BSI Standards Publication

Electric vehicle battery swap system

Part 3: Particular safety and interoperability requirements for battery swap systems operating with removable RESS/battery systems

Documents
Document Sharing Hub

National foreword

This Published Document is the UK implementation of IEC PAS 62840-3:2021.

The UK participation in its preparation was entrusted to Technical Committee PEL/69, Electric vehicles.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication is not to be regarded as a British Standard.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 580 95472 6

ICS 43.120

Compliance with a Published Document cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 October 2021.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

IEC PAS 62840-3

Edition 1.0 2021-09

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

Electric vehicle battery swap system –
Part 3: Particular safety and interoperability requirements for battery swap systems operating with removable RESS/battery systems

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 43.120

ISBN 978-2-8322-1031-6

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 8
3 Terms and definitions 9
4 Abbreviated terms 12
5 General requirements 12
6 Classification 13
6.8 Automation level 13
7 Requirements for battery swap system 13
7.1 General 13
7.2 Battery swap station (BSS) 14
7.2.1 General 14
7.2.2 Lane systems 15
7.2.3 Handling system 15
7.2.4 Requirements for storage system 16
7.2.5 Charging system 18
7.2.6 Supervisory and control system 18
7.3 Supporting systems (optional) 18
7.4 Removable battery systems 18
7.4.1 General 18
7.4.2 Interoperability requirements 19
7.5 Power supply system (optional) 19
7.6 Interfaces 19
7.7 Zones of accessibility 19
8 Communications 20
9 Protection against electric shock 20
10 Specific requirements for accessories 20
11 Cable assembly requirements 20
12 DRI EV supply equipment constructional requirements and tests 20
12.3 IP degrees 20
13 Overload and short-circuit protection 20
14 Emergency switching or disconnect (optional) 20
15 Marking and instructions 21
15.1 Installation manual 21
Annex A (informative) Use cases 22
A.1 General 22
A.2 Use case description 22
A.2.1 Convenience store device (attended) 22
A.2.2 Unattended locking compartment 23
A.2.3 Battery exchange box 26
A.2.4 Automatic battery exchange box 28
A.2.5 Automatic vehicle storage system 29
Annex B (informative) Examples of BSS wirings for removable battery systems 32
B.1 General 32

AVA Documents
Document Sharing Hub
Full document details: PD IEC PAS 62840-3:2021

B.2 Example of a BSS wiring providing independent VCU for each battery system 32
B.3 Example of a BSS wiring providing common VCU for all battery systems 34
Annex C (informative) Examples of BSS for stackable removable battery systems 35
C.1 General 35
C.2 Connection of battery systems connected together 35
Bibliography 38

Figure 1 – Composition of the battery swap system 14
Figure B.1 – Example of a removable battery system wiring (for information) 32
Figure B.2 – Example of a BSS wiring providing independent VCU for each battery system 33
Figure B.3 – Example of a BSS wiring providing common VCU for all battery systems 34
Figure C.1 – Example of a stackable removable battery system wiring 35
Figure C.2 – Example of a BSS for stackable removable battery systems 36
Figure C.3 – Connection of battery systems connected together 37

Table 1 – Sub-systems mandatory for use-cases 14
Table 2 – Interoperability requirements 19
Table A.1 – UC convenience store device (attended) 22
Table A.2 – UC unattended locking compartment DC 24
Table A.3 – UC unattended locking compartment AC 25
Table A.4 – UC battery exchange box 27
Table A.5 – UC automatic battery exchange box 29
Table A.6 – UC automatic vehicle storage system 30

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRIC VEHICLE BATTERY SWAP SYSTEM –

Part 3: Particular safety and interoperability requirements for battery swap systems operating with removable RESS/battery systems

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.

A PAS is an intermediate specification made available to the public and needing a lower level of consensus than an International Standard to be approved by vote (simple majority).

IEC PAS 62840-3 has been processed by IEC technical committee 69: Electrical power/energy transfer systems for electrically propelled road vehicles industrial trucks.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
69/749/DPAS	69/772/RVDPAS

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

This PAS shall remain valid for an initial maximum period of 2 years starting from the publication date. The validity may be extended for a single period up to a maximum of 2 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

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.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

INTRODUCTION

The IEC 62840 series is published in separate parts according to the following structure:

IEC TS 62840-1: Electric vehicle battery swap system – Part 1: General and guidance

IEC 62840-2: Electric vehicle battery swap system – Part 2: Safety requirements

IEC PAS 62840-3: Electric vehicle battery swap system – Part 3: Particular safety and interoperability requirements for battery swap systems operating with removable RESS/battery systems

This document derives from IEC 61851-3 (all parts) and was established by IEC TC 69 WG10 as a referencing document to IEC TS 61851-3-1.

NOTE In this document, EV supply equipment configuration type F according to IEC TS 61851-3-1 for removable battery systems is named "battery swap station".

After moving of the document to IEC TC 69 WG13, IEC TC 69 decided to publish the document as PAS based on IEC TS 61851-3-3 as an intermediate specification, which responds to particular market needs according to 2.4.8 of ISO/IEC Directives, Part 1:2020, published prior to the development of a full International Standard.

For this reason, this document is to be used in conjunction with IEC 61851-3 (all parts).

By the upcoming revision of IEC 62840 (all parts), this document will be fully integrated into the IEC 62840 series.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

ELECTRIC VEHICLE BATTERY SWAP SYSTEM –

Part 3: Particular safety and interoperability requirements for battery swap systems operating with removable RESS/battery systems

1 Scope

This document applies to battery swap systems for removable RESS of electric road vehicle when connected to the supply network, with a rated supply voltage up to 480 V AC or up to 400 V DC, for battery systems with a rated voltage up to 120 V DC.

NOTE 1 In the following countries, the acceptable nominal supply voltage is up to 600 V AC: CA, US.

This document applies to battery swap systems for removable RESS/EV where the removable RESS/EV is stored for the purpose of transfer power between the battery swap station and removable RESS/EV.

Requirements for bidirectional energy transfer DC to AC are under consideration and are not part of this document.

This document applies to:

– battery swap systems supplied from on-site storage systems (for example buffer batteries etc);
– manual, mechanically assisted and automatic systems;
– battery swap systems intended to supply removable battery systems having communication allowing to identify the battery system characteristics;
– battery swap systems intended to be installed at an altitude of up to 2 000 m.

The aspects covered in this document include:

– requirements for power transfer between the battery systems;
– additional requirements for communication;
– the connection to supply network.

Additional requirements may apply to special locations.

This document does not apply to:

– safety requirements for mechanical equipment covered by ISO 10218 (all parts);
– locking compartments systems providing AC socket-outlets for the use of manufacturer specific voltage converter units and manufacturer specific battery systems;
– safety aspects related to maintenance;
– electrical devices and components which are covered by their specific product standards;
– trolley buses, rail vehicles;
– any on-board equipment which is covered by ISO;
– EMC requirements for on-board equipment while connected to the supply, which are covered by IEC 61851-21-1.

Requirements for battery swap systems using protective measures as covered by 410 of IEC 60364-4-41:2005 other than double or reinforced insulation are under consideration.

AVA Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

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 60038, *IEC standard voltages*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC TS 61851-3-1:—, *Electric vehicles conductive power supply system – Part 3-1: Particular requirements for EV supply equipment where protection relies on double or reinforced insulation – AC and DC conductive power supply systems*[1]

IEC TS 61851-3-2: —, *Electric vehicles conductive power supply system – Part 3-2 Particular requirements for EV supply equipment where protection relies on double or reinforced insulation – Portable and mobile DRI EV supply equipment*[2]

IEC TS 61851-3-4: —, *Electric vehicles conductive power supply system – Part 3-4 Particular requirements for EV supply equipment where protection relies on double or reinforced insulation – General definitions and requirements for CANopen communication*[3]

IEC TS 61851-3-5: —, *Electric vehicles conductive power supply system – Part 3-5 Particular requirements for EV supply equipment where protection relies on double or reinforced insulation – Pre-defined communication parameters and general application objects*[4]

IEC TS 61851-3-6: —, *Electric vehicles conductive power supply system – Part 3-6: Particular requirements for EV supply equipment where protection relies on double or reinforced insulation – Voltage converter unit communication*[5]

IEC TS 61851-3-7: —, *Electric vehicles conductive power supply system – Part 3-7: Particular requirements for EV supply equipment where protection relies on double or reinforced insulation – Battery system communication*[6]

IEC TS 62196-4:—, *Plugs, socket-outlets, vehicle connectors and vehicles inlet – Conductive charging of electric vehicles – Part 4: Dimensional compatibility and interchangeability requirements for DC pin and contact-tube accessories for class II or class III applications*[7]

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

IEC 62840-2:2016, *Electric vehicle battery swap system – Part 2: Safety requirements*

---

[1] Under preparation. Stage at the time of publication: IEC ADTS 61851-3-1:2021.

[2] Under preparation. Stage at the time of publication: IEC ADTS 61851-3-2:2021.

[3] Under preparation. Stage at the time of publication: IEC RPUB 61851-3-4:2021.

[4] Under preparation. Stage at the time of publication: IEC RPUB 61851-3-5:2021.

[5] Under preparation. Stage at the time of publication: IEC RPUB 61851-3-6:2021.

[6] Under preparation. Stage at the time of publication: IEC RPUB 61851-3-7:2021.

[7] Under preparation. Stage at the time of publication: IEC BPUB TS 62196-4:2021.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

IEC TS 63066:2017, *Low-voltage docking connectors for removable energy storage units*

ISO 10218-1:2011, *Robots and robotic devices – Safety requirements for industrial robots – Part 1: Robots*

ISO 10218-2:2011, *Robots and robotic devices – Safety requirements for industrial robots – Part 2: Robot systems and integration*

ISO 19353:2019, *Safety of machinery – Fire prevention and fire protection*

EN 14470 (all parts), *Fire safety storage cabinets*

EN 50604-1:2016, *Secondary lithium batteries for light EV (electric vehicle) applications – Part 1: General safety requirements and test methods*
EN 50604-1:2016/AMD1:2021

3 Terms and definitions

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
battery swap system
battery swap station and supporting systems

[SOURCE: IEC TS 62840-1:2016, 3.2]

3.2
battery swap station
BSS
facility that provides a removable battery swap service for EVs and client

Note 1 to entry: In the context of this document, BSS is representing the DRI EV supply equipment type F according to IEC TS 61851-3-1.

[SOURCE: IEC TS 62840-1:2016, 3.4 modified – Addition of Note 1]

3.3
supporting system
system which serves the battery swap station

[SOURCE: IEC TS 62840-1:2016, 3.3]

3.4
battery pack
energy storage device that includes cells or cell assemblies normally connected with cell electronics, power supply circuits and overcurrent shut-off device, including electrical interconnections, interfaces for external systems

Note 1 to entry: See Clause A.2 of ISO 12405-4:2018 for further explanations.

Note 2 to entry: Examples of external systems are cooling, voltage class B, auxiliary voltage class A and communication

[SOURCE: ISO 12405-4:2018, 3.2]

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

3.5
battery swap equipment
swap equipment
equipment used for mounting/unmounting removable battery system to/from EVs

Note 1 to entry: The battery transferring function may be integrated in the battery swap equipment

[SOURCE: IEC TS 62840-1:2016, 3.13, modified – SBS is replaced by removable battery system.]

3.6
handling system
equipment that provides the function of moving, positioning or otherwise manipulating removable battery systems

Note 1 to entry: Handling system could be a part of BSS or external to the BSS.

3.7
battery control unit
BCU
electronic device that controls, manages, detects or calculates electric and thermal functions of the battery system and that provides communication between the battery system and other vehicle controllers

Note 1 to entry: See also Annex A for further explanation.

[SOURCE: ISO 12405-4:2018, 3.1]

3.8
battery management system
BMS
local energy management system (EMS unit) for the battery system, protecting the battery system from damage, monitoring and increasing the lifetime, and maintaining the functional state

Note 1 to entry: BMS and BCU (according to ISO 12405 all parts) do not have the same functions.

[SOURCE: IEC TS 61851-3-4, 3.7]

3.9
removable battery system
removable RESS
RBS
battery system/RESS that can be moved/removed from an EV by hand (portable RESS) or with the assistance of an installation/device (mobile RESS)

3.10
RESS coupler
means enabling the connection of RESS to an EV or a DRI EV supply equipment

3.11
double or reinforced insulated EV supply equipment
DRI EV supply equipment
EV supply equipment in which protection against electric shock relies on double insulation or reinforced insulation, there being no provision for protective earthing or reliance upon installation conditions

[SOURCE: IEC TS 61851-3-1:—, 3.1.1]

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

3.12
EV supply system
complete system including the DRI EV supply equipment and the EV/RESS functions that are required to transfer power between the fixed installation or supply network and the EV/RESS

[SOURCE: IEC TS 61851-3-1:—, 3.1.2]

3.13
charging
all functions necessary to condition voltage and/or current provided by the AC or DC supply network to assure the supply of electric energy to the RESS

[SOURCE: IEC 61851-1:2017, 3.1.8]

3.14
voltage converter
set of equipment to convert one type of electric current to another type different in nature, voltage and/or frequency

[SOURCE: IEC 60050-811:2017, 811-19-01, modified – The word "voltage" has been added to the term, and the words "static or rotating" has been deleted from the definition.]

3.15
voltage converter unit
VCU
voltage converter with local EMS and communication interface

[SOURCE: IEC TS 61851-3-1:—, 3.1.8]

3.16
DC power circuit
circuit for DC conductive power transfer

[SOURCE: IEC TS 61851-3-1:—, 3.1.11]

3.17
gateway
functional unit that connects two networks with different network architectures and protocols

[SOURCE: IEC 60050-732:1998, 732-01-17, modified – The words "computer networks" has been replaced by "networks" in the definition, and Note 1 and 2 have been deleted.]

3.18
energy management system
EMS
system consisting of active and passive devices for controlling the power transfer

[SOURCE: IEC TS 61851-3-1:—, 3.3.3]

3.19
active device
device connected to DC power circuit, AUX circuit and CAN circuit

[SOURCE: IEC TS 61851-3-1:—, 3.3.4]

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021

3.20
passive device
device connected to AUX circuit and CAN circuit

[SOURCE: IEC TS 61851-3-1:—, 3.3.5]

3.21
energy management system controller
EMSC
device or virtual device that manages the communication as well as the energy exchange

[SOURCE: IEC TS 61851-3-4:—, 3.9]

4 Abbreviated terms

BCU	battery control unit
BMS	battery management system
BSS	battery swap station
EMSC	energy management system controller
EMS	energy management system
HMI	human machine interface
SOC	state of charge
SOH	state of health
VCU	voltage converter unit

5 General requirements

The battery swap system for removable battery systems described in this document allows simultaneous connection of removable battery systems to the BSS independent of their state of charge (SOC), state of health (SOH), chemistry and performance.

EV supply system configuration type F according to 6.7 of IEC TS 61851-3-1:— is considered to be stationary equipment according to a) of 6.6 of IEC TS 61851-3-1:— (see also 7.2.1).

The BSS shall be rated for one or a range of standard nominal voltages as given in IEC 60038.

NOTE 1 In the following countries, standard nominal voltages are given in CAN3-C235-83: CA.

For extreme environment or other special service conditions, see IEC 61439-7:2018.

Unless otherwise specified, the tests shall be carried out in a draught-free location and at an ambient temperature of 20°C ± 5°C.

For robots and robotic devices and their integration into the BSS, a hazard identification and risk assessment shall be provided according to Clause 4 of ISO 10218-1:2011 or ISO 10218-2:2011 and under consideration of Annex A and Annex F of ISO 10218-1:2011 or Annex A and Annex G of ISO 10218-2:2011 depending on the application.

NOTE 2 For BSS with more than one robot systems implemented in the same application, ISO 10218-2 is applicable.

Additional attention regarding hazards of fire shall be given by the risk assessment considering ISO 19353:2019.

All tests indicated in this document are type tests unless otherwise mentioned.

Documents
Document Sharing Hub

Full document details: PD IEC PAS 62840-3:2021