

# 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**



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**Partie 5: Fonctionnement en toute sécurité des batteries ions-lithium  
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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 29.220.20; 29.220.30

ISBN 978-2-8322-9091-0

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**SAFETY REQUIREMENTS FOR SECONDARY  
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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

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## 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.

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## 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

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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]