# IEC 60086-2

Edition 12.0 2011-02

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE





**Primary batteries –**
**Part 2: Physical and electrical specifications**

**Piles électriques –**
**Partie 2: Spécifications physiques et électriques**



IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

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# PRIMARY BATTERIES –

## Part 2: Physical and electrical specifications

## FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60086-2 has been prepared by IEC technical committee 35: Primary cells and batteries.

This twelfth edition cancels and replaces the eleventh edition (2006) and constitutes a technical revision.

Significant changes from the previous edition are the deletion of eight battery types from this standard, the addition of an air hole placement diagram and deletion of the resistive hearing aid tests for the P-system (zinc air) hearing aid batteries, standardization of a new form of alkaline (L-system) 9 volt battery (6LP3146), addition of a common designation reference as Annex D and general adjustment of application tests and their minimum average duration values to reflect changes in battery usage.

The text of this standard is based on the following documents:

| CDV | Report on voting |
|---|---|
| 35/1271/CDV | 35/1275/RVC |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

# INTRODUCTION

The technical content of this part of IEC 60086 provides physical dimensions, discharge test conditions and discharge performance requirements. IEC 60086-2 complements the general information and requirements of IEC 60086-1.

This part 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 has been changed to improve its contents and may 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.

This current revision is the result of a reformatting initiative, as well as some content changes, aimed at making this part more user-friendly, less ambiguous, and, from a cross reference basis, fully harmonized with other parts of IEC 60086.

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

# PRIMARY BATTERIES –

# Part 2: Physical and electrical specifications

## 1 Scope

This part of IEC 60086 is applicable to primary batteries based on standardized electrochemical systems.

It specifies

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

## 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 60086-1:2011, *Primary batteries – Part 1: General*

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



## 3 Terms, definitions, symbols and abbreviations

For the purposes of this document, the terms, definitions, symbols and abbreviations given in IEC 60086-1 and the following apply.

### 3.1 Terms and definitions

**3.1.1**
**application test**
simulation of the actual use of a battery in a specific application

**3.1.2**
**closed-circuit voltage**
**CCV** (abbreviation)
voltage across the terminals of a battery when it is on discharge

[IEC 60050- 482:2004, 482-03-28, modified]

**3.1.3**
**end-point voltage**
**EV** (abbreviation)
specified voltage of a battery at which the battery discharge is terminated

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

**3.1.4**
**minimum average duration**
**MAD** (abbreviation)
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.

**3.1.5**
**nominal voltage** (of a primary battery )
$V_n$ (symbol)
suitable approximate value of the voltage used to designate or identify a cell, a battery or an electrochemical system

[IEC 60050-482:2004, 482-03-31, modified]

**3.1.6**
**open-circuit voltage**
**OCV** (abbreviation)
voltage across the terminals of a battery when it is off discharge

[IEC 60050-482:2004, 482-03-32, modified]

**3.1.7**
**primary** (cell or battery)
cell or battery that is not designed to be electrically recharged

**3.1.8**
**round** (cell or battery)
cell or battery with circular cross section

**3.1.9**
**service output** (of a primary battery)
service life, or capacity, or energy output of a battery under specified conditions of discharge

**3.1.10**
**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.

**3.1.11**
**storage life**
duration under specified conditions at the end of which a battery retains its ability to perform a specified service output

[IEC 60050-482:2004, 482-03-47, modified]

**3.1.12**
**terminals** (of a primary battery)
conductive parts provided for the connection of a battery to external conductors

## 3.2 Symbols and abbreviations

EV end-point voltage

MAD minimum average duration

OCV open-circuit voltage (off-load voltage)

$R$ load resistance

$V_n$ nominal voltage of a primary battery

## 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;

$\varnothing\ P$ concentricity of the positive contact.

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 must be satisfied:

$$d_6 > d_3$$
$$d_2 > d_7$$
$$h_3 > h_4$$

## 5 Constitution of the battery specification tables

**5.1** Batteries are categorized into several groups according to their shapes.

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

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

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

**5.5** 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.

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

**5.7** Batteries are categorized into the following groups:

a) Category 1: Round batteries according to Figure 1
R1, R03, R6P, R6S, R14P, R14S, R20P, R20S
LR8D425, LR1, LR03, LR6, LR14, LR20

b) Category 2: Round batteries according to Figure 2
CR14250, CR15H270, CR17345, CR17450, BR17335

c) Category 3: Round batteries according to Figure 3
LR9, LR53, CR11108

d) Category 4: Round batteries according to Figure 4
PR70, PR41, PR48, PR44
LR41, LR55, LR54, LR43, LR44
SR62, SR63, SR65, SR64, SR60, SR67, SR66, SR58, SR68, SR59, SR69, SR41, SR57, SR55, SR48, SR54, SR42, SR43, SR44
CR1025, CR1216, CR1220, CR1616, CR2012, CR1620, CR2016, CR2025, CR2320, CR2032,CR2330, CR2430, CR2354, CR3032, CR2450
BR1225, BR2016, BR2320, BR2325, BR3032

e) Category 5: Other round batteries – Miscellaneous
R40
4LR44
2CR13252
4SR44

f) Category 6: Non-round batteries – Miscellaneous
3R12P, 3R12S, 3LR12
4LR61
CR-P2
2CR5
2EP3863
4R25X, 4LR25X
4R25Y
4R25-2, 4LR25-2
6AS4
6AS6
6F22, 6LR61, 6LP3146
6F100

**5.8** Drawings of round batteries which correspond to Figure 1, Figure 2, Figure 3 and Figure 4 are prepared by reduction or enlargement of the relevant original drawings. The other drawings are prepared by reduction or enlargement of conventional specification drawings.

In each case the drawings show the shape of the relevant batteries. Dimensions for each battery are shown in the tables.

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

# 6 Physical and electrical specifications

## 6.1 Category 1 batteries

### 6.1.1 Category 1 – Physical and electrical specifications



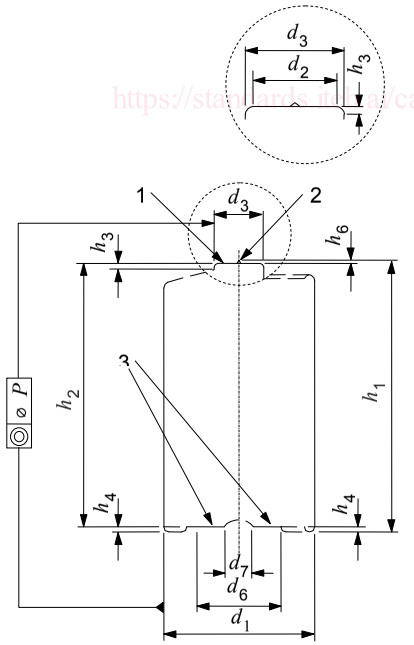


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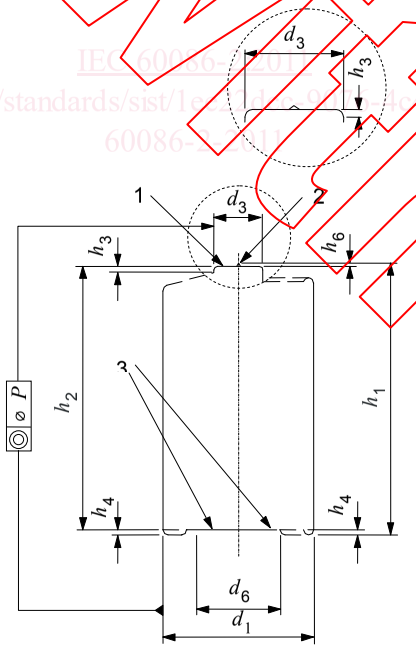
**Figure 1a**




IEC 275/11

**Figure 1b**

**Figure 1 – Category 1 dimensional drawings**

Batteries complying with these physical and electrical specifications are:

| Designation |
|---|
| R1, R03, R6P, R6S, R14P, R14S, R20P, R20S |
| LR8D425, LR1, LR03, LR6, LR14, LR20 |

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 may 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 figures 1a and 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 "$\varnothing\ P$" 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

### 6.1.1.1 Category 1 – Specifications: R1, R03, R6P, R6S

| Electro-chemical system letter | Designation | $V_n$ V | OCV max. V | Dimensions mm | | | | | | | | | Discharge conditions | | | MAD[a] (initial) | Applications |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $h_1$ | $h_2$ | $h_3$ | $h_4$ | $d_1$ | | $d_3$ | $d_6$ | $\varnothing P$ | $R$ Ω | Daily period | EV V | | |
| | | | | max. | min. | min. | max. | max. | min. | max. | min. | max. | | | | | |
| No letter (see NOTE) | R1 | 1,5 | 1,73 | 30,2 | 29,1 | 0,5 | 0,2 | 12,0 | 10,9 | 4,0 | 5,0 | 0,5 | 300 | 12 h | 0,9 | 76 h | Hearing aid |
| | | | | | | | | | | | | | 5,1 | 5 min | 0,9 | 30 min | Portable lighting |
| | R03 | 1,5 | 1,73 | 44,5 | 43,3 | 0,8 | 0,5 | 10,5 | 9,5 | 3,8 | 4,3 | 0,4 | 5,1 | b | 0,9 | 50 min | Portable lighting |
| | | | | | | | | | | | | | 10 | 1 h | 0,9 | 1,5 h | Digital audio |
| | | | | | | | | | | | | | 75 | 4 h | 0,9 | 20 h | Radio/Clock |
| | | | | | | | | | | | | | 24 | 15 s per min 8 h per day | 1,0 | 4 h | Remote control |
| | R6P (high power) | 1,5 | 1,73 | 50,5 | 49,2 | 1,0 | 0,5 | 14,5 | 13,5 | 5,5 | 7,0 | 0,5 | 43 | 4 h | 0,9 | 27 h | Radio/Clock |
| | | | | | | | | | | | | | 3,9 | 1 h | 0,8 | 65 min | Motor/toy |
| | | | | | | | | | | | | | 10 | 1 h | 0,9 | 4 h | Tape recorder |
| | | | | | | | | | | | | | 24 | 15 s per min 8 h per day | 1,0 | 11 h | Remote control |
| | | | | | | | | | | | | | 1,8 | c | 0,9 | 60 pulses | Pulse test |
| | R6S (standard) | 1,5 | 1,73 | 50,5 | 49,2 | 1,0 | 0,5 | 14,5 | 13,5 | 5,5 | 7,0 | 0,5 | 43 | 4 h | 0,9 | 22 h | Radio/Clock |

NOTE Delayed discharge performance after 12 months is 80 % of MAD.

a Standard conditions (see IEC 60086-1, Table 5, Initial discharge test).
b 4 min beginning at hourly intervals for 8 h per day.
c 15 s on, 45 s off for 24 h per day.

### 6.1.1.2 Category 1 – Specifications: R14P, R14S

| Electro-chemical system letter | Designation | $V_n$ V | OCV max. V | Dimensions mm | | | | | | | | Discharge conditions | | | MAD[a] (initial) | Applications |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $h_1$ | $h_2$ | $h_3$ | $h_4$ | $d_1$ | | $d_3$ | $d_6$ | $\varnothing P$ | $R$ Ω | Daily period | EV V | | |
| | | | | max. | min. | min. | max. | max. | min. | max. | min. | max. | | | | | |
| No letter (see NOTE) | R14P (high power) | 1,5 | 1,73 | 50,0 | 48,6 | 1,5 | 0,9 | 26,2 | 24,9 | 7,5 | 13,0 | 1,0 | 3,9 | b | 0,9 | 270 min | Portable lighting |
| | | | | | | | | | | | | | 20 | 4 h | 0,9 | 28 h | Radio |
| | | | | | | | | | | | | | 3,9 | 1 h | 0,8 | 4 h | Toy |
| | R14S (standard) | 1,5 | 1,73 | 50,0 | 48,6 | 1,5 | 0,9 | 26,2 | 24,9 | 7,5 | 13,0 | 1,0 | 3,9 | b | 0,9 | 120 min | Portable lighting |
| | | | | | | | | | | | | | 20 | 4 h | 0,9 | 15 h | Radio |
| | | | | | | | | | | | | | 3,9 | 1 h | 0,8 | 1,5 h | Toy |

NOTE Delayed discharge performance after 12 months is 80 % of MAD.

[a] Standard conditions (see IEC 60086-1, Table 5, Initial discharge test).

[b] 4 min beginning at hourly intervals for 8 h per day.