

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



---

**High-temperature secondary batteries –  
Part 2: Safety requirements and tests**

**Batteries d'accumulateurs à haute température –  
Partie 2: Exigences de sécurité et essais**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, 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 either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

#### IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

---

### A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

### A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### Recherche de publications IEC -

[webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

#### Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [sales@iec.ch](mailto:sales@iec.ch).

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

#### Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



---

**High-temperature secondary batteries –  
Part 2: Safety requirements and tests**

**Batteries d'accumulateurs à haute température –  
Partie 2: Exigences de sécurité et essais**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 29.220.20

ISBN 978-2-8322-7923-6

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

## CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references .....	6
3 Terms, definitions, symbols and abbreviated terms.....	6
3.1 Battery safety.....	7
3.2 Symbols and abbreviated terms .....	9
4 Environmental (service) conditions .....	9
4.1 General.....	9
4.2 Normal service conditions for stationary installations .....	9
4.3 Special service conditions for stationary installations .....	9
4.4 Normal service conditions for mobile installations (except propulsion).....	9
4.5 Special service conditions for mobile installations (except propulsion) .....	9
5 Safety requirements .....	10
5.1 Functional safety requirements .....	10
5.1.1 Safety of battery management system .....	10
5.1.2 Battery protective management .....	10
5.1.3 Thermal management .....	10
5.2 Mechanical requirements .....	10
5.2.1 General .....	10
5.2.2 Battery enclosure.....	10
5.3 Protection against electrical shock.....	10
5.3.1 General .....	10
5.3.2 Normal conditions.....	11
5.3.3 Single-fault conditions .....	11
5.3.4 Insulation voltage .....	12
5.3.5 Separation.....	15
5.3.6 Spacing .....	15
5.3.7 Earthing.....	16
5.4 Resistance to abnormal conditions.....	18
5.4.1 Resistance to overcharge .....	18
5.4.2 Resistance to short circuit .....	18
5.4.3 Resistance to external fire .....	19
5.4.4 Resistance to internal overheating.....	19
5.4.5 Flooding .....	19
5.4.6 Drop .....	19
6 Safety tests .....	20
6.1 General.....	20
6.1.1 Classification of tests.....	20
6.1.2 Test object selection.....	20
6.1.3 DUT initial conditions before tests .....	20
6.1.4 Measuring equipment .....	20
6.2 List of tests .....	21
6.3 Type tests.....	21
6.3.1 Overcharge test.....	21
6.3.2 Short circuit test .....	22
6.3.3 External fire exposure test.....	22

6.3.4	Cell failure propagation test .....	24
6.3.5	Overheating test .....	25
6.3.6	Drop test .....	27
6.4	Routine tests .....	28
6.4.1	Withstand voltage test .....	28
6.4.2	Insulation resistance measurement .....	29
6.5	Special tests .....	30
6.5.1	Immersion test .....	30
7	Markings .....	30
7.1	General .....	30
7.2	Data plate marking .....	32
8	Rules for transportation, installation and maintenance .....	32
8.1	Transportation .....	32
8.2	Installation .....	32
8.3	Maintenance .....	32
9	Documentation .....	32
9.1	Instruction manual .....	32
9.2	Test report .....	32
Annex A (informative) Standard template for report of test results and description of the DUT – Report of type test .....		33
Bibliography .....		36
Figure 1 – Examples of binding screw assemblies .....		18
Figure 2 – Fire exposure test: pre-heating .....		23
Figure 3 – Fire exposure test: direct exposure .....		24
Figure 4 – Fire exposure: end .....		24
Figure 5 – Plan view of specimen cross section for cell failure propagation test .....		25
Figure 6 – Temperature management subsystem .....		26
Figure 7 – Application of test voltage .....		29
Figure 8 – Insulation resistance measurement .....		29
Figure 9 – Examples of safety labels for sodium-nickel-chloride / sodium-sulfur batteries .....		31
Table 1 – List of symbols and abbreviated terms .....		9
Table 2 – Withstand voltages .....		13
Table 3 – Actual test voltage for impulse test with corresponding altitudes .....		14
Table 4 – Guide to overvoltage category assignment .....		15
Table 5 – Multiplication factors for clearances of equipment rated for operation at altitudes up to 5 000 m .....		16
Table 6 – Type tests .....		21
Table 7 – Routine tests .....		21
Table 8 – Special tests .....		21
Table 9 – Drop test severity classes .....		27

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HIGH-TEMPERATURE SECONDARY BATTERIES –****Part 2: Safety requirements and tests**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62984-2 has been prepared by IEC technical committee 21: Secondary cells and batteries.

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

FDIS	Report on voting
21/1032/FDIS	21/1042/RVD

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

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

This document is to be read in conjunction with IEC 62984-1:2020.

A list of all parts in the IEC 62984 series, published under the general title *High-temperature secondary batteries*, can be found on the IEC website.

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

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

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

# HIGH-TEMPERATURE SECONDARY BATTERIES –

## Part 2: Safety requirements and tests

### 1 Scope

This part of IEC 62984 specifies safety requirements and test procedures for high-temperature batteries for mobile and/or stationary use and whose rated voltage does not exceed 1 500 V.

This document does not cover aircraft batteries, which are covered by IEC 60952 (all parts), and batteries for the propulsion of electric road vehicles, covered by IEC 61982 (all parts).

NOTE High-temperature batteries are electrochemical systems whose cells' internal minimum operating temperature is above 100 °C.

### 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 60068-2-18:2017, *Environmental testing – Part 2-18: Tests – Test R and guidance: Water*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 62984-1:2020, *High-temperature secondary batteries – Part 1: General requirements*

### 3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 62984-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>