

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Electric vehicle conductive charging system –
Part 1: General requirements**

**Système de charge conductive pour véhicules électriques –
Partie 1: Exigences générales**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2017 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Electric vehicle conductive charging system –
Part 1: General requirements**

**Système de charge conductive pour véhicules électriques –
Partie 1: Exigences générales**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 43.120

ISBN 978-2-8322-3766-3

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	9
INTRODUCTION.....	12
1 Scope.....	14
2 Normative references	15
3 Terms and definitions	17
3.1 Electric supply equipment	17
3.2 Insulation.....	19
3.3 Functions.....	20
3.4 Vehicle	21
3.5 Cords, cables and connection means.....	21
3.6 Service and usage	24
3.7 General terms.....	25
4 General requirements	27
5 Classification.....	27
5.1 Characteristics of power supply and output.....	27
5.1.1 Characteristics of power supply input.....	27
5.1.2 Characteristics of power supply output	28
5.2 Normal environmental conditions	28
5.3 Special environmental conditions.....	28
5.4 Access.....	28
5.5 Mounting method	28
5.6 Protection against electric shock.....	28
5.7 Charging modes.....	29
6 Charging modes and functions	29
6.1 General.....	29
6.2 Charging modes.....	29
6.2.1 Mode 1	29
6.2.2 Mode 2	30
6.2.3 Mode 3	30
6.2.4 Mode 4	30
6.3 Functions provided in Mode 2, 3 and 4.....	31
6.3.1 Mandatory functions in Modes 2, 3, and 4.....	31
6.3.2 Optional functions for Modes 2, 3 and 4.....	32
7 Communications	33
7.1 Digital communication between the EV supply equipment and the EV	33
7.2 Digital communication between the EV supply equipment and the management system	34
8 Protection against electric shock	34
8.1 Degrees of protection against access to hazardous-live-parts	34
8.2 Stored energy	35
8.2.1 Disconnection of plug connected EV supply equipment.....	35
8.2.2 Loss of supply voltage to permanently connected EV supply equipment	35
8.3 Fault protection.....	35
8.4 Protective conductor	35
8.5 Residual current protective devices.....	36

8.6	Safety requirements for signalling circuits between the EV supply equipment and the EV	37
8.7	Isolating transformers	37
9	Conductive electrical interface requirements	37
9.1	General	37
9.2	Functional description of standard accessories	37
9.3	Functional description of the basic interface	38
9.4	Functional description of the universal interface	38
9.5	Functional description of the DC interface	38
9.6	Functional description of the combined interface	38
9.7	Wiring of the neutral conductor	38
10	Requirements for adaptors	39
11	Cable assembly requirements	39
11.1	General	39
11.2	Electrical rating	39
11.3	Dielectric withstand characteristics	40
11.4	Construction requirements	40
11.5	Cable dimensions	40
11.6	Strain relief	40
11.7	Cable management and storage means for cables and assemblies	40
12	EV supply equipment constructional requirements and tests	41
12.1	General	41
12.2	Characteristics of mechanical switching devices	41
12.2.1	General	41
12.2.2	Switch and switch-disconnector	41
12.2.3	Contactors	42
12.2.4	Circuit-breaker	42
12.2.5	Relays	42
12.2.6	Inrush current	42
12.2.7	Residual direct current monitoring device (RDC MD)	42
12.3	Clearances and creepage distances	42
12.4	IP degrees	43
12.4.1	Degree of protection against solid foreign objects and water for the enclosures	43
12.4.2	Degree of protection against solid foreign objects and water for basic, universal and combined and DC interfaces	43
12.5	Insulation resistance	44
12.6	Touch current	44
12.7	Dielectric withstand voltage	45
12.7.1	AC withstand voltage	45
12.7.2	Impulse dielectric withstand (1,2 μ s/50 μ s)	45
12.8	Temperature rise	45
12.9	Damp heat functional test	46
12.10	Minimum temperature functional test	46
12.11	Mechanical strength	46
13	Overload and short-circuit protection	46
13.1	General	46
13.2	Overload protection of the cable assembly	47
13.3	Short-circuit protection of the charging cable	47

14	Automatic reclosing of protective devices	47
15	Emergency switching or disconnect (optional)	48
16	Marking and instructions	48
16.1	Installation manual of EV charging stations	48
16.2	User manual for EV supply equipment	49
16.3	Marking of EV supply equipment	49
16.4	Marking of charging cable assemblies case B	49
16.5	Durability test for marking	50
Annex A (normative) Control pilot function through a control pilot circuit using a PWM signal and a control pilot wire.....		51
A.1	General.....	51
A.2	Control pilot circuit.....	51
A.2.1	General	51
A.2.2	Typical control pilot circuit	52
A.2.3	Simplified control pilot circuit	53
A.2.4	Additional components and high frequency signals	53
A.3	Requirements for parameters and system behaviour	54
A.4	Test procedures	72
A.4.1	General	72
A.4.2	Constructional requirements of the EV simulator	72
A.4.3	Test procedure	72
A.4.4	Oscillator frequency and generator voltage test	73
A.4.5	Duty cycle test.....	73
A.4.6	Pulse wave shape test.....	74
A.4.7	Sequences test.....	74
A.4.8	Test of interruption of the protective conductor	76
A.4.9	Test of short-circuit value of the voltage.....	76
A.4.10	Example of a test simulator of the vehicle (informative)	76
A.4.11	Optional hysteresis test.....	79
A.5	Implementation hints	80
A.5.1	Retaining a valid authentication until reaching CP State B	80
A.5.2	Load control during transitions between state x1 and x2	81
A.5.3	Information on difficulties encountered with some legacy EVs for wake-up after a long period of inactivity (informative)	81
Annex B (normative) Proximity detection and cable current coding circuits for the basic interface		82
B.1	Circuit diagram for vehicle couplers using an auxiliary switch associated with the proximity detection contact.....	82
B.2	Circuit for simultaneous proximity detection and current coding	83
Annex C (informative) Examples of circuit diagrams for a basic and universal vehicle couplers.....		86
C.1	General.....	86
C.2	Circuits diagrams for Mode 1, Mode 2 and Mode 3, using a basic single phase vehicle coupler	86
C.3	Circuits diagrams for Mode 3, using a basic single phase or three-phase accessory without proximity switch.....	90
C.4	Example of circuit diagram for Mode 4 connection using universal coupler.....	91
Annex D (informative) Control pilot function that provides LIN communication using the control pilot circuit.....		93
D.1	Overview.....	93

D.1.1	General	93
D.1.2	LIN-CP features	93
D.1.3	Normative references	93
D.1.4	Terms and abbreviations	94
D.2	Scope and context	94
D.3	Overview of control pilot functions	96
D.4	Control pilot circuit	97
D.4.1	General	97
D.4.2	Control pilot circuit	97
D.4.3	Charging station control pilot circuit interface	98
D.4.4	EV control pilot circuit interface	99
D.4.5	LIN communication transceiver	99
D.4.6	Optional cable assembly node	100
D.5	Control pilot circuit interaction	100
D.5.1	General	100
D.5.2	Control pilot circuit states and transitions	101
D.6	System requirements	102
D.6.1	General	102
D.6.2	Control of LIN signals	102
D.6.3	Control of the S2 switch and the vehicle load current	103
D.6.4	Control of the switching device in the charging station	103
D.6.5	Control of latching and unlatching of IEC 62196-2 type 2 socket-outlets and vehicle inlets	104
D.7	Charging sequences	105
D.7.1	General	105
D.7.2	Start-up of normal AC charging sequence	105
D.7.3	Normal EV-triggered stop of charging	107
D.7.4	Normal stop of charging triggered by charging station	109
D.8	LIN Communication	110
D.8.1	General	110
D.8.2	Schedules	110
D.8.3	Frames	117
D.8.4	Signals	120
D.9	Requirements for charging stations and EVs that implement both LIN-CP and PWM-CP	128
D.9.1	General	128
D.9.2	Interoperability between charging stations and EVs	128
D.9.3	Control pilot circuit hardware	129
D.9.4	Control pilot circuit functionality	129
D.9.5	Sequence to select LIN-CP or PWM-CP after plug-in	130
D.10	Procedures for test of charging stations	131
D.10.1	General	131
D.10.2	Test of normal use	131
D.10.3	Test of disconnection under load	131
D.10.4	Overcurrent test	132
D.10.5	Test of interruption of LIN communication	132
D.10.6	Test of short circuit between the control pilot conductor and the protective conductor	132
D.10.7	Test of options	132

Annex E (informative) Charging station designed with a standard socket-outlet – Minimum gap for connection of Modes 1 and 2 cable assembly	133
E.1 Overview.....	133
E.2 General.....	133
E.3 Minimum gap for connection of Mode 2 cables with type E/F plug and socket-outlet systems	134
E.4 Minimum gap for connection of Mode 2 cables with type BS1363 plug and socket-outlet systems	134
E.5 Minimum gap for connection of Mode 2 cables with IEC 60309-2 straight plug and socket-outlet systems	134
Bibliography.....	136
Figure 1 – Case A connection.....	18
Figure 2 – Case B connection.....	18
Figure 3 – Case C connection.....	19
Figure A.1 – Typical control pilot circuit (equivalent circuit).....	52
Figure A.2 – Simplified control pilot circuit (equivalent circuit).....	53
Figure A.3 – State diagram for typical control pilot (informative)	60
Figure A.4 – State diagram for simplified control pilot (informative).....	61
Figure A.5 – Test sequence using a typical control pilot circuit.....	75
Figure A.6 – Test sequence using the simplified control pilot circuit.....	75
Figure A.7 – Optional test sequence with interruption by EV supply equipment.....	76
Figure A.8 – Example of a test circuit (EV simulator)	78
Figure B.1 – Equivalent circuit diagram for proximity function using an auxiliary switch and no current coding	82
Figure B.2 – Equivalent circuit diagram for simultaneous proximity detection and current coding.....	84
Figure C.1 – Example of Mode 1 case B using the proximity circuit as in B.1	87
Figure C.2 – Example of Mode 2 case B using proximity detection as in B.1	88
Figure C.3 – Example of Mode 3 case B using proximity detection as in B.1	89
Figure C.4 – Example of Mode 3 case C using proximity detection as in B.1	90
Figure C.5 – Example of Mode 3 case B using proximity detection as in B.2 (without proximity push button switch S3).....	91
Figure C.6 – Example of Mode 4 case C using the universal vehicle coupler.....	92
Figure D.1 – Example of an EV charging system with a typical configuration of functions, information flow and power flow.....	95
Figure D.2 – Electrical equivalent circuit for connection of LIN nodes to the control pilot circuit.....	98
Figure D.3 – Control pilot circuit state diagram for LIN-CP (key list in Table D.5).....	101
Figure D.4 – Example of timing diagram for start-up of normal AC charging sequence.....	105
Figure D.5 – Timing diagram for normal EV-triggered stop of charging.....	107
Figure D.6 – Example of timing diagram for normal stop of charging triggered by charging station	109
Figure D.7 – State diagram of the LIN node in the charging station.....	111
Figure D.8 – Energy transfer between different charging stations and EVs that are equipped with accessories according to IEC 62196-2.....	129

Figure D.9 – Control pilot circuit state diagram for LIN-CP and PWM-CP (See key list in Table D.5).....	130
Figure E.1 – Examples of standard plugs that are considered for this Annex E	133
Figure E.2 – Packaging configurations allowing the use of a large part of the common products for standard plugs and socket-outlets	135
Table 1 – Touch current limits.....	44
Table A.1 – Maximum allowable high frequency signal voltages on control pilot conductor and the protective conductor.....	54
Table A.2 – Control pilot circuit parameters and values for the EV supply equipment.....	55
Table A.3 – EV control pilot circuit values and parameters and values for the EV	55
Table A.4 – System states detected by the EV supply equipment.....	57
Table A.5 – State behaviour.....	59
Table A.6 – List of sequences	61
Table A.7 – PWM duty cycle provided by EV supply equipment	71
Table A.8 – Maximum current to be drawn by vehicle.....	71
Table A.9 – Test resistance values	72
Table A.10 – Parameters of control pilot voltages	73
Table A.11 – Test parameters of control pilot signals	74
Table A.12 – Parameters for sequence tests.....	75
Table A.13 – Position of switches	79
Table A.14 – Initial settings of the potentiometer at the beginning of each test.....	79
Table B.1 – Component values proximity circuit without current coding.....	83
Table B.2 – Current coding resistor for EV plug and vehicle connector	85
Table C.1 – Component description for Figure C.6 Mode 4 case C.....	92
Table D.1 – Control pilot functions in LIN-CP and PWM-CP	96
Table D.2 – Additional LIN-CP control pilot functions	97
Table D.3 – Generation and detection of CP voltage levels	99
Table D.4 – Generation and detection of LIN communication levels	100
Table D.5 – Key list for Figure D.3 and Figure D.9	102
Table D.6 – Control of LIN signals	103
Table D.7 – Control of the S2 switch and the vehicle load	103
Table D.8 – Control of the switching device	104
Table D.9 – Control of latching and unlatching	104
Table D.10 – Timing for start-up of normal charging sequence.....	106
Table D.11 – Timing for normal EV-triggered stop of charging	108
Table D.12 – Timing for normal stop of charging triggered by charging station.....	110
Table D.13 – States of the LIN node in the charging station and frame schedule description.....	112
Table D.14 – Transitions of the LIN node in the charging station.....	113
Table D.15 – Frames for AC charging	118
Table D.16 – General signals.....	125
Table D.17 – Signals for version negotiation	125
Table D.18 – Signals for system initialization	126

Table D.19 – Signals for EV status information	127
Table D.20 – Signals for charging station status information	127
Table D.21 – Codes for the frame <i>StNotReadyList</i>	127
Table D.22 – Codes for frame <i>EvS2openList</i>	128
Table D.23 – Codes for frame <i>StErrorList</i>	128
Table D.24 – Codes for frame <i>EvErrorList</i>	128
Table D.25 – Normal charge cycle test.....	131

Currently in preview, click buy full version

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –**Part 1: General 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.
- 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.

International Standard IEC 61851-1 has been prepared by IEC technical committee 69: Electric road vehicles and electric industrial trucks.

This third edition cancels and replaces the second edition published in 2010. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) The contents of IEC 61851-1:2010 have been re-ordered. Numbering of clauses has changed as new clauses were introduced and some contents moved for easy reading. The following lines give an insight to the new ordering in addition to the main technical changes.
- b) All requirements from IEC 61851-22 have been moved to this standard, as work on IEC 61851-22 has ceased.

- c) Any requirements that concern EMC have been removed from the text and are expected to be part of the future version of 61851-21-21.
- d) Clause 4 contains the original text from IEC 61851-1:2010 and all general requirements from Clause 6 of IEC 61851-1:2010.
- e) Clause 5 has been introduced to provide classifications for EV supply equipment.
- f) Previous general requirements of Clause 6 have been integrated into Clause 4. Clause 6 contains all Mode descriptions and control requirements. Specific requirements for the combined use of AC and DC on the same contacts are included.
- g) Clause 9 is derived from previous Clause 8. Adaptation of the description of DC accessories to allow for the DC charging modes that have only recently been proposed by industry and based on the standards IEC 61851-23, IEC 61851-24 as well as IEC 62196-1, IEC 62196-2 and IEC 62196-3. Information and tables contained in the IEC 62196 series standards have been removed from this standard.
- h) Clause 10 specifically concerns the requirements for adaptors, initially in Clause 6.
- i) Clause 11 includes new requirements for the protection of the cable.
- j) Specific requirements for equipment that is not covered in the IEC 62752 remain in the present document.
- k) Previous Clause 11 is now treated in Clauses 12 to 13. The requirements in 61851-1 cover the EV supply equipment of both mode 2 and mode 3 types, with the exception in-cable control and protection devices for mode 2 charging of electric road vehicles (IC-CPD) which are covered by IEC 62752.
- l) Clause 14 gives requirements on automatic reclosing of protection equipment.
- m) Clause 16 gives requirements for the marking of equipment and the contents of the installation and user manual. This makes specific mention of the need to maintain coherence with the standards for the fixed installation. It also contains an important text on the markings for temperature ratings.
- n) Annex A has been reviewed to introduce complete sequences and tests and to make the exact cycles explicit. Annex A in this edition supersedes IEC TS 62763 (Edition 1).
- o) Annex B is normative and has requirements for proximity circuits with and without current coding.
- p) Previous Annex C has been removed and informative descriptions of pilot function and proximity function implementations initially in Annex B are moved to Annex C.
- q) New informative Annex D describing an alternative pilot function system has been introduced.
- r) Dimensional requirements for free space to be left around socket-outlets used for EV energy supply are given in the informative Annex E.
- s) The inclusion of protection devices within the EV supply equipment could, in some cases, contribute to the protection against electric shock as required by the installation. This is covered by the information required for the installation of EV supply equipment in Clause 16 (Marking).

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

FDIS	Report on voting
69/436/FDIS	69/469/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.

1 Under preparation.

A list of all parts of the IEC 61851 series, under the general title *Electric vehicle conductive charging system* can be found on the IEC website.

In this standard, the following print types are used:

- *test specifications and instructions regarding application of Part 1: italic type.*
- notes: smaller roman type.

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.

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

This standard is the first part of the IEC 61851 series of standards that gives the general requirements for the supply² of electric energy to Electric road vehicles³. It is to be noted that the vehicle and the EV supply equipment² make up a complete system that is covered by a number of IEC and ISO standards.

IEC 61851 covers the mechanical, electrical, communications, EMC and performance requirements for EV supply equipment used to charge electric vehicles, including light electric vehicles.

IEC 61851 is divided into several parts as follows:

- *Part 1: General Requirements*,
This document gives the general requirements that serve as a basis for all the subsequent standards in the series. It includes the requirements for AC EV supply equipment.
- *Part 21-1⁴: Electric vehicle onboard charger EMC requirements for conductive connection to an AC/DC supply*. This part will cover requirements for EMC onboard the vehicle.
- *Part 21-2⁵: EMC requirements for OFF board electric vehicle charging systems*. This part will cover all requirements for AC and DC EV supply equipment. EMC requirements for wireless power transfer systems (WPT) will not be included.
- *Part 23: DC electric vehicle charging station (2014)*. This part covers the requirements for DC charging stations both permanently wired and cable and plug connected.
- *Part 24: Digital communication between a d.c. EV charging station and an electric vehicle for control of d.c. charging (2014)*. This part provides the requirements for communication between the vehicle and the DC charging stations of Part 23.

IEC 61851-3 subseries is under development and is intended to cover EV supply equipment with a DC output not exceeding 120 V where reinforced or double insulation or class III is used as the principal means of protection against electric shock (information on scope as available on 3/2016).

- *Part 3-1: Electric vehicles conductive power supply system – Part 3-1: General Requirements for Light Electric Vehicles (LEV) AC and DC conductive power supply systems*.
- *Part 3-2: Electric vehicles conductive power supply system – Part 3-2: Requirements for Light Electric Vehicles (LEV) DC off-board conductive power supply systems*.
- *Part 3-3: Electric vehicles conductive power supply system – Part 3-3: Requirements for Light Electric Vehicles (LEV) battery swap systems*.
- *Part 3-4: Electric vehicles conductive power supply system – Part 3-4: Requirements for Light Electric Vehicles (LEV) communication*.
- *Part 3-5: Electric vehicles conductive power supply system – Part 3-5: Requirements for Light Electric Vehicles communication – Pre-defined communication parameters*.
- *Part 3-6: Electric vehicles conductive power supply system – Part 3-6: Requirements for Light Electric Vehicles communication – Voltage converter unit*.
- *Part 3-7: Electric vehicles conductive power supply system – Part 3-7: Requirements for Light Electric Vehicles communication – Battery system*.

² The term “supply or electric energy” is used to designate energy flow to and from the electric vehicle. The term “charging” used in the title is also used to designate such energy flow.

³ The reader is advised to refer to the definitions clause 3 for this and all subsequent terms that are used in this document.

⁴ Under preparation.

⁵ Under preparation.

Documents directly related to the present document:

- ISO 17409:2015, *Electrically propelled road vehicles – Connection to an external electric power supply – Safety requirements*.

This document gives requirements for electric vehicle that is to be connected to the EV supply equipment. It covers all the classes of vehicles that are in the scope of ISO/TC 22/SC 37.

- IEC 62752:2016, *In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)*.

This product standard gives the requirements for Mode 2 cable assemblies that include supplementary protective and control devices that allow the safe connection of a vehicle to a mains socket-outlet of an installation.

- ISO/IEC 15118 (all parts), *Road vehicles — Vehicle to grid communication interface*

This series of documents gives the description and the requirements for high level data communication between the EV and the EV supply equipment.

Requirements for wireless power transfer systems are given in IEC 61980-1.

ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 1: General requirements

1 Scope

This part of IEC 61851 applies to EV supply equipment for charging electric road vehicles, with a rated supply voltage up to 1 000 V AC or up to 1 500 V DC. and a rated output voltage up to 1 000 V AC. or up to 1 500 V DC.

Electric road vehicles (EV) cover all road vehicles, including plug-in hybrid road vehicles (PHEV), that derive all or part of their energy from on-board rechargeable energy storage systems (RESS).

This standard also applies to EV supply equipment supplied from on-site storage systems (e.g. buffer batteries).

The aspects covered in this standard include:

- the characteristics and operating conditions of the EV supply equipment;
- the specification of the connection between the EV supply equipment and the EV;
- the requirements for electrical safety for the EV supply equipment.

Additional requirements may apply to equipment designed for specific environments or conditions, for example:

- EV supply equipment located in hazardous areas where flammable gas or vapour and/or combustible materials, fuels or other combustible, or explosive materials are present;
- EV supply equipment designed to be installed at an altitude of more than 2 000 m;
- EV supply equipment intended to be used on board on ships;

Requirements for electrical devices and components used in EV supply equipment are not included in this standard and are covered by their specific product standards.

EMC requirements for EV supply equipment are expected to be covered in the future IEC 61851-21-2⁶.

Requirements for bi-directional energy transfer are under consideration and are not in this edition of IEC 61851-1.

This standard does not apply to:

- safety aspects related to maintenance;
- charging of trolley buses, rail vehicles, industrial trucks and vehicles designed primarily for use off-road;
- equipment on the EV;
- EMC requirements for equipment on the EV while connected, which are covered in IEC 61851-21-1;
- Charging RESS off board of the EV;

⁶ Under consideration.

- DC EV supply equipment that relies specifically on double/reinforced insulation or class III protection against electric shock. See IEC 61851-23 or the future IEC 61851-3 series.

The IEC 61851 series covers all EV supply equipment with the exception of in-cable control and protection devices for mode 2 charging of electric road vehicles (IC-CPD) which are covered by IEC 62752.

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 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60309-1, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60364-4-41, *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 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 60884-1, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*

IEC 60898 (all parts), *Circuit-breakers for overcurrent protection for household and similar installations*

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 controlgear – 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 60947-6-2, *Low-voltage switchgear and controlgear – Part 6-2: Multiple function equipment – Control and protective switching devices (or equipment) (CPS)*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 60990, *Methods of measurement of touch current and protective conductor current*

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

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

IEC 61180, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC 61316:1999, *Industrial cable reels*

IEC TS 61439-7:2014, *Low-voltage switchgear and controlgear assemblies – Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61558-1, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 61558-2-4, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-4: Particular requirements and tests for isolating transformers and power supply units incorporating isolating transformers*

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

IEC 61851 (all parts), *Electric vehicle conductive charging system*

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

IEC 61851-24:2014, *Electric vehicle conductive charging system – Part 24: Digital communication between a d.c. EV charging station and an electric vehicle for control of d.c. charging*

IEC 62196 (all parts), *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles*

IEC 62196-1:2014, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 1: General requirements*

IEC 62196-2:2016, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 2: Dimensional compatibility and interchangeability requirements for a.c.pin and contact-tube accessories*

IEC 62196-3:2014, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 3: Dimensional compatibility and interchangeability requirements for d.c. and a.c./d.c. pin and contact-tube vehicle couplers*

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 62752, *In-Cable Control and Protection Device for mode 2 charging of electric road vehicles (IC-CPD)*

ISO 17409:2015, *Electrically propelled road vehicles – Connection to an external electric power supply – Safety requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 Electric supply equipment

3.1.1

EV supply equipment

equipment or a combination of equipment, providing dedicated functions to supply electric energy from a fixed electrical installation or supply network to an EV for the purpose of charging

EXAMPLE 1: For Mode 3 case B, the EV supply equipment consists of the charging station and the cable assembly.

EXAMPLE 2: For Mode 3 case C, the EV supply equipment consists of the charging station with its cable assembly.

3.1.2

AC EV supply equipment

EV supply equipment that supplies alternating current to an EV

3.1.3

DC EV supply equipment

EV supply equipment that supplies direct current to an EV

3.1.4

EV charging system

complete system including the EV supply equipment and the EV functions that are required to supply electric energy to an EV for the purpose of charging

3.1.5

EV charging station

stationary part of EV supply equipment connected to the supply network

Note 1 to entry: For case C, the cable assembly is part of the EV charging station.

3.1.6

DC EV charging station

EV charging station that supplies direct current to an EV