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Interested committees:

Title: BS EN IEC 60086-1 Primary batteries

Part 1: General

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



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SECRETARIAT:

Japan

SECRETARY:

Mr Takao Uyama

OF INTEREST TO THE FOLLOWING COMMITTEES:

SC 3C,TC 21,SC 21A,TC 61,TC 108

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

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TITLE:

Primary batteries - Part 1: General

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRIMARY BATTERIES –

Part 1: General

FOREWORD

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

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) Clause 3, Terms and definitions, was changed from alphabetical order to hierarchy order;
- 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 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 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:

FDIS	Report on voting
35/XXXX/CD	35/XXXX/XX

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. The main document types developed by IEC are described in greater detail at 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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.

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.

This document also contains requirements in Annex A 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, *Primary batteries – Part 2-1: Physical and electrical specifications of batteries with aqueous electrolyte*

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

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:

- 288 • IEC Electropedia: available at <https://www.electropedia.org>
- 289 • ISO Online browsing platform: available at <https://www.iso.org/obp>

290 **3.1**

291 **cell**

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

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

296 **3.2**

297 **battery**

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

300 [SOURCE:IEC 60050-482:2004, 482-01-04, modified – removal of "fitted with devices
301 necessary for use.]

302 **3.3**

303 **primary cell**

304 **primary battery**

305 cell or battery that is not designed to be electrically recharged

306 **3.4**

307 **round cell**

308 **round battery**

309 cell or battery with circular cross section

310 **3.5**

311 **button cell**

312 **button battery**

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

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

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

317 **3.6**

318 **coin cell**

319 **coin battery**

320 **lithium button cell**

321 **lithium button battery**

322 small round cell or battery where the overall height is less than the diameter, containing non-
323 aqueous electrolyte

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

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

326 **3.7**

327 **cylindrical cell**

328 **cylindrical battery**

329 round cell or battery in which the overall height is equal to or greater than the diameter

330 [SOURCE:IEC 60050-482:2004, 482-02-39, modified – "cell with a cylindrical shape" replaced
331 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**

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**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

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.

3.17**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 "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

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]

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 60086-2-1, 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 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 and Figures 1 to 4 of IEC 60086-2-2 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 and Figures 5, 6, 7 of IEC 60086-2-2, 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.

NOTE This standard currently does not contain such batteries.

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 ₂)	1,5	1,73
A	Zinc (Zn)	Ammonium chloride, zinc chloride	Oxygen (O ₂)	1,4	1,55
B	Lithium (Li)	Organic electrolyte	Carbon monofluoride (CF) _x	3,0	3,7
C	Lithium (Li)	Organic electrolyte	Manganese dioxide (MnO ₂)	3,0	3,7
E	Lithium (Li)	Non-aqueous inorganic	Thionyl chloride (SOCl ₂)	3,6	3,9
F	Lithium (Li)	Organic electrolyte	Iron disulfide (FeS ₂)	1,5	1,90
G	Lithium (Li)	Organic electrolyte	Copper (II) oxide (CuO)	1,5	2,3
L	Zinc (Zn)	Alkali metal hydroxide	Manganese dioxide (MnO ₂)	1,5	1,68
P	Zinc (Zn)	Alkali metal hydroxide	Oxygen (O ₂)	1,4 or 1,45	1,59
S	Zinc (Zn)	Alkali metal hydroxide	Silver oxide (Ag ₂ O)	1,55	1,63
T	Zinc (Zn)	Alkali metal hydroxide	Manganese dioxide (MnO ₂) / Nickel (III) oxide (NiO _x)	1,5	1,75
W	Lithium (Li)	Organic electrolyte	Sulfur dioxide (SO ₂)	3,0	3,05
Y	Lithium (Li)	Non-aqueous inorganic	Sulfuryl chloride (SO ₂ Cl ₂)	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 (see 3.9) 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, e.g. 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".

4.1.5 Designation

The designation of primary batteries is based on their physical parameters, their electrochemical system as well as modifiers, if needed.

A comprehensive explanation of the designation system (nomenclature) can be found in Annex C.

4.1.6 Marking

4.1.6.1 General

For an overview of marking requirements refer to Table 2. With the exception of batteries too small to mark with all items (see 4.1.6.2), each battery shall be marked with the following information:

- a) designation, IEC or common;
- b) expiration of a recommended usage period or year and month or week of manufacture. The year and month or week of manufacture may be in code;
- c) polarity of the positive (+) terminal;
- d) nominal voltage;
- e) name or trademark of the manufacturer or supplier;
- f) cautionary advice.

NOTE Examples of the common designations can be found in Annex H.

4.1.6.2 Marking of batteries too small to accommodate all markings

- a) Some batteries, mainly category 3 and category 4 batteries, have a surface too small to accommodate all markings shown in 4.1.6.1. For these batteries the designation 4.1.6.1a) and the polarity 4.1.6.1c) shall be marked on the battery. All other markings shown in 4.1.6.1 may be given on the immediate packaging instead of on the battery.
- b) For P-system batteries, 4.1.6.1a) may be on the battery, the sealing tab or the package. 4.1.6.1c) may be marked on the sealing tab and/or on the battery. 4.1.6.1b), 4.1.6.1d) and 4.1.6.1e) may be given on the immediate packaging instead of on the battery. The nominal voltage may be marked either 1,4 V or 1,45 V.
- c) Caution for ingestion of swallowable batteries shall be given. Refer to IEC 60086-4 and IEC 60086-5 for details.