IEC 60364-5-57

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Low voltage electrical installations – Part 5-57: Selection and erection of electrical equipment – Erection of stationary secondary batteries

Installations électriques à basse tension – Partie 5-57: Choix et mise en œuvre des matériels électriques – Mise en œuvre des batteries d'accumulateurs stationnaires

IEC 60364-5-57:2022-10(en-fr)

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CONTENTS

FOREWORD 4
570.1 Scope 6
570.2 Normative references 6
570.3 Terms and definitions 7
570.4 Operation modes 8
570.4.1 Grid connected 8
570.4.2 Grid connected and islanding mode 9
570.5 Main characteristics of stationary secondary batteries 9
570.5.1 Types of equipment 9
570.5.2 Selection of battery 10
570.5.3 Converter 10
570.6 Selection and erection of electrical equipment 10
570.6.1 General 10
570.6.2 Measures for protection against electric shock 11
570.6.3 Protection against thermal effects 12
570.6.4 Protection against short-circuit 12
570.6.5 Isolation 13
570.6.6 Unexpected islanding 13
570.6.7 Protection against other hazards 14
Annex A (informative) Technical characteristics 15
A.1 Nominal voltage 15
A.2 Discharge 15
A.2.1 Discharge voltage curve 15
A.2.2 Temperature dependence 16
A.3 Internal Impedance 16
A.3.1 General 16
A.3.2 Battery equivalent circuit 16
A.3.3 Voltage drop 17
A.3.4 Thermal effects 17
A.3.5 Time dependence 17
A.3.6 Gas evolution of lead acid, nickel-cadmium batteries and zinc dibromide aqueous electrolyte 18
Annex B (informative) Technical characteristics for battery load 19
B.1 C-rate 19
B.2 Battery discharge performance 19
B.3 Ripple effects 20
Annex C (normative) Battery accommodation 21
C.1 General 21
C.2 Specific requirements for separate battery rooms 21
C.3 Specific requirements for the specially separated areas in rooms accommodating electrical equipment 22
C.4 Accommodation for lead acid and NiCd batteries in the same room 22
C.5 Detection means 22
Annex D (informative) Identification labels and warning notices 23
Annex E (informative) List of notes concerning certain countries 24
Bibliography 25

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Full document details: IEC 60364-5-57 2022

Figure 1 – Battery operating only when grid connected 9
Figure 2 – Battery operation with the grid and in island mode 9
Figure 3 – Battery charger contribution to a DC system fault 13
Figure A.1 – Examples of cell discharge characteristics for different technologies and for constant current discharge 16
Figure A.2 – Battery equivalent circuit impedance 17
Figure B.1 – Typical discharge curves of lead acid as a function of C-rate as a parameter 19
Figure B.2 – Capacity characteristic as a function of discharge time 20

Table 1 – Protective measures where converter without galvanic separation is used 12

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LOW VOLTAGE ELECTRICAL INSTALLATIONS –

Part 5-57: Selection and erection of electrical equipment – Erection of stationary secondary batteries

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

Draft	Report on voting
64/2558/FDIS	64/2561/RVD

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

The language used for the development of this International Standard is English.

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The reader's attention is drawn to the fact that Annex E lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

A list of all parts in the IEC 60364 series, published under the general title *Low voltage electrical installations*, can be found on the IEC website.

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- withdrawn,
- replaced by a revised edition, or
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LOW VOLTAGE ELECTRICAL INSTALLATIONS –

Part 5-57: Selection and erection of electrical equipment – Erection of stationary secondary batteries

570.1 Scope

This part of IEC 60364 provides requirements and recommendations for the design, erection, correct use and protection of installations with secondary stationary batteries as prime storage medium, hereinafter referred to as "stationary secondary batteries".

This document is not applicable to products such as batteries and to systems design (including batteries) which are already covered by their own IEC standard.

570.2 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 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-5-53:2019, *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 60364-8-82, *Low-voltage electrical installations – Part 8-2: Prosumer's low-voltage electrical installations*

IEC 60896-21, *Stationary lead-acid batteries – Part 21: Valve regulated types – Methods of test*

IEC 61340-4-1, *Electrostatics – Part 4-1: Standard test methods for specific applications – Electrical resistance of floor coverings and installed floors*

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 62485-2, *Safety requirements for secondary batteries and battery installation – Part 2: Stationary 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*

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570.3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology 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

570.3.1
cell
basic functional unit, consisting of an assembly of electrodes, electrolyte, container, terminals and usually separators, that is a source of electric energy obtained by direct conversion of chemical energy

[SOURCE: IEC 60050-482:2004, 482-01-01, modified – Note deleted.]

570.3.2
capacity
<of a cell or battery> quantity of electricity (electric charge) which a fully charged cell or battery can deliver under specified conditions

Note 1 to entry: Capacity is usually expressed in ampere hour (Ah) or watt hour (Wh).

[SOURCE: IEC 60050-482:2020, 482-03-14, modified – "quantity of electricity" and "fully charged" added, "discharge" deleted and Note 1 to entry replaced with a new Note 1 to entry.]

570.3.3
secondary cell
cell which is designed to be electrically recharged

Note 1 to entry: The recharge is accomplished by way of a reversible chemical reaction.

[SOURCE: IEC 60050-482:2004, 482-01-03]

570.3.4
secondary battery
assembly of secondary cell(s) ready for use as a source of electrical energy characterized by its voltage, size, terminal arrangement, capacity and rate capability

[SOURCE: IEC 62133-1:2017, 3.8, modified – Note deleted.]

570.3.5
stationary secondary battery
secondary battery that is permanently connected to the DC power supply and which is designed for service in a fixed location and is not habitually moved from place to place during operation

570.3.6
battery
one or more cells fitted with devices necessary for use, for example case, terminals, marking and protective devices

[SOURCE: IEC 60050-482:2004, 482-01-04]

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570.3.7
vented cell
secondary cell having a cover provided with an opening through which products of electrolysis and evaporation are allowed to escape freely from the cell to the atmosphere

[SOURCE: IEC 60050-482:2004, 482-05-14]

570.3.8
valve regulated lead acid battery
VRLA
secondary battery in which cells are closed but have a valve which allows the escape of gas if the internal pressure exceeds a predetermined value

Note 1 to entry: The cell or battery cannot normally receive additions to the electrolyte.

[SOURCE: IEC 60050-482:2004, 482-05-15]

570.3.9
converter
device for changing one or more characteristics associated with electrical energy

Note 1 to entry: Characteristics associated with electrical energy are for example voltage, number of phases and frequency including zero frequency.

[SOURCE: IEC 60050-151:2001, 151-13-36, modified – "electric" replaced with "electrical" and in the note "electrical" added to "energy".]

570.3.10
island mode
operating mode in which the prosumer's electrical installation (PEI) is disconnected from the distribution network

570.3.11
System referencing conductor
conductor connecting one live conductor of the power system and an earthing arrangement

Note 1 to entry: The live conductor connected is the neutral or the mid-point if existing, or a line conductor when not existing.

570.4 Operation modes

570.4.1 Grid connected

The battery is permanently connected to the grid.

In case of outage of the grid, the battery shall be automatically disconnected from the installation. See Figure 1.

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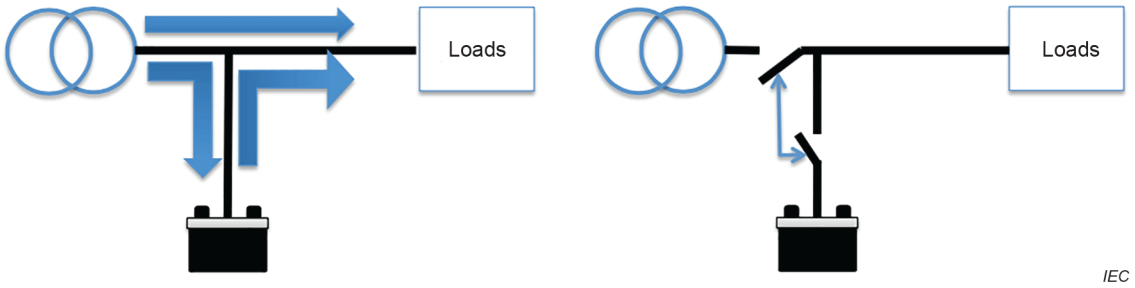

Figure 1 – Battery operating only when grid connected

570.4.2 Grid connected and islanding mode

In islanding mode, the battery supplies the installation even when the grid is disconnected from the installation. See Figure 2.

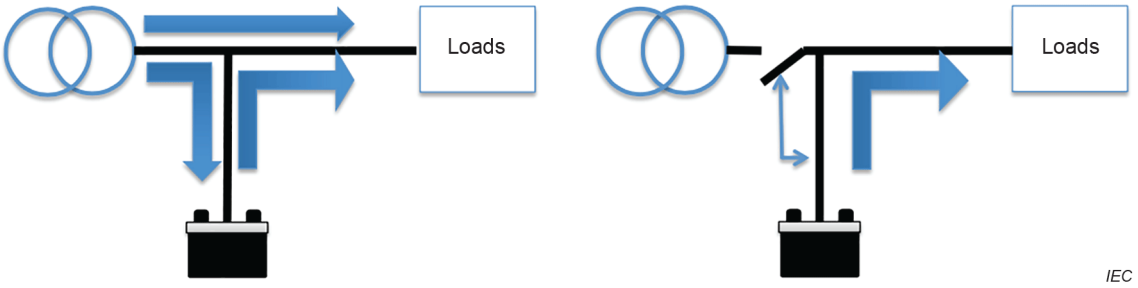

Figure 2 – Battery operation with the grid and in island mode

570.5 Main characteristics of stationary secondary batteries

570.5.1 Types of equipment

Stationary secondary batteries are defined by their physical construction. They shall be designed to be fixed installed and fixed connected to an electrical installation.

Various types of secondary cells, defined by their chemical composition, can be used.

EXAMPLE

a) lead acid;

b) nickel;

- nickel-cadmium (NiCd);
- nickel-metal-hydride (NiMH);

c) lithium-ion (Li-ion);

- lithium cobalt oxide (LiCoO2);
- lithium manganese oxide (LiMn2O4);
- lithium iron phosphate (LiFePO4);
- lithium nickel manganese cobalt oxide (LiNiMnCoO2);
- lithium nickel cobalt aluminium oxide (LiNiCoAlO2);
- lithium titanate (Li4Ti5O12);
- lithium ion polymer (LiPo);

d) zinc dibromide aqueous electrolyte.

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570.5.2 Selection of battery

The selection of capacity and battery types depends on many parameters such as:

- load characteristics;
- battery voltage;
- usable battery capacity;
- charge time and discharge time;
- converter connection.

The required usable capacity of batteries shall be estimated according to the following formulas:

$$\text{Capacity}(\text{Ah}) = \frac{\{\text{Load power}(\text{W})\} \text{ x } \{\text{Running time}(\text{h})\}}{\text{Battery voltage}(\text{V})}$$

$$\text{Capacity (Wk)} = \{\text{Load power (W)}\} \times \{\text{Running time (h)}\}$$

NOTE 1 Usable battery capacity can also depend on the ambient temperature and number of charging cycles.

NOTE 2 See Annex A for technical characteristics of secondary cells that can be relevant for the erection of stationary secondary batteries.

570.5.3 Converter

The type of converter shall be selected to be suitable for the type of battery and its application.

NOTE See Annex B for technical characteristics for battery load.

The AC voltage ripple shall be kept within the range specified by the battery manufacturer (see also Clause B.3).

Protective provisions and DC safety instructions shall be provided.

570.6 Selection and erection of electrical equipment

570.6.1 General

570.6.1.1 Main principle

A battery shall be considered as both supply and load. Therefore, energy can flow in both directions and safety devices shall be chosen accordingly.

The voltage at the battery terminals shall be assumed to be always present, therefore all safety precautions shall be taken considering this fact.

In general, battery protection shall address the following undesirable events or conditions, as applicable:

– excessive current during charging or discharging;
– short-circuit;
– overvoltage;
– overcharging;
– undervoltage – exceeding preset depth of discharge (DoD) limits;

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– extreme ambient temperatures (see A.2.2);
– overheating – exceeding a cell temperature limit;
– pressure build-up inside the cell;
– automatic disconnection of the battery from the connected system in case of an emergency.

Some batteries can include built-in protective devices which can provide several layers of additional protection.

EXAMPLE Lithium-ion battery built-in protection can include:
– excess of temperature;
– short-circuit current.

In all cases manufacture's instructions shall be complied with.

For Li-ion batteries the following risks shall be considered:

a) Faults which can be avoided by suitable monitoring of each cell for current (charge current is temperature dependent), voltage and temperature (U, I, T). If one or more cells were outside of one of their operating limits, they shall be considered as damaged and should not continue to operate.
b) Cell internal problems (short-circuits by dendrites, gassing, material degradation). These risks can be reduced by the selection of cells regarding quality and homogeneity. Refer also to IEC 62619:2017, 7.3. (internal short-circuits) and 7.3.3 (propagation test). Single cell defects can propagate by affecting other Li-ion cells nearby and can cause a slow chain reaction. The cells should be placed or separated in a way which avoids propagation.

For an erected battery made from Li-ion cells, the same safety requirements as for complete battery products shall at least comply with the requirements of IEC 62619.

Batteries intended for use by other than skilled or instructed persons shall be installed within enclosures which shall only be opened by a key or tools. See Annex C.

570.6.1.2 Protective earthing

Where an earthing arrangement is connected on the DC side of the converter, the converter shall have a galvanic separation.

To prevent circulating currents, the system shall be earthed at one point only.

Where the battery system is designed to be used in islanding mode, the earthing of the battery system during the island mode shall be designed in accordance with IEC 60364-8-82 and IEC 60364-5-54.

Where earthing is provided on the DC side, measures shall be taken to prevent the risk of electrolytic corrosion due to DC currents.

570.6.2 Measures for protection against electric shock

570.6.2.1 General

Where the protective measure consists in the automatic disconnection of supply or of the PELV system, battery racks or battery cabinets made from conductive material shall be connected to the protective conductor. Otherwise the battery racks or battery cabinet shall be insulated from the battery and its place of installation.

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Where batteries are installed in a dedicated room, the room shall be only accessible to instructed persons (BA4) or skilled persons (BA5) and a supplementary equipotential bonding shall be provided.

Where batteries are installed in a dedicated enclosure, the enclosure shall be only accessible by use of a key or tool.

570.6.2.2 Automatic disconnection of the supply

570.6.2.2.1 Converter without galvanic separation

Protection against electric shock shall be provided according to Table 1.

Table 1 – Protective measures where converter without galvanic separation is used

	TN – TT systems	IT system
Grid connected	RCD type B at the origin of the dedicated circuit connected to the battery	Automatic disconnection of supply at the origin of the dedicated circuit connected to the battery is required at the first fault
Island mode	RCD type B on the AC side of the converter and a RCD on the dedicated circuit connected to the battery system	Automatic disconnection of supply at the origin of the dedicated circuit connected to the battery system is required at the first fault

570.6.2.2.2 Converter with galvanic separation

In TT and TN systems, the converter shall be switched off on the DC side at the first fault and the System referencing conductor shall be switched off.

In IT systems, the converter shall be switched off on the DC side at the first fault.

570.6.2.3 Electrical separation

An electrical separation shall not be used.

570.6.2.4 SELV system or PELV system

Where the protective measure is a SELV system or a PELV system, the battery assembly and the converter shall comply with the requirements relating to the source for the SELV system and the PELV system.

570.6.3 Protection against thermal effects

The location or enclosure of fixed stationary secondary batteries shall be adequately ventilated in accordance with the manufacturer's instructions.

Electrical equipment liable to generate sparks, arcs or flames shall be installed at a safe distance from battery types that are able to produce gases.

570.6.4 Protection against short-circuit

570.6.4.1 Short-circuit current

Calculation of the battery short-circuit current reference shall be made in accordance with IEC 61660-1 and IEC 61660-2 as well as IEC 60896-21.

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570.6.4.2 Battery contribution

As a battery will operate as a continuous power source until the end of its discharge voltage is reached, it could be considered that the power delivered by the battery remains constant in all circumstances. However, the current will increase as the battery voltage declines during usage, or until the battery reaches the end of its discharge voltage lower limit. During abnormal conditions such as short-circuit, the current will be limited by the internal impedance of the battery and the inductance of the cable runs attached to the terminal.

570.6.4.3 Battery charger contribution

Estimation of the short-circuit current shall also consider the contribution of the battery charger. The charger output capacitances can generate a short spike for a few microseconds, then until the current limiting takes effect a few milliseconds later, the charger contribution to the short-circuit current will be limited by its internal resistance. Afterwards, the charger provides its current limit rating (see Figure 3).

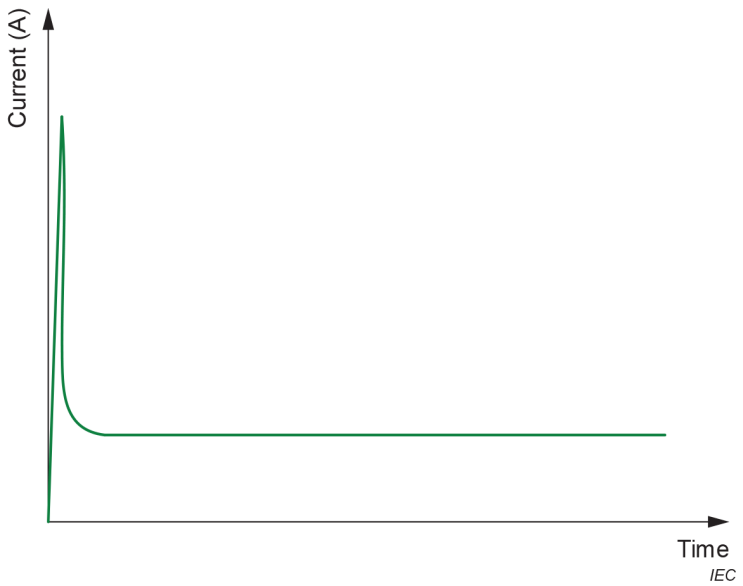

Figure 3 – Battery charger contribution to a DC system fault

570.6.5 Isolation

A battery system can be supplied by multiple sources. A battery system is considered as a source of supply. Every feeder connected to the battery system as an input and/or output shall be provided with a means of isolation in compliance with IEC 60364-5-53:2019, 536.2.

570.6.6 Unexpected islanding

Unexpected islanding shall be considered during the design of the installation.

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570.6.7 Protection against other hazards

The location or enclosure of fixed stationary secondary batteries shall provide measures of protection in accordance with the battery manufacturer's instructions to mitigate the following:

– risk of explosion;
– safety distances;
– unsuitable conditions arising by remote control;
– working space;
– egress and protection from physical hazards.

NOTE 1 See IEC TS 62933-5-1, IEC 62485-2 and IEC 62933-5-2.

NOTE 2 See Annex D for Identification labels and warning notices.

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Annex A
(informative)

Technical characteristics

A.1 Nominal voltage

Nominal voltages for each type of secondary cell follow an agreed convention as follows:

– Lead acid: The nominal voltage of a cell of lead acid is fixed at 2,00 V. The open circuit voltage (OCV) for a fully charged lead acid cell is normally in the range between 2,05 V to 2,15 V per cell.

  NOTE If lead batteries are stored for too long, especially at elevated temperatures without regular recharging, sulfation of the active mass will occur. This can irreversibly affect battery life and performance.

– Nickel-based: The nominal voltage of nickel-cadmium (NiCd) and nickel metal hybrid (NiMH) are fixed at 1,2V per cell.

– Lithium-ion: The nominal voltage of lithium-ion cells shall be taken from the manufacturer's instructions.

A.2 Discharge

A.2.1 Discharge voltage curve

The voltage of a secondary cell is fixed by the chemical reaction characteristics within the cell. The voltage at terminals depends on the load current and the internal impedance of the cell. This voltage can vary with the temperature, the amount the cell is charged and the age of the cell.

Figure A.1 shows typical discharge curves for different technologies of secondary cells when discharged at 20 % of their nominal capacity.

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