INTERNATIONAL STANDARD

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First edition
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Stationary lead-acid batteries –

Part 11:
Vented types –
General requirements and methods of tests

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

STATIONARY LEAD-ACID BATTERIES –

Part 11: Vented types – General requirements and methods of tests

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
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6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60896-11 has been prepared by IEC technical committee 21: Secondary cells and batteries.

This first edition of IEC 60896-11 cancels and replaces IEC 60896-1 (first edition) published in 1987 and its amendments 1 (1988) and 2 (1990), and constitutes a technical revision.

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

FDIS	Report on voting
21/572/FDIS	21/579/RVD

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 3.

Annex A is for information only.

This standard constitutes part 11 of the IEC 60896 series, published under the general title *Stationary lead acid batteries*. At the time of the publication of this part, the following parts had already been published or were in the process of being published:

- Part 11: *Vented types – General requirements and methods of tests* (this part)
- Part 21: *Valve regulated types – Functional characteristics and methods of test* [1].

The committee has decided that this publication remains valid until 2008. At this date, in accordance with the committee's decision, the publication will be

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

[1] To be published. This standard will replace IEC 60896-2:1995, *Stationary lead-acid batteries – General requirements and methods of test – Part 2: Valve regulated types.*

STATIONARY LEAD-ACID BATTERIES –

Part 11: Vented types – General requirements and methods of tests

1 Scope and object

This part of IEC 60896 is applicable to lead-acid cells and batteries which are designed for service in fixed locations (i.e. not habitually to be moved from place to place) and which are permanently connected to the load and to the d.c. power supply. Batteries operating in such applications are called “stationary batteries”.

Any type or construction of lead-acid battery may be used for stationary battery applications. This part 11 of the standard is applicable to vented types only.

The object of this standard is to specify general requirements and the main characteristics, together with corresponding test methods associated with all types and construction modes of lead-acid stationary batteries, excluding valve-regulated types.

Recommendations on the use of tests for stationary battery application are given in Table A.1.

Recommendations relating the type of cell or monobloc to the use of tests are given in Table A.2.

Statements and claims of basic performance data by the manufacturer shall correspond to those tests.

The tests may also be used for type qualification.

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 60050(151), *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

IEC 60051 (all parts), *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60359, *Electrical and electronic measurement equipment – Expression of performance*

IEC 60417 (all parts), *Graphical symbols for use on equipment*

IEC 60485, *Digital electronic d.c. voltmeters and d.c. electronic analogue-to-digital converters*

3 Definitions

For the purposes of the present part of IEC 60896, the following definitions apply.

3.1
electrolyte reserve
volume of electrolyte between minimum and maximum level indication

3.2
rated capacity
C_{rt}
quantity of electricity, declared by the manufacturer, which a cell or battery can deliver under specified conditions after a full charge. This value is usually expressed in ampere-hours (see IEV 486-03-22)

3.3
nominal capacity
C_{nom}
suitable approximate quantity of electricity used to identify the capacity of a cell or battery. This value is usually expressed in ampere-hours (see IEV 486-03-21)

3.4
endurance
ability of a cell or battery to function and withstand operations under specified conditions for a minimum period of time or repeated application thereof

4 Mechanical strength

Stationary cells or batteries shall be designed to withstand mechanical stresses during normal transportation and handling.

Resistance to earthquakes, if required, shall be particularly specified.

5 Electrolyte levels

5.1 Each cell shall be equipped with a device to indicate the minimum and maximum electrolyte levels.

5.2 For containers made of translucent material, the minimum and maximum levels shall be indicated on the container wall.

5.3 For containers made of an opaque material, a gauge shall be provided indicating the position of the electrolyte level in relation to the minimum and maximum levels.

6 Electrolyte reserve

6.1 The electrolyte reserve (see 3.1), together with the battery design and the charging method used, governs the frequency of inspections for electrolyte level readjustments.

6.2 For batteries in float operation (see 8.1) the minimum electrolyte reserve is specified in Item d) of 8.2.

7 Capacity

(Test, see Clause 14).

7.1 The essential characteristic of a stationary cell or battery is its capacity for the storage of electric energy. This capacity, expressed in ampere-hours (Ah) varies with the conditions of use (discharge current and voltage, and temperature).

The recommended t-values are:

t = 240 h, 20 h, 10 h, 8 h, 5 h, 3 h, 2 h, 1 h, 0,5 h.

From these various C_{rt} values one value may be selected and declared as rated capacity C_{rt} (see 3.2).

7.2 The most commonly used values of t are between 10 h and 3 h. For these, the final voltage (end-of-discharge voltage) shall be U_f = 1,80 V per cell (unless otherwise recommended or requested by the manufacturer or user). For other discharge rates, the recommended value of U_f shall be set by national standards or shall be stated by the manufacturer together with the value of C_{rt} or together with the particular performance data (see 7.5).

7.3 The discharge current corresponding to the rated capacity C_{rt} at the chosen reference temperature 20 °C or 25 °C is:

$$I_{rt} = C_{rt} / t \qquad \text{(A)}$$

to the final discharge voltage U_f in accordance with 7.2.

7.4 The actual capacity C_a shall be determined by discharging a fully charged cell or battery in accordance with Clause 14. The resultant value shall be used for comparison with the rated capacity C_{rt} stated by the manufacturer, or for control of the state of a battery after long periods of service.

7.5 The determination of the actual capacity C_a in accordance with Clause 14 may also be used for comparison with particular performance data indicated by the supplier. In this case the current I_{rt} in 14.4 shall be substituted by the particular current corresponding to the relevant performance data.

8 Suitability for floating battery operation

(Test, see Clause 15).

8.1 Stationary batteries are mainly used in floating operation

A battery in floating operation has a constant voltage U_{flo}, permanently applied to its terminal which is sufficient to maintain it in a state close to full charge and is intended to supply a circuit whose normal power supply may fail. Suitability for this operation shall be checked by a test carried out on cells or on batteries.

Batteries which are not in true floating operation (for example, solar power storage) should not be qualified according to the test method described in Clause 15.

8.2 Batteries operating in continuous floating operation

Batteries operating in continuous floating operation according to Clause 15 shall meet the following requirements:

a) the electrolyte densities shall remain within specified limits in all cells;

b) the individual cell voltages shall remain within specified limits;

NOTE In some batteries with monobloc design the voltage of individual cells cannot be measured. In those cases the assessment of uniformity should be made with the voltage of individual monobloc units.

c) after a period of six months the actual capacity C_a on discharge according to Clause 14 shall be at least equal to C_{rt};

d) after a period of six months the loss of electrolyte shall not exceed 50 % of the volume between the minimum and maximum levels. The volume between the minimum and maximum levels shall be available from the manufacturer.

9 Endurance

See definition 3.4.

Depending on the battery and system application an endurance test based on discharge-charge cycles or an overcharge shall be carried out.

9.1 Endurance in cycles

The endurance in discharge-charge cycles shall be tested according to Clause 16 where frequent discharges of the battery are to be encountered due either to a deliberate choice of operational application or to frequent power-line outages.

The minimum requirement of the test shall be two sets of 50 cycles each (N = 100 cycles) before capacity drops below 0,95· C_{10} where C_{10} is the rated capacity at the 10 h-rate

Optionally, the manufacturer may state the number of cycles as $C_a = 0{,}8 \cdot C_{10}$.

9.2 Endurance in overcharge

The endurance in overcharge shall be tested according to Clause 17 where natural overcharge related potential failure modes such as corrosion of grids, plate group bars or terminals of the battery are to be encountered due either to high ambient temperatures, poor float voltage regulation or similar.

The minimum requirement of the test shall be six periods of 720 h each before the capacity drops below 0,8 C where C is the rated capacity at the 1 h rate to U_f as defined in Clause 7.

10 Charge retention

Although, in the majority of cases, stationary batteries are on permanent charge, it is useful to establish their capability to retain charge by means of a test for cases where the battery may become electrically disconnected either normally or accidentally.