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INTERNATIONAL STANDARD

colour inside

Primary batteries –
Part 4: Safety of lithium batteries

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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 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 60086-4:2025 edition 6.0 allows the user to identify the changes made to the previous IEC 60086-4:2019 edition 5.0. Furthermore, comments from IEC TC 35 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 60086-4 has been prepared by technical committee 35: Primary cells and batteries. It is an International Standard.

This sixth edition cancels and replaces the fifth edition published in 2019. This edition constitutes a technical revision.

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

a) Added definitions for leakage and venting, in addition to the test criteria;
b) Revised overdischarge test;
c) Revised marking requirements;
d) Revised criteria for the child resistant packaging test;
e) Changed the purpose of Annex F from "informative" to "normative";
f) Added a new Annex G with additional measures against misuse of batteries not intended for consumer replacement;
g) Integrated the contents of Interpretation Sheet 1 (IEC 60086-4:2019/ISH1:2020);
h) In Clause 3, terms were reordered according their functions: basic terms, electrochemical systems, battery shapes, battery sizes, electrical characteristics, specifications, safety aspects, failure modes;
i) In 6.4.4, the exemption for the shock acceleration for lithium primary batteries was reduced from 12 kg to 4,482 kg in order to reflect the fact that this is the threshold in IEC 62281, Test T-4, where the peak acceleration decreases below 150 g_n.

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

Draft	Report on voting
35/1571/FDIS	35/1579/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.

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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

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- withdrawn, or
- revised.

NOTE 2 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC document in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests. It is the recommendation of the committee that the content of this document be adopted for implementation nationally not earlier than 2 years from the date of publication. The transitional period applies specifically to changes in Table 10. In the meantime, the previous edition can still be ordered by contacting your local IEC member National Committee or the IEC Secretariat.

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INTRODUCTION

The concept of safety is closely related to safeguarding the integrity of people and property. This document 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 document 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 document.

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 document and, for transport, IEC 62281. The fourth edition of this document reflected 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 Annex B reflect experience with lithium batteries used in camera applications and are based on [22][1].

The ingestion hazard of coin cell batteries has become an issue and was addressed in the fifth and sixth editions of this document by several independent measures such as the development of a new safety sign "KEEP OUT OF REACH OF CHILDREN" as well as the introduction of child resistant packaging.

A new Annex G addresses measures against misuse of cells and batteries not intended for consumer replacement.

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 document, when followed on a judicious "use when applicable" basis, will provide reasonably consistent standards for safety.

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1 Numbers in square brackets refer to the Bibliography.

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 part of IEC 60086 will fulfil or not fulfil any of the user's particular purposes or needs.

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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 60086-1:2021, *Primary batteries – Part 1: General*

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Primary batteries –
Part 4: Safety of lithium batteries

Piles électriques –
Partie 4: Sécurité des piles au lithium

IEC 60086-4:2025-01(en-fr)

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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PILES ÉLECTRIQUES –

Partie 4: Sécurité des piles au lithium

AVANT-PROPOS

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L'IEC 60086-4 a été établie par le comité d'études 35 de l'IEC: Piles. Il s'agit d'une Norme internationale.

Cette sixième édition annule et remplace la cinquième édition parue en 2019. Cette édition constitue une révision technique.

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

a) ajout de définitions pour les concepts de fuite et de dégazage, en complément des critères d'essai;
b) révision de l'essai de décharge excessive;
c) révision des exigences de marquage;
d) révision des critères relatifs à l'essai des emballages à l'épreuve des enfants;
e) modification de l'objet de l'Annexe F, passant de "informative" à "normative";
f) ajout d'une Annexe G stipulant des mesures supplémentaires contre le mauvais usage des piles qui ne sont pas destinées à être remplacées par le consommateur;
g) intégration du contenu de la Feuille d'Interprétation 1 (IEC 60086-4:2019/ISH1:2020);
h) réordonnancement des termes énumérés à l'Article 3 selon leurs fonctions: termes de base, systèmes électrochimiques, formes de piles, tailles de piles, caractéristiques électriques, spécifications, considérations relatives à la sécurité, modes de défaillance;
i) en 6.4.4, réduction de l'exemption d'accélération pour l'essai de chocs des piles au lithium, passant de 12 kg à 4,482 kg, afin de refléter le fait qu'il s'agit du seuil défini pour l'essai T-4 de l'IEC 62281, dans lequel l'accélération maximale descend en dessous de 150 g_n.

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

Projet	Rapport de vote
35/1571/FDIS	35/1579/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.

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INTRODUCTION

La notion de sécurité est étroitement liée à la sauvegarde de l'intégrité des personnes et des biens. Le présent document spécifie les essais et les exigences pour les piles au lithium, et a été établi conformément aux lignes directrices ISO/IEC, en prenant en compte toutes les normes nationales et internationales qui s'appliquent.

Les piles au lithium sont différentes des piles électriques conventionnelles utilisant un électrolyte aqueux, dans la mesure où elles contiennent des matériaux inflammables.

Par conséquent, il est important de bien prendre en compte la sécurité aux étapes que sont la conception, la production, la distribution, l'utilisation et la mise au rebut des piles au lithium. Compte tenu de leurs caractéristiques spécifiques, les piles au lithium pour les applications grand public étaient à l'origine de petite taille et de faible puissance. Il existait également des piles au lithium de forte puissance qui étaient utilisées pour des applications industrielles et militaires particulières, dont l'une des particularités était d'être "remplaçables par un technicien". La première édition du présent document avait été rédigée pour prendre en compte cette situation.

Cependant, depuis la fin des années 1980 environ, des piles au lithium de forte puissance ont commencé à être largement utilisées sur le marché des piles remplaçables par le consommateur, principalement en tant que source d'énergie dans les appareils de prise de vue. La demande pour de telles piles au lithium de forte puissance ayant augmenté de manière significative, différents fabricants ont commencé à en produire. Par conséquent, les considérations relatives à la sécurité des piles au lithium de forte puissance ont été incluses dans la seconde édition du présent document.

Les piles au lithium, tant pour les applications grand public que pour les applications industrielles, sont des produits du marché dont la sûreté et la fiabilité sont bien établies, cela étant dû, au moins en partie, à l'existence de normes de sécurité telles que le présent document, ainsi que l'IEC 62281 pour le secteur du transport. La quatrième édition du présent document ne reflétait que les modifications mineures qui étaient devenues nécessaires pour qu'elle reste harmonisée avec l'IEC 62281, et pour continuer à améliorer les informations destinées à l'utilisateur en ce qui concerne la sécurité.

Des lignes directrices relatives aux questions de sécurité inhérentes à la conception des piles au lithium sont données à l'Annexe A. L'Annexe B donne des lignes directrices relatives aux questions de sécurité inhérentes à la conception des matériels dans lesquels sont installées des piles au lithium. L'Annexe A ainsi que l'Annexe B reflètent l'expérience acquise avec les piles au lithium utilisées dans les applications pour les appareils de prise de vue et sont fondées sur le document de référence [22][1].

Le danger d'ingestion des piles boutons est devenu un problème et a été traité dans les cinquièmes et sixièmes éditions du présent document par plusieurs mesures indépendantes, telles que le développement d'une nouvelle signalétique de sécurité "TENIR À L'ÉCART DES ENFANTS", ainsi que l'introduction d'emballages à l'épreuve des enfants.

Une nouvelle Annexe G stipule des mesures contre le mauvais usage des éléments et piles qui ne sont pas destinés à être remplacés par le consommateur.

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1 Les chiffres entre crochets se réfèrent à la Bibliographie.

La sécurité est l'absence de risques inacceptables. La sécurité absolue ne peut pas exister: il subsiste toujours un risque. De ce fait, la sécurité d'un produit, d'un procédé ou d'un service ne peut être que relative. La sécurité est obtenue en réduisant le risque à un niveau tolérable, déterminé par la recherche d'un équilibre optimal entre l'idéal de sécurité absolue et les exigences auxquelles doit répondre un produit, un procédé ou un service, et des facteurs tels que le bénéfice pour l'utilisateur, l'adéquation à l'usage prévu, la rentabilité et les conventions de la société concernée.

Dans la mesure où la sécurité pose toutes sortes de problèmes, il est impossible d'établir une liste de dispositions et de recommandations précises qui s'appliquent dans tous les cas. Cependant, s'il est suivi de manière judicieuse en fonction de son applicabilité, le présent document constitue une référence raisonnable et cohérente en ce qui concerne la sécurité.

PILES ÉLECTRIQUES –

Partie 4: Sécurité des piles au lithium

1 Domaine d'application

La présente partie de l'IEC 60086 spécifie les essais et les exigences pour les piles électriques au lithium afin d'assurer leur fonctionnement en toute sécurité dans les conditions d'utilisation prévue et en cas de mauvais usage raisonnablement prévisible.

NOTE Les piles électriques au lithium qui sont normalisées dans l'IEC 60086-2 sont prévues pour satisfaire à toutes les exigences applicables ci-dessous. Il est entendu que la présente partie de l'IEC 60086 est également susceptible d'être prise en compte pour mesurer les piles électriques au lithium non normalisées et/ou s'assurer de leur sécurité. Dans les deux cas, il n'existe aucune déclaration ou garantie que la conformité ou la non-conformité à la présente partie de l'IEC 60086 répondra ou ne répondra pas aux objectifs ou aux besoins particuliers de l'utilisateur.

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 60086-1:2021, *Piles électriques – Partie 1: Généralités*

IEC 60086-2, *Piles électriques – Partie 2: Spécifications physiques et électriques*

IEC 62281, *Sécurité des piles et des accumulateurs au lithium pendant le transport*