

Stationary lead-acid batteries —

Part 21: Valve regulated types — Methods of test

ICS 29.220.20

National foreword

This British Standard is the UK implementation of EN 60896-21:2004. It is identical with IEC 60896-21:2004. It supersedes BS EN 60896-2:1996 which is withdrawn. Together with BS EN 60896-22:2004 it supersedes BS 6290-4:1997 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/21, Secondary cells and batteries.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English version

**Stationary lead-acid batteries
Part 21: Valve regulated types –
Methods of test
(IEC 60896-21:2004)**

Batteries stationnaires au plomb
Partie 21: Types étanches à soupapes -
Méthodes d'essais
(CEI 60896-21:2004)

Ortsfeste Blei-Akkumulatoren
Teil 21: Verschlussene Bauarten -
Prüfverfahren
(IEC 60896-21:2004)

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CENELEC

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Foreword

The text of document 21/594/FDIS, future edition 1 of IEC 60896-21, prepared by IEC TC 21, Secondary cells and batteries, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60896-21 on 2004-03-01.

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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) 2004-12-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2007-03-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60896-21:2004 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60050-826	NOTE	Harmonized as HD 384.2 S1:1986 (not modified).
IEC 60095	NOTE	Harmonized in EN 60095 series (partly modified).
IEC 61056	NOTE	Harmonized in EN 61056 series (not modified).
IEC 61427	NOTE	Harmonized as EN 61427:2001 (not modified).
ISO 9000	NOTE	Harmonized as EN ISO 9000:2000 (not modified).
ISO 9001	NOTE	Harmonized as EN ISO 9001:1994 (not modified).
ISO 9001	NOTE	Harmonized as EN ISO 9001:2000 (not modified).

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1 Scope

This part of IEC 60896 applies to all stationary lead-acid cells and monobloc batteries of the valve regulated type for float charge applications, (i.e. permanently connected to a load and to a d.c. power supply), in a static location (i.e. not generally intended to be moved from place to place) and incorporated into stationary equipment or installed in battery rooms for use in telecom, uninterruptible power supply (UPS), utility switching, emergency power or similar applications.

The objective of this part of IEC 60896 is to specify the methods of test for all types and construction of valve regulated stationary lead acid cells and monobloc batteries used in standby power applications.

This part of IEC 60896 does not apply to lead-acid cells and monobloc batteries used for vehicle engine starting applications (IEC 60095 series), solar photovoltaic energy systems (IEC 61427), or general purpose applications (IEC 61056 series).

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 60068-2-32:1975, *Basic environmental testing procedures – Part 2: Test; Test Ed: Free fall Amendment 2* (1990)

IEC 60695-11-10, *Fire hazard testing – Part 11-10 Test flames – 50 W horizontal and vertical flame test methods*

IEC 60707, *Flammability of solid non-metallic materials when exposed to flame sources – List of test methods*

IEC 60896-22:2004, *Stationary lead acid batteries – Part 22: Valve regulated types – Requirements*

IEC 60950-1:2001, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61430:1997, *Secondary cells and batteries – Test methods for checking the performance of devices designed for reducing explosion hazards – Lead-acid starter batteries*

ISO 1043-1, *Plastics – Symbols and abbreviated terms – Part 1: Basic polymers and their special characteristics*

3 Definitions

For the purpose of this part of IEC 60896, the following definitions apply:

3.1

accuracy (of a measuring instrument)

quality which characterizes the ability of a measuring instrument to provide an indicated value close to a true value of the measurand

[IEV 311-06-08]

NOTE Accuracy is all the better when the indicated value is closer to the corresponding true value.

3.2

accuracy class

category of measuring instruments, all of which are intended to comply with a set of specifications regarding uncertainty

[IEV 311-06-09]

3.3

ambient temperature

temperature of the medium in the immediate vicinity of a cell or battery

[IEV 486-03-12]

3.4

ampere-hour

quantity of electricity or a capacity of a battery obtained by integrating the discharge current in ampere with respect to time in hours.

NOTE One ampere-hour equals 3 600 coulombs.

3.5

secondary battery

two or more secondary cells connected together and used as a source of electrical energy

[IEV 486-01-03]

3.6

monobloc battery

secondary battery in which the plate packs are fitted in a multi-compartment container

[IEV 486-01-17]

3.7

floating battery

secondary battery whose terminals are permanently connected to a source of constant voltage sufficient to maintain the battery approximately fully charged, intended to supply a circuit, if the normal supply is temporarily interrupted

[IEV 486-04-10]

3.8

battery capacity

quantity of electricity or electrical charge, which a fully charged battery can deliver under specified conditions

[IEV 486-03-01]

NOTE The SI unit for electric charge is the coulomb ($1\text{ C} = 1\text{ A.s}$) but in practice, battery capacity is expressed in ampere-hours (Ah).

3.9

charge

operation during which a secondary battery receives from an external circuit electrical energy, which is converted into chemical energy

[IEV 486-01-11]

NOTE A charge is defined by its maximum voltage, current and duration.

3.10

full charge

state where all the available active material of a secondary cell or battery has been reconverted to its fully charged status

[IEV 486-03-37]

3.11

overcharge

continued charging after the full charge of a secondary cell or battery

[IEV 486-03-35]

3.12

cell

assembly of electrodes and electrolyte, which constitutes the basic unit of a secondary battery

[IEV 486-01-02]

3.13

electrochemical cell

electrochemical system capable of storing in chemical form the electric energy received and which can give it back by reversion, i.e. a secondary cell

[IEV 486-01-01, modified]

3.14

secondary cell

assembly of electrodes and electrolyte which constitutes the basic unit of a secondary battery

[IEV 486-01-02]

3.15

valve regulated cell

secondary cell which is closed under normal conditions but which has an arrangement which allows the escape of gas if the internal pressure exceeds a predetermined value. The cell cannot normally receive the addition of electrolyte

[IEV 486-01-20]

NOTE Such cells have an immobilized electrolyte to prevent spillage and allow for oxygen recombination on the negative electrode.

3.16

actual capacity

C_a

quantity of electricity delivered by a cell or battery, determined experimentally with a discharge at a specified rate to a specified end-voltage and at a specified temperature

NOTE This value is usually expressed in ampere-hours (Ah).

3.17

nominal capacity

C_n

suitable approximate quantity of electricity used to identify the capacity of a cell or battery

NOTE This value is usually expressed in ampere-hours (Ah).

[IEV 486-03-021]

3.18

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

NOTE This value is usually expressed in ampere-hours (Ah).

[IEV 486-03-22]

3.19

shipping capacity

C_{sh}

quantity of electricity, declared by the manufacturer, which a cell or battery can deliver, at the time of shipment, under specified conditions of charge.

NOTE 1 This value is usually expressed in ampere-hours (Ah).

NOTE 2 In the present standard this value is assumed to be at least 0,95 C_{rt} .

3.20

durability

ability of an item (battery) to perform a required function under given conditions of use and maintenance, until a limiting state is reached

NOTE A limiting state of an item (battery) may be characterized by the end of the useful life, unsuitability for any economic or technological reasons or other relevant factors.

[IEV 191-02-02]

3.21

electrolyte

solid or liquid phase containing mobile ions that render the phase electrically conducting

[IEV 486-02-19]

3.22

stationary equipment

either fixed equipment or equipment not provided with a carrying handle and having such a mass that it cannot easily be moved

[IEV 826-07-06]

3.23

failure

termination of the ability of an item (battery) to perform the required function

[IEV 603-035-06]

3.24

lead-acid battery

secondary battery in which the electrodes are made mainly from lead and the electrolyte is a sulphuric acid solution

[IEV 486-01-04]

3.25

design life

expected period of useful life of a battery according to components, design and application

3.26

service life

period of useful life of a battery under specified conditions

[IEV 486-03-23]

3.27

useful life

under given conditions, the time interval beginning at a certain instant of time, and ending when the failure intensity becomes unacceptable or when the item (battery) is considered un-repairable as a result of a fault

[IEV 191-10-06]

3.28

performance

characteristics defining the ability of a battery to achieve its intended functions

[IEV 311-06-11]

3.29

product range

range of products, i.e. cells or monobloc batteries, over which specified design features, materials, manufacturing processes, and quality systems (e.g. ISO 9000) of manufacturing locations are identical

NOTE This definition guides the selection of the units to be tested in the framework of this standard.

3.30**accelerated test**

test in which the applied stress level is chosen to exceed that stated in the reference conditions in order to shorten the time duration required to observe the stress response of the item (battery), or to magnify the response in a given time duration

NOTE To be valid, an accelerated test shall not alter (or conceal) the basic fault modes and failure mechanisms, or their relative prevalence.

[IEV 191-14-07]

3.31**acceptance test**

contractual test to prove to the customer that the device (battery) meets certain conditions of its specification

[IEV 151-16-23]

3.32**commissioning test**

tests applied on a device (battery) carried out on site to prove the correctness of installation and operation

[IEV 151-15-24]

3.33**compliance test**

test used to show whether or not a characteristic or property of an item (battery) complies with the stated requirements.

[IEV 191-14-02]

3.34**endurance test**

test carried out over a time interval to investigate how properties of an item (battery) are affected by the application of stated stresses and by their time duration or repeated application

[IEV 151-16-22]

3.35**laboratory test**

compliance test made under prescribed and controlled conditions, which may or may not simulate field conditions

[IEV191-14-04]

3.36**life test**

test to ascertain the probable life, under specified conditions, of a component or a device (battery)

[IEV 151-16-21]

NOTE In VRLA batteries it is customary to assume that for every 10 K rise in service temperature above the reference temperature (20 °C – 25 °C) a halving of the life in a life test is observed. (For a test temperature up to 60 °C)

3.37

performance test

test carried out to determine the characteristics of a machine (battery) and to show that the machine (battery) achieves its intended function

3.38

type test

conformity test made on one or more items representative of the production

[IEV 151-16-16]

3.39

thermal runaway

critical condition arising during constant voltage charge in which the current and the temperature of the battery produce a cumulative mutually reinforcing effect which further increases them and can lead to the destruction of the battery

[IEV 486-03-34]

3.40

boost voltage

U_{boost}

voltage specified by the manufacturer for charging at an elevated voltage so as to accelerate charge, mildly overcharge or to equalized the state of charge of cells and monobloc batteries

3.41

final voltage

U_{final}

specified voltage at which a discharge of a battery is considered finished.

[IEV 486-03-04]

NOTE This voltage relates to the demand of the exterior circuit, the discharge rate and temperature.

3.42

float voltage

U_{flo}

constant charge voltage specified by the manufacturer for a floating battery

4 Functional characteristics

4.1 Overview

In this part of IEC 60896 the following characteristics are deemed essential to comprehensively define the ability of stationary lead-acid batteries of the valve regulated type to perform their intended function as a reliable source of emergency power.

This part of IEC 60896 is a collection of test methods used to define specified characteristics.

The applicability of a test method and the relevant requirements for each application are specified in IEC 60896-22.

The characteristics are grouped into safe operation, performance and durability properties.

4.2 Safe operation characteristics

These tests (see Table 1) verify essential safe operation properties of stationary lead-acid batteries of the valve regulated type.

Table 1 – Safe operation characteristics

Test clause	Measures	Purpose
6.1	Gas emission	To determine the emitted gas volume
6.2	High current tolerance	To verify the adequacy of current conduction cross- sections
6.3	Short circuit current and d.c. internal resistance	To provide data for the sizing of fuses in the exterior circuit
6.4	Protection against internal ignition from external spark sources	To evaluate the adequacy of protective features
6.5	Protection against ground short propensity	To evaluate the adequacy of design features
6.6	Content and durability of required markings	To evaluate the quality of the markings and the content of the information
6.7	Material identification	To ensure the presence of material identification markings
6.8	Valve operation	To ensure the correct opening of safety valves
6.9	Flammability rating of materials	To verify the fire hazard class of battery materials
6.10	Intercell connector performance	To verify the maximum surface temperatures of the connectors during high rate discharges

4.3 Performance characteristics

These tests (see Table 2) describe essential performance properties of stationary lead-acid batteries of the valve regulated type.

Table 2 – Performance characteristics

Test Clause	Measures	Purpose
6.11	Discharge capacity	To verify the available capacities at selected discharge rates or discharge durations.
6.12	Charge retention during storage	To provide storage duration data
6.13	Float service with daily discharges	To determine cyclic performance under float charge conditions
6.14	Recharge behaviour	To determine the recovery of capacity or autonomy time after a power outage

4.4 Durability characteristics

These tests (see Table 3) describe essential durability properties of stationary lead-acid batteries of the valve regulated type. It must be noted that certain conditions of test are abusive and severely detrimental to battery life and safe operation. Operating batteries at these conditions is not recommended and predictions of operational life under these conditions are difficult.

Table 3 – Durability characteristics

Test Clause	Measures	Purpose
6.15	Service life at an operating temperature of 40 °C	To determine the operational life at elevated temperatures
6.16	Impact of a stress temperature of 55 °C or 60 °C	To determine the influence of high stress temperatures on cell or monobloc battery life
6.17	Abusive over-discharge	To determine the expected behaviour when excessive capacity is discharged
6.18	Thermal runaway sensitivity	To determine the expected times to establish a condition of escalating current and temperature
6.19	Low temperature sensitivity	To determine the sensitivity toward damage induced by electrolyte freezing
6.20	Dimensional stability at elevated internal pressure and temperature	To determine the propensity of the cell or monobloc battery to be deformed by internal pressure and at elevated temperature
6.21	Stability against mechanical abuse of units during installation	To determine the propensity of the cell or monobloc battery to fracture or leak when dropped.

4.5 Test result requirements

The test results required to verify the characteristics defined in 6.1 to 6.21, are stated and maintained in the separate standard IEC 60896-22.

A stationary lead-acid battery of the VRLA type covered by this present standard will be thus considered as “Tested according to IEC 60896-21 and compliant with defined requirements of IEC 60896-22.”

The results of the test for the safe operation characteristics will be reported on a “pass” or “report/state the value” basis.

The requirements for performance and/or durability characteristics, defined in IEC 60896-22, will depend not only on the general category of intended use of the stationary lead-acid battery (telecom, uninterruptible power supply (UPS), utility switching, emergency power or similar applications)) but also on the particular environmental and operational condition within each application.

5 Test set-up

5.1 Accuracy of measuring instruments

5.1.1 Voltage measurements

The instruments used shall be of an accuracy class 0,5 or better where required. The resistance of the voltmeters shall be at least 10 000 Ω/V .

5.1.2 Current measurements

The instruments used shall be of an accuracy class 0,5 or better where required.