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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Lead-acid starter batteries –
Part 1: General requirements and methods of test

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FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60095-1 has been prepared by IEC technical committee 21: Secondary cells and batteries.

This eighth edition cancels and replaces the seventh edition published in 2006. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) charge acceptance test;

b) cranking performance test;

c) charge retention test; and

d) endurance test added.

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

FDIS	Report on voting
21/974/FDIS	21/987/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.

A list of all parts in the IEC 60095 series, published under the general title *Lead-acid starter batteries*, can be found on the IEC website.

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- withdrawn,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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

LEAD-ACID STARTER BATTERIES –

Part 1: General requirements and methods of test

1 Scope

This part of IEC 60095 is applicable to lead-acid batteries with a nominal voltage of 12 V, used primarily as a power source for the starting of internal combustion engines, lighting, and for auxiliary equipment of internal combustion engine vehicles. These batteries are commonly called "starter batteries".

This document is applicable to batteries for the following purposes:

- batteries for passenger cars;
- batteries for commercial and industrial vehicles.

This document is not applicable to batteries for other purposes, such as the starting of railcar internal combustion engines or for motorcycles and other power sport vehicles.

This document defines many general properties of lead-acid batteries. Single sections can be referenced in other parts of the IEC 60095 series even if the application is excluded in the scope of this document.

This document specifies the:

- general requirements;
- essential functional characteristics, relevant test methods and results required,

for several classes of starter batteries:

- according to the general type of application;
- according to the type of product.

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 60050-482, *International Electrotechnical Vocabulary – Chapter 482: Primary and secondary cells and batteries*

IEC 60095-2, *Lead-acid starter batteries – Part 2: Dimensions of batteries and dimensions and marking of terminals*

IEC 60095-4, *Lead-acid starter batteries – Part 4: Dimensions of batteries for heavy ~~trucks~~ vehicles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-482 and the following 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
flooded battery
lead-acid battery having a cover provided with one or more openings through which gaseous products may escape

3.2
enhanced flooded battery
EFB battery
flooded lead-acid battery with additional special design features to significantly improve the cycling capability compared to standard flooded batteries

3.3
valve regulated lead-acid battery
VRLA battery
lead-acid battery which is closed under normal conditions but which has an arrangement that allows the escape of gas if the internal pressure exceeds a predetermined value

Note 1 to entry: The VRLA battery cannot receive addition to the electrolyte and after activation of dry-charged VRLA.

Note 2 to entry: In VRLA batteries the electrolyte is immobilized.

3.4
absorbent glass mat battery
AGM battery
VRLA battery in which the electrolyte is immobilized by absorption in a glass mat

3.5
gel battery
VRLA battery in which the electrolyte is immobilized by fixing as a gel

4 ~~Classification and~~ Designation of starter batteries – Electrolyte density and open circuit voltage

~~**4.1 Battery classification according to application**~~

~~Three classes of batteries are defined according to their application, as follows:~~

~~– Class A: batteries for starter applications with usual cycling capability and normal mechanical resistance;~~

~~– Class B: batteries for starter applications which have an important higher requirement in cycling ability and /or mechanical resistance;~~

~~– Class C: batteries for starter applications and high temperature duty.~~

4.1 ~~Battery~~ Designation according to type

Batteries are designated according to their type, as follows:

~~– Vented (flooded) battery: a vented battery is a secondary battery having a cover provided with one or more openings through which gaseous products may escape.~~

~~– Valve-regulated (with gas recombination) battery: a valve-regulated battery is a secondary battery that is closed under normal conditions and has an arrangement that allows the escape of gas if the internal pressure exceeds a predetermined value. The battery cannot normally receive an addition of water or electrolyte. In this type of battery, the electrolyte is immobilised.~~

- flooded batteries (vented);
- enhanced flooded batteries, EFB;
- valve regulated lead-acid batteries, VRLA;
  - absorbent glass mat batteries, AGM;
  - gel batteries.

4.2 Dry-charged batteries

Lead-acid batteries may be supplied in a dry-charged state. Dry-charged batteries can be activated by filling with the defined electrolyte indicated by internal or external marks or according to the manufacturer's activation instructions. After activation, these batteries are ready to use.

4.3 Electrolyte density and open circuit voltage

The density of the electrolyte in all fully charged vented batteries shall be in the range of 1,27 kg/l to 1,30 kg/l at 25 °C unless otherwise specified by the manufacturer.

NOTE For valve-regulated batteries, the electrolyte is not accessible and, therefore, its density cannot be checked.

The open circuit voltage (OCV) at 25 °C, of fully charged batteries after a minimum 24 h stand on open circuit, shall be in the range of 12,70 V to 12,90 V for vented types and 12,80 V ~~minimum~~ to 13,10 V for valve regulated types unless otherwise specified by the manufacturer.

The manufacturer shall specify the value and tolerance of the electrolyte density or OCV. If such information is not available, vented battery testing shall be carried out with a density of 1,28 kg/l ± 0,01 kg/l at 25 °C or an OCV of 12,76 V ± 0,06 V at 25 °C and valve regulated battery testing shall be carried out with a minimum OCV of 12,80 V.

5 Condition on delivery

New vented batteries may be supplied either:

- in a state ready for use, or
- in a dry-charged (or charge-conserved) state not filled with electrolyte. The density of the electrolyte to fill these batteries before use (unless otherwise recommended by the manufacturer) shall be:
  - 1,28 kg/l ± 0,01 kg/l at 25 °C;

Valve-regulated batteries are normally supplied in a state ready for use.

6 General requirements

6.1 Identification, labelling

6.1.1 General

Batteries ~~according to~~ complying with this document shall bear the following characteristics on at least the top or one of their four sides.

6.1.2 The identification of manufacturer or supplier

The name of the manufacturer or supplier shall be indicated.

~~**6.1.2 Class of battery: (IEC) A, B or C (see 4.1)**~~

~~NOTE In some countries, the class is indicated by the battery numbering system. In these cases, there is no need to include the class on the label.~~

6.1.3 Nominal voltage: 12 V

The nominal voltage of 12 V shall be indicated.

~~**6.1.4 Capacity: (see 7.1.2)**~~

~~– either 20 hour capacity C_n (Ah),~~

~~– or reserve capacity C_{rn} (min).~~

~~NOTE In some countries, the capacity is indicated by the battery numbering system. In these cases, there is no need to include the capacity on the label.~~

~~**6.1.5 Nominal cranking current: I_{cc} (A) (see 7.1.1)**~~

6.1.4 Capacity or reserve capacity (see 7.1.2) and nominal cranking current (see 7.1.1)

Three options are possible for the identification and labelling of capacity (or reserve capacity) and nominal cranking current:

Option 1:

- 20 h capacity C_{20} (Ah);
- with nominal cranking current I_{cc} (A) (see 7.1.1 and 9.3.1) defined at −18 °C with $U_{10s} \geq 7{,}5$ V and $U_{90s} \geq 6{,}0$ V (under $I_{cc}/0{,}6$).

Option 2:

- reserve capacity RC (minutes);
- with nominal cranking current I_{cc} (A) (see 7.1.1 and 9.3.1) defined at −18 °C with $U_{30\ s} \geq 7{,}20$ V.

Option 3:

- 20 h capacity C_{20} (Ah);
- with nominal cranking current I_{cc} (A) (see 7.1.1 and 9.3.1) defined at −18 °C with $U_{30\ s} > 7{,}20$ V.

NOTE These three options are in accordance with the present use in the different areas in the world.

The preferred version is Option 1.

6.1.5 Production date code

Batteries shall be marked with the date of production. This can be part of a more complex code.

6.1.6 Safety labelling

~~Batteries shall be marked with the six coloured symbols as described in part 1 of Annex B.~~

If under national regulations, coloured safety symbols are required to be used, they should follow the design as set out in Annex C, Clause C.1.

However, to be in compliance with some national regulations, additional wording or special labelling can be used (for example, the safety label for North America area shown in Annex C, Clause C.2).

6.1.7 Recycling labelling

Batteries shall be marked for separate collection and recycling, if required by local area regulations.

6.1.8 Valve-regulated batteries

VRLA batteries shall be marked using the term "VRLA". In addition it is recommended that ~~Valve regulated~~ VRLA batteries shall bear special indication ~~mentioning~~ that the battery shall not be opened.

EXAMPLE: "VRLA – Do not open"

6.2 Marking of the polarity

The terminals shall be identified according to the requirements of IEC 60095-2 or of IEC 60095-4.

~~6.3 Water loss designation~~

~~Vented starter batteries may be designated as "Low water loss" or "Very low water loss" according to IEC 60095-1, if they comply with the requirements of 9.5 and 9.7. If they do not comply, they are designated as "Normal".~~

~~This additional designation shall be indicated either on the battery label or in the catalogue.~~

~~NOTE Starter batteries are subject to a wide variety of operating conditions, for example temperature, overcharge voltage, etc., that have an influence on the decomposition of water from the electrolyte, regardless of internal design features. Thus, the terms "low water loss" or "very low water loss" in the sense of this standard are linked to well-defined conditions in 9.7 that do not cover the complete range of practical operating conditions.~~

6.3 Fastening of the battery

Where batteries are fastened to the vehicle by means of integral parts (for example, bottom ledges), these shall be in compliance with the requirements of IEC 60095-2 and of IEC 60095-4.

7 Functional characteristics

7.1 Electrical characteristics

7.1.1 The cranking performance is the discharge current I_{cc}, as indicated by the manufacturer according to the option chosen (Option 1 or Option 2), which a battery can supply according to 9.3.

7.1.2 The *capacity* of a starter battery is defined for a temperature of 25 °C ± 2 °C.

It may be indicated by the manufacturer as either:

- nominal 20 h capacity ~~C_n~~ C_{20}, or
- nominal reserve capacity ~~$C_{r,n}$~~ RC_n.

The nominal 20 h capacity C_n is the electric charge in ampere hours (Ah) that a battery can supply with a current:

$$I_n = C_n / 20\ \text{h} \quad \text{(A)}$$

until the terminal voltage falls to U_f = 10,50 V.

The effective 20 h capacity C_e shall be determined by discharging a battery with constant current I_n to U_f = 10,50 V (see 9.1). The resultant discharge time, in hours, is used for the verification of C_n.

The nominal reserve capacity ~~$C_{r,n}$~~ RC_n is the period of time (in minutes) for which a battery can maintain a discharge current of 25 A to a cut-off voltage U_f = 10,50 V.

The effective reserve capacity ~~$C_{r,e}$~~ RC_e shall be determined by discharging a battery with the constant current I = 25 A to U_f = 10,50 V (see 9.2). The resultant discharge time, in minutes, is used for the verification of ~~$C_{r,n}$~~ RC_n.

NOTE For the correlation (relationship) of C_n and ~~$C_{r,n}$~~ RC_n, see Annex A.

7.1.3 The *charge acceptance* is expressed as the current I_{ca} which a partially discharged battery accepts at 0 °C and a constant charging voltage of 14,40 V.

7.1.4 The *charge retention* is ~~defined as~~ rated by the cold cranking performance of the charged and filled battery after storage on open circuit under defined conditions of temperature and time (see 9.5).

7.1.5 *The endurance test consists of two parts:*

~~**7.1.5.1**~~ • the corrosion test represents the ability of a battery to perform repeated overcharge/storage periods (see 9.6.1.1).

~~**7.1.5.2**~~ • the *cycling test* represents the ability of a battery to perform repeated discharge/recharge cycles and long rest periods on open circuit. This ability shall be tested by a series of cycles and rest periods under specified conditions after which the cold cranking or the capacity performances shall be determined (see 9.6.1.2 or 9.6.2).

~~**7.1.6** *Water consumption*: maintenance-free service of a battery requires a low rate of water decomposition through overcharge (see 9.7).~~

~~Valve regulated batteries have a very low water consumption and are not intended to receive additional water.~~

The water consumption test checks if the battery can keep its performance under extended exposure to heat and overcharge conditions. It is measured as loss of weight during overcharge of a fully charged battery and is defined as g/Ah C_e (see 9.7).

~~**7.1.7** *Dry charged battery (or conserved charge battery)*: a new battery may be designated as dry charged (or conserved charge) if it can be activated ready for service just by filling it with the appropriate electrolyte and if it then conforms to the requirements of 9.10.~~

7.2 Mechanical characteristics

7.2.1 *Vibration resistance* represents the ability of a battery to maintain service under periodic or irregular acceleration forces. Minimum requirements shall be verified by a test (see 9.8).

7.2.2 *Electrolyte retention* is the ability of a battery to retain the electrolyte under specified physical conditions (see 9.9).

8 General test conditions

8.1 Sampling of batteries

~~All tests shall be carried out on new battery samples. Samples shall be considered as "new" not later than:~~

- ~~30 days after shipment date of the manufacturer in the case of filled batteries;~~
- ~~60 days after shipment date of the manufacturer in the case of dry-charged or charge-conserved batteries.~~

Samples shall be tested not later than:

- 45 days after the production date of the manufacturer in the case of filled batteries;
- 60 days after the production date of the manufacturer in the case of dry-charged batteries.

8.2 ~~Preparation of batteries prior to test~~ Charging method – Definition of a fully charged battery

~~All tests, except that in 9.10, shall commence with fully-charged batteries.~~

~~Vented batteries shall be considered as fully-charged if they have undergone one of the two charging procedures of 8.2.1 or 8.2.2 carried out at 25 °C ± 10 °C. If necessary, an appropriate temperature control system, for example a water bath, shall be used.~~

~~Valve regulated batteries shall be considered as fully-charged if they have undergone one of the two charging procedures of 8.2.3 or 8.2.4 carried out at 25 °C ± 10 °C. If necessary, an appropriate temperature control system, for example a water bath, shall be used.~~

~~**8.2.1 Charging of vented batteries at constant current**~~

~~The battery shall be charged:~~

- ~~at a constant current of 2 I_n (see 7.1.2), until voltage stabilisation is established when three consecutive voltage or specific density measurements, corrected for the battery temperature, taken at 15 min intervals, remain constant.~~

~~**8.2.2 Charging of vented batteries at constant voltage and constant current** (two step method)~~

~~The battery shall be charged:~~