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INTERNATIONAL STANDARD

Primary batteries -
Part 1: General

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Primary batteries - Part 1: General

FOREWORD

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IEC 60086-1 has been prepared by IEC technical committee 35: Primary cells and batteries. It is an International Standard.

This fourteenth edition cancels and replaces the thirteenth edition published in 2021. This edition constitutes a technical revision.

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

a) In Clause 3, terms were reordered according to their functions: basic terms, electrochemical systems, battery shapes, electrical characteristics, specifications, failure modes;
b) New letter "T" was added in Table 1, *Standardized electrochemical systems of 4.1.4 classification*;
c) Maximum open circuit voltage of letter "F" was changed from 1,83 V to 1,90 V;
d) Drawing of pulse tests with multiple load was moved from IEC 60086-2 to 5.2.2.2, *Application tests with multiple loads*;

e) Annex F, *Guidance for proposing value of minimum average duration* was modified;

f) Annex D of IEC 60086-2:2021, *Common designation*, has been transferred to Annex H of this document;

g) Table H.1, *Common designation index*, was modified to provide reference to IEC 60086-2-1 and IEC 60086-2-2 for each battery;

h) Annex I identifies the batteries of general use and the applicable tests to compare their performance, in support of Regulation (EU) 2023/1542 (Batteries Regulation).

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

Draft	Report on voting
35/1590/FDIS	35/1600/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.

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 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

– reconfirmed,

– withdrawn, or

– revised.

INTRODUCTION

The technical content of this part of IEC 60086 provides fundamental requirements and information on primary cells and batteries. In this sense, IEC 60086-1 is the main component of the IEC 60086 series and forms the basis for the subsequent parts. For example, this part includes elementary information on definitions, nomenclature, dimensions and marking. While specific requirements are included, the content of this part tends to explain methodology (how) and justification (why).

Over the years, this part has been changed to improve its content and remains under continual scrutiny to ensure that the publication is kept up to date with the advances in both battery and battery-powered device technologies.

Safety requirements and recommendations are available in IEC 60086-4, IEC 60086-5 and IEC 62281. Specifications are available in IEC 60086-2-1, IEC 60086-2-2 and IEC 60086-3. Environmental aspects are dealt with in IEC 60086-6.

1 Scope

This part of IEC 60086 is intended to standardize primary batteries with respect to dimensions, nomenclature, terminal configurations, markings, test methods, typical performance, safety and environmental aspects.

This document on one side specifies requirements for primary cells and batteries. On the other side, this document also specifies procedures of how requirements for these batteries are to be standardised.

As a classification tool for primary batteries, this document specifies system letters, electrodes, electrolytes, and nominal as well as maximum open circuit voltage of electrochemical systems.

The object of this part of IEC 60086 is to benefit primary battery users, device designers and battery manufacturers by ensuring that batteries from different manufacturers are interchangeable according to standard form, fit and function. Furthermore, to ensure compliance with the above, this document specifies standard test methods for testing primary cells and batteries.

This document also contains requirements in Annex A of this document justifying the inclusion or the ongoing retention of batteries in the IEC 60086 series.

2 Normative references

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 60086-2-1:2026, *Primary batteries - Part 2-1: Physical and electrical specifications of batteries with aqueous electrolyte*

IEC 60086-2-2:2026, *Primary batteries - Part 2-2: Physical and electrical specifications of lithium batteries*

IEC 60086-3:2021, *Primary batteries - Part 3: Watch batteries*

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

IEC 60086-5, *Primary batteries - Part 5: Safety of batteries with aqueous electrolyte*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

3.1
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, modified – removal of Note]

3.2
battery
one or more cells electrically connected and fitted with devices necessary for use, for example case, labels, terminals, marking and protective devices etc.

[SOURCE: IEC 60050-482:2004, 482-01-04, modified – addition of "electrically connected", "labels" and "etc."]

3.3
primary cell
primary battery
cell or battery that is not designed to be electrically recharged

3.4
round cell
round battery
cell or battery with circular cross section

3.5
button cell
button battery
small round cell or battery where the overall height is less than the diameter, containing aqueous electrolyte

Note 1 to entry: See coin cell, coin battery, lithium button cell, lithium button battery.

[SOURCE: IEC 60050-482:2004, 482-02-40, modified – addition of "small round", "or battery", removal of "e.g. in the shape of a button or a coin", addition of "containing aqueous electrolyte"]

3.6
coin cell
coin battery
lithium button cell
lithium button battery
small round cell or battery where the overall height is less than the diameter, containing non-aqueous electrolyte

Note 1 to entry: The nominal voltage of lithium batteries is typically greater than 2 V.

Note 2 to entry: See button cell, button battery.

3.7
cylindrical cell
cylindrical 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 with "round cell or battery"]

3.8
nominal voltage
U_n
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, modified – addition of U_n]

3.9
open-circuit voltage
OCV
voltage across the terminals of a cell or battery when it is off discharge

3.10
closed-circuit voltage
CCV
voltage across the terminals of a battery when it is on discharge

[SOURCE: IEC 60050-482:2004, 482-03-28, modified – "voltage between the terminals of a cell or battery" replaced by "voltage across the terminals of a battery"]

3.11
end-point voltage
EV
specified voltage of a battery at which the battery discharge is terminated

[SOURCE: IEC 60050-482:2004, 482-03-30]

3.12
minimum average duration
MAD

acceptable minimum average time on discharge, which is met by testing a sample of batteries according to specified methods, to be deemed compliant

Note 1 to entry: The discharge test is carried out according to the specified methods or standards and designed to show conformity with the standard applicable to the battery types.

3.13
application test
simulation of the actual use of a battery in a specific application

3.14
discharge
operation during which a battery delivers current to an external circuit

3.15
service output
service life, or capacity, or energy output of a battery under specified conditions of discharge

3.16
service output test
test designed to measure the service output of a battery

3.17
storage life
duration under specified conditions at the end of which a battery retains its ability to perform a specified service output

[SOURCE: IEC 60050-482:2004, 482-03-47, modified – "function" replaced by "service output"]

3.18
terminal
conductive parts of a battery providing connection to an external circuit

[SOURCE: IEC 60050-482:2004, 482-02-22, modified – "conductive part of a device, electric circuit or electric network, provided" replaced by to "conductive parts of a battery providing" and "device, electric circuit or electric network to one or more external conductor" replaced by "an external circuit"]

3.19
leakage
unplanned escape of electrolyte, gas or other material from a cell or battery

[SOURCE: IEC 60050-482:2004, 482-02-32]

3.20
terms applicable to Annex I

3.20.1
non-rechargeable battery
battery that is not designed to be electrically recharged

Note 1 to entry: The term "non-rechargeable" is used in the European Batteries Regulation in place of "primary".

[SOURCE: Batteries Regulation, Article 2(1), point (6), modified — Note to entry has been added]

3.20.2
portable battery of general use
portable battery specifically produced to be interoperable and with the following common formats: 4,5 Volts (3R12), button cell, D, C, AA, AAA, AAAA, A23, 9 Volts (PP3)

Note 1 to entry: See I.2 for more information on the meaning of "interoperable".

Note 2 to entry: See I.3 for a tabulation of portable non-rechargeable batteries of general use.

Note 3 to entry: (3R12) is not part of the common designation but part of some IEC designations. See Table I.1.

[SOURCE: Batteries Regulation, Article 2(1), point (10), modified — Notes to entry have been added]

4 Requirements

4.1 General

4.1.1 Design

Primary batteries are sold mainly in consumer markets. In recent years, they have become more sophisticated in both chemistry and construction, for example both capacity and rate capability have increased to meet the growing demands from new, battery-powered equipment technology.

When designing primary batteries, the aforementioned considerations shall be taken into account. Specifically, their dimensional conformity and stability, their physical and electrical performance and their safe operation under normal use and foreseeable misuse conditions shall be assured.

Additional information on equipment design can be found in Annex B of this document.

4.1.2 Battery dimensions

The dimensions for individual types of batteries are given in IEC 60086-2-1, IEC 60086-2-2 and IEC 60086-3.

4.1.3 Terminals

4.1.3.1 General

Terminals shall be in accordance with Clause 8 of IEC 60086-2-1:2026 and IEC 60086-2-2.

Their physical shape shall be designed in such a way that they ensure that the batteries make and maintain good electrical contact at all times.

They shall be made of materials that provide good electrical conductivity and resistance to corrosion.

4.1.3.2 Contact pressure resistance

Where stated in the battery specification tables or the individual specification sheets in IEC 60086-2-1 and IEC 60086-2-2, the following applies:

– a force of 10 N applied through a steel ball of 1 mm diameter at the centre of each contact area for a period of 10 s shall not cause any apparent deformation which might prevent satisfactory operation of the battery.

NOTE See also IEC 60086-3:2021, 4.5 for exceptions.

4.1.3.3 Cap and base

This type of terminal is used for batteries which have their dimensions specified according to Figures 1 to 6 of IEC 60086-2-1:2026 and Figures 1 to 4 of IEC 60086-2-2:2026 which have the cylindrical side of the battery insulated from the terminals.

4.1.3.4 Cap and case

This type of terminal is used for batteries which have their dimensions specified according to Figures 7, 8, 9, 13, 14 of IEC 60086-2-1:2026 and Figures 5, 6, 7 of IEC 60086-2-2:2026, but in which the cylindrical side of the battery forms part of the positive terminal.

4.1.3.5 Screw terminals

This contact consists of a threaded rod in combination with either a metal or insulated metal nut.

4.1.3.6 Flat contacts

These are essentially flat metal surfaces adapted to make electrical contact by suitable contact mechanisms bearing against them.

4.1.3.7 Flat or spiral springs

These contacts comprise flat metal strips or spirally wound wires which are in a form that provides pressure contact.

4.1.3.8 Plug-in-sockets

These are made up of a suitable assembly of metal contacts, mounted in an insulated housing or holding device and adapted to receive the corresponding pins of a mating plug.

4.1.3.9 Snap fasteners

4.1.3.9.1 General

These contacts are composed of a combination comprising a stud (non-resilient) for the positive terminal and a socket (resilient) for the negative terminal.

They shall be of suitable metal so as to provide efficient electrical connection when joined to the corresponding parts of an external circuit.

4.1.3.9.2 Snap fastener

This type of terminal consists of a stud for the positive terminal and a socket for the negative terminal. These shall be made from nickel plated steel or other suitable material. They shall be designed to provide a secure physical and electrical connection, when fitted with similar corresponding parts for connection to an electrical circuit.

4.1.3.10 Wire

Wire leads may be single or multi-strand flexible insulated tinned copper. The positive terminal wire covering shall be red and the negative black.

4.1.3.11 Other spring contacts or clips

These contacts are generally used on batteries when the corresponding parts of the external circuit are not precisely known. They shall be of spring brass or of other material having similar properties.

4.1.4 Classification (electrochemical system)

Primary batteries are classified according to their electrochemical system.

Each system, with the exception of the zinc-ammonium chloride, zinc chloride-manganese dioxide system, has been allocated a letter denoting the particular system.

The electrochemical systems that have been standardized up to now are given in Table 1.