

INTERNATIONAL STANDARD

IEC 60086-5

Second edition
2005-04

Primary batteries –

Part 5: Safety of batteries with aqueous electrolyte

iTech Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 60086-5:2005](https://standards.iteh.ai/standards/iec/792ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005)

<https://standards.iteh.ai/standards/iec/792ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005>

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number
IEC 60086-5:2005(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site** (www.iec.ch)

- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

This summary of recently issued publications (www.iec.ch/online_news/justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

Email: custserv@iec.ch
Tel: +41 22 919 02 11
Fax: +41 22 919 03 00

<https://standards.iteh.ai/catalog/standards/sic/75/iec31b-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005>

INTERNATIONAL STANDARD

IEC 60086-5

Second edition
2005-04

Primary batteries –

Part 5: Safety of batteries with aqueous electrolyte

iTech Standards
(<https://standards.iteh.ai>)
Document Preview

<https://standards.iteh.ai/standards/iec/792ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005>

<https://standards.iteh.ai/standards/iec/792ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005>

© IEC 2005 Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE

V

For price, see current catalogue

CONTENTS

FOREWORD.....	7
INTRODUCTION.....	11
1 Scope.....	13
2 Normative references	13
3 Terms and definitions	13
4 Requirements for safety	17
4.1 Design.....	17
4.1.1 General	17
4.1.2 Venting.....	17
4.1.3 Insulation resistance	17
4.2 Quality plan	17
5 Sampling	19
5.1 General	19
5.2 Sampling for type approval.....	19
6 Testing and requirements	21
6.1 General	21
6.1.1 Safety notice	23
6.1.2 Ambient temperature	23
6.2 Intended use	23
6.2.1 Intended use tests and requirements	23
6.2.2 Intended use test procedures	23
6.3 Reasonably foreseeable misuse	29
6.3.1 Reasonably foreseeable misuse tests and requirements.....	29
6.3.2 Reasonably foreseeable misuse test procedures	29
7 Information for safety	33
7.1 Safety precautions during handling of batteries	33
7.2 Packaging	37
7.3 Handling of battery cartons.....	39
7.4 Display and storage.....	39
7.5 Transportation.....	39
7.6 Disposal	39
8 Instructions for use	41
9 Marking	41
9.1 General	41
9.2 Small batteries	41
Annex A (informative) Additional information to Subclause 7.4.....	43
Annex B (informative) Battery compartment design guidelines	45
Bibliography.....	69

Figure 1 – Sampling for type approval tests and number of batteries required.....	19
Figure 2 – Temperature cycling procedure.....	29
Figure 3 – Incorrect installation (four batteries in series).....	31
Figure 4 – External short circuit.....	31
Figure 5 – Overdischarge.....	33
Figure 6 – XYZ axes for free fall.....	33
Figure 7 – Ingestion gauge.....	37
Figure B.1 – Example of series connection with one battery reversed.....	45
Figure B.2 – Positive contact recessed between ribs.....	49
Figure B.3 – Positive contact recessed within surrounding insulation.....	49
Figure B.4 – Negative contact U-shaped to ensure no positive (+) battery contact.....	51
Figure B.5 – Design with respect to battery orientation.....	53
Figure B.6 – Example of the design of a positive contact of an appliance.....	55
Figure B.7 – Example of a short circuit, a switch is piercing the battery insulating jacket.....	57
Figure B.8 – Typical example of insulation to prevent short circuit.....	57
Figure B.9 – Insertion against spring (to be avoided).....	59
Figure B.10 – Examples showing distorted springs.....	59
Figure B.11 – One example of protected insertion.....	59
Figure B.12 – Example of negative contacts.....	63
Figure B.13 – Example of series connection of batteries with voltage tapping.....	65
Table 1 – Test matrix.....	21
Table 2 – Intended use tests and requirements.....	23
Table 3 – Shock pulse.....	25
Table 4 – Test sequence.....	25
Table 5 – Test sequence.....	27
Table 6 – Reasonably foreseeable misuse tests and requirements.....	29
Table B.1 – Dimensions of battery terminals and recommended dimensions of the positive contact of an appliance in Figure B.6.....	55
Table B.2 – Minimum wire diameters.....	61
Table B.3 – Dimensions of the negative battery terminal.....	63

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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 60086-5 has been prepared by IEC technical committee 35: Primary cells and batteries.

This second edition cancels and replaces the first edition published in 2000, and constitutes a technical revision. It is the result of a reformatting initiative aimed at making it more user-friendly, less ambiguous and, from a cross-reference point of view, fully harmonized with other parts of IEC 60086. In addition, and from a safety perspective, the standard contains further guidance for appliance designers with respect to battery compartment design together with information regarding packaging, handling, warehousing and transportation.

The text of this standard is based on the following documents:

FDIS	Report on voting
35/1225/FDIS	35/1228/RVD

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

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

IEC 60086 consists of the following parts, under the general title *Primary batteries*:

Part 1: General

Part 2: Physical and electrical specifications

Part 3: Watch batteries

Part 4: Safety of lithium batteries

Part 5: Safety of batteries with aqueous electrolyte

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

iTech Standards
(<https://standards.itih.ai>)
Document Preview

[IEC 60086-5:2005](https://standards.itih.ai/iec/standards/iec/792ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005)

<https://standards.itih.ai/iec/standards/iec/792ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005>

INTRODUCTION

The concept of safety is closely related to safeguarding the integrity of people and property. This part of IEC 60086 specifies requirements and tests 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 standard 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 standard, when followed on a judicious "use when applicable" basis, will provide reasonably consistent standards for safety.

iTech Standards
(<https://standards.iteh.ai>)
Document Preview

<https://standards.iteh.ai/standards/iec/792ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005>

<https://standards.iteh.ai/standards/iec/792ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005>

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 referenced documents are indispensable for the application 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 60050-482:2004, *International Electrotechnical Vocabulary (IEV) – Part 482: Primary and secondary cells and batteries*

IEC 60086-1:2000, *Primary batteries – Part 1: General*

IEC 60086-2:2000, *Primary batteries – Part 2: Physical and electrical specifications*

3 Terms and definitions

For the purposes of this document, the definitions given in IEC 60050-482 and IEC 60086-1 (some of which are repeated below for convenience) apply, together with the following definitions.

3.1

battery (primary)

one or more primary cells, including case, terminals and marking

3.2

button battery

small round battery, where the overall height is less than the diameter; batteries complying with Figures 2, 3 and 4 of IEC 60086-2

3.3

cell (primary)

source of electrical energy obtained by the direct conversion of chemical energy that is not designed to be charged by any other electrical source

3.4

cylindrical battery

primary battery with cylindrical geometry where the overall height is equal to or greater than the diameter; batteries complying with Figures 1a and 1b of IEC 60086-2

3.5**explosion (battery explosion)**

an instantaneous release wherein solid matter from any part of the battery is propelled to a distance greater than 25 cm away from the battery

3.6**harm**

physical injury or damage to health of people, or damage to property or the environment

3.7**hazard**

potential source of harm

NOTE The term hazard can be qualified in order to define its origin or the nature of the expected harm (e.g. electric shock hazard, crushing hazard, cutting hazard, toxic hazard, fire hazard, drowning hazard).

3.8**intended use**

use of a product, process or service in accordance with information provided by the supplier

3.9**leakage**

unplanned escape of electrolyte, gas or other material from a battery

3.10**nominal voltage**

suitable approximate value of voltage used to identify the voltage of a primary battery

3.11**prismatic battery**

primary battery with non-round geometry; batteries complying with IEC 60086-2, Subclause 6.7, category 6

3.12**reasonably foreseeable misuse**

use of a product, process or service in a way not intended by the supplier, but which may result from readily predictable human behaviour

3.13**risk**

combination of the probability of occurrence of a harm and the severity of that harm

3.14**safety**

freedom from unacceptable risk

3.15**venting**

release of excessive internal pressure from a battery in a manner intended by design to preclude explosion

4 Requirements for safety

4.1 Design

4.1.1 General

Batteries shall be so designed that they do not present a safety hazard under conditions of normal (intended) use and reasonable foreseeable misuse.

4.1.2 Venting

All batteries shall incorporate a pressure relief feature or shall be so constructed that they will relieve excessive internal pressure at a value and rate which will preclude explosion. If encapsulation is necessary to support cells within an outer case, the type of encapsulant and the method of encapsulation shall not cause the battery to overheat during normal operation nor inhibit the operation of the pressure relief feature.

The battery case material and/or its final assembly shall be so designed that, in the event of one or more cells venting, the battery case does not present a hazard in its own right.

4.1.3 Insulation resistance

The insulation resistance between externally exposed metal surfaces of the battery excluding electrical contact surfaces and either terminal shall be not less than 5 M Ω at (500 \pm 20) V.

4.2 Quality plan

The manufacturer shall prepare a quality plan defining the procedures for the inspection of materials, components, cells and batteries during the course of manufacture, to be applied to the total process of producing a specific type of battery.

IEC 60086-5:2005

<https://standards.iteh.ai/standards/iec/752ec3fb-ed86-4f42-9932-74b5b132874f/iec-60086-5-2005>

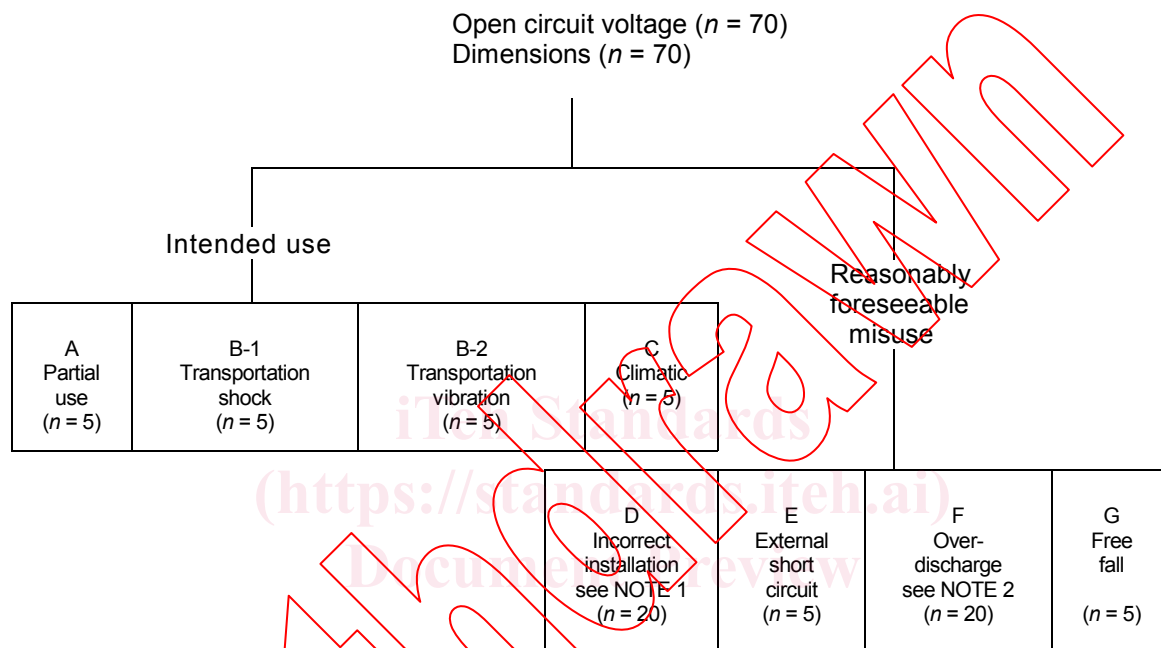
5 Sampling

5.1 General

Samples should be drawn from production lots in accordance with accepted statistical methods.

5.2 Sampling for type approval

The following number of samples are drawn for type approval.



IEC 929/2000

NOTE 1 Four batteries connected in series with one of the four batteries reversed (5 sets).

NOTE 2 Four batteries connected in series, one of which is discharged (5 sets).

Figure 1 – Sampling for type approval tests and number of batteries required