IEC 60086-5

Edition 5.0 2021-09
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.220.10

ISBN 978-2-8322-1035-1

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*~~

IEC 60086-5

Edition 5.0 2021-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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

IEC 60086-5:2021-09(en-fr)

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*

SOMMAIRE

AVANT-PROPOS 47
INTRODUCTION 49
1 Domaine d'application 50
2 Références normatives 50
3 Termes et définitions 50
4 Exigences relatives à la sécurité 52
4.1 Conception 52
4.1.1 Généralités 52
4.1.2 Dégazage 52
4.2 Plan qualité 52
5 Echantillonnage 53
5.1 Généralités 53
5.2 Echantillonnage pour les essais de type 53
5.3 Validité des essais 53
6 Essais et exigences 54
6.1 Généralités 54
6.1.1 Essais de sécurité applicables 54
6.1.2 Mention de mise en garde 55
6.1.3 Température ambiante 55
6.2 Evaluation des critères d'essai 55
6.2.1 Explosion 55
6.2.2 Feu 55
6.2.3 Fuite 55
6.2.4 Dégazage 55
6.3 Utilisation prévue 55
6.3.1 Essais et exigences dans les conditions d'utilisation prévue 55
6.3.2 Procédures d'essai dans les conditions d'utilisation prévue 56
6.4 Mauvais usage raisonnablement prévisible 59
6.4.1 Essais et exigences en cas de mauvais usage raisonnablement prévisible 59
6.4.2 Procédures d'essai en cas de mauvais usage raisonnablement prévisible 59
7 Informations de sécurité 61
7.1 Précautions au cours de la manipulation des piles 61
7.2 Emballage 63
7.3 Manipulation des cartons de piles 63
7.4 Présentation et stockage 63
7.5 Transport 64
7.6 Mise au rebut 64
8 Instructions d'utilisation 64
9 Marquage et emballage 65
9.1 Piles ordinaires 65
9.2 Eléments boutons susceptibles d'être avalés 65
9.3 Pictogrammes de sécurité 65
Annexe A (informative) Informations complémentaires concernant la présentation et le stockage 67

Annexe B (informative) Lignes directrices pour la conception des compartiments de piles 68
B.1 Contexte 68
B.1.1 Généralités 68
B.1.2 Défaillances des piles provenant d'une mauvaise conception des compartiments de piles 68
B.1.3 Dangers potentiels liés à l'inversion des piles 68
B.1.4 Dangers potentiels provenant d'un court-circuit 69
B.2 Recommandations générales pour la conception des appareils 69
B.2.1 Facteurs clés à prendre en compte pour les piles 69
B.2.2 Autres facteurs importants à prendre en compte 69
B.3 Mesures spécifiques contre l'inversion des piles lors de l'installation 70
B.3.1 Généralités 70
B.3.2 Conception du contact positif 70
B.3.3 Conception du contact négatif 71
B.3.4 Conception et orientation des piles 71
B.3.5 Considérations dimensionnelles 72
B.4 Mesures spécifiques pour empêcher la mise en court-circuit des piles 75
B.4.1 Mesures pour empêcher les courts-circuits dus à des dommages de l'enveloppe de la pile 75
B.4.2 Mesures pour empêcher un court-circuit externe de la pile provoqué lorsque des contacts à ressort hélicoïdal sont utilisés 75
B.5 Considérations particulières concernant les bornes négatives en retrait 77
B.6 Appareils étanches à l'eau et non ventilés 78
B.7 Autres considérations de conception 78
Annexe C (informative) Pictogrammes de sécurité 80
C.1 Généralités 80
C.2 Pictogrammes 80
C.3 Recommandations d'utilisation 81
Annexe D (informative) Utilisation du signal de sécurité TENIR HORS DE PORTÉE DES ENFANTS 83
D.1 Généralités 83
D.2 Signal de sécurité 83
D.3 Meilleures pratiques pour le marquage des emballages 83
Annexe E (informative) Emballage à l'épreuve des enfants 84
E.1 Généralités 84
E.1.1 Généralités 84
E.1.2 Applicabilité 84
E.1.3 Conception de l'emballage 84
E.2 Essais des emballages 84
E.2.1 Généralités 84
E.2.2 Essais 84
E.2.3 Procédure d'essai 86
E.2.4 Critères 86
Bibliographie 88

Figure 1 – Echantillonnage pour les essais et nombre de piles exigé 53
Figure 2 – Procédure de cycles de températures 58
Figure 3 – Schéma de circuit d'une installation incorrecte (quatre piles en série) 59

Figure 4 – Schéma de circuit d'un court-circuit externe 60
Figure 5 – Schéma de circuit d'une décharge excessive 60
Figure 6 – Axes XYZ pour la chute libre 61
Figure 7 – Gabarit d'ingestion 62
Figure B.1 – Exemple d'installation en série avec une pile inversée 68
Figure B.2 – Contact positif en retrait entre les nervures 70
Figure B.3 – Contact positif en retrait à l'intérieur de l'enveloppe isolante 71
Figure B.4 – Contact négatif en U pour éviter un contact positif (+) de la pile 71
Figure B.5 – Conception et orientation des piles 72
Figure B.6 – Exemple de conception d'un contact positif d'un appareil 74
Figure B.7 – Exemple de court-circuit où l'enveloppe isolante de la pile est percée par un interrupteur 75
Figure B.8 – Exemple d'isolation type pour empêcher les courts-circuits 75
Figure B.9 – Insertion contre le ressort (à éviter) 76
Figure B.10 – Exemples de ressorts déformés 76
Figure B.11 – Exemple d'insertion protégée 76
Figure B.12 – Exemples de contacts négatifs 78
Figure B.13 – Exemple de connexion en série de piles avec prise de tension 79
Figure E.1 – Essai de pliage 85
Figure E.2 – Essai de torsion 85
Figure E.3 – Essai de déchirement 86
Figure E.4 – Essai de poussée 86
Figure E.5 – Ouvertures maximales des emballages 87

Tableau 1 – Matrice d'essai 54
Tableau 2 – Essais et exigences dans les conditions d'utilisation prévue 55
Tableau 3 – Impulsion de chocs 56
Tableau 4 – Séquence de l'essai de chocs 57
Tableau 5 – Séquence de l'essai de vibrations 57
Tableau 6 – Essais et exigences en cas de mauvais usage raisonnablement prévisible 59
Tableau 7 – Exigences relatives au marquage et à l'emballage 66
Tableau B.1 – Dimensions des bornes de piles et dimensions recommandées du contact positif d'un appareil à la Figure B.6 73
Tableau B.2 – Diamètres minimaux des fils 77
Tableau B.3 – Dimensions de la borne négative de la pile 78
Tableau C.1 – Pictogrammes de sécurité 80
Tableau E.1 – Procédure d'essai 86

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

_____

PILES ÉLECTRIQUES –

Partie 5: Sécurité des piles à électrolyte aqueux

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets.

L'IEC 60086-5 a été établie par le comité d'études 35 de l'IEC: Piles. Il s'agit d'une Norme internationale.

Cette cinquième édition annule et remplace la quatrième édition parue en 2016. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) révision des informations de sécurité relatives au maintien des piles hors de portée des enfants;
b) suppression de la méthode de détermination de la résistance d'isolement;
c) modifications de la matrice d'essai;

d) révision de l'essai de décharge excessive;

e) révision de la définition et de la note pour le terme "élément bouton" ou "pile bouton" en 3.2;

f) révision de la méthode d'évaluation d'une explosion, qui a été déplacée du 3.6 au 6.2.1.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
35/1471/FDIS	35/1472/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Le présent document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 60086, publiées sous le titre général *Piles électriques*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu du présent document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

NOTE L'attention des Comités nationaux est attirée sur le fait que les fabricants d'appareils et les organismes d'essai peuvent avoir besoin d'une période transitoire après la publication d'un nouveau document IEC, ou d'un document amendé ou révisé, pour fabriquer des produits conformes aux nouvelles exigences et pour adapter leurs équipements aux nouveaux essais ou aux essais révisés.

Le comité recommande que le contenu du présent document soit adopté pour application nationale au plus tôt 2 ans après la date de publication. La période transitoire s'applique spécifiquement au Tableau 7.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture du présent document indique qu'il contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer ce document en utilisant une imprimante couleur.

INTRODUCTION

La notion de sécurité est étroitement liée à la protection de l'intégrité des personnes et des biens. La présente partie de l'IEC 60086 spécifie les exigences et essais pour les piles à électrolyte aqueux. Elle a été établie conformément aux lignes directrices ISO/IEC en prenant en compte les normes nationales et internationales correspondantes. Le présent document donne également des recommandations pour les concepteurs d'appareils concernant les compartiments de piles et des informations relatives à l'emballage, à la manipulation, à l'entreposage et au transport.

La sécurité consiste en un équilibre entre l'absence de risques de dommages et d'autres exigences auxquelles le produit doit satisfaire. La sécurité absolue ne peut pas être assurée. Même au niveau de sécurité le plus élevé, le produit ne peut offrir qu'une sécurité relative. A cet égard, la prise de décision repose sur une évaluation des risques et sur une appréciation de la sécurité.

Compte tenu des différents problèmes posés par la sécurité, il n'est pas possible de fournir un ensemble de dispositions et de recommandations précises qui s'appliquent à chaque cas. Cependant, le présent document, s'il est suivi de manière judicieuse, c'est-à-dire en "l'utilisant lorsqu'il est applicable", fournit des dispositions suffisamment cohérentes en matière de sécurité.

PILES ÉLECTRIQUES –

Partie 5: Sécurité des piles à électrolyte aqueux

1 Domaine d'application

La présente partie de l'IEC 60086 spécifie les essais et exigences pour les piles à électrolyte aqueux afin d'assurer leur fonctionnement sûr dans les conditions d'utilisation prévue et en cas de mauvais usage raisonnablement prévisible.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60086-1:2015, *Piles électriques – Partie 1: Généralités*

IEC 60086-2:2015, *Piles électriques – Partie 2: Spécifications physiques et électriques*