

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Safety requirements for secondary batteries and battery installations –
Part 5: Safe operation of stationary lithium ion batteries**

**Exigences de sécurité pour les batteries d'accumulateurs et les installations
de batteries –**

**Partie 5: Fonctionnement en toute sécurité des batteries ions-lithium
stationnaires**



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
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

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 It also gives information on projects, replaced and withdrawn publications.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

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

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

Electropedia - 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

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

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

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

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

Electropedia - 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

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



**Safety requirements for secondary batteries and battery installations –
Part 5: Safe operation of stationary lithium ion batteries**

**Exigences de sécurité pour les batteries d'accumulateurs et les installations
de batteries –**
**Partie 5: Fonctionnement en toute sécurité des batteries ions-lithium
stationnaires**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.220.20; 29.220.30

ISBN 978-2-8322-9091-0

**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.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitions and abbreviated terms.....	10
3.1 Terms and definitions.....	10
3.2 Abbreviated terms.....	14
4 Protection against electric shock	14
4.1 General.....	14
4.2 Basic protection	14
4.3 Fault protection.....	15
4.3.1 General	15
4.3.2 Protection by automatic disconnection of supply	16
4.3.3 Protection by use of class II equipment or by equivalent insulation	20
4.3.4 Protection by electrical separation	20
4.4 Protective measure: extra-low voltage provided by SELV, PELV and FELV	20
4.4.1 General	20
4.4.2 Protection by SELV or by PELV	20
4.4.3 Protection by functional extra-low voltage (FELV) without protective separation	20
5 Disconnection and separation.....	21
6 Prevention of short-circuits and protection from other effects of electric current.....	21
6.1 General.....	21
6.2 Short-circuits	22
6.3 Maintenance instructions	22
6.3.1 General	22
6.3.2 Protective measures during maintenance	22
6.4 Leakage currents	23
7 Provision against hazards.....	23
7.1 General.....	23
7.2 Charging modes.....	23
7.3 Overcharging or overdischarging under fault conditions	24
7.4 Prevention of electrostatic discharges when working with batteries	24
8 Provision against hazards posed by chemical substances	24
8.1 General.....	24
8.2 Initial actions in case of hazardous chemical release	24
8.2.1 General	24
8.2.2 Eye or skin contact	25
8.2.3 Swallowing	25
8.2.4 Respiratory tract.....	25
8.2.5 Burns.....	25
8.3 Battery accessories and maintenance tools.....	25
9 Accommodation, housing.....	25
9.1 General.....	25
9.2 Specific requirements for separate battery rooms	25

9.3	Specific requirements for the specially separated areas in rooms accommodating electrical equipment.....	26
9.4	Battery enclosures	26
9.5	Working on or near batteries	26
9.5.1	Working distances within battery rooms	26
9.5.2	Remarks on special work in battery rooms	27
9.6	Accommodation of lithium ion batteries in combination with batteries containing aqueous electrolyte (e.g. lead-acid and NiCd batteries) in the same room.....	27
10	Charge current requirements	27
10.1	General.....	27
10.2	Superimposed ripple current	27
10.3	Maximum ripple current.....	27
11	Identification labels, warning notices and instructions for use, installation and maintenance	28
11.1	Warning labels and notices in rooms.....	28
11.2	Identification labels or marking on cell, module, battery pack or battery system	28
11.3	Instructions for use, installation and maintenance	28
12	Transportation, storage and environmental aspects	28
13	Inspection and monitoring	29
14	EMC for stationary application	29
Annex A (informative)	Charging methods and modes of operation.....	31
A.1	Parallel operation mode	31
A.1.1	General	31
A.1.2	Battery "stand-by" operation mode	31
A.1.3	Battery "buffer" operation mode	31
A.1.4	Shallow cycling operation mode.....	32
A.2	Response mode operation	32
A.3	Charging methods.....	32
A.3.1	General	32
A.3.2	Temperature compensation of the charge voltage and limiting of charge currents	33
A.4	Discharge	33
Annex B (normative)	Electromagnetic compatibility (EMC)	34
B.1	Case 1 – EMC requirements for battery systems depending on each end-device application	34
B.2	Case 2 – EMC requirements for testing battery system as an end-device.....	34
Annex C (informative)	Cell behaviour inside and outside of operating region	35
Bibliography		36
Figure 1	TN system with separate protective conductor (PE) in the entire system (TN-S network)	16
Figure 2	TN system with functional earthing and protective earthing (FPE, PEN) combined with an external line conductor (TN-C system)	17
Figure 3	TT system	18
Figure 4	IT system	19
Figure 5	Converters with intermediate DC circuit (IT system) (example).....	19
Figure A.1	Parallel operation mode circuit.....	31

Figure A.2 – Example of battery charge current interlaced with frequent temporary discharge events due to a load current exceeding the current supply capability	32
Figure A.3 – Response mode operation circuit	32
Figure A.4 – Constant current/constant voltage charge	33
Figure C.1 – An example for operating region of lithium ion cell	35

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

IEC 62485-5:2020

<https://standards.iteh.ai/catalog/standards/sist/b8be1390-a41d-4c42-8ee6-86181ca9074a/iec-62485-5-2020>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY REQUIREMENTS FOR SECONDARY
BATTERIES AND BATTERY INSTALLATIONS –****Part 5: Safe operation of stationary lithium ion batteries**

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 62485-5 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
21/1069/FDIS	21/1076/RVD

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

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

A list of all parts in the IEC 62485 series, published under the general title *Safety requirements for secondary batteries and battery installations*, 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.

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

[IEC 62485-5:2020](https://standards.iteh.ai/catalog/standards/sist/b8be1390-a41d-4c42-8ee6-86181ca9074a/iec-62485-5-2020)

<https://standards.iteh.ai/catalog/standards/sist/b8be1390-a41d-4c42-8ee6-86181ca9074a/iec-62485-5-2020>

INTRODUCTION

The described safety requirements comprise the protective measures to protect from hazards generated by electricity and chemical substances when using secondary batteries. In addition measures are described to maintain the functional safety of batteries and battery installations.

For electrical safety (protection against electric shock) under Clause 4, this document refers to IEC 60364-4-41. The pilot function of this document is fully observed by indication of cross-reference numbers of the relevant clauses, but interpretation is given where adoption to direct current (DC) circuits is required.

This document comes into force with the date of publication and applies to all new batteries and battery installations. Previous installations are intended to conform to the existing national standards at the time of installation. In the case of the redesign of old installations, this document applies.

Lithium ion cells/batteries used in stationary industrial applications are intended to fulfil safety requirements in accordance with IEC 62619.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

IEC 62485-5:2020

<https://standards.iteh.ai/catalog/standards/sist/b8be1390-a41d-4c42-8ee6-86181ca9074a/iec-62485-5-2020>

SAFETY REQUIREMENTS FOR SECONDARY BATTERIES AND BATTERY INSTALLATIONS –

Part 5: Safe operation of stationary lithium ion batteries

1 Scope

This part of IEC 62485 applies to the installation of one or more stationary secondary batteries having a maximum aggregate DC voltage of 1 500 V to any DC part of the power network, and describes the principal measures for protections during normal operation or under expected fault conditions against hazards generated from:

- electricity,
- short-circuits,
- electrolyte,
- gas emission,
- fire,
- explosion.

This document provides requirements on safety aspects associated with the installation, use, inspection, and maintenance and disposal of lithium ion batteries used in stationary applications.

This document covers stationary batteries for industrial applications that are installed in separate closed buildings or housings as well as stationary batteries that are installed in public buildings, offices and private residences. This document also covers the maintenance and disposal of lithium ion batteries used in stationary applications.

Batteries containing lithium metal are not covered by this document.

Examples of the main applications are:

- telecommunications,
- power station operation,
- central emergency lighting and alarm systems,
- uninterruptible power supplies (UPS),
- stationary engine starting,
- photovoltaic systems.

In general, the safety requirements for secondary batteries and battery installations – General safety information and definitions are specified for lead-acid, nickel-cadmium and nickel-metal hybrid batteries in accordance with IEC 62485-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-482, *International Electrotechnical Vocabulary (IEV) – Part 482: Primary and secondary cells and batteries*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*
IEC 60364-4-41:2005/AMD1:2017

IEC 60364-4-43, *Low-voltage electrical installations – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60364-5-53, *Low-voltage electrical installations – Part 5-53: Selection and erection of electrical equipment – Devices for protection for safety, isolation, switching, control and monitoring*

IEC 60364-5-54, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

IEC 60417, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

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

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60755, *General safety requirements for residual current operated protective devices*

IEC 61000-1-2, *Electromagnetic compatibility (EMC) – Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61000-6-7, *Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*

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

IEC/TR 61340-1, *Electrostatics – Part 1: Electrostatic phenomena – Principles and measurements*

IEC 61340-5-1, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*

IEC 61660-1, *Short-circuit currents in d.c. auxiliary installations in power plants and substations – Part 1: Calculation of short-circuit currents*

IEC 61660-2, *Short-circuit currents in d.c. auxiliary installations in power plants and substations – Part 2: Calculation of effects*

IEC 62133-2, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 2: Lithium systems*

IEC 62485-1, *Safety requirements for secondary batteries and battery installations – Part 1: General safety information*

IEC 62619:2017, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC 62620:2014, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for use in industrial applications*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

ISO 3864 (all parts), *Graphical symbols – Safety colours and safety signs*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

3 Terms and definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 60050-482, ISO/IEC Guide 51, 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/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Terms and definitions

3.1.1

secondary lithium cell

secondary cell where electrical energy is derived from the insertion/extraction reactions of lithium ions or oxidation/reduction reaction of lithium between the negative electrode and the positive electrode

Note 1 to entry: The cell typically has an electrolyte that consists of a lithium salt and organic solvent compound in liquid, gel or solid form and has a metal or a laminate film casing.

Note 2 to entry: A cell is not ready for use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device.

3.1.2

home energy storage system **HESS**

stationary battery system used in or next to a single or multi-family dwelling or in internal home energy storage installations

Note 1 to entry: The system is typically installed in rooms which are not designed as electrical service rooms or battery rooms.

3.1.3

battery energy storage system

BESS

stationary system to store and convert back electrical energy, which contains components necessary for this function, especially the battery, the power conversion system and the energy management system

Note 1 to entry: In general, the safety functions and the enclosure are also part of BESS.

Note 2 to entry: The power conversion system can be an AC/DC converter or DC/DC converter to charge or discharge the battery.

3.1.4

battery system

battery

system which comprises one or more cells, modules or battery packs and has a battery management system capable of controlling current in case of overcharge, overcurrent, overdischarge and overheating

Note 1 to entry: Overdischarge cut off is not mandatory if there is an agreement on this between the cell manufacturer and the customer.

Note 2 to entry: The battery system may have cooling or heating units. A larger battery system may comprise more than one battery system. The battery system is sometimes also referred to as a battery.

3.1.5

stationary battery

battery system which is designed for service in a fixed location and is not habitually moved from place to place during the service life

Note 1 to entry: Overdischarge cut off is not mandatory if there is an agreement on this between the cell manufacturer and the customer.

Note 2 to entry: The function of the BMS can be assigned to the battery pack or to equipment that uses the battery.

Note 3 to entry: The BMS can be divided and it can be found partially in the battery pack and partially on the equipment that uses the battery.

Note 4 to entry: The BMS is sometimes also referred to as a BMU (battery management unit).

3.1.6

electrolyte

liquid or solid substance containing mobile ions which render it ionically conductive

Note 1 to entry: The electrolyte may be liquid, solid or a gel.

[SOURCE: IEC 60500-482:2004, 482-02-29]

3.1.7

battery management system

BMS

electronic system associated with a battery which has functions to control current in case of overcharge, overcurrent, overdischarge, and overheating, and which monitors and/or manages the state of the battery, calculates secondary data, reports that data and/or controls its environment to influence the battery's safety, performance and/or service life

Note 1 to entry: Overcharge cut off is not mandatory if there is an agreement on this between the cell manufacturer and the customer.

Note 2 to entry: The function of the BMS can be assigned to the battery pack or to equipment that uses the battery.

Note 3 to entry: The BMS can be divided and it can be found partially in the battery pack and partially on the equipment that uses the battery.

Note 4 to entry: The BMS is sometimes also referred to as a BMU (battery management unit).

3.1.8

charging of a battery

operation during which a secondary cell or battery is supplied with electric energy from an external circuit which results in chemical changes within a cell and thus storage of energy as chemical energy

[SOURCE: IEC 60500-482:2004, 482-05-27]

3.1.9

battery on float (charge)

battery whose terminals are permanently connected to a source of constant voltage sufficient to maintain the battery approximately fully charged, and which is intended to supply power to an electrical circuit, if the normal supply is temporarily interrupted

Note 1 to entry: In order to increase the lifetime of a lithium ion battery, the state of charge during float charge is sometimes < 100 %.

[SOURCE: IEC 60500-482:2004, 482-05-35, modified – The deprecated term "floating battery" has been omitted, along with "secondary" from the definition; the note has been added.]

3.1.10

float charge voltage

constant voltage needed to keep the secondary cell or battery fully charged or at the intended state of charge

3.1.11

float charge current

current resulting from the float charge

iTech STANDARD PREVIEW
(standards.iteh.ai)
<https://standards.iteh.ai/catalog/standards/sist/b8be1390-a41d-4c42-8ee6-86181ca9074a/iec-62485-5-2020>
IEC 62485-5:2020

Note 1 to entry: This float charge current may be zero once the charge process is terminated (if specified by the manufacturer).

3.1.12

overcharge

overcharging

<of a cell or battery> continued charging after the full charge of a secondary cell or battery

Note 1 to entry: Overcharge is also the act of charging beyond a certain limit specified by the manufacturer.

[SOURCE: IEC 60500-482:2004, 482-05-44, modified – The term "overcharging" and the domain have been added and the wording "of a fully charged" has been replaced with "after the full charge of" in the definition.]

3.1.13

nominal voltage

suitable approximate value of the voltage used to designate or identify a cell, a battery or an electrochemical system

Note 1 to entry: The cell or battery manufacturer may provide the nominal voltage.

Note 2 to entry: The nominal voltage of a battery of n cells connected in series is equal to n times the nominal voltage of a single cell.

[SOURCE: IEC 60050-482:2004, 482-03-31, modified – Addition of Notes 1 and 2.]

3.1.14**lower limit discharging voltage**

lowest discharging voltage in the cell operating region specified by the cell manufacturer

3.1.15**overdischarge**

state of the battery when one or more cells of a battery are discharged below their lower limit discharge voltage

3.1.16**maximum voltage of battery system**

highest voltage of the battery system in which the maximum voltage of any individual cell is below or equal to the upper limit charging voltage and components operate in their specified/permissible operating range under all operating conditions

3.1.17**upper limit charging voltage**

highest charging voltage in the cell operating region specified by the cell manufacturer

Note 1 to entry: The charging process should be terminated before reaching the upper limit charging voltage.

3.1.18**external short-circuit**

abnormally high current discharge due to a conductive fault over parts at opposite polarity either within the battery circuitry or over the external terminals

3.1.19**internal short-circuit**

electrical conduction through insulation within the cell due to cell manufacturing defects, cell design faults or damage due to abuse of the cell during its use

3.1.20**cell block**

group of cells connected together in parallel configuration with or without protective devices (e.g. fuse or positive temperature coefficient device (PTC)) and monitoring circuitry

Note 1 to entry: It is not ready for use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device.

3.1.21**module**

group of cells connected together either in a series and/or parallel configuration with or without protective devices (e.g. fuse or positive temperature coefficient device (PTC)) and monitoring circuitry

3.1.22**battery pack**

energy storage device comprised of one or more cells or modules electrically connected, and has monitoring circuitry which provides information (e.g. cell voltage) to a battery system to influence the battery's safety, performance and/or service life

Note 1 to entry: It may incorporate a protective housing and be provided with terminals or other interconnection arrangements.

3.1.23**thermal runaway**

uncontrolled intensive increase in the temperature of a cell driven by exothermic reaction

[SOURCE: IEC 62619:2017, 3.21]