.com.

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Preface (UL)

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Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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UL Effective Date

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NATIONAL DIFFERENCES

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are national differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRIMARY BATTERIES – PART 4: SAFETY OF LITHIUM BATTERIES

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 nongovernmental 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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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60086-4 has been prepared by technical committee 35: Primary cells and batteries.

This fourth edition cancels and replaces the third edition published in 2007. This edition constitutes a technical revision.

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

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a) Harmonization with the second edition of IEC 62281 [12][1];

b) Alternative protective circuits in 7.1.1;

c) More information regarding risks of swallowing lithium batteries in (former) 7.2.m) and promotion of this item to 7.2a);

d) A new Annex D with pictograms for some of the safety precautions in 7.2.

[1]Numbers in square brackets refer to the Bibliography.

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

FDIS	Report on voting
35/1324/FDIS	35/1332/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.

NOTE The following print types are used:

– requirements: in roman type;

– instructions/warnings for consumers: *in italic type*.

A list of all parts in the IEC 60086 series, under the general title Primary batteries, can be found on the IEC website.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication 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.

DV.1 DE *Addition of the following:*

– The numbering system in the standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

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DV.2 DE *Addition of the following:*

– Words in SMALL CAPITALS in the text are defined in Clause 3.

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INTRODUCTION

The concept of safety is closely related to safeguarding the integrity of people and property. This standard specifies tests and requirements for lithium batteries and has been prepared in accordance with ISO/IEC guidelines, taking into account all relevant national and international standards which apply.

Lithium batteries are different from conventional primary batteries using aqueous electrolyte in that they contain flammable materials.

Consequently, it is important to carefully consider safety during design, production, distribution, use, and disposal of lithium batteries. Based on such special characteristics, lithium batteries for consumer applications were initially small in size and had low power output. There were also lithium batteries with high power output which were used for special industrial and military applications and were characterized as being “technician replaceable”. The first edition of this standard was drafted to accommodate this situation.

However, from around the end of the 1980s, lithium batteries with high power output started to be widely used in the consumer replacement market, mainly as a power source in camera applications. Since the demand for such lithium batteries with high power output significantly increased, various manufacturers started to produce these types of lithium batteries. As a consequence of this situation, the safety aspects for lithium batteries with high power output were included in the second edition of this standard.

Primary lithium batteries both for consumer and industrial applications are well-established safe and reliable products in the market, which is at least partly due to the existence of safety standards such as this standard and, for transport, IEC 62281. The fourth edition of this standard therefore reflects only minor changes which became necessary in order to keep it harmonized with IEC 62281 and to continuously improve the user information about safety related matters.

Guidelines addressing safety issues during the design of lithium batteries are provided in Annex A. Annex B provides guidelines addressing safety issues during the design of equipment where lithium batteries are installed. Both Annex A and B reflect experience with lithium batteries used in camera applications and are based on [20].

Safety is freedom from unacceptable risk. There can be no absolute safety: some risk will remain. Therefore a product, process or service can only be relatively safe. Safety is achieved by reducing risk to a tolerable level determined by the search for an optimal balance between the ideal of absolute safety and the demands to be met by a product, process or service, and factors such as benefit to the user, suitability for purpose, cost effectiveness, and conventions of the society concerned.

As safety will pose different problems, it is impossible to provide a set of precise provisions and recommendations that will apply in every case. However, this standard, when followed on a judicious ″use when applicable″ basis, will provide reasonably consistent standards for safety.

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PRIMARY BATTERIES – Part 4: SAFETY OF LITHIUM BATTERIES

1 Scope

This Part of IEC 60086 specifies tests and requirements for primary lithium BATTERIES to ensure their safe operation under INTENDED USE and REASONABLY FORESEEABLE MISUSE.

NOTE Primary lithium BATTERIES that are standardized in IEC 60086-2 are expected to meet all applicable requirements herein. It is understood that consideration of this part of IEC 60086 might also be given to measuring and/or ensuring the SAFETY of non-standardized primary lithium BATTERIES. In either case, no claim or warranty is made that compliance or non-compliance with this standard will fulfil or not fulfil any of the user's particular purposes or needs.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60086-1:2011,
Primary batteries – Part 1: General

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

3 Terms and definitions

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

NOTE Certain definitions taken from IEC 60050-482, IEC 60086-1, and IEC Guide 51 are repeated below for convenience.

3.1 **BATTERY**: one or more cells electrically connected and fitted in a case, with terminals, markings and PROTECTIVE DEVICES etc., as necessary for use

[SOURCE: IEC 60050-482:2004, 482-01-04, modified (″fitted with devices necessary for use, for example case″ replaced by ″electrically connected and fitted in a case″, addition of ″etc., as necessary for use″)]

3.2 **COIN CELL, COIN BATTERY**: small round cell or BATTERY where the overall height is less than the diameter

Note 1 to entry: In English, the term ″coin (CELL or BATTERY)″ is used for lithium BATTERIES only while the term ″button (CELL or BATTERY)″ is only used for non-lithium BATTERIES. In languages other than English, the terms ″coin″ and ″button″ are often used interchangeably, regardless of the electrochemical system.

[SOURCE: IEC 60050-482:2004, 482-02-40, modified (term ″button″ deleted, NOTE ″In practice terms, the term coin is used exclusively for non-aqueous lithium cells.″ replaced with a different note)]

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3.3 **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

[SOURCE: IEC 60050-482:2004, 482-01-01]

3.4 **COMPONENT CELL**: CELL contained in a BATTERY

3.5 **CYLINDRICAL (CELL OR BATTERY)**: round CELL or BATTERY in which the overall height is equal to or greater than the diameter

[SOURCE: IEC 60050-482:2004, 482-02-39, modified (″CELL with a cylindrical shape″ replaced by ″round CELL or BATTERY″)]

3.6 **DEPTH OF DISCHARGE, DOD**: percentage of RATED CAPACITY discharged from a BATTERY

3.7 **FULLY DISCHARGED**: state of charge of a CELL or BATTERY corresponding to 100 % DEPTH OF DISCHARGE

3.8 **HARM**: physical injury or damage to health of people, or damage to property or the environment

[SOURCE: ISO/IEC Guide 51:1999, 3.3]

3.9 **HAZARD**: potential source of HARM

[SOURCE: ISO/IEC Guide 51:1999, 3.5, modified (removal of NOTE)]

3.10 **INTENDED USE**: use of a product, process or service in accordance with information provided by the supplier

[SOURCE: ISO/IEC Guide 51:1999, 3.13]

3.11 **LARGE BATTERY**: BATTERY with a gross mass of more than 12 kg

3.12 **LARGE CELL**: CELL with a gross mass of more than 500 g

3.13 **LITHIUM CELL**: CELL containing a non-aqueous electrolyte and a negative electrode of lithium or containing lithium

[SOURCE: IEC 60050-482:2004 482-01-06, modified (removal of NOTE)]

3.14 **NOMINAL VOLTAGE**: suitable approximate value of the voltage used to designate or identify a CELL, a BATTERY or an electrochemical system

[SOURCE: IEC 60050-482:2004, 482-03-31]

3.15 **OPEN CIRCUIT VOLTAGE, OCV, U_{OC}, OFF-LOAD VOLTAGE**: voltage across the terminals of a CELL or BATTERY when no external current is flowing

[SOURCE: IEC 60050-482:2004, 482-03-32, modified (alternative terms ″OCV, U_{OC}, OFF-LOAD VOLTAGE″ added, ″across the terminals″ added, ″when the discharge current is zero″ replaced with ″when no external current is flowing″)]

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