

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Railway applications – Rolling stock – Onboard lithium-ion traction batteries

Applications ferroviaires – Matériel roulant – Batteries d'accumulateurs de traction embarquées au lithium-ion

[IEC 62928:2017](#)

<https://standards.iteh.ai/catalog/standards/sist/a17d8be6-667e-434b-926f-5682f8c7de65/iec-62928-2017>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2017 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
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms, containing 20 000 terms and definitions 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

65 000 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.

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: csc@iec.ch.

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.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

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 aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions 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

65 000 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.

Service Clients - webstore.iec.ch/csc

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

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Railway applications – Rolling stock – Onboard lithium-ion traction batteries

Applications ferroviaires – Matériel roulant – Batteries d'accumulateurs de traction embarquées au lithium-ion

<https://standards.iteh.ai/catalog/standards/sist/a17d8be6-667e-434b-926f-5682f8c7de65/iec-62928-2017>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 45.060.01

ISBN 978-2-8322-5019-8

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.....	9
2 Normative references	9
3 Terms, definitions and abbreviated terms	10
3.1 Terms and definitions.....	10
3.2 Abbreviated terms.....	17
4 Configuration of battery system	17
4.1 Battery system.....	17
4.2 Battery pack/module	18
4.3 Battery management system (BMS)	19
4.4 Battery thermal management system (BTMS)	20
5 Parameter measurement tolerances	20
6 Operational conditions.....	20
6.1 General.....	20
6.2 Mechanical conditions.....	21
6.3 Environmental conditions.....	21
6.3.1 General.....	21
6.3.2 Ambient temperature	21
6.3.3 Temperature in battery enclosure.....	21
6.3.4 Temperature for life time calculation.....	21
6.4 Electrical conditions.....	21
6.4.1 Traction circuits.....	21
6.4.2 Control circuits	21
6.4.3 Insulation coordination.....	22
6.5 Electromagnetic compatibility (EMC).....	22
6.6 Software	22
7 Designation and marking	22
7.1 Nameplate	22
7.2 Designations for cells and battery system	22
7.3 Marking.....	23
7.3.1 General	23
7.3.2 Battery pack/module and cells	23
7.3.3 Other components	23
7.3.4 Additional information	23
8 Safety requirements	23
8.1 General safety consideration	23
8.2 Safety signs.....	24
8.2.1 Outside the battery box.....	24
8.2.2 Inside the battery box	24
8.3 Isolation for maintenance or service.....	24
8.4 Fire protection	25
9 Dimensions	25
10 Electrical requirements	25
10.1 Operating voltage range of the battery system	25

10.2	Ripple current	25
10.3	Charge and discharge control of the battery system	25
10.4	Communication	25
10.5	Starting of disabled battery system	26
10.6	Insulation status	26
10.7	Battery management system (BMS)	26
11	Mechanical requirement	26
11.1	Mechanical integration	26
11.2	Shock and vibration	26
11.3	Degree of protection	27
12	Performance requirement	27
12.1	Design energy and power calculation methodology	27
12.1.1	General	27
12.1.2	Sizing	27
12.1.3	Documentation	28
12.2	Cooling / heating requirement	28
12.3	End of life performance	28
13	Storage and transportation conditions	29
13.1	Transportation	29
13.2	Storage of battery systems	29
13.3	Self-discharge	29
14	Tests	29
14.1	Kind of tests	29
14.1.1	General	29
14.1.2	Test categories	30
14.2	Electrical tests	31
14.2.1	Electrical characteristics tests	31
14.2.2	Battery management system (BMS) tests	32
14.2.3	Performance test	33
14.2.4	Endurance in cycles	34
14.2.5	Dielectric test	37
14.2.6	Self-discharge test	37
14.2.7	Operational balancing test	39
14.3	Mechanical tests	40
14.3.1	Physical appearance	40
14.3.2	Mass measurement	40
14.3.3	Shock and vibration test	40
14.3.4	Test of the degree of protection	40
14.4	Safety tests	40
14.4.1	Safety test according to IEC 62619:2017	40
14.4.2	Special tests for rolling stock	41
Annex A (informative)	Examples of battery system configuration	45
Annex B (informative)	Examples of parameter ranges for additional high power cycling tests	49
Bibliography	50
Figure 1 – Hierarchy of standards related to IEC 62928	8
Figure 2 – Functional block of battery system	18

Figure 3 – Illustration of definitions for cell, cell block and battery pack/module	19
Figure 4 – Illustration of self-discharge test	38
Figure A.1 – Example of configuration for contactor inside of the battery box.....	45
Figure A.2 – Examples of battery box configurations with the contactor outside battery box..	47
Figure A.3 – Example of configuration of a BTMS outside of battery box.....	48
Figure A.4 – Example of configuration of a BMS and a BTMS included in another system outside of battery box	48
Table 1 – List of tests	30
Table B.1 – Examples of parameter ranges for additional high power cycling tests	49

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 62928:2017](https://standards.iteh.ai/catalog/standards/sist/a17d8be6-667e-434b-926f-5682f8c7de65/iec-62928-2017)

<https://standards.iteh.ai/catalog/standards/sist/a17d8be6-667e-434b-926f-5682f8c7de65/iec-62928-2017>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS – ROLLING STOCK –
ONBOARD LITHIUM-ION TRACTION 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 62928 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

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

FDIS	Report on voting
9/2317/FDIS	9/2329/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.

The committee has decided that the contents of this publication will remain unchanged until the stability 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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 62928:2017](#)

<https://standards.iteh.ai/catalog/standards/sist/a17d8be6-667e-434b-926f-5682f8c7de65/iec-62928-2017>

INTRODUCTION

In the 90s the market started developing mainly portable lithium technology batteries. Existing standards for lithium-ion batteries currently focus on small portable batteries:

- IEC 61960-3:2017, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 3: Prismatic and cylindrical lithium secondary cells and batteries made from them
- IEC 62133 (all parts): 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.

These above mentioned documents do not cover large cells and batteries for industrial and railway applications, which are non-portable and weigh hundreds of kilograms.

TC 21 and SC 21A decided to start work on large capacity lithium cells and batteries:

- 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.

The documents are often generic and mention railway applications only as an example.

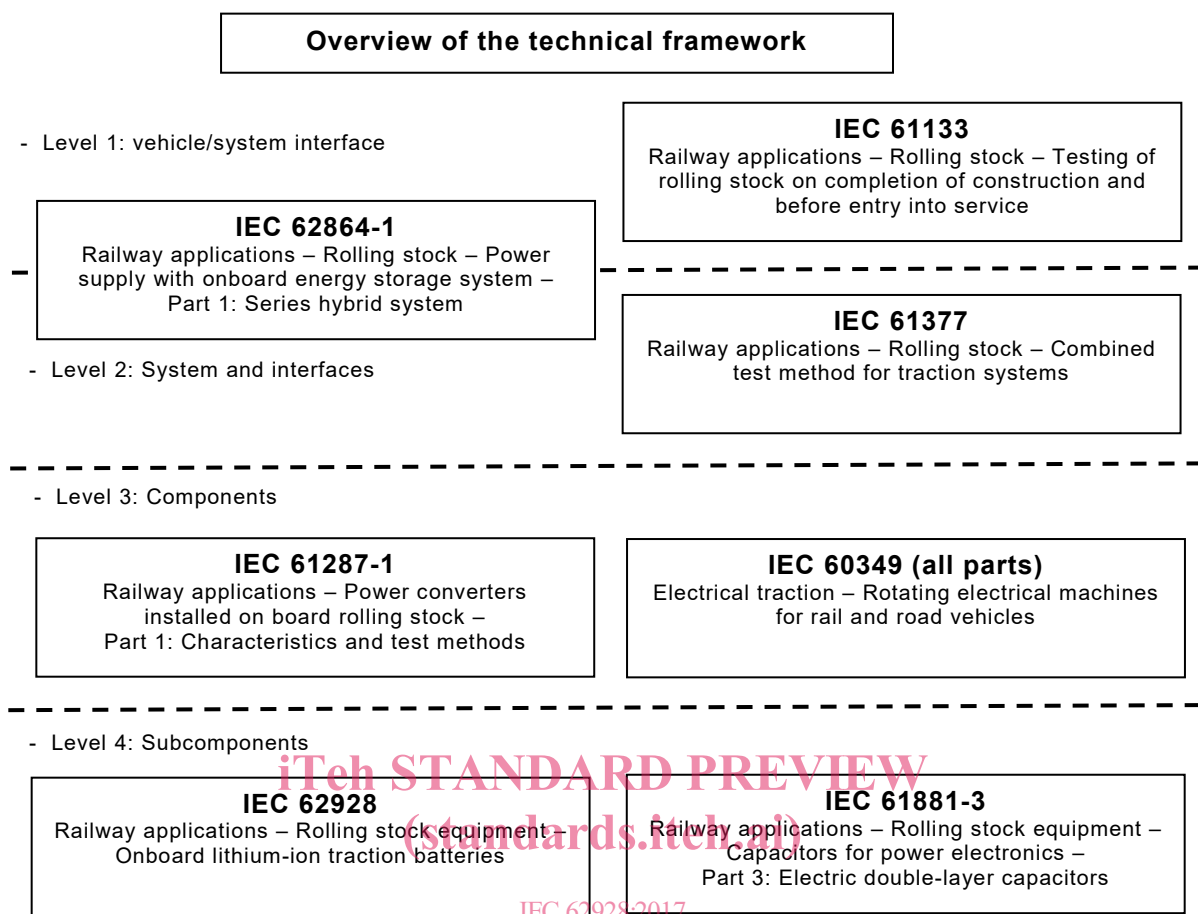
Therefore, this document is developed for specifying the requirements for railway traction applications.

In addition, TC 9 has developed the following document:

- IEC 62864-1:2016, Railway applications – Rolling stock – Power supply with onboard energy storage system – Part 1: Series hybrid system

IEC 62864-1:2016 specifies the general requirements for the onboard energy storage system as a system level. The hierarchy of standards is shown in Figure 1 of IEC 62864-1:2016.

It is part of a series of standards, referring to each other. The hierarchy of the standards used in the railway specific area related to IEC 62928 is as follows:



<https://standards.iteh.ai/catalog/standards/sist/a17d8be6-667e-434b-926f-36623874dc0e/iec-62928-2017>
Figure 1 – Hierarchy of standards related to IEC 62928

The standards listed in Figure 1 are not exhaustive.

RAILWAY APPLICATIONS – ROLLING STOCK – ONBOARD LITHIUM-ION TRACTION BATTERIES

1 Scope

This document applies to onboard lithium-ion traction batteries for railway applications.

This document specifies the design, operation parameters, safety recommendations, data exchange, routine and type tests, as well as marking and designation.

Battery systems described in this document are used for the energy storage system (ESS) for the traction power of railway vehicles such as hybrid vehicles as defined in IEC 62864-1:2016. Auxiliary batteries to supply power only to the auxiliary equipment are excluded.

Subcomponents within the battery systems, e.g. battery management system (BMS) and battery thermal management system (BTMS), are also covered in this document.

Power conversion equipment (e.g. chopper, converter, etc.), inductors, capacitors and switchgear are excluded from the scope of this document.

General requirements for onboard ESS are described in IEC 62864-1:2016.

This document specifies the lithium-ion battery technology but does not prevent the use of battery technologies other than lithium-ion technology for application as traction batteries.

A hybrid energy storage system, which uses two or more energy storage technologies combined, e.g. a traction battery and double layer capacitors, is not covered in this document. However, if different technologies of energy storage systems are used on the same railway vehicle and managed independently, each independent energy storage system is covered by its own document.

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 60050-482:2004, *International Electrotechnical Vocabulary – Part 482: Primary and secondary cells and batteries*

IEC 60050-811:2017, *International Electrotechnical Vocabulary – Chapter 811: Electric traction*

IEC 60051 (all parts), *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60077-1, *Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules*

IEC 60077-5, *Railway applications – Electric equipment for rolling stock – Part 5: Electrotechnical components – Rules for HV fuses*

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

IEC 60571, *Railway applications – Electronic equipment used on rolling stock*

IEC 60850, *Railway applications – Supply voltages of traction systems*

IEC 61373, *Railway applications – Rolling stock equipment – Shock and vibration tests*

IEC 61991, *Railway applications – Rolling stock – Protective provisions against electrical hazards*

IEC 62236-3-2, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

IEC 62278:2002, *Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS)*

IEC 62279, *Railway applications – Communications, signalling and processing systems – Software for railway control and protection systems*

IEC 62497-1, *Railway application – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

IEC 62498-1:2010, *Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*

IEC 62619:2017, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements 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*

IEC 62864-1:2016, *Railway applications – Rolling stock – Power supply with onboard energy storage system – Part 1: Series hybrid system*

ISO/IEC Guide 51: 2014, *Safety aspects – Guidelines for their inclusion in standards*

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

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-482, IEC 60050-811 and ISO/IEC Guide 51, as well as 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>

3.1.1**charge retention**

capacity retention

ability of battery system to retain capacity on open circuit under specified conditions

Note 1 to entry: See also self-discharge.

[SOURCE: IEC 60050-482:2004, 482-03-35, modified – “a cell or battery” has been changed to “battery system”]

3.1.2**self-discharge**

phenomenon by which a cell or battery system loses energy in other ways than by discharge into an external circuit

Note 1 to entry: See also charge retention.

[SOURCE: IEC 60050-482:2004, 482-03-27, modified – “battery” has been changed to “battery system”.]

3.1.3**final voltage**

end-of-discharge voltage

specified closed circuit voltage at which a discharge of a cell or battery system is terminated

[SOURCE: IEC 62620:2014, 3.3 modified – “battery” has been changed to “battery system”.]

3.1.4**nominal voltage**

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

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

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

[SOURCE: IEC 62620:2014, 3.4, modified – “identify a cell” has been changed to “identify the voltage of a cell” and “battery” is changed to “battery system”.]

3.1.5**rated capacity**

capacity value of a cell or battery system determined under specified conditions and declared by the manufacturer

Note 1 to entry: The rated capacity is the quantity of electricity C_n Ah (ampere-hours) declared by the manufacturer which a single cell or battery can deliver during a n h period when charging, storing and discharging under the conditions specified in 6.3.1 of IEC 62620:2014. n is 5 for an E, M and H discharge rate type cell or battery.

[SOURCE: IEC 60050-482:2004, 482-03-15, modified – “battery” has been changed to “battery system” and Note 1 to entry has been added.]

3.1.6**state of charge****SOC**

remaining capacity to be discharged, normally expressed as a percentage of full capacity by selected expression as defined in Annex A of IEC 62864-1:2016

[SOURCE: IEC 62864-1:2016, 3.1.13, modified – “as expressed in relevant standards” has been changed to “by selected expression as defined in Annex A of IEC 62864-1:2016” and Note 1 to entry has been deleted.]

3.1.7

cell

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. 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.

[SOURCE: IEC 62620:2014, 3.6]

3.1.8

cell block

group of cells connected together in parallel configuration with or without protective devices (e.g. fuse or 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.

[SOURCE: IEC 62620:2014, 3.7]

3.1.9

battery pack/module

energy storage device, which is comprised of one or more cells electrically connected

Note 1 to entry: In this document a module is same as a battery pack.
<https://standards.iteh.ai/catalog/standards/sist/a17d8be6-667e-434b-926f-568218c7dc05/iec-62928-2017>

Note 2 to entry: It incorporates a protective housing and be provided with terminals or other interconnection arrangement.

Note 3 to entry: It includes at least monitoring circuitry, which provides information (e.g. cell voltage, temperature) to a battery system.

Note 4 to entry: It may include a protective device and control circuitry.

[SOURCE: IEC 62620:2014, 3.9, modified – “/module” has been added in the term and “or module” has been deleted in the definition. Note 1 to entry has been divided into Note 2 to entry to Note 4 to entry and Note 1 to entry has been added.]

3.1.10

battery branch

group of battery packs/modules connected together either in a series and/or parallel configuration, which has the voltage equal to that of the battery system and is the smallest electrically isolatable subsystem

Note 1 to entry: Electrical isolation is done by means of disconnecting devices, e.g. contactors, switchgears, circuit breakers, etc.

Note 2 to entry: A battery branch may be contained in a single enclosure or multiple enclosures.

3.1.11

battery system

system which incorporates one or more cells, modules or battery packs including battery management system and thermal management system as well as disconnecting and/ or isolating devices, e.g. contactors, disconnectors, fuses, etc.

Note 1 to entry: Refer to Figure 2, Figure 3 and Figure A.1 to Figure A.4.

[SOURCE: IEC 62620:2014, 3.10, modified – Definition after “battery packs” has been changed. Note 1 to entry has been replaced.]

3.1.12

hybrid vehicle

vehicle that can store energy in an onboard ESS and is driven by using the stored energy as well as electric power from a generator or overhead lines

[SOURCE: IEC 62864-1:2016, 3.1.14]

3.1.13

safety

freedom from risk which is not tolerable

[SOURCE: ISO/IEC Guide 51:2014, 3.14]

3.1.14

hazard

potential source of harm

[SOURCE: IEC 60050-903:2013, 903-01-02, modified – Note 1 to entry, Note 2 to entry and Note 3 to entry have been deleted.]

3.1.15

intended use

use in accordance with information provided with a product or system, or, in the absence of such information, by generally understood patterns of usage

Note 1 to entry: Intended use can include load profile agreed between the integrator and the battery system manufacturer.

[SOURCE: ISO/IEC Guide 51:2014, 3.6, modified – Note 1 to entry has been added.]

3.1.16

leakage

visible escape of liquid electrolyte

[SOURCE: IEC 62619:2017, 3.13]

3.1.17

venting

release of excessive internal pressure from a cell, module, battery pack, or battery system in a manner intended by design to preclude rupture or explosion

[SOURCE: IEC 62619:2017, 3.14]

3.1.18

rupture

mechanical failure of a cell container or battery case induced by an internal or external cause, resulting in exposure or spillage but not ejection of materials

[SOURCE: IEC 62619:2017, 3.15]