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Primary batteries -
Part 2-1: Physical and electrical specifications of batteries with aqueous electrolyte

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Primary batteries - Part 2-1: Physical and electrical specifications of batteries with aqueous electrolyte

FOREWORD

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IEC 60086-2-1 has been prepared by IEC technical committee 35: Primary cells and batteries. It is an International Standard.

This first edition cancels and replaces the fourteenth edition of IEC 60086-2 published in 2021. This edition constitutes a technical revision.

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

a) the physical and electrical specifications of IEC 60086-2:2021 were divided into two new standards based on their electrolyte types. IEC 60086-2-1 provides specifications for standardized primary batteries containing aqueous electrolyte. IEC 60086-2-2 covers specifications for standardized lithium-based primary batteries;
b) in Clause 3, terms were reordered according to their functions: basic terms, electrochemical systems, electrical characteristics and specifications;

c) TR03 and TR6 were added in Category 1, Round batteries;

d) load of digital audio test for LR03, TR03 and R03 was changed from 50 mA to 75 mA and MAD was modified;

e) personal grooming test of LR6 was added instead of high drain application test;

f) high drain application test was added for TR6;

g) radio /clock /remote control test was added for R6S;

h) CD, digital audio, wireless gaming and accessories test was removed for LR6, R6P and R6S;

i) 4.5V of common designation was added for 3LR12, 3R12P and 3R12S;

j) Annex D for common designation of IEC 60086-2:2021 was moved to IEC 60086-1:2026, as Annex H;

k) Annex E for Compliance checklist of IEC 60086-2:2021 was removed and merged into Annex J of IEC 60086-1:2026.

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

Draft	Report on voting
35/1591/FDIS	35/1599/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 physical dimensions, discharge test conditions and discharge performance requirements. IEC 60086-2-1 and IEC 60086-2-2 complement the general information and requirements of IEC 60086-1. Safety information of IEC 60086-2-1 is available in IEC 60086-5.

This document was prepared to benefit primary battery users, device designers and battery manufacturers by furnishing the specifics of form, fit and function for individual standardized primary cells and batteries. Over the years, this part of IEC 60086 has been changed to improve its contents and might again be revised in due course in the light of comments made by national committees and experts on the basis of practical experience and changing technology.

1 Scope

This part of IEC 60086 is applicable to primary batteries which are based on standardised electrochemical systems using aqueous electrolytes.

It specifies

– the physical dimensions,
– the discharge test conditions and discharge performance requirements.

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 60086-1:2026, *Primary batteries - Part 1: General*

ISO 1101, *Geometrical product specifications (GPS) - Geometrical tolerancing - Tolerances of form, orientation, location and run-out*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60086-1:2026 and the following 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
primary cell
primary battery
cell or battery that is not designed to be electrically recharged

3.2
round cell
round battery
cell or battery with circular cross section

3.3
button cell
button battery
small round cell or battery where the overall height is less than the diameter, containing aqueous electrolyte

3.4
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: For the specifications, refer to IEC 60086-2-2.

3.5
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]

3.6
open-circuit voltage
OCV
voltage across the terminals of a cell or battery when it is off discharge

3.7
end-point voltage
EV
specified voltage of a battery at which the battery discharge is terminated

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

3.8
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.

3.9
application test
simulation of the actual use of a battery in a specific application

3.10
service output
service life, or capacity, or energy output of a battery under specified conditions of discharge

3.11
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.

3.12
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”]

4 Battery dimensions – Symbols

The symbols used to denote the various dimensions are as follows:

h_1 maximum overall height of the battery;

h_2 minimum distance between the flats of the positive and negative contacts;

h_3 minimum projection of the flat positive contact;

h_4 maximum recess of the negative flat contact surface;

h_5 minimum projection of the flat negative contact;

d_1 maximum and minimum diameters of the battery;

d_2 minimum diameter of the flat positive contact;

d_3 maximum diameter of the positive contact within the specified projection height;

d_4 minimum diameter of the flat negative contact;

d_5 maximum diameter of the negative contact within the specified projection height;

d_6 minimum outer diameter of the negative flat contact surface;

d_7 maximum inner diameter of the negative flat contact surface;

$øP$ concentricity of the positive contact.

5 Dimensional stability

Refer to IEC 60086-1 for dimensional stability.

6 Validity of testing

Portable primary batteries shall be subjected to the tests, as required in the IEC 60086 series. Testing remains valid until a design change or requirement revision has been made. Retesting is required when:

a) a battery specification changes by more than 0,1 g or 20 % mass, whichever is greater, for the cathode, anode or electrolyte;
b) a battery specification changes that would lead to a failure of any of the tests;
c) there is an addition of new tests or requirements; or
d) there is a requirement change that would lead to a failure on any of the tests.

7 Constitution of the battery specification tables

– Batteries are categorized into several groups according to their shapes.

– In each category, batteries having the same shape but belonging to a different electrochemical system are grouped together and shown in succession.

– Batteries are always listed in ascending order of nominal voltage and, within each nominal voltage, in ascending order of volume.

– One common shape drawing of these batteries which fall in the same group is exhibited.

– Designation, nominal voltage, dimensions, discharge conditions, minimum average duration and application for these batteries which fall into the same group are summarized in one table.

– When a drawing represents only one type of battery, the dimensions of the relevant battery may be directly shown on the drawing.

– Batteries are categorized into the following groups:

  - Category 1: Round batteries according to Figure 1

    R1, R03, R6P, R6S, R14P, R14S, R20P, R20S

    LR8D425, LR1, LR03, LR6, LR14, LR20

    TR03, TR6

  - Category 2: Round battery

    Void

  - Category 3: Round battery according to Figure 7

    LR9

  - Category 4: Round batteries according to Figure 8

    PR70, PR41, PR48, PR44, PR1154

    LR41, LR55, LR54, LR43, LR44

    SR62, SR63, SR65, SR64, SR60, SR67, SR66, SR58, SR68, SR59, SR69, SR41, SR57, SR55, SR48, SR54, SR42, SR43, SR44

  - Category 5: Other round batteries – Miscellaneous

    4LR44

    4SR44

    8LR932

    AR40

    5AR40

    6AR40

    5PR175/172

    6PR 225/155

- Category 6: Non-round batteries – Miscellaneous
  3R12P, 3R12S, 3LR12
  4LR61
  AS4, AS6P, AS6S, AS8, AS10, AS12, PS8S, PS8P, PS10
  4R25X, 4LR25X
  4R25Y
  4R25-2, 4LR25-2
  6F22, 6LR61, 6LP3146
  6AS4S, 6PS4S, 6PS4P
  6AS6P, 6AS6S, 6PS6P, 6PS6S

The specification drawings show the shape of the relevant batteries. Dimensions for each battery are shown in Table 8 and in Figure 1 to Figure 27.

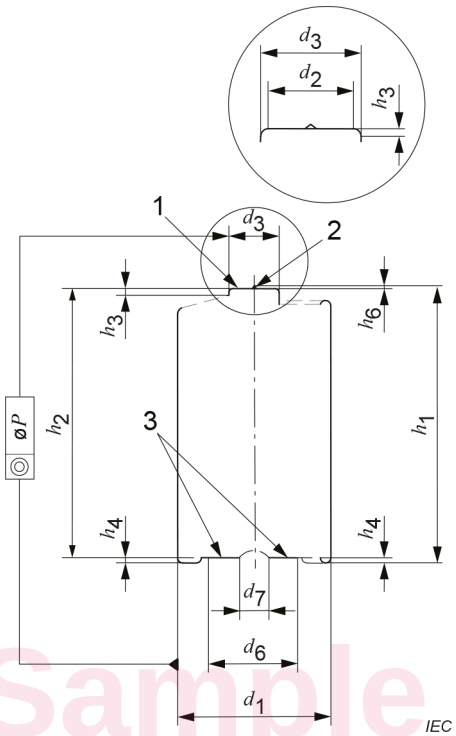
NOTE 1 See Annex A, Annex B and Annex C for ease of locating battery sizes.

NOTE 2 For lithium batteries, see IEC 60086-2-2: Physical and electrical specifications of lithium batteries.

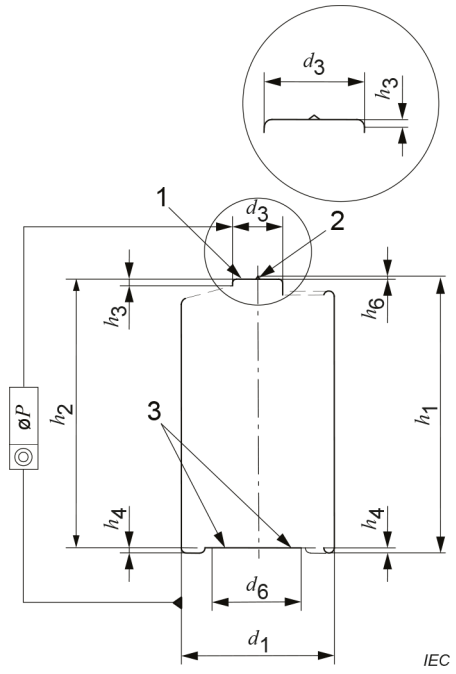
8 Physical and electrical specifications

8.1 Category 1 batteries

8.1.1 General



a)



b)

For the definition of the dimensions, see Clause 4.

The cylindrical surface is insulated from the contacts.

Terminals: flat/cap and base.

For general information, see IEC 60086-1.

Figure 1a): negative contact surface might not be flat over the whole area.

Figure 1b): negative contact surface shall be essentially flat over the whole surface area.

For batteries complying with Figure 1a) and Figure 1b), flat negative contact is not necessarily recessed.

When the flat negative contact surface forms the lower part of the battery, dimensions "h_1" and "h_2" are both measured from the surface and dimension "h_4" is zero.

Dimensions "øP" to be measured in accordance with ISO 1101.

The profile over the dotted lines is not specified.

1 Positive contact

2 Optional pip (dimension "h_6" for batteries having the pip is 0,4 mm max.)

3 Negative contact area

Recesses are permitted in the negative flat contact surface defined by dimensions d_6 and d_7 for batteries having the shape shown in Figure 1a), provided that batteries placed end to end in series make electrical contact with each other and that the contact separation is an integral multiple of the contact separation for one battery. The following conditions shall be satisfied:

$d_6 > d_3$

$d_2 > d_7$

$h_3 > h_4$

Figure 1 – Dimensional drawing: Category 1