

Primary batteries —

Part 1: General

The European Standard EN 60086-1:1997, with the incorporation of amendments A1:1999 and A2:1999 has the status of a British Standard

ICS 29.220.10

National foreword

This British Standard is the English language version of EN 60086-1:1997, including amendments A1:1999 and A2:1999. It is identical with IEC 60086-1:1996 including amendments A1:1998 and A2:1999. It supersedes BS EN 60086-1:1996 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CPL/35, Primary cells and batteries, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 45 and a back cover.

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Descriptors: Primary batteries, definitions, nomenclature, dimensions, terminals, marking, conditions of tests

English version

Primary batteries Part 1: General

(includes amendments A1:1999 and A2:1999)
(IEC 60086-1:1996 + A1:1998 + A2:1999)

Piles électriques

Partie 1: Généralités

(inclut les amendements A1:1999 et A2:1999)

(CEI 60089-1:1996 + A1:1998 + A2:1999)

Primärbatterien

Teil 1: Allgemeines

(enthält Änderungen A1:1999 und A2:1999)

(IEC 60086-1:1996 + A1:1998 + A2:1999)

This European Standard was approved by CENELEC on 1997-07-01; amendment A1 was approved by CENELEC on 1999-01-01; amendment A2 was approved by CENELEC on 1999-05-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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This amendment exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of the International Standard IEC 60086-1:1996, prepared by IEC TC 35, Primary cells and batteries, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60086-1 on 1997-07-01 without any modification.

This European Standard supersedes EN 60086-1:1995 and its amendment A1:1996.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-06-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1998-06-01

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given for information only. In this standard, Annex A and Annex ZA are normative and Annex B is informative. Annex ZA has been added by CENELEC.

Foreword to EN 60086-1/A1:1999

The text of amendment 1:1998 to the International Standard IEC 60086-1:1996, prepared by IEC TC 35, Primary cells and batteries, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A1 to EN 60086-1:1997 on 1999-01-01 without any modification.

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Foreword to amendment A2

The text of document 35/1090/FDIS, future amendment 2 to IEC 60068-1, prepared by IEC TC 35, Primary cells and batteries, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 60086-1:1997 on 1999-05-01.

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- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2002-05-01

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1 Scope

This part of IEC 86 applies to primary cells and batteries based on any electrochemical system.

The objects of its publication are:

- a) to ensure the electrical and physical interchangeability of products from different manufacturers;
- b) to limit the number of battery types;
- c) to define a standard of quality and provide guidance for its assessment;
- d) to provide guidance on matters of safety.

These objects are achieved by specifying nomenclature, dimensions, polarity, terminals, marking, test conditions and service output requirements for each battery.

2 Basic definitions

For the purposes of this part of IEC 86, the following definitions apply:

2.1

primary battery

a source of electrical energy obtained by the direct conversion of chemical energy

NOTE When ready for delivery, a primary battery includes terminals and may include a case. The word “battery” can refer to one single complete cell.

2.2

dry cell or battery

a cell or battery ready for use in which the electrolyte is made unspillable

2.3

off-load voltage

the difference of potential existing between the terminals of a battery when the circuit is open

2.4

on-load voltage

the difference of potential existing between the terminals of a battery when it is delivering current

2.5

nominal voltage

the specified off-load voltage of a cell or battery

2.6

end-point voltage

the specified on-load voltage at which the discharge is considered complete

2.7

discharge

a procedure by which a battery delivers current to an external circuit. The discharge can be continuous or intermittent

2.8

polarization

the difference between the voltage of a battery subjected to current flow, and the voltage of the same battery at a reference state at zero or stationary current

2.9

service output

the useful service life of a battery under specified conditions. It may be expressed in watt-hours, ampere-hours or as a duration

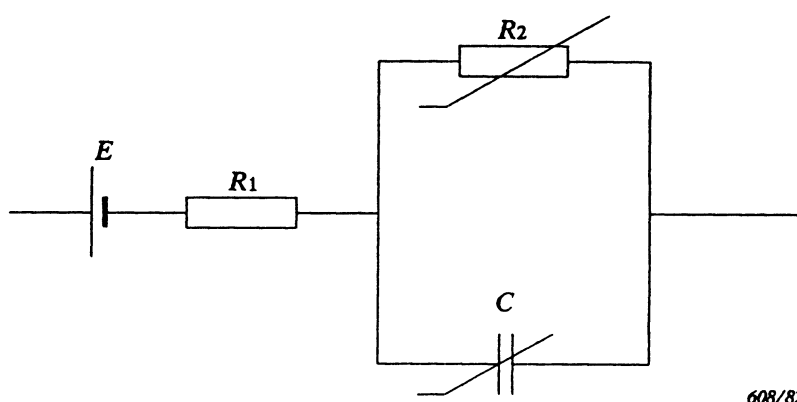
2.10 storage life

the duration of storage under specified conditions at the end of which a battery retains its ability to give a specified performance

the discharge performance stated after six or twelve months' storage on the individual specification sheets of batteries do not necessarily indicate the maximum age at which the batteries are capable of meeting the performance requirements

2.11 internal resistance and impedance

the current/voltage relationship of primary cells can normally be represented by the equivalent circuit shown below:



in which:

- E is a source of e.m.f.
- R_1 is a fixed resistance at a specified moment in the life of the cell and is dependent upon the conductivity of mixes, electrolytes and current collectors, etc.
- R_2 is a resistance which decreases in value as the current is increased and is related to polarization
- C is a capacitor of which the capacity decreases as the current is increased

R_1 is known as the internal resistance of the cell. The combined effect of R_1 , R_2 and C is known as the impedance of the cell and is characterized by a magnitude and a phase angle

the component R_1 represents the true ohmic resistance of the cell, whereas R_2 represents that part of the resistance due to electrode polarization effects and is dependent on both the measuring current and its frequency

under certain conditions, the behaviour of the cell may not be adequately represented by the equivalent circuit shown above

2.12 terminals

the parts to which the external electric circuit is connected

2.13 application test

a battery discharge test which simulates the actual use in a specific application

2.14 conformance test

a battery discharge test with a specified minimum average test duration which shall be met by batteries, when checked according to the method laid down in 8.7, in order to conform to the IEC standard for that battery type

2.15

minimum average duration

that average value for the summated time on discharge under the specified test conditions, which shall be met by test batteries when checked according to the method laid down in 8.7, in order to conform to the IEC standard for that battery type

2.16

minimum duration

the lowest acceptable value resulting from the discharge of a battery under the conditions which are described on the individual system specification sheets

2.17

service output test

a test under specified conditions to determine the useful service life 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 Nomenclature

The battery nomenclature defines as unambiguously as possible the physical dimensions, shape, electrochemical system, nominal voltage and where necessary the type of terminals, rate capability and special characteristics.

This clause is divided into two sections.

Section 1 defines designation system in use up to 1990.

Section 2 defines the designation system to accommodate present day and future needs.

3.1 Section 1

This section applies to all batteries which have been standardized up to October 1990 and will remain valid for those batteries after that date.

3.1.1 Cells

A cell is designated by a capital letter followed by a number. The letters R, F and S define round, flat (layer built) and square cells respectively. This letter, together with the following number¹⁾, is defined by a set of nominal dimensions.

Where a single-cell battery is specified, the maximum diameter and overall height of the battery instead of the nominal dimensions of the cell, are given in Table I, Table II and Table III.

¹⁾ At the time this system was applied numbers were allocated sequentially. Omissions in the sequence arise because of deletions or by the different approach to numbering used even before the sequential system.

Table I — Designation and dimensions of round cells and batteries^a

Designation	Nominal cell dimensions (mm)		Maximum battery dimensions (mm)	
	Diameter	Height	Diameter	Height
R06	10	22	—	—
R03	—	—	10,5	44,5
R01	—	—	12,0	14,7
R0	11	19	—	—
R1	—	—	12,0	30,2
R3	13,5	25	—	—
R4	13,5	38	—	—
R6	—	—	14,5	50,5
R9	—	—	16,0	6,2
R10	—	—	21,8	37,3
R12	—	—	21,5	60,0
R14	—	—	26,2	50,0
R15	24	70	—	—
R17	25,5	17	—	—
R18	25,5	83	—	—
R19	32	17	—	—
R20	—	—	34,2	61,5
R22	32	75	—	—
R25	32	91	—	—
R26	32	105	—	—
R27	32	150	—	—
R40	—	—	67,0	172,0
R41	—	—	7,9	3,6
R42	—	—	11,6	3,6
R43	—	—	11,6	4,2
R44	—	—	11,6	5,4
R45	9,5	3,6	—	—
R48	—	—	7,9	5,4
R50	—	—	16,4	16,8
R51	16,5	50,0	—	—
R52	—	—	16,4	11,4
R53	—	—	23,2	6,1
R54	—	—	11,6	3,05
R55	—	—	11,6	2,1
R56	—	—	11,6	2,6
R57	—	—	9,5	2,7
R58	—	—	7,9	2,1
R59	—	—	7,9	2,6
R60	—	—	6,8	2,15
R61	7,8	39	—	—
R62	—	—	5,8	1,65
R63	—	—	5,8	2,15
R64	—	—	5,8	2,70
R65	—	—	6,8	1,65
R66	—	—	6,8	2,60
R67	—	—	7,9	1,65
R68	—	—	9,5	1,65
R69	—	—	9,5	2,10

^a The complete dimensions of batteries are given in the relevant specification sheets.

Table II — Designation and nominal overall dimensions of flat cells^a

Designation	Dimensions in millimetres			
	Diameter	Length	Width	Thickness
F15	23	14,5	14,5	3,0
F16		14,5	14,5	4,5
F20		24	13,5	2,8
F22		24	13,5	6,0
F24		—	—	6,0
F25		23	23	6,0
F30		32	21	3,3
F40		32	21	5,3
F50		32	32	3,6
F70		43	43	5,6
F80		43	43	6,4
F90		43	43	7,9
F92		54	37	5,5
F95		54	38	7,9
F100		60	45	10,4

^a The complete dimensions of batteries are given in the relevant specification sheets.

Table III — Designation and dimensions of square cells and batteries^a

Designation	Nominal cell dimensions (mm)			Maximum battery dimensions (mm)		
	Length	Width	Height	Length	Width	Height
S4	—	—	—	57,0	57,0	125,0
S6	57	57	150	—	—	—
S8	—	—	—	85,0	85,0	200,0
S10	95	95	180	—	—	—

^a The complete dimensions of batteries are given in the relevant specification sheets.

In some cases, cell sizes which are not used in IEC 86-2 have been retained in the tables because of their use in national standards.

3.1.2 Electrochemical system

With the exception of the manganese dioxide-ammonium chloride, zinc chloride-zinc system, the letters R, F, S and P are preceded by an additional letter which denotes the electrochemical system, as shown:

Letter	Positive electrode	Electrolyte	Negative electrode	Nominal voltage (V)
—	Manganese dioxide	Ammonium chloride, zinc chloride	Zinc	1,5
A	Oxygen	Ammonium chloride, zinc chloride	Zinc	1,4
B	Carbon monofluoride	Organic electrolyte	Lithium	3
C	Manganese dioxide	Organic electrolyte	Lithium	3
E	Thionyl chloride (SOCl ₂)	Non-aqueous inorganic	Lithium	3,6
F	Iron disulfide (FeS ₂)	Organic electrolyte	Lithium	1,5
G	Copper (II) oxide (CuO)	Organic electrolyte	Lithium	1,5
L	Manganese dioxide	Alkali metal hydroxide	Zinc	1,5
P	Oxygen	Alkali metal hydroxide	Zinc	1,4
S	Silver oxide (Ag ₂ O)	Alkali metal hydroxide	Zinc	1,55
T	Silver oxide (AGO, Ag ₂ O)	Alkali metal hydroxide	Zinc	1,55

NOTE The letter K will not be used for primary cells and batteries since it relates to nickel-cadmium secondary batteries for which standards are given in IEC 285.

3.1.3 Batteries

If a battery contains one cell only, the cell designation is used.

If a battery contains more than one cell in series, a numeral denoting the number of cells precedes the cell designation.

If cells are connected in parallel, a numeral denoting the number of parallel groups follows the cell designation and is connected to it by a hyphen.

If a battery contains more than one section, each section is designated separately, with an oblique stroke separating their designation.

3.1.4 Examples:

- R20 a battery consisting of a single R20-size cell of the manganese dioxide-ammonium chloride, zinc chloride-zinc system.
- LR20 a battery consisting of a single R20-size cell of the manganese dioxide-alkali metal hydroxide-zinc system.
- 3R12 a battery consisting of three R12-size cells of the manganese dioxide-ammonium chloride, zinc chloride-zinc system, connected in series.

In order to preserve the unambiguity of the battery nomenclature, variants of one basic type are differentiated by the addition of a letter X or Y to indicate the different arrangements or terminals and C, P or S to indicate different electrical performance characteristics.

3.2 Section 2

This section applies to all batteries considered for standardization by IEC technical committee 35 after October 1990.

The basis for this nomenclature system is to convey a mental concept of the battery through the designation system. This is accomplished by using a cylindrical diameter and height related concept for all batteries, round (R) and non-round (P).

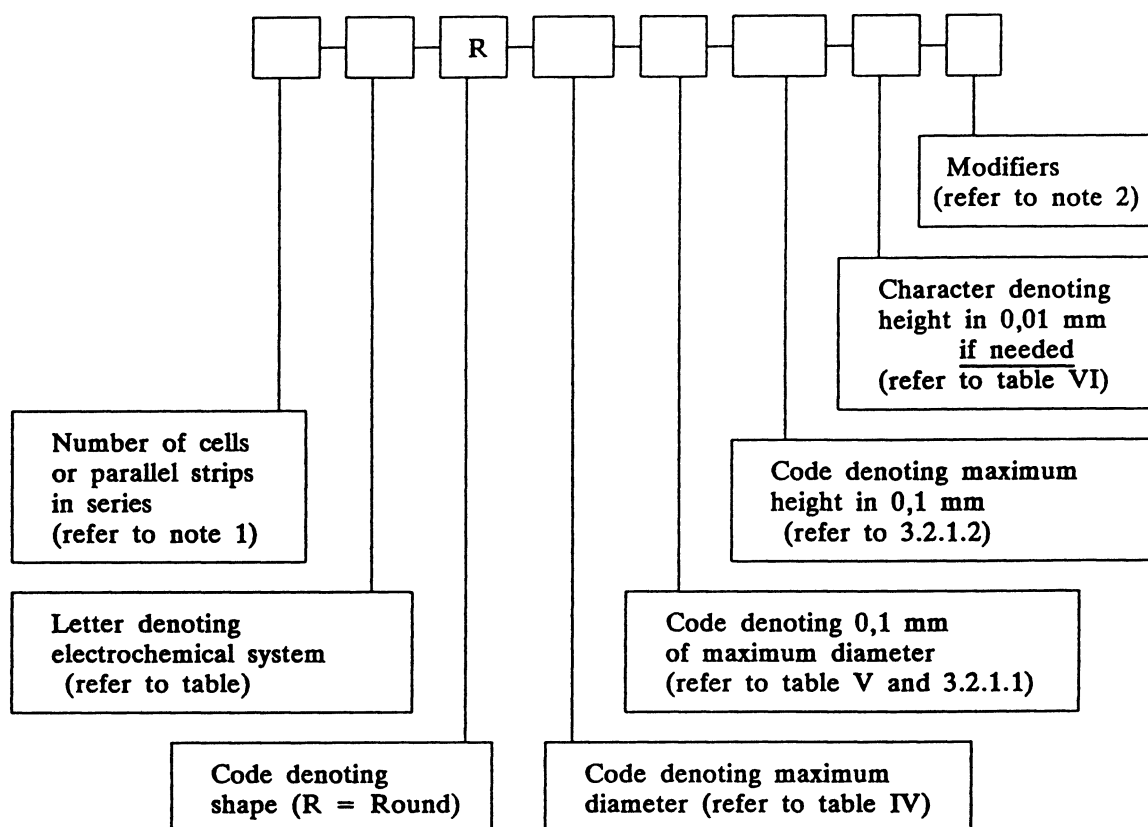
This section also applies to monocell batteries and multicell batteries with cells in series and/or parallel connection.

For example a battery of maximum diameter 11,6 mm and a height of maximum 5,4 mm is designated as R1154 preceded by a code for its electrochemical system, as described in this section.

3.2.1 Round batteries

3.2.1.1 Round batteries with diameter and height less than 100 mm

The designation for round batteries with a diameter and height less than 100 mm is:



NOTE 1 The number of cells or strips in parallel is not identified.

NOTE 2 Modifiers are included to designate e.g. specific terminal arrangement, load capability and further special characteristics.

1) Method for assigning the diameter code

The diameter code is derived from the maximum diameter.

The diameter code number is:

- Assigned according to Table IV in case of a recommended diameter.
- Assigned according to Table V in case of a non-recommended diameter.

Table IV — Diameter code for recommended diameters

Code	Recommended maximum diameter	Code	Recommended maximum diameter
4	4,8	20	20,0
5	5,8	21	21,0
6	6,8	22	22,0
7	7,9	23	23,0
8	8,5	24	24,5
9	9,5	25	25,0
10	10,0	26	26,2
11	11,6	28	28,0
12	12,5	30	30,0
13	13,0	32	32,0
14	14,5	34	34,2
15	15,0	36	36,0
16	16,0	38	38,0
17	17,0	40	40,0
18	18,0	41	41,0
19	19,0	67	67,0

Table V — Diameter code for non-recommended diameters

XX	C																						
Diameter (mm) (integer)	<table> <tr> <th>Decimal part of maximum diameter</th><th>Code "C"</th></tr> <tr><td>0,0</td><td>A</td></tr> <tr><td>0,1</td><td>B</td></tr> <tr><td>0,2</td><td>C</td></tr> <tr><td>0,3</td><td>D</td></tr> <tr><td>0,4</td><td>E</td></tr> <tr><td>0,5</td><td>G</td></tr> <tr><td>0,6</td><td>H</td></tr> <tr><td>0,7</td><td>J</td></tr> <tr><td>0,8</td><td>K</td></tr> <tr><td>0,9</td><td>L</td></tr> </table>	Decimal part of maximum diameter	Code "C"	0,0	A	0,1	B	0,2	C	0,3	D	0,4	E	0,5	G	0,6	H	0,7	J	0,8	K	0,9	L
Decimal part of maximum diameter	Code "C"																						
0,0	A																						
0,1	B																						
0,2	C																						
0,3	D																						
0,4	E																						
0,5	G																						
0,6	H																						
0,7	J																						
0,8	K																						
0,9	L																						

2) Method for assigning the height code

The height code is the number, denoted by the integer of the maximum height of the battery, expressed in tenths of a millimeter (e.g. 3,2 mm maximum height is denoted 32).

The maximum height is specified as follows:

- In case of flat terminals (e.g. batteries according to Figure 1 – Figure 4), the maximum height is the overall height including the terminals.
- In case of all other types of terminals the maximum height is the maximum overall height excluding the terminals (i.e. shoulder-to-shoulder).