IEC 62840-2

Edition 1.0 2016-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electric vehicle battery swap system –
Part 2: Safety requirements

Système d'échange de batterie de véhicule électrique –
Partie 2: Exigences de sécurité

IEC 62840-2:2016-10(en-fr)

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Electric vehicle battery swap system – Part 2: Safety requirements

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ELECTRIC VEHICLE BATTERY SWAP SYSTEM –

Part 2: Safety requirements

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.

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International Standard IEC 62840-2 has been prepared by IEC technical committee 69: Electric road vehicles and electric industrial trucks.

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

FDIS	Report on voting
69/420/FDIS	69/433/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.

This standard is to be read in conjunction with IEC 62840-1:2016.

in this document, the following print types are used:

– requirements: in roman type;

– *test specifications: in italic type;*

– notes: in small roman type.

A list of all parts in the IEC 62840 series, published under the general title *Electric vehicle battery swap system*, can be found on the IEC website.

The following differing practices of a less permanent nature exist in the countries indicated below

– 7.6.1: RCDs of type AC may be used (Japan).

– 7.6.1: a device which measures leakage current over a range of frequencies and trips at pre-defined levels of leakage current, based upon the frequency, is required (United States).

– 10.4: three-part cautionary statements are required (United States).

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

INTRODUCTION

The purpose of the battery swap system is to provide energy partly or in total to electric vehicles (EV) through fast replacement of their swappable battery systems (SBS). While charging, the EV typically takes a relatively long time, whereas the battery swap process takes only a few minutes to complete. Thus it will reduce the range anxiety and will facilitate travel for longer distances.

As there is a possibility to charge the batteries after their removal from the vehicle in various ways, the impact of this process on the critical infrastructure of the electrical grid can be minimized.

Battery swap stations mainly include one or more of the following functions:

- swap of EV swappable battery system (SBS);
- storage of EV SBS;
- charging and cooling of EV SBS;
- testing, maintenance and safety management of EV SBS.

This part of IEC 62840 serves as a generic approach for safety during the lifecycle of battery swap systems and stations for electric vehicles.

ELECTRIC VEHICLE BATTERY SWAP SYSTEM –

Part 2: Safety requirements

1 Scope

This part of IEC 62840 provides the safety requirements for a battery swap system, for the purposes of swapping swappable battery system (SBS) of electric vehicles. The battery swap system is intended to be connected to the supply network. The power supply is up to 1 000 V AC or up to 1 500 V d.c, in accordance with IEC 60038.

This standard also applies to battery swap systems supplied from on-site storage systems (e.g. buffer batteries).

Aspects covered in this standard:

- safety requirements of the battery swap system and/or its systems;
- security requirements for communication;
- electromagnetic compatibility (EMC);
- signs and instructions;
- protection against electric shock and other hazards.

This standard is applicable to battery swap systems for EV equipped with one or more SBS.

NOTE Battery swap systems for light EVs according to the IEC 61851-3 series[1] are under consideration.

This standard is not applicable to:

- aspects related to maintenance and service of the battery swap station (BSS);
- trolley buses, rail vehicles and vehicles designed primarily for use off-road;
- maintenance and service of EVs.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038, *IEC standard voltages*

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

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

IEC 60364 (all parts), *Low-voltage electrical installations*

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1 Under consideration.

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

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

IEC 60364-7-722, *Low-voltage electrical installations – Part 7-722: Requirements for special installations or locations – Supply of electric vehicle*

IEC 60479 (all parts), *Effects of current on human beings and livestock*

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

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

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

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

IEC 60898-1, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation*

IEC 60947-2, *Low-voltage switchgear and control gear – Part 2: Circuit-breakers*

IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-4-1, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*
IEC 60950-1:2005/AMD1:2009
IEC 60950-1:2005/AMD2:2013

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

IEC 61008 (all parts), *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)*

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009 (all parts), *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)*

IEC 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

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

IEC 61439-1:2011, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 61508-1, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*

IEC 61511-1, *Functional safety – Safety instrumented systems for the process industry sector – Part 1: Framework, definitions, system, hardware and application programming requirements*

IEC 61784-3, *Industrial communication networks – Profiles – Part 3: Functional safety fieldbuses – General rules and profile definitions*

IEC 61810-1, *Electromechanical elementary relays – Part 1: General and safety requirements*

IEC 61851-23:2014, *Electric vehicle conductive charging system – Part 23: DC electric vehicle charging station*

IEC 62052-11, *Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 11: Metering equipment*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

IEC 62423, *Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses*

IEC 62840-1:2016, *Electric vehicle battery swap system – Part 1: General and guidance*

ISO 2972, *Numerical control of machines – Symbols*

ISO 7000, *Graphical symbols for use on equipment – Registered symbols*

ISO 10218-1, *Robots and robotic devices – Safety requirements for industrial robots – Part 1: Robots*

ISO 10218-2, *Robots and robotic devices – Safety requirements for industrial robots – Part 2: Robot systems and integration*

ISO 12405-1, *Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 1: High-power applications*

ISO 13849-1, *Safety of machinery –Safety-related parts of control systems – Part 1: General principles for design*

ISO 14119, *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62840-1 and the following apply.

3.1
hazard
potential source of injury or death

3.2
operator
trained personnel who installs, operates, adjusts, maintains, cleans, repairs or works in the battery swap station premises

3.3
direct contact
electric contact of persons or animals with live parts

[SOURCE: IEC 60050-195:1998, 195-06-03]

3.4
indirect contact
electric contact of persons or animals with exposed-conductive-parts which have become live under fault conditions

[SOURCE: IEC 60050-195:1998, 195-06-04]

3.5
live part
conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

[SOURCE: IEC 60050-195:1998, 195-02-19, modified — The note to entry has been deleted.]

3.6
risk
combination of the probability of occurrence of harm and the severity of that harm

Note 1 to entry: In French, the term “risque” also denotes the potential source of harm, in English “hazard” (see 903-01-02). [ISO/IEC Guide 51:1999, definition 3.2]

[SOURCE: IEC 60050-903:1998, 903-01-07]

3.7
real time
pertaining to the processing of data by a computer in connection with another process outside the computer according to time requirements imposed by the outside process

[SOURCE: IEC 60050-714:1992, 714-21-03]

3.8
alternating current
AC
electric current that is a periodic function of time with a zero direct component or, by extension, a negligible direct component

Note 1 to entry: This note only applies to the French language.

[SOURCE: IEC 60050-131:2002, 131-11-24, modified — The note to entry has been replaced by another one.]

3.9
direct current
DC
electric current that is time-independent or, by extension, periodic current the direct component of which is of primary importance

Note 1 to entry: This note only applies to th French language.

[SOURCE: IEC 60050-131:2002, 131-11-22, modified — The note to entry has been replaced by another one.]

3.10
residual current device
RCD
a mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions

[SOURCE: IEC 60050-442:1998, 442-05-02, modified — The note to entry has been deleted.]

4 General

The battery swap system shall be rated for one, or a range of, standard nominal voltages according to IEC 60038. The safe operation of a battery swap system will be achieved by fulfilling the relevant requirements specified in this standard, and compliance is checked by carrying out all relevant tests.

The battery swap system shall be so designed and constructed that in normal use its performance is reliable and minimizes the risk of danger to the human individuals, equipment and surroundings.

In general, this principle is achieved by fulfilling the relevant requirements specified by this standard and IEC 62840-1, together with IEC 61851-21-2 [2]. Compliance is checked by carrying out the relevant tests.

Unless otherwise stated, tests may be conducted on separate samples at the discretion of the manufacturer.

Unless otherwise specified, all other tests shall be carried out in the order of the clauses and subclauses in this standard.

The electrical interface and communication interface characteristics of the battery swap system will be specified in another part of the IEC 62840 series.

5 Safety requirements of systems

5.1 General

The battery swap system for electrical vehicles shall be in accordance with IEC 60204-1, IEC 61511-1 and ISO 13849-1. Specific requirements are the subject of this standard.

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2 Under consideration.

5.2 Lane system

5.2.1 Vehicle lane

At the entrance to the lane, the EV information shall be identified and fed into the supervisor and control system in order to use the right parameters and components for this vehicle.

The lane may include a cleaning station for the purposes of cleaning EV/battery parts before the swap process starts. All lane system components shall be able to resist the effect of automotive solvents and fluids.

Drivers and passengers may be allowed to stay on-board during the battery swap process. The lane system shall be built in such a manner that humans and EVs are not at risk as a result of movement of mechanical parts or as a result of open underground cavities.

5.2.2 Measures in case of emergency

During each phase of the battery swap process, the driver (if on board) and system operators should have immediate access to emergency stop buttons to stop all automation motions in case of emergency.

The lane shall be equipped with suitable escape routes and emergency exits allowing people (if on board), including disabled persons, children and infants to evacuate from the lane area in case of fire or other emergency.

All marking, routing and geometry of escape routes and exits should be done according to local regulations.

5.3 Battery handling system

5.3.1 Interlock protection guarding

In automatic mode, a door or a sensor system shall be installed to prevent an unauthorized person gaining access to the battery swap zone:

- if a door or access is opened, the system has to stop;
- the system can only operate if all accesses are closed;
- a door can be opened from outside only if the system stops;
- a door, if one exists, shall be able to open from inside in any case;
- a restart can only be performed if all accesses are closed and no person is inside the zone;
- ISO 14119 applies.

5.3.2 Interlock with the lane

The battery handling system shall only be enabled to operate when the vehicle is immobilized and/or the vehicle powertrain is turned off.

During the battery handling process, the vehicle on the lane shall be immobilized by specific measures (e.g. chocking and blocking the wheels, hand braking, turning off the powertrain).

5.3.3 Battery handling process

Battery handling systems shall have an emergency procedure when the SBS to be removed from vehicle is suffering from a contact welding malfunction.

In automatic mode and semi-automatic mode, the battery handling system shall communicate with the supervisory and control system. The operator should control the battery handling

system remotely through the human machine interface (HMI) or a remote control device which allows the operator to be located a safe distance away from any moving parts.

The battery handling system shall be able to detect if the SBS has been unlocked successfully before it moves the SBS out of the vehicle, and detect if the SBS is locked after it moves the SBS into the vehicle.

An automatic battery handling system shall have the function of detecting presence of SBS in the storage compartment to prevent an SBS being loaded into a compartment which is already occupied by another SBS.

The battery handling system shall be designed in such a manner that deflections of structural parts generated by SBS's weight and/or acceleration of the system moving parts will not cause SBS to fall down from their supports.

If the battery handling system is using a crane or lift type devices, all relevant safety measures appearing in the regional machinery directive shall be respected.

Mechanical safety requirements for handling system shall be in accordance with ISO 10218-1 and ISO 10218-2 as far as applicable.

5.3.4 Measures in case of emergency

In the event of a grid power outage (loss of electrical power), the battery handling system shall have a function that prevents the battery handling system from releasing unsafely.

The battery handling system of either automatic mode or semi-automatic mode shall have emergency operation mode and manual operation mode.

An emergency stop device shall be provided, so that the operator can stop the battery handling system immediately in case of emergency.

Detecting and warning devices or relevant protection measures are recommended in case of a human or an animal having unexpected proximity to the system.

5.4 Storage system

5.4.1 Battery storage

The storage condition provided by the battery storage system shall comply with the specific requirements of SBS. Structural elements carrying SBS in battery storage system shall be rigid and precise enough to prevent a risk of a SBS falling down from a storage compartment.

Structural elements supporting SBS in the storage system shall be secured to the ground or to the wall in such a manner that the structure shall not collapse under SBS weight or as the result of impact or vibration, such as failure in undesired motion of automatic devices against battery storage.

If SBS is not fully sealed, each SBS shall be separated by coverage from other SBS stored in the same rack by at least IP4x.

If SBS is not fully sealed, each SBS shall be protected by coverage to avoid liquid drops from other SBS stored in the same rack by at least IPx2.

The storage system shall be designed and constructed in accordance with local construction regulations. The storage rack shall be equipped with locking device to prevent unintended motion of SBS, and provide locking state information to the supervisor and control system.