

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

Primary batteries – **STANDARD PREVIEW**  
Part 1: General **(standards.iteh.ai)**

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



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## PRIMARY BATTERIES –

## Part 1: General

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

This thirteenth edition cancels and replaces the twelfth edition published in 2015. This edition constitutes a technical revision.

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

- a) a compliance checklist was added as an Annex H;
- b) definitions were harmonized with the other 60086 series documents;
- c) the nominal voltage of the zinc air system is now listed as either 1,4 V or 1,45 V;
- d) Annex F for calculation of MAD values was simplified;
- e) a validity period for testing was added;
- f) the accelerated aging test at 45 °C was changed from 13 to 4 weeks;

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

FDIS	Report on voting
35/1465/FDIS	35/1469/RVD

Full information on the voting for the approval of this International Standard 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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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## INTRODUCTION

The technical content of this part of IEC 60086 provides fundamental requirements and information on primary cells and batteries. All batteries within the IEC 60086 series are considered dry cell 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 and IEC 60086-3. Environmental aspects are dealt with in IEC 60086-6.

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# PRIMARY BATTERIES –

## Part 1: General

### 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 part specifies standard test methods for testing primary cells and batteries.

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

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### 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 60086-2:2015, *Primary batteries – Part 2: Physical and electrical specifications*

IEC 60086-3, *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 terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

**3.1****application test**

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

**3.2****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 – removal of "fitted with devices necessary for use.]

**3.3****button** (cell or 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 or battery), lithium button (cell or battery).

[SOURCE: IEC 60050-482:2004 482-02-40]

**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

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

**3.5****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".]

**3.6****coin** (cell or battery)**lithium button** (cell or 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 or battery).

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

**3.8****discharge** (of a primary battery)

operation during which a battery delivers current to an external circuit

**3.9**

**dry (primary) battery**

primary battery in which the liquid electrolyte is essentially immobilized

[SOURCE:IEC 60050-482:2004, 482-04-14, modified – replacement of "containing an immobilized electrolyte.]"

**3.10**

**end-point voltage**

**EV**

specified voltage of a battery at which the battery discharge is terminated

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

**3.11**

**leakage**

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

Note 1 to entry: Leakage in this sense should not be confused with the test evaluation criteria for leakage specified in Clause 4 and Clause 5 of this document.

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

**3.12**

**minimum average duration**

**MAD**

minimum average time on discharge which is met by a sample of batteries

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**

**nominal voltage** (of a primary battery)

$U_n$

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 "(of a primary battery)" and symbol  $U_n$ .]

**3.14**

**open-circuit voltage**

**OCV**

voltage across the terminals of a cell or battery when it is off discharge

**3.15**

**primary** (cell or battery)

cell or battery that is not designed to be electrically recharged

**3.16**

**round** (cell or battery)

cell or battery with circular cross section

**3.17**

**service output** (of a primary battery)

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

### 3.18

#### **service output test**

test designed to measure the service output of a battery

Note 1 to entry: A service output test may be prescribed, for example, when

- a) an application test is too complex to replicate;
- b) the duration of an application test would make it impractical for routine testing purposes.

### 3.19

#### **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".]

### 3.20

#### **terminals** (of a primary battery)

conductive parts of a battery that provide connection to an external circuit

## 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.

#### 4.1.2 Battery dimensions

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

#### 4.1.3 Terminals

##### 4.1.3.1 General

Terminals shall be in accordance with Clause 6 of IEC 60086-2:2015.

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, 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 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 7 of IEC 60086-2:2015 and 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 8, 9, 10, 14, 15 and 16 of IEC 60086-2:2015, 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.

**Table 1 – Standardized electrochemical systems**

Letter	Negative electrode	Electrolyte	Positive electrode	Nominal voltage V	Maximum open circuit voltage V
No letter	Zinc (Zn)	Ammonium chloride, zinc chloride	Manganese dioxide (MnO <sub>2</sub> )	1,5	1,73
A	Zinc (Zn)	Ammonium chloride, zinc chloride	Oxygen (O <sub>2</sub> )	1,4	1,55
B	Lithium (Li)	Organic electrolyte	Carbon monofluoride (CF) <sub>x</sub>	3,0	3,7
C	Lithium (Li)	Organic electrolyte	Manganese dioxide (MnO <sub>2</sub> )	3,0	3,7
E	Lithium (Li)	Non-aqueous inorganic	Thionyl chloride (SOCl <sub>2</sub> )	3,6	3,9
F	Lithium (Li)	Organic electrolyte	Iron disulfide (FeS <sub>2</sub> )	1,5	1,83
G	Lithium (Li)	Organic electrolyte	Copper (II) oxide (CuO)	1,5	2,3
L	Zinc (Zn)	Alkali metal hydroxide	Manganese dioxide (MnO <sub>2</sub> )	1,5	1,68
P	Zinc (Zn)	Alkali metal hydroxide	Oxygen (O <sub>2</sub> )	1,4 or 1,45	1,59
S	Zinc (Zn)	Alkali metal hydroxide	Silver oxide (Ag <sub>2</sub> O)	1,55	1,63
W	Lithium (Li)	Organic electrolyte	Sulphur dioxide (SO <sub>2</sub> )	3,0	3,05
Y	Lithium (Li)	Non-aqueous inorganic	Sulfuryl chloride (SO <sub>2</sub> Cl <sub>2</sub> )	3,9	4,1
Z	Zinc (Zn)	Alkali metal hydroxide	Nickel oxyhydroxide (NiOOH)	1,5	1,78

NOTE 1 The value of the nominal voltage is not verifiable; therefore it is only given as a reference.

NOTE 2 The maximum open-circuit voltage (3.14) is measured as defined in 5.5 and 6.8.1.

NOTE 3 When referring to an electrochemical system, common protocol is to list negative electrode first, followed by positive electrode, i.e. lithium-iron disulfide.

NOTE 4 Reference to the electrochemical systems of this table usually appears in a simplified form such as, for example, "B and C system batteries" or "batteries of the no letter system".