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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Lead-acid batteries for propulsion power of lightweight vehicles – General requirements and methods of test

Batteries au plomb pour la puissance de propulsion des véhicules légers – Exigences générales et méthodes d'essai

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LEAD-ACID BATTERIES FOR PROPULSION POWER OF LIGHTWEIGHT VEHICLES – GENERAL REQUIREMENTS AND METHODS OF TEST

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International Standard IEC 63193 has been prepared by IEC technical committee 21: Secondary cells and batteries.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
21/1056/FDIS	21/1066/RVD

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

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

LEAD-ACID BATTERIES FOR PROPULSION POWER OF LIGHTWEIGHT VEHICLES – GENERAL REQUIREMENTS AND METHODS OF TEST

1 Scope

This document is applicable to lead-acid batteries powering electric two-wheelers (mopeds) and three-wheelers (e-rickshaws and delivery vehicles), and also to golf cars and similar light utility and multi-passenger vehicles.

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a) Electric two- and three-wheelers

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b) Electric golf car and light utility and multi-passenger vehicles

Figure 1 – Examples of vehicles covered by this document

Persons with a low level of technical skills as regards these vehicles and associated batteries, operate them most often in an environment with many bystanders who are unaware of the possible risks involved. The batteries have thus to be eminently reliable, consumer friendly and minimize risks of fire, explosions, electrical shocks and chemical burns.

These batteries are submitted to frequent and deep discharges with electrical power delivered to the propulsion system in short surges of high current when accelerating, followed by lower current levels when at cruising speed. The subsequent charge of the battery can also occur in areas accessible to the public.

The document specifies methods of tests tailored to batteries destined for the above-referenced types of vehicles so as to ensure satisfactory and safe battery performance in the intended application.

This document does not apply for example to lead acid cells and batteries used for:

- vehicle engine starting applications (IEC 60095 series);
- traction applications (IEC 60254 series);

- stationary applications (IEC 60896 series);
- general purpose applications (IEC 61056 series); or to
- motorized wheelchairs and similar personal assist vehicles.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60695-11-4:2011, *Fire hazard testing – Part 11-4: Test flames – 50 W flame – Apparatus and confirmational test method*

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

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

IEC 62902:2019, *Secondary cells and batteries – Marking symbols for identification of their chemistry*

ISO 1043-1:2011, *Plastics – Symbols and abbreviated terms – Part 1: Basic polymers and their special characteristics*

ISO 3864-1:2011, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

ISO 3864-3:2012, *Graphical symbols – Safety colours and safety signs – Part 3: Design principles for graphical symbols for use in safety signs*

ISO 7000, *Graphical symbols for use on equipment – Registered symbols* (available at http://www.graphical-symbols.info/equipment)

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs* (available at https://www.iso.org/obp)

ISO 8608:2016, *Mechanical vibration – Road surface profiles – Reporting of measured data*

Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
acceptance test
<of a battery> contractual test to prove to the customer that the battery meets certain conditions of its specification

Note 1 to entry: Such a test consists generally in a capacity determination carried out at the manufacturer's premises prior to shipping and in the presence of the customer.

Note 2 to entry: Such a test could be also be combined with the commissioning test.

[SOURCE: IEC 60050-151:2001, 151-16-23, modified – The second preferred term "hand-over test" has been omitted, "item" has been replaced with "battery" in the definition, and the domain and notes to entry have been added.]

3.2
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

Note 1 to entry: This term is used in the "true value" approach.

Note 2 to entry: Accuracy is all the better when the indicated value is closer to the corresponding true value.

[SOURCE: IEC 60050-311:2001, 311-06-08]

3.3
ambient temperature
average temperature of air or another medium in the vicinity of the battery

Note 1 to entry: During the measurement of the ambient temperature the measuring instrument/probe should be shielded from draughts and radiant heating.

[SOURCE: IEC 60050-826:2001, 826-10-03, modified – The word "equipment" has been replaced with "battery" in the definition.]

3.4
running time
autonomy time
<of a battery> extent of time over which the battery can support independently the electrical load by providing all the load's required power

Note 1 to entry: This time is also called back-up or discharge duration and varies in function of battery age, load size, state of charge and temperature.

3.5
capacity
<for cells or batteries> electric charge which a cell or battery can deliver under specified discharge conditions

Note 1 to entry: The SI unit for electric charge, or quantity of electricity, is the coulomb (1 C = 1 A·s) but in practice, capacity is usually expressed in ampere hours (Ah).

[SOURCE: IEC 60050-482:2004, 482-03-14]

3.6
actual capacity
<of cells and batteries> capacity value determined experimentally at a defined instant of time with a discharge at a specified rate to a specified end-voltage and at a specified temperature

Note 1 to entry: Each actual capacity determination may yield a capacity value which may differ from the preceding one.

3.7
rated capacity
<of cells and batteries> capacity value of a battery determined under specified conditions and declared by the manufacturer

[SOURCE: IEC 60050-482:2004, 482-03-15, modified – The domain "<of cells and batteries>" has been added.]

3.8
nominal voltage
suitable approximate value of the voltage used to designate or identify a cell, a battery or an electrochemical system

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

3.9
residual capacity
<of cells and batteries> capacity remaining in a cell or battery following a discharge, operation or storage under specific test condition

[SOURCE: IEC 60050-482:2004, 482-03-16, modified – The domain "<of cells and batteries>" has been added.]

3.10
charging
<of a battery> operation during which a secondary cell or battery is supplied with electric energy from an external circuit which results in chemical changes within the cell and thus the storage of energy as chemical energy

Note 1 to entry: A charge operation is defined by its maximum voltage, current, duration and ancillary conditions as specified by the manufacturer.

[SOURCE: IEC 60050-482:2004, 482-05-27, modified – The note has been added.]

3.11
charge voltage
voltage specified by the manufacturer for charging a battery in a specific application

3.12
end-of-charge voltage
voltage attained at the end of a charging step, at a specified constant current

Note 1 to entry: The end-of charge voltage may be used to initiate the termination of the charge process.

[SOURCE: IEC 60050-482:2004, 482-05-55]

3.13
compliance test
<of a battery system> procedure to verify if a characteristic or a property complies with the stated requirements

[SOURCE: IEC 60050-192:2015, 192-09-02, modified – The domain "<of a battery system>" has been added.]

3.14
depth-of-discharge
DoD
<of a battery> amount of capacity discharged from a cell or battery relative to a rated capacity value and expressed as a percentage

Note 1 to entry: A discharge with I_5 current for 2,5 h would result in a 50 % depth of discharge or DoD, relative to the rated 5 h or C_5 capacity.

3.15
discharge
operation by which a battery delivers, to an external electric circuit and under specified conditions, electric energy produced in the cells

[SOURCE: IEC 60050-482:2004, 482-03-23, modified – "(of a battery)" omitted from the term.]

3.16
electrolyte
liquid or solid substance containing mobile ions that render it ionically conductive

Note 1 to entry: The electrolyte may be liquid, solid or a gel.

[SOURCE: IEC 60050-482:2004, 482-02-29]

3.17
final voltage
end-of-discharge voltage
cut-off voltage
end-point voltage
U_{final}
specified voltage of a battery at which the battery discharge is terminated

[SOURCE: IEC 60050-482:2004, 482-03-30, modified – The symbol has been added, and "final voltage" has been moved ahead of "end-of-discharge voltage" to be the first preferred term.]

3.18
full charge
<of a battery> state of charge wherein the battery has been charged in accordance with the manufacturer's recommended charging conditions and has reached the specified end-of-charge criteria and the specified maximum storable energy level

3.19
lead acid battery
lead dioxide lead battery
secondary battery with an aqueous electrolyte based on dilute sulphuric acid, a positive electrode of lead dioxide and a negative electrode of lead

Note 1 to entry: Novel types of lead acid batteries incorporate various amounts of carbon or carbon structures, but the active materials are still lead, lead dioxide and sulphuric acid.

[SOURCE: IEC 60050-482:2004, 482-05-01, modified – The term "lead acid battery" has been added and the original note has been replaced with the note as formulated.]

3.20
laboratory test
<of a battery> test made under prescribed and controlled conditions that may or may not simulate field conditions

[SOURCE: IEC 60050-192:2015,192-09-05, modified – The domain "<of a battery>" has been added.]

3.21
test
<of a battery> technical operation that consists of the determination of one or more characteristics of a given battery according to a specified procedure

Note 1 to entry: A test is carried out to measure or classify a characteristic or a property of a battery by applying to the battery a set of environmental and operating conditions and/or requirements.

[SOURCE: IEC 60050-151:2001, 151-16-13, modified – Addition of the domain "<of a battery>" and replacement of the words "product, process or service" with "battery" in the definition, and the word "item" with "battery" in the note.]

3.22
type test
<of a battery> conformity test made on one or more batteries representative of the production

[SOURCE: IEC 60050-151:2001, 151-16-16, modified – Addition of the domain "<of a battery>" and replacement of the word "item" with "batteries" in the definition.]

3.23
valve regulated lead acid battery
VRLA
secondary battery in which cells are closed but have a valve which allows the escape of gas if the internal pressure exceeds a predetermined value

Note 1 to entry: The cell or battery cannot normally receive additions to the electrolyte.

3.24
VRLA/AGM
<cell or battery> valve regulated lead acid cell or battery where the electrolyte is immobilized in an absorbent glass mat (AGM)

3.25
VRLA/Gel
<cell or battery> valve regulated lead acid cell or battery where the electrolyte is immobilized in a gel

3.26
monobloc battery
monobloc
battery with multiple separate but electrically connected cell compartments each of which is designed to house an assembly of electrodes, electrolyte, terminals or interconnections and possible separators

Note 1 to entry: The cells in a monobloc can be connected in series or in parallel.

[SOURCE: IEC 60050-482:2004, 482-02-17, modified – The term "monobloc" has been added.]

3.27
battery
two or more cells fitted with devices necessary for use, for example case, terminals, marking and protective devices

[SOURCE: IEC 60050-482:2004, 482-01-04, modified – The wording "one or more cells" has been replaced with "two or more cells" in the definition.]

3.28
flooded, adj.
<cell or monobloc or battery> lead acid design where the mobile liquid electrolyte also occupies part of the free volume above the plate groups

4 Test set-up

4.1 Accuracy of the measuring instruments

The overall accuracy, i.e. the measurement's degree of correctness of controlled or measured values, relative to the specified or actual values, shall be within the following tolerances:

- Class of 0,5 or better for voltage measurements;
- Class of 0,5 or better for current measurements;
- 1 °C or better with 1 °C resolution for temperature measurements;
- ±1 % for time measurements;
- ±1 % for mass measurements;
- ±1 % for frequency measurements.

These tolerances comprise the combined accuracy of the measuring instruments, the measurement technique used, and all other sources of error in the test procedure.

4.2 General test features and rules

4.2.1 Number of test units

The number and layout of test samples is specified in each test clause and summarized in Table 1 and Table 23.

4.2.2 Age of test units

Monoblocs produced and stored for long periods prior to testing may not yield an accurate view of their capabilities. The monoblocs to be tested according to this document shall not therefore have been produced more than ninety days prior to the commencement of testing except for those cases when aged or used batteries are to be verified for specific properties.

In order to ensure that the test of the selected monoblocs gives a comprehensive view of their capabilities, it is necessary that the entire sample set (see Table 1 and Table 23) be selected at once and randomly from a designated production lot. This production lot shall have been manufactured with identical materials and production process specifications.

The date of final inspection in the factory of origin shall be taken as the production date. In the case of third party testing this date shall be requested from the manufacturer or be read from the nameplate, i.e. the information label on the monobloc.

The production date (in MM.YYYY format) of the monoblocs shall be reported in the relevant test documentation.

The tests in this document are destined to give the user a view of the capabilities of the monoblocs when first put to use. For this purpose, and especially in tests destined to confirm rated capacities or running times, no activation cycling or similar treatments are permissible except where expressly allowed.

4.2.3 Electrolyte maintenance activities during tests

VRLA-type monoblocs shall not undergo any maintenance operation such as water or electrolyte additions or withdrawals during the entire duration of a test. In flooded-type monoblocs, distilled water additions are allowed only so as to keep the electrolyte level between the minimum and maximum level specified by the manufacturer. No water additions to flooded-type monoblocs are allowed during the determination of the electrolyte level maintenance interval in accordance with 6.8.