

Primary batteries

Part 1. General

The European Standard EN 60086-1 : 1995 has the status of a
British Standard

ICS 29.220.10

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee CPL/35, Primary batteries, upon which the following bodies were represented:

British Battery Manufacturers' Association
British Horological Federation
British Horological Institute
British Railways Board
British Toy and Hobby Association
Consumer Policy Committee of BSI
Consumers' Association
Department of Trade and Industry (Consumer Safety Unit, CA Division)
Department of Transport
Federation of the Electronics Industry
Institute of Trading Standards Administration
Ministry of Defence

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Summary of pages

The following table identifies the current issue of each page. Issue 1 indicates that a page has been introduced for the first time by amendment. Subsequent issue numbers indicate an updated page. Vertical sidelining on replacement pages indicates the most recent changes (amendment, addition, deletion).

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National foreword

This British Standard has been prepared by Technical Committee CPL/35 and is the English language version of EN 60086-1 : 1995 *Primary batteries Part 1: General* and its amendment A1, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 86-1 : 1993 including its corrigendum December 1993 and its amendment 1 : 1994, published by the International Electrotechnical Commission (IEC).

This standard supersedes BS 397 : Part 1 : 1989 which will be withdrawn on 15 April 1996 in accordance with the CENELEC Internal Regulations.

Cross-references

Publication referred to	Corresponding British Standard
IEC 63 : 1974	BS 2488 : 1966 <i>Schedule of preferred numbers for the resistance of resistors and the capacitance of capacitors for telecommunication equipment</i>
HD 211.2 S9 : 1993 (IEC 86-2 : 1987)	BS 397 <i>Primary batteries</i>
ISO 3951 : 1981	Part 2 : 1989 <i>Specification sheets</i>
	BS 6002 <i>Sampling procedures for inspection by variables</i>
	Part 1 : 1993 <i>Specification for single sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection</i>
ISO 3461-1 : 1988	BS 7477 : 1991 <i>Guide for general principles for the creation of graphical symbols for use on equipment</i>
ISO 7000 : 1989	BS 7324 : 1990 <i>Guide for graphical symbols for use on equipment</i>

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS EN ISO 9000.

Enquiries as to the availability of third party certification schemes will be forwarded by BSI to the Association of British Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

English version

Primary batteries
Part 1: General
(includes amendment A1 : 1996)

(IEC 86-1 : 1993 + corrigendum 1993 + A1 : 1996)

Piles électriques
Partie 1: Généralités
(inclut l'amendement A1 : 1996)
(CEI 86-1 : 1993 + corrigendum 1993 + A1 : 1996)

Primärbatterien
Teil 1: Allgemeines
(enthält Änderung A1 : 1996)
(IEC 86-1 : 1993 + corrigendum A1 : 1993
+ A1 : 1996)

This European Standard was approved by CENELEC on 1994-07-05. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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 86-1 : 1993 and its corrigendum December 1993, prepared by IEC TC 35, Primary cells and batteries, was submitted to the formal vote and was approved by CENELEC as EN 60086-1 on 1994-07-05 without any modification.

This European Standard supersedes HD 211.1 S6 : 1988

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) 1996-04-15
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1996-04-15

Annexes designated 'normative' are part of the body of the standard.

In this standard, annex ZA is normative.

Annex ZA has been added by CENELEC.

Foreword to amendment A1

The text of amendment 1 : 1994 to the International Standard IEC 86-1 : 1993, prepared by IEC TC 35, Primary cells and batteries, was submitted to the formal vote and was approved by CENELEC as amendment A1 to EN 60086-1 : 1995 on 1996-07-02 without any modification.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-06-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1997-06-01

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PRIMARY BATTERIES

Part 1 : General

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.

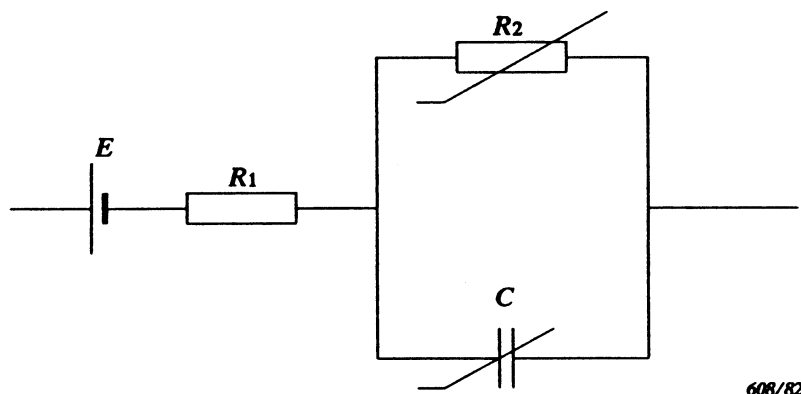
2.10 Storage life

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 8.8, 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 8.8, 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 number*, 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 Tables I, II and III.

* 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**

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

* The complete dimensions of batteries are given in the relevant specification sheet.

TABLE II

*Designation and nominal overall dimensions of flat cells**

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

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

TABLE III

*Designation and dimensions of square cells and batteries**

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	—	—	—

* 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 and S 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
G	Copper (II) oxide CuO	Organic	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 ₁ 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.