

TECHNICAL SPECIFICATION



Electric vehicle battery swap system – Part 1: General and guidance

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 43.120

ISBN 978-2-8322-3489-1

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

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	7
4 System overview	9
4.1 Battery swap system	9
4.2 Battery swap station.....	10
4.2.1 General description.....	10
4.2.2 Lane system	10
4.2.3 Battery handling system	11
4.2.4 Storage system	11
4.2.5 Charging system	11
4.2.6 Supervisory and control system.....	11
4.3 Supporting systems (optional)	12
4.3.1 General supporting systems	12
4.3.2 SBS logistic system	12
4.3.3 Battery maintenance system.....	12
4.4 Swappable battery system.....	12
4.5 Power supply system.....	12
4.6 Interfaces.....	12
4.7 Zones	13
4.7.1 General	13
4.7.2 Vehicle lane zone.....	13
4.7.3 Battery swap zone	13
4.7.4 Battery storage zone	14
4.7.5 Battery charging zone	14
5 Classification.....	15
5.1 General.....	15
5.2 Automation level	15
5.2.1 General	15
5.2.2 Full automatic	15
5.2.3 Semi-automatic.....	15
5.2.4 Manual mode	16
5.3 SBS swapping direction.....	16
5.4 EV categories	16
5.5 Environmental conditions	16
Annex A (informative) Use case	17
A.1 Use case for positioning vehicle	17
A.2 Use case for swapping battery pack.....	17
A.3 Use case for charging SBS.....	18
A.4 Use case for maintaining SBS	18
A.5 Use case for emergency charging vehicle	18
Annex B (informative) Battery swap station solutions.....	20
B.1 General.....	20

B.2	Commercial vehicles battery swap station.....	22
B.2.1	Automatic side-swapping station	22
B.2.2	Automatic top-swapping station	22
B.3	Passenger cars battery swap station.....	23
B.3.1	Semi-automatic rear-swapping station	23
B.3.2	Automatic bottom-swapping station	24
B.3.3	Automatic side-swapping station	25
Bibliography	27
Figure 1	– EV battery swap system	10
Figure B.1	– Automatic side-swapping station layout	22
Figure B.2	– Automatic top-swapping station layout	23
Figure B.3	– Semi-automatic rear-swapping station layout	24
Figure B.4	– Automatic bottom-swapping station layout	25
Figure B.5	– Automatic side-swapping station layout	26
Table 1	– Accessibility of vehicle lane zone	13
Table 2	– Accessibility of battery swap zone.....	14
Table 3	– Accessibility of battery storage zone	14
Table 4	– Accessibility of battery charging zone	15
Table A.1	– Use case for positioning vehicle.....	17
Table A.2	– Use case for swapping battery pack.....	17
Table A.3	– Use case for charging SBS	18
Table A.4	– Use case for maintaining SBS	18
Table A.5	– Use case for emergency charging vehicle	19
Table B.1	– Key index of the systems in different types of battery swap stations	21

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRIC VEHICLE BATTERY SWAP SYSTEM –

Part 1: General and guidance

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.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62840-1, which is a Technical Specification, has been prepared by IEC technical committee 69: Electric road vehicles and electric industrial trucks.

The text of this Technical Specification is based on the following documents:

Enquiry draft	Report on voting
69/368/DTS	69/399/RVC

Full information on the voting for the approval of this technical specification 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.

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 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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The purpose of the battery swap system is to provide energy partly or in total to electric road vehicles (EVs) through fast replacement of their swappable battery system (SBS). While charging, the EV typically takes a relatively long time, the battery swap process takes only a few minutes to complete. Thus it will reduce 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 is 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 document serves as generic requirements for battery swap systems for EVs.

The IEC 62840 series includes two parts:

- IEC 62840-1: General and guidance;
- IEC 62840-2: Safety requirements.

ELECTRIC VEHICLE BATTERY SWAP SYSTEM –

Part 1: General and guidance

1 Scope

This part of IEC 62840, which is a Technical Specification, gives the general overview for battery swap systems, for the purposes of swapping batteries of electric road vehicles (EVs) when the vehicle powertrain is turned off and when the battery swap system is connected to the supply network at standard supply voltages according to IEC 60038 with a rated voltage up to 1 000 V AC and up to 1 500 V DC.

This document is applicable for battery swap systems for EV equipped with one or more swappable battery system (SBS).

NOTE Battery swap systems for light electric vehicles (LEVs) according to the IEC 61851-3¹ series are under consideration.

This document 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*

¹ Under consideration.