

Primary batteries —

Part 1: General

The European Standard EN 60086-1:2007 has the status of a British Standard

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National foreword

This British Standard was published by BSI. It is the UK implementation of EN 60086-1:2007. It is identical with IEC 60086-1:2006. It supersedes BS EN 60086-1:2001, which will be withdrawn on 1 February 2010.

The UK participation in its preparation was entrusted to Technical Committee CPL/35, Primary cells.

A list of organizations represented on CPL/35 can be obtained on request to its secretary.

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 35/1244/FDIS, future edition 10 of IEC 60086-1, prepared by IEC TC 35, Primary cells and batteries, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60086-1 on 2007-02-01.

This European Standard supersedes EN 60086-1:2001.

The major technical changes concern the addition of "Test condition tolerances" in 6.6 and the standardization of the "Z" electrochemical system (Nickel oxyhydroxide) included in Table 3.

The following dates were fixed:

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Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60086-1:2006 was approved by CENELEC as a European Standard without any modification.

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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.

NOTE Safety information is available in IEC 60086-4, IEC 60086-5 and IEC 62281.

PRIMARY BATTERIES –

Part 1: General

1 Scope

The purpose of this part of IEC 60086 is to standardize primary batteries with respect to their electrochemical system, dimensions, nomenclature, terminal configurations, markings, test methods, typical performance, safety and environmental aspects.

NOTE The requirements justifying the inclusion or the ongoing retention of batteries in the IEC 60086 series are given in Annex A.

The objective of IEC 60086-1 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.

2 Normative references

The following referenced documents are indispensable for the application 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, *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*

IEC 60410, *Sampling plans and procedures for inspection by attributes*

IEC 61429, *Marking of secondary cells and batteries with the international recycling symbol*
ISO 7000-1135

ISO/IEC Directives, Part 1: *Procedures for the technical work*

ISO 3951 (all parts as applicable), *Sampling procedures for inspection by variables*

3 Terms and definitions

For the purposes of this document, the definitions given in IEC 60050(482) (some of which are repeated below for convenience), as well as the following definitions, apply.

3.1

application test

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

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

operation during which a battery delivers current to an external circuit

[IEV 482-03-23:2004, modified]

3.3**dry (primary) battery**

primary battery in which the liquid electrolyte is immobilized

[IEV 482-04-14:2004, modified]

3.4**effective internal resistance – DC method**

resistance of any electrical component determined by calculating the ratio between the voltage drop ΔU across this component and the range of current Δi passing through this component and causing the voltage drop $R = \Delta U / \Delta i$

NOTE As an analogy, the internal d.c. resistance of any electrochemical cell is defined by the following relation:

$$R_i (\Omega) = \frac{\Delta U (V)}{\Delta i (A)} \quad (1)$$

The internal d.c. resistance is illustrated by the schematic voltage transient as given below:

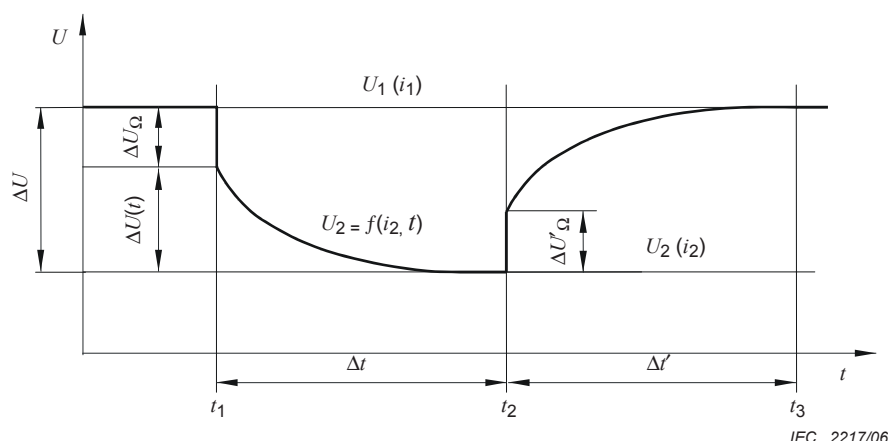


Figure 1 – Schematic voltage transient

As can be seen from this diagram, the voltage drop ΔU of the two components differs in nature, as shown in the following relation:

$$\Delta U = \Delta U_{\Omega} + \Delta U(t) \quad (2)$$

The first component ΔU_{Ω} for $(t = t_1)$ is independent of time, and results from the increase in current Δi according to the relation:

$$\Delta U_{\Omega} = \Delta i \times R_{\Omega} \quad (3)$$

In this relation, R_{Ω} is a pure ohmic resistance. The second component $\Delta U(t)$ is time dependent and is of electrochemical origin.

3.5
end-point voltage
EV

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

[IEV 482-03-30:2004, modified]

3.6
leakage

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

[IEV 482-02-32:2004, modified]

3.7
minimum average duration
MAD

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

NOTE 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.

3.8
nominal voltage of a primary battery

V_n

suitable approximate value of voltage used to identify the voltage of a primary battery

[IEV 482-03-31:2004, modified]

3.9
on-load voltage

closed-circuit voltage

CCV

voltage across the terminals of a battery when it is on discharge

[IEV 482-03-28:2004, modified]

3.10
open-circuit voltage

off-load voltage

OCV

voltage across the terminals of a battery when no current is flowing

[IEV 482-03-32:2004, modified]

3.11
primary battery

one or more primary cells, including case, terminals and marking

3.12
primary cell

source of electrical energy obtained by the direct conversion of chemical energy, that is not designed to be charged by any other electrical source

[IEV 482-01-02:2004, modified]

3.13
service output (of a primary battery)

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

3.14**service output test**

test designed to measure the service output of a battery

NOTE 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.

3.15**storage life**

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

[IEV 482-03-47:2004, modified]

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

conductive parts provided for the connection of a battery to external conductors

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 mis-use conditions shall be assured.

Additionally, 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

Terminals shall be in accordance with Clause 7 of IEC 60086-2.

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 adequate electrical conductivity and corrosion protection.

4.1.3.1 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.

4.1.3.2 Cap and base

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

4.1.3.3 Cap and case

This type of terminal is used for batteries which have their dimensions specified according to Figures 3 and 4 of IEC 60086-2, but in which the cylindrical side of the battery forms part of the positive terminal.

4.1.3.4 Screw terminals

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

4.1.3.5 Flat contacts

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

4.1.3.6 Flat or spiral springs

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

4.1.3.7 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 corresponding pins of a mating plug.

4.1.3.8 Snap fasteners

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.

4.1.3.8.1 Spacing of contacts

The spacing between the stud and socket is given in the following table and applies from centre to centre. The stud always forms the positive connection and the socket the negative connection on the battery.

Table 1 – Spacing of contacts

Nominal voltage V	Standard mm	Miniature mm
9	35 ± 0,4	12,7 ± 0,25

4.1.3.8.2 Non-resilient snap fastener connectors (studs)

All dimensions not specified are free. The shape of the studs shall be chosen so that they conform to the dimensions specified.

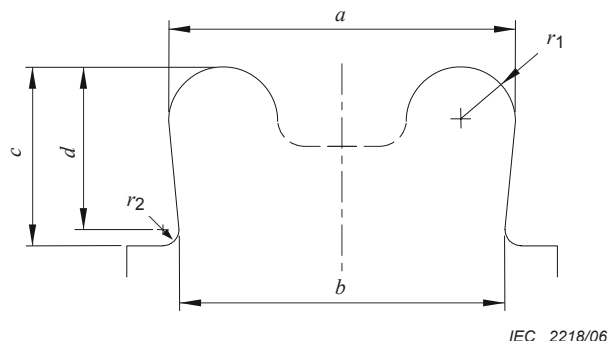


Figure 2 – Stud

Table 2 – Snap fastener connectors

	Standard mm	Miniature mm
<i>a</i>	$7,16 \pm 0,05$	$5,72 \pm 0,05$
<i>b</i>	$6,65^{+0,07}_{-0,05}$	$5,38 \pm 0,05$
<i>c</i>	$3,20 \pm 0,1$	$3,00 \pm 0,1$
<i>d</i>	$2,67 \pm 0,05$	$2,54 \pm 0,05$
<i>r</i> ₁	$0,61^{+0,05}_{-0,08}$	$0,9^{+0,1}_{-0,3}$
<i>r</i> ₂	$0,4^{+0,3}_0$	$0,3^{+0,2}_0$

4.1.3.8.3 Resilient snap fastener connectors (sockets)

Dimensions and requirements:

The dimensions of the resilient (socket) parts of snap fastener connectors are not specified as such. The properties shall be such that

- the resiliency ensures that the standardized studs can be properly mated,
- good electrical contact is maintained.

4.1.3.9 Wire

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

4.1.3.10 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 3.

Table 3 – 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	1,725
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	1,83
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	1,65
P	Zinc (Zn)	Alkali metal hydroxide	Oxygen (O_2)	1,4	1,68
S	Zinc (Zn)	Alkali metal hydroxide	Silver oxide (Ag_2O)	1,55	1,63
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 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.					

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

With the exception of batteries designated as small, each battery shall be marked with the following information:

- designation;