



IEC 60095-1

Edition 8.0 2018-11  
REDLINE VERSION

# INTERNATIONAL STANDARD



---

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 29.220.20; 43.040.10

ISBN 978-2-8322-6285-6

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references .....	6
3 Terms and definitions .....	7
4 <del>Classification and</del> Designation of starter batteries – Electrolyte density and open circuit voltage .....	7
4.1 <del>Battery</del> Designation according to type.....	7
4.2 Dry-charged batteries .....	8
4.3 Electrolyte density and open circuit voltage.....	8
5 Condition on delivery .....	8
6 General requirements .....	9
6.1 Identification, labelling .....	9
6.1.1 General .....	9
6.1.2 The identification of manufacturer or supplier .....	9
6.1.3 Nominal voltage: 12 V.....	9
6.1.4 Capacity or reserve capacity (see 7.1.2) and nominal cranking current (see 7.1.1) .....	9
6.1.5 Production date code.....	10
6.1.6 Safety labelling.....	10
6.1.7 Recycling labelling.....	10
6.1.8 Valve-regulated batteries.....	10
6.2 Marking of the polarity .....	10
<del>Water loss designation.....</del>	
6.3 Fastening of the battery .....	10
7 Functional characteristics .....	11
7.1 Electrical characteristics .....	11
7.2 Mechanical characteristics .....	12
8 General test conditions.....	12
8.1 Sampling of batteries .....	12
8.2 <del>Preparation of batteries prior to test</del> Charging method – Definition of a fully charged battery .....	12
8.3 Test equipment .....	14
8.3.1 Measuring instruments.....	14
8.3.2 Water bath.....	15
8.3.3 Environmental chamber .....	15
8.4 Test sequence .....	15
8.4.1 Batteries filled and charged .....	15
8.4.2 Dry-charged or conserved-charge batteries .....	17
9 Tests methods.....	17
9.1 20 h capacity check $C_e$ .....	17
9.2 Reserve capacity check <del><math>C_{r,e}</math></del> $RC_e$ .....	18
9.3 Cranking performance test.....	18
9.3.1 Cranking performance test – Standard temperature ( $-18\text{ °C}$ ).....	18
9.3.2 Cranking performance test – Very cold climates .....	20
9.3.3 High current discharge test at low temperature .....	20

9.4	Charge acceptance test .....	20
9.5	Charge retention test .....	21
9.6	Endurance test for batteries .....	21
9.6.1	Corrosion test .....	21
9.6.2	Optional endurance cycle test for passenger car batteries – Maximum capacity 100 Ah .....	28
9.7	Water consumption test .....	28
9.8	Vibration resistance test .....	29
9.9	Electrolyte retention test .....	30
9.10	Cranking performance for dry-charged (or conserved-charge) batteries after activation .....	30
10	Requirements .....	30
Annex A (normative)	Correlation between $C_n$ and $-G_{r,n} RC_n$ .....	33
Annex B (informative)	Water consumption test – Conversion of test temperatures and test durations .....	34
B.1	General .....	34
B.2	Conversion formula .....	34
Annex C (normative informative)	Safety labelling .....	35
C.1	Definition of the six coloured symbols .....	35
C.2	Safety labelling – Label for North America area .....	36
Bibliography	.....	38
Figure	<del>Symbols for safety labelling .....</del>	
Figure C.1	Symbol dimensions <del>for symbols in safety labelling</del> .....	36
Figure C.2	Safety labelling – Label for North America area, former version (still valid) .....	37
Figure C.3	Safety labelling – Label for North America area, new version .....	37
Table	<del>Charging voltage .....</del>	
Table	<del>Discharge current and charge current .....</del>	
Table	<del>Endurance test sequence vented batteries .....</del>	
Table	<del>Endurance test sequence VRLA batteries .....</del>	
Table	<del>Values for vibration resistance test .....</del>	
Table 1	Charging method .....	13
Table 2	Accuracy of test equipment .....	15
Table 3	Test <del>Battery</del> sequence .....	16
Table 4	Parameters cycle test .....	27
Table 5	Vibration resistance – Levels V1 to V3 .....	29
Table 6	Summary of requirements .....	31
Table C.1	Definition of safety symbols according to ISO 7010 .....	35

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

LEAD-ACID STARTER BATTERIES –

## Part 1: General requirements and methods of test

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). 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. 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 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

**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*

# INTERNATIONAL STANDARD



---

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

## CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references .....	6
3 Terms and definitions .....	6
4 Designation of starter batteries – Electrolyte density and open circuit voltage .....	7
4.1 Designation according to type .....	7
4.2 Dry-charged batteries .....	7
4.3 Electrolyte density and open circuit voltage.....	8
5 Condition on delivery .....	8
6 General requirements .....	8
6.1 Identification, labelling .....	8
6.1.1 General .....	8
6.1.2 The identification of manufacturer or supplier .....	8
6.1.3 Nominal voltage: 12 V.....	8
6.1.4 Capacity or reserve capacity (see 7.1.2) and nominal cranking current (see 7.1.1) .....	8
6.1.5 Production date code.....	9
6.1.6 Safety labelling.....	9
6.1.7 Recycling labelling.....	9
6.1.8 Valve-regulated batteries.....	9
6.2 Marking of the polarity .....	9
6.3 Fastening of the battery .....	9
7 Functional characteristics .....	10
7.1 Electrical characteristics .....	10
7.2 Mechanical characteristics .....	11
8 General test conditions.....	11
8.1 Sampling of batteries .....	11
8.2 Charging method – Definition of a fully charged battery .....	11
8.3 Test equipment .....	11
8.3.1 Measuring instruments.....	11
8.3.2 Water bath.....	12
8.3.3 Environmental chamber .....	12
8.4 Test sequence .....	12
8.4.1 Batteries filled and charged .....	12
8.4.2 Dry-charged or conserved-charge batteries .....	13
9 Tests methods.....	14
9.1 20 h capacity check $C_e$ .....	14
9.2 Reserve capacity check $RC_e$ .....	14
9.3 Cranking performance test.....	14
9.3.1 Cranking performance test – Standard temperature (–18 °C).....	14
9.3.2 Cranking performance test – Very cold climates .....	15
9.3.3 High current discharge test at low temperature .....	15
9.4 Charge acceptance test .....	16
9.5 Charge retention test .....	16
9.6 Endurance test for batteries .....	16



9.6.1	Corrosion test.....	16
9.6.2	Optional endurance cycle test for passenger car batteries – Maximum capacity 100 Ah.....	18
9.7	Water consumption test .....	19
9.8	Vibration resistance test .....	19
9.9	Electrolyte retention test .....	20
9.10	Cranking performance for dry-charged (or conserved-charge) batteries after activation .....	20
10	Requirements .....	20
Annex A (normative) Correlation between $C_n$ and $RC_n$ .....		22
Annex B (informative) Water consumption test – Conversion of test temperatures and test durations.....		23
B.1	General.....	23
B.2	Conversion formula.....	23
Annex C (informative) Safety labelling .....		24
C.1	Definition of the six coloured symbols .....	24
C.2	Safety labelling – Label for North America area .....	24
Bibliography.....		26
Figure C.1 – Symbol dimensions.....		24
Figure C.2 – Safety labelling – Label for North America area, former version (still valid) .....		25
Figure C.3 – Safety labelling – Label for North America area, new version.....		25
Table 1 – Charging method.....		11
Table 2 – Accuracy of test equipment .....		12
Table 3 – Test sequence.....		13
Table 4 – Parameters cycle test.....		17
Table 5 – Vibration resistance – Levels V1 to V3 .....		19
Table 6 – Summary of requirements .....		21
Table C.1 – Definition of safety symbols according to ISO 7010.....		24

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**LEAD-ACID STARTER BATTERIES –****Part 1: General requirements and methods of test****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). 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. 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 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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.

A bilingual version of this publication may be issued at a later date.

**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 vehicles*