

© Copyright SEK Svensk Elstandard. Reproduction in any form without permission is prohibited.

REDLINE VERSION

Primärbatterier –

Del 5: Säkerhet beträffande batterier med vattenhaltig elektrolyt

Primary batteries –

Part 5: Safety of batteries with aqueous electrolyte

En så kallad ”Redline version” (RLV) innehåller både den fastställda IEC-standard och en ändringsmarkerad standard. Alla tillägg och borttagningar sedan den tidigare utgåvan är markerade med färg. Med en RLV sparar du mycket tid när du ska identifiera och bedöma aktuella ändringar i standarden. SEK Svensk Elstandard kan bara ge ut en RLV i de fall den finns tillgänglig från IEC.



IEC 60086-5

Edition 5.0 2021-09
REDLINE VERSION

INTERNATIONAL STANDARD



Primary batteries – Part 5: Safety of batteries with aqueous electrolyte

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.220.10

ISBN 978-2-8322-1035-1

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

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	2
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 Requirements for safety.....	10
4.1 Design	10
4.1.1 General	10
4.1.2 Venting	11
4.1.3 Insulation resistance	11
4.2 Quality plan	11
5 Sampling	11
5.1 General.....	11
5.2 Sampling for type type-approval testing	11
5.3 Validity of testing	12
6 Testing and requirements	12
6.1 General.....	12
6.1.1 Applicable safety tests.....	12
6.1.2 Cautionary notice.....	13
6.1.3 Ambient temperature	14
6.2 Evaluation of test criteria	14
6.2.1 Explosion.....	14
6.2.2 Fire.....	14
6.2.3 Leakage	14
6.2.4 Venting	14
6.3 Intended use	14
6.3.1 Intended use tests and requirements	14
6.3.2 Intended use test procedures.....	14
6.4 Reasonably foreseeable misuse.....	17
6.4.1 Reasonably foreseeable misuse tests and requirements.....	17
6.4.2 Reasonably foreseeable misuse test procedures	17
7 Information for safety.....	19
7.1 Precautions during handling of batteries	19
7.2 Packaging	21
7.3 Handling of battery cartons	21
7.4 Display and storage	21
7.5 Transportation	22
7.6 Disposal.....	22
8 Instructions for use	22
9 Marking and packaging.....	23
9.1 General batteries (see Table 7).....	23
9.2 Marking of small batteries (see Table 7) Swallowable button cells	23
9.3 Safety pictograms	23
Annex A (informative) Additional information on display and storage.....	25
Annex B (informative) Battery compartment design guidelines	26

B.1	Background.....	26
B.1.1	General	26
B.1.2	Battery failures resulting from poor battery compartment design	26
B.1.3	Potential hazards resulting from battery reversal	26
B.1.4	Potential hazards resulting from a short circuit	26
B.2	General guidance for appliance design	27
B.2.1	Key battery factors to be first considered	27
B.2.2	Other important factors to consider	27
B.3	Specific measures against reversed installation	28
B.3.1	General	28
B.3.2	Design of the positive contact	28
B.3.3	Design of the negative contact.....	28
B.3.4	Design with respect to battery orientation	29
B.3.5	Dimensional considerations	29
B.4	Specific measures to prevent short-circuiting of batteries.....	31
B.4.1	Measures to prevent short-circuiting due to battery jacket damage	31
B.4.2	Measures to prevent external short circuit of a battery caused when coiled spring contacts are employed for battery connection	32
B.5	Special considerations regarding recessed negative contacts	34
B.6	Waterproof and non-vented devices	35
B.7	Other design considerations.....	35
Annex C (informative)	Safety pictograms	37
C.1	General.....	37
C.2	Pictograms.....	37
C.3	Recommendations for use.....	39
Annex D (informative)	Use of the KEEP OUT OF REACH OF CHILDREN safety sign	40
D.1	General.....	40
D.2	Safety sign.....	40
D.3	Best practices for marking the packaging	40
Annex E (informative)	Child resistant packaging	41
E.1	General.....	41
E.1.1	General	41
E.1.2	Applicability	41
E.1.3	Packaging design	41
E.2	Packaging tests	41
E.2.1	General	41
E.2.2	Test items.....	41
E.2.3	Test procedure	43
E.2.4	Criteria	43
Bibliography	45
Figure 1	– Sampling for type approval tests and number of batteries required.....	12
Figure 2	– Temperature cycling procedure	17
Figure 3	– Circuit diagram for incorrect installation (four batteries in series)	18
Figure 4	– Circuit diagram for external short circuit	18
Figure 5	– Circuit diagram for overdischarge.....	19
Figure 6	– XYZ axes for free fall	19
Figure 7	– Ingestion gauge	20

Figure B.1 – Example of series connection with one battery reversed	26
Figure B.2 – Positive contact recessed between ribs.....	28
Figure B.3 – Positive contact recessed within surrounding insulation	28
Figure B.4 – Negative contact U-shaped to ensure no positive (+) battery contact	28
Figure B.5 – Design with respect to battery orientation	29
Figure B.6 – Example of the design of a positive contact of an appliance.....	31
Figure B.7 – Example of a short circuit where a switch is piercing the battery insulating jacket.....	32
Figure B.8 – Typical example of insulation to prevent short circuit	32
Figure B.9 – Insertion against spring (to be avoided)	32
Figure B.10 – Examples showing distorted springs	33
Figure B.11 – Example of protected insertion.....	33
Figure B.12 – Example of negative contacts	34
Figure B.13 – Example of series connection of batteries with voltage tapping	36
Figure E.1 – Bending test	42
Figure E.2 – Torsion test.....	42
Figure E.3 – Tearing test	43
Figure E.4 – Pushing test.....	43
Figure E.5 – Maximum packaging opening.....	44
Table 1 – Test matrix	13
Table 2 – Intended use tests and requirements.....	14
Table 3 – Shock pulse	15
Table 4 – Test sequence of the shock test	15
Table 5 – Test sequence of the vibration test.....	16
Table 6 – Reasonably foreseeable misuse tests and requirements.....	17
Table 7 – Marking and packaging requirements	24
Table B.1 – Dimensions of battery terminals and recommended dimensions of the positive contact of an appliance in Figure B.6	30
Table B.2 – Minimum wire diameters	33
Table B.3 – Dimensions of the negative battery terminal.....	35
Table C.1 – Safety pictograms	37
Table E.1 – Test procedure.....	43

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRIMARY BATTERIES –

Part 5: Safety of batteries with aqueous electrolyte

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 IEC 60086-5:2016. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60086-5 has been prepared by IEC technical committee 35: Primary cells and batteries. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2016. This edition constitutes a technical revision.

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

- a) revised information for safety dealing with keeping batteries out of the reach of children;
- b) removal of the method to determine the insulation resistance;
- c) changes to the test matrix;
- d) revision of the over-discharge test;
- e) revised definition and note for "button cell" or "button battery" in 3.2;
- f) revised method for evaluation of an explosion, moved from 3.6 to 6.2.1.

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

FDIS	Report on voting
35/1471/FDIS	35/1472/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 60086 series, published under the general title *Primary 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 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.

NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC document in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this document be adopted for implementation nationally not earlier than 2 years from the date of publication. The transitional period applies specifically to Table 7.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

INTRODUCTION

The concept of safety is closely related to safeguarding the integrity of people and property. This part of IEC 60086 specifies tests and requirements for primary batteries with aqueous electrolyte and has been prepared in accordance with ISO/IEC guidelines, taking into account all relevant national and international standards which apply. Also included in this document is guidance for appliance designers with respect to battery compartments and information regarding packaging, handling, warehousing and transportation.

Safety is a balance between freedom from risks of harm and other demands to be met by the product. There can be no absolute safety. Even at the highest level of safety, the product can only be relatively safe. In this respect, decision-making is based on risk evaluation and safety judgement.

As safety will pose different problems, it is impossible to provide a set of precise provisions and recommendations that will apply in every case. However, this document, when followed on a judicious "use when applicable" basis, will provide reasonably consistent standards for safety.

PRIMARY BATTERIES –

Part 5: Safety of batteries with aqueous electrolyte

1 Scope

This part of IEC 60086 specifies tests and requirements for primary batteries with aqueous electrolyte to ensure their safe operation under intended use and reasonably foreseeable misuse.

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 60086-1:2015, *Primary batteries – Part 1: General*

IEC 60086-2:2015, *Primary batteries – Part 2: Physical and electrical specifications*

~~IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*~~

~~IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*~~

~~IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment type specimens*~~

© Copyright SEK Svensk Elstandard. Reproduction in any form without permission is prohibited.

Primärbatterier – Del 5: Säkerhet beträffande batterier med vattenhaltig elektrolyt

*Primary batteries –
Part 5: Safety of batteries with aqueous electrolyte*

Som svensk standard gäller europastandarden EN IEC 60086-5:2021. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 60086-5:2021.

Nationellt förord

Europastandarden EN IEC 60086-5:2021

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 60086-5, Fifth edition, 2021 - Primary batteries - Part 5: Safety of batteries with aqueous electrolyte**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 60086-5, utgåva 4, 2017, gäller ej fr o m 2024-11-04.

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a mätning, säkerhet och provning och för utförande, skötsel och dokumentation av elprodukter och elanläggningar.

Genom att utforma sådana standarder blir säkerhetsfordringar tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK Svensk Elstandard

Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

English Version

**Primary batteries - Part 5: Safety of batteries with aqueous
electrolyte
(IEC 60086-5:2021)**

Piles électriques - Partie 5: Sécurité des piles à électrolyte
aqueux
(IEC 60086-5:2021)

Primärbatterien - Teil 5: Sicherheit von Batterien mit
wässrigem Elektrolyt
(IEC 60086-5:2021)

This European Standard was approved by CENELEC on 2021-11-04. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 35/1471/FDIS, future edition 5 of IEC 60086-5, prepared by IEC/TC 35 "Primary cells and batteries" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60086-5:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2022-08-04
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2024-11-04

This document supersedes EN 60086-5:2016 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 60086-5:2021 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 60068-2-27 NOTE Harmonized as EN 60068-2-27

IEC 60068-2-6 NOTE Harmonized as EN 60068-2-6

IEC 60068-2-31 NOTE Harmonized as EN 60068-2-31

ISO 7010:2019 NOTE Harmonized as EN ISO 7010:2020 (not modified)

IEC 60086-3 NOTE Harmonized as EN IEC 60086-3

IEC 60086-4 NOTE Harmonized as EN IEC 60086-4

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60086-1	2015	Primary batteries - Part 1: General	EN 60086-1	2015
IEC 60086-2	2015	Primary batteries - Part 2: Physical and electrical specifications	EN 60086-2	2016

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Primary batteries –
Part 5: Safety of batteries with aqueous electrolyte**

**Piles électriques –
Partie 5: Sécurité des piles à électrolyte aqueux**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.220.10

ISBN 978-2-8322-1007-4

<p>Warning! Make sure that you obtained this publication from an authorized distributor.</p> <p>Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.</p>
--

CONTENTS

FOREWORD	5
INTRODUCTION	7
1 Scope	8
2 Normative references	8
3 Terms and definitions	8
4 Requirements for safety	10
4.1 Design	10
4.1.1 General	10
4.1.2 Venting	10
4.2 Quality plan	10
5 Sampling	10
5.1 General	10
5.2 Sampling for type testing	11
5.3 Validity of testing	11
6 Testing and requirements	11
6.1 General	11
6.1.1 Applicable safety tests	11
6.1.2 Cautionary notice	12
6.1.3 Ambient temperature	12
6.2 Evaluation of test criteria	13
6.2.1 Explosion	13
6.2.2 Fire	13
6.2.3 Leakage	13
6.2.4 Venting	13
6.3 Intended use	13
6.3.1 Intended use tests and requirements	13
6.3.2 Intended use test procedures	13
6.4 Reasonably foreseeable misuse	16
6.4.1 Reasonably foreseeable misuse tests and requirements	16
6.4.2 Reasonably foreseeable misuse test procedures	16
7 Information for safety	18
7.1 Precautions during handling of batteries	18
7.2 Packaging	20
7.3 Handling of battery cartons	20
7.4 Display and storage	20
7.5 Transportation	21
7.6 Disposal	21
8 Instructions for use	21
9 Marking and packaging	22
9.1 General batteries	22
9.2 Swallowable button cells	22
9.3 Safety pictograms	22
Annex A (informative) Additional information on display and storage	24
Annex B (informative) Battery compartment design guidelines	25
B.1 Background	25

B.1.1	General	25
B.1.2	Battery failures resulting from poor battery compartment design	25
B.1.3	Potential hazards resulting from battery reversal	25
B.1.4	Potential hazards resulting from a short circuit	25
B.2	General guidance for appliance design	26
B.2.1	Key battery factors to be first considered	26
B.2.2	Other important factors to consider	26
B.3	Specific measures against reversed installation	27
B.3.1	General	27
B.3.2	Design of the positive contact	27
B.3.3	Design of the negative contact	27
B.3.4	Design with respect to battery orientation	28
B.3.5	Dimensional considerations	28
B.4	Specific measures to prevent short-circuiting of batteries	31
B.4.1	Measures to prevent short-circuiting due to battery jacket damage	31
B.4.2	Measures to prevent external short circuit of a battery caused when coiled spring contacts are employed for battery connection	31
B.5	Special considerations regarding recessed negative contacts	33
B.6	Waterproof and non-vented devices	34
B.7	Other design considerations	34
Annex C (informative)	Safety pictograms	36
C.1	General	36
C.2	Pictograms	36
C.3	Recommendations for use	38
Annex D (informative)	Use of the KEEP OUT OF REACH OF CHILDREN safety sign	39
D.1	General	39
D.2	Safety sign	39
D.3	Best practices for marking the packaging	39
Annex E (informative)	Child resistant packaging	40
E.1	General	40
E.1.1	General	40
E.1.2	Applicability	40
E.1.3	Packaging design	40
E.2	Packaging tests	40
E.2.1	General	40
E.2.2	Test items	40
E.2.3	Test procedure	42
E.2.4	Criteria	42
Bibliography	44
Figure 1	– Sampling for tests and number of batteries required	11
Figure 2	– Temperature cycling procedure	16
Figure 3	– Circuit diagram for incorrect installation (four batteries in series)	17
Figure 4	– Circuit diagram for external short circuit	17
Figure 5	– Circuit diagram for overdischarge	18
Figure 6	– XYZ axes for free fall	18
Figure 7	– Ingestion gauge	19
Figure B.1	– Example of series connection with one battery reversed	25

Figure B.2 – Positive contact recessed between ribs.....	27
Figure B.3 – Positive contact recessed within surrounding insulation	27
Figure B.4 – Negative contact U-shaped to ensure no positive (+) battery contact	27
Figure B.5 – Design with respect to battery orientation	28
Figure B.6 – Example of the design of a positive contact of an appliance.....	30
Figure B.7 – Example of a short circuit where a switch is piercing the battery insulating jacket.....	31
Figure B.8 – Typical example of insulation to prevent short circuit	31
Figure B.9 – Insertion against spring (to be avoided)	32
Figure B.10 – Examples showing distorted springs	32
Figure B.11 – Example of protected insertion.....	32
Figure B.12 – Example of negative contacts	34
Figure B.13 – Example of series connection of batteries with voltage tapping	35
Figure E.1 – Bending test	41
Figure E.2 – Torsion test.....	41
Figure E.3 – Tearing test	42
Figure E.4 – Pushing test.....	42
Figure E.5 – Maximum packaging opening	43
Table 1 – Test matrix	12
Table 2 – Intended use tests and requirements.....	13
Table 3 – Shock pulse	14
Table 4 – Test sequence of the shock test	14
Table 5 – Test sequence of the vibration test.....	15
Table 6 – Reasonably foreseeable misuse tests and requirements.....	16
Table 7 – Marking and packaging requirements	23
Table B.1 – Dimensions of battery terminals and recommended dimensions of the positive contact of an appliance in Figure B.6	29
Table B.2 – Minimum wire diameters	33
Table B.3 – Dimensions of the negative battery terminal	34
Table C.1 – Safety pictograms	36
Table E.1 – Test procedure.....	42

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRIMARY BATTERIES –**Part 5: Safety of batteries with aqueous electrolyte**

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.

IEC 60086-5 has been prepared by IEC technical committee 35: Primary cells and batteries. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2016. This edition constitutes a technical revision.

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

- a) revised information for safety dealing with keeping batteries out of the reach of children;
- b) removal of the method to determine the insulation resistance;
- c) changes to the test matrix;
- d) revision of the over-discharge test;
- e) revised definition and note for "button cell" or "button battery" in 3.2;
- f) revised method for evaluation of an explosion, moved from 3.6 to 6.2.1.

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

FDIS	Report on voting
35/1471/FDIS	35/1472/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 60086 series, published under the general title *Primary 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 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.

NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC document in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this document be adopted for implementation nationally not earlier than 2 years from the date of publication. The transitional period applies specifically to Table 7.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

INTRODUCTION

The concept of safety is closely related to safeguarding the integrity of people and property. This part of IEC 60086 specifies tests and requirements for primary batteries with aqueous electrolyte and has been prepared in accordance with ISO/IEC guidelines, taking into account all relevant national and international standards which apply. Also included in this document is guidance for appliance designers with respect to battery compartments and information regarding packaging, handling, warehousing and transportation.

Safety is a balance between freedom from risks of harm and other demands to be met by the product. There can be no absolute safety. Even at the highest level of safety, the product can only be relatively safe. In this respect, decision-making is based on risk evaluation and safety judgement.

As safety will pose different problems, it is impossible to provide a set of precise provisions and recommendations that will apply in every case. However, this document, when followed on a judicious "use when applicable" basis, will provide reasonably consistent standards for safety.

PRIMARY BATTERIES –

Part 5: Safety of batteries with aqueous electrolyte

1 Scope

This part of IEC 60086 specifies tests and requirements for primary batteries with aqueous electrolyte to ensure their safe operation under intended use and reasonably foreseeable misuse.

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 60086-1:2015, *Primary batteries – Part 1: General*

IEC 60086-2:2015, *Primary batteries – Part 2: Physical and electrical specifications*